California Regional Water Quality Control Board, Lahontan Region

Bishop Creek Vision Plan

A water quality improvement plan to address fecal indicator bacteria affecting Bishop Creek, Inyo County

DRAFT DOCUMENT – MAY 2022

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1 Introduction

The Bishop Creek Vision Plan (Plan) is a plan to address fecal indicator bacteria (FIB) impairments of water quality in Bishop Creek, Inyo County. Actions taken in accordance with this Plan are reasonably expected to improve FIB water quality to a level that protects the Water Contact Recreation (REC-1) beneficial use. Once the requisite amount of FIB water quality data indicates the REC-1 use is supported in Bishop Creek, the surface water may be removed (also referred to as *delisted*) from the Clean Water Act Section 303(d) List of Impaired Waters.

This Plan identifies the significant sources of fecal bacteria pollution within the Bishop Creek watershed and identifies a suite of implementation actions or approaches designed to reduce FIB in creek waters to attain the requisite water quality objectives. The Plan sets out a timeline for implementation, with water quality expected to support beneficial uses by September 2032.

1.1 Background

The federal Clean Water Act (CWA) requires States to adopt and enforce water quality standards to protect waterbodies. The Water Quality Control Plan for the Lahontan Region (Basin Plan) sets out these water quality standards, which are comprised of beneficial uses, narrative and numeric water quality objectives (WQOs) to protect beneficial uses, and an antidegradation policy to enhance and protect existing water quality. The Basin Plan is administered by the Lahontan Regional Water Quality Control Board (Water Board). The Water Board is responsible for regulating surface and groundwater quality throughout the Lahontan Region, doing so via the California Water Code and other plans and policies contained in the Basin Plan necessary to implement water quality objectives. The Lahontan Region encompasses Eastern California from the Modoc Plateau in the north to the Mojave Desert in the south.

CWA Section 303(d) requires States to identify waterbodies that do not meet water quality standards for one or more pollutants and to take appropriate actions to remedy those impairment(s). The beneficial use impacted by the FIB impairments addressed in this Plan is REC-1 (activities include but are not limited to swimming, wading, fishing, etc.). Impairment of REC-1 is demonstrated by concentrations of *Escherichia Coli* (*E. coli*) FIB which exceed WQOs applicable to Bishop Creek. Water quality data also indicates that REC-1 uses assigned to the Bishop Creek B-1 Drain (B-1 Drain) (a major irrigation water conveyance in the project area) and Bishop Creek Canal are threatened, demonstrated by elevated *E. coli* pollution approaching the threshold of the WQO. Neither the Bishop B-1 Drain nor the Bishop Creek Canal are presently 303(d) listed for *E. coli*.

All Bishop Creek surface waters were assessed for the 2018 Integrated Report, the result of which was placement of the mainstem of Bishop Creek on the 303(d) List. The B-1 Drain and Bishop Creek Canal are included in this Plan because they are hydrologically intertwined with Bishop Creek, show evidence of FIB impairment, and should benefit from implementation actions taken in accordance with this Plan.

The primary tool for remedying impaired water quality is development of a Total Maximum Daily Load (TMDL), in which the total load of a pollutant causing the impairment is allocated among all pollutant sources to facilitate source-specific actions to reduce the cumulative load. TMDLs are required for 303(d) listed waterbodies. This Plan is an alternative to a TMDL, based on the United States Environmental Protection Agency (U.S. EPA) 2013 Long Term Vision for Assessment, Restoration, and Protection under the CWA 303(d) Program (The Vision). The Vision recognizes that alternative restoration approaches to TMDLs may be more appropriate to restore impaired waters and maintain water quality. Alternative approaches include voluntary actions taken by stakeholders developed in collaboration with States. The philosophy allows actions that are customized to a watershed and facilitates implementation actions that may attain water quality standards sooner and in a manner that is beneficial for affected communities.

If the Plan is not successful in achieving REC-1 WQOs then a TMDL, implemented through permit requirements, may be needed. Many of the actions that a TMDL might require are incorporated into this Plan, however the actions taken in accordance with this Plan are done so voluntarily. If Plan stakeholders, or groups of stakeholders, do not implement the types of actions detailed in this Plan, the Water Board may prioritize the issuance of permits to compel compliance with water quality standards. Such permits could be developed subsequent to the development of a TMDL, or independent of a TMDL, under provisions of California Water Code section 13241 or section 13269 and in compliance with the Non-point Source Policy, to protect beneficial uses. Voluntary actions taken in accordance with this Plan may minimize the chances that a TMDL or other permit requirements are needed in the future.

This Plan includes milestones to assess progress implementing the Plan and improvements in water quality to guide Water Board's support of the Plan's voluntary approach. The Plan is also consistent with the Lahontan Water Board's 2021 Irrigated Lands Regulatory Program strategy.

Whereas U.S. EPA is required to approve TMDLs adopted by the State, no approval is necessary for a TMDL-alternative plan. In addition, U.S. EPA does not have any specific guidance or requirements for alternative plans. If Plan implementation results in improved FIB water quality, U.S. EPA may approve or disapprove a recommendation to remove Bishop Creek surface waters from the 303(d) List.

1.2 Document Organization

The process for addressing water quality impairments includes compiling and considering available data and information, conducting analyses to define the impairment, identifying the sources of pollution, and developing a suite of appropriate implementation actions or strategies to resolve the impairment.

This Plan is organized as follows:

- Section 2 (Watershed description) provides the background information about the physical setting of Bishop Creek.
- Section 3 (Project Summary) defines the project, explains why it is necessary, and presents its objectives.
- Section 4 (Water Quality Standards) provides information on water quality standards, including beneficial uses and FIB WQOs applicable to this Plan.
- Section 5 (Monitoring Results) inventories the FIB water quality monitoring data available for the project area and provides analyses of these data.
- Section 6 (Pollutant Source Assessment) contains the FIB source assessment for the project and ranks the sources as high, medium, or low priority for implementation actions.
- Section 7 (Implementation Plan) details the implementation actions to address the FIB impairment by source.
- Section 8 (Stakeholder Outreach Plan) provides details of stakeholder communications undertaken in development of this Plan.
- Section 9 (Monitoring and Reporting Plan) provides details of the monitoring and reporting required to track and verify progress towards achieving Plan goals.
- Section 10 (Plan Evaluation and Adaptive Management) includes information for periodic review and improvement of the Plan strategy and implementation.

1.3 U.S. EPA 9-element Watershed Plans

This Plan includes information necessary to satisfy the criteria of a nine-element Watershed Plan. The nine elements are provided below together with information which directs the reader to the relevant document section where information pertaining to each element may be found. Satisfaction of each of the nine elements makes implementation actions taken in accordance with this Plan eligible for CWA Section 319 Nonpoint Source grants funds.

1) Identify causes and sources of pollution
    - Section 5 (Monitoring Results)
    - Section 6 (Pollutant Source Assessment)
2) Estimate load reductions expected

- Section 7 (Implementation Plan)

3) Describe management measures and targeted critical areas
    - Section 7 (Implementation Plan)
4) Estimate technical and financial assistance needed
    - Section 7 (Implementation Plan)
5) Develop and information and education component
    - Section 7 (Implementation Plan)
    - Section 8 (Stakeholder Outreach Plan)
6) Develop a project schedule
    - Section 9 (Monitoring and Reporting Plan)
    - Section 10 (Plan Evaluation and Adaptive Management)
7) Describe interim, measurable milestones
    - Section 9 (Monitoring and Reporting Plan)
    - Section 10 (Plan Evaluation and Adaptive Management)
8) Identify indicators to measure progress
    - Section 9 (Monitoring and Reporting Plan)
    - Section 10 (Plan Evaluation and Adaptive Management)
9) Develop a monitoring component
    - Section 9 (Monitoring and Reporting Plan)

2. Watershed description

2.1 General overview

The Bishop Creek watershed (Figure 2-1) spans approximately 129,052 acres of Inyo County in eastern California and drains 104 square miles of the Sierra Nevada mountain range (Kleinschmidt, 2019). Bishop Creek is approximately ten miles long, flowing as several channels at multiple locations throughout its reach. In its lower reaches the creek has been substantially modified. Modifications include alterations to the natural hydrograph because of water storage for hydroelectric generation, channel modification for residential and agricultural development, water diversion for agricultural irrigation, and water diversion for residential irrigation and ornamental purposes.

The headwaters of the creek exist as three distinct branches, each of which passes through generally undisturbed alpine environments as they flow from the Sierra crest. While there are many small tributary streams in the alpine portions of the watershed, the three major headwaters branches of Bishop Creek can be described as: 1) Lamarck and Paiute Creeks, making up the northern headwaters branch, which flow from the John Muir Wilderness in the northwest portion of the watershed and empty into North Lake found upstream of the community of Aspendell; 2) the Middle Fork Bishop Creek, making up the middle headwaters branch, which originates at the base of Mount Mendel and Mount Darwin in the western portion of the watershed and flows to Lake Sabrina, also upstream of Aspendell; and, 3) the South Fork Bishop Creek, making up the southern headwaters branch, which originates at the base of Mount Johnson in the southwestern portion of the watershed and flows to South Lake.

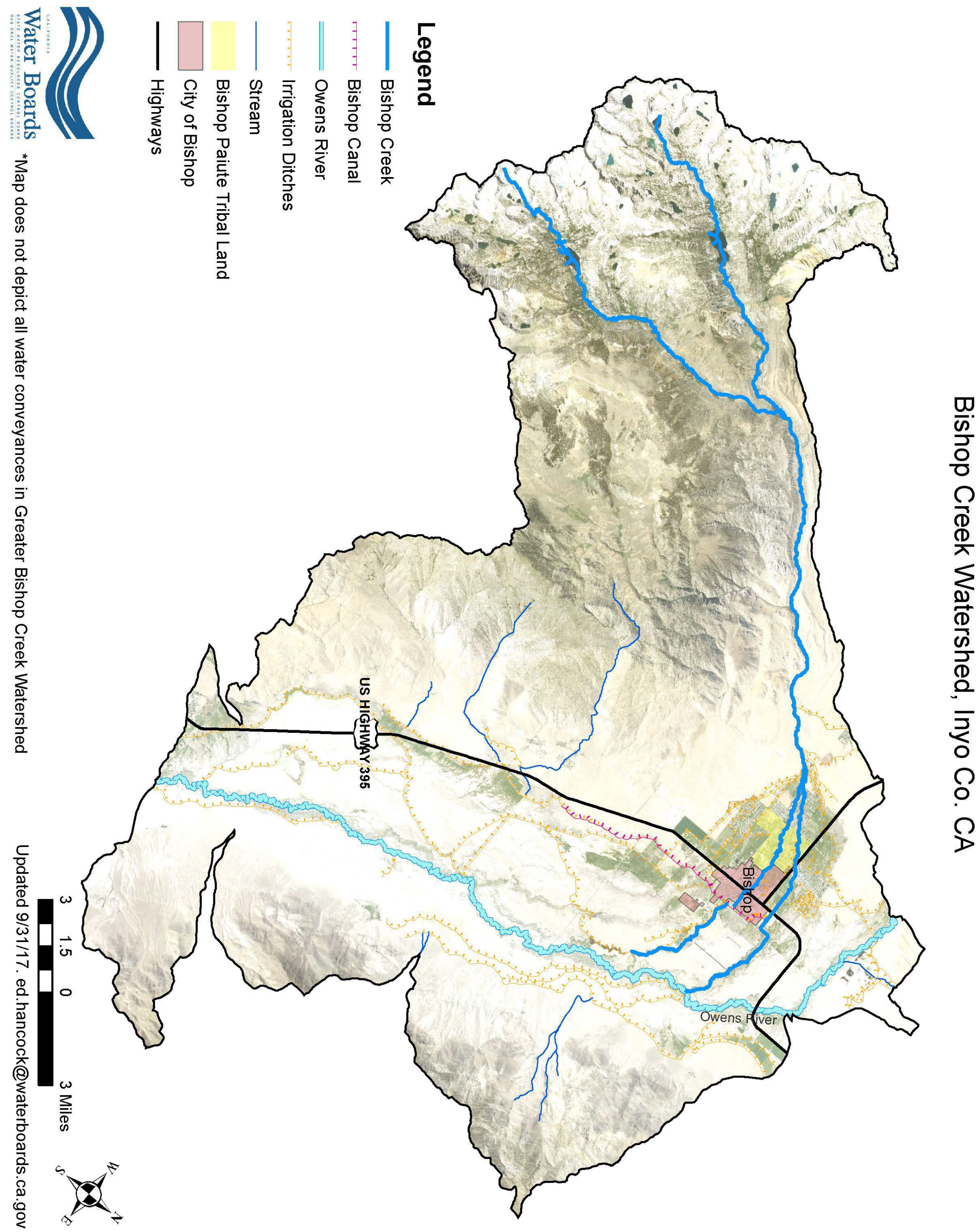
Both Lake Sabrina and South Lake are dammed for hydropower generation and provide five downstream Southern California Edison (SCE) hydroelectric facilities with water. North Lake is also harnessed for hydropower purposes. The northern and middle branch of the headwaters portions of the creek join at Cardinal Village Resort, becoming the Middle Fork Bishop Creek. The South Fork Bishop Creek becomes Bishop Creek at the confluence with Middle Fork Bishop Creek at Big Trees Campground.

Most of the upgradient portions of the watershed are Inyo National Forest lands, with some of the western most parts designated as the John Muir Wilderness. Uses in these portions are predominantly hydropower generation (POW) and recreation (water contact (REC-1) & non-contact (REC-2)), including fishing, hiking, camping, and horseback riding. Some grazing occurs in upland areas during the summer months. The northern branch of the creek upgradient of Lake Sabrina was used for mining activities at the Cardinal Mine in the early 20th century, although legacy mining impacts are believed to be minimal.

The first SCE powerhouse (known as Powerhouse Two) occurs downstream of Lake Sabrina and the community of Aspendell, while the remaining four facilities are located downstream of the confluence of Middle and South Forks. Water contact and non-contact recreation occurs throughout these portions of the watershed. FIB water quality data collected from these portions of Bishop Creek demonstrate exceptional water quality, meaning no or very little FIB were present during monitoring.

As Bishop Creek flows from National Forest lands, it crosses an undeveloped alluvial fan upgradient of the Owens Valley floor. The creek passes through the SCE facilities located in this zone, bifurcating into two channels downstream of the Powerhouse 6, east of the Cerro Coso Community College. The bifurcation creates the North Fork and the South Fork, which flow through the lower portions of the watershed on the valley floor. The official name of this section creek is Bishop Creek Forks (North and South Forks downstream of bifurcation), referred to as Bishop Creek for purposes of this Plan. Each channel of Bishop Creek converges with Bishop Creek Canal, yet each channel also continues past the canal as a separate waterbody. The continuation of the North Fork empties into the Owens River approximately 1.5 miles below the City of Bishop, and the continuation of the South Fork dissipates in agricultural land to the southwest of the city. Bishop Creek Canal conveys water south towards the Owens River.

Figure 2-1 Bishop Creek Watershed, Inyo Co. CA



Downstream of Powerhouse 6 and upstream of the City of Bishop, Bishop Creek passes through the community of West Bishop and the Bishop Paiute Tribe (Tribe) Reservation. The Tribe is a sovereign nation with a well-developed environmental program, including a Water Quality Control Plan. The Tribes' Reservation comprises 877 acres of the watershed between Brockman Lane and See Vee Lane, and land uses on Tribe lands are a mixture of rural residential and pastureland. Land uses in West Bishop are similarly distributed.

In both West Bishop and on Tribe lands, Bishop Creek is diverted for agricultural and residential irrigation uses via a series of irrigation ditches which cross the project area (Figure 2-2, Figure 2-3). In several instances, irrigation ditches connect the North and South channels of Bishop Creek, such as the B-1 Drain which carries irrigation return flows from the west end of Sierra Street at the South Fork of Bishop Creek northward across Highway 395 to the North Fork of the creek. Agricultural diversions are used for stock water and flood irrigation on grazing allotments throughout the project area. In addition, many private residences divert creek waters for backyard irrigation, ornamental watering, and small-scale hobby ranching (e.g., horses, goats, chickens). Residential diversions tend to be concentrated in the western portion of the project area.

The project area for the Vision Plan (Figure 2-2) spans Bishop Creek beginning at the bifurcation of North and South Forks, extending to the Bishop Creek Canal on the eastern boundary of the City of Bishop approximately four miles downstream. The project goal is to improve FIB water quality in Bishop Creek, the B-1 Drain, and Bishop Creek Canal (which is the receiving water for the system).

2.2 Climate

The climate of the Bishop Creek watershed is directly influenced by the Sierra Nevada mountain range which creates a rain shadow and significantly reduces precipitation falling in the middle and lower watershed (Danskin, 1998). Annual average precipitation recorded at Bishop Airport (located to the east of the Vision Plan study area) from 1948 to 2016 is 5.28 inches, with a maximum monthly average of 1.14 inches recorded in the month of January and a minimum monthly average of 0.11 inches recorded in the month of August (Desert Research Institute, 2016). At the Sierra Nevada crest on the western most edge of the Bishop Creek watershed, precipitation can average more than 30 inches (Danskin, 1998), which is approximately five times the amount of precipitation received in the eastern most portion of Bishop Creek watershed.

This area of Eastern California is characterized by cool winters and warm, arid summers, with most precipitation (85%) falling as snow in the Sierra Nevada between December and May (Space, 1988). The yearly average temperature in the study area is 56°F (Bishop Paiute Tribe, 2007). January average temperatures range from 21.8°F to 53.1°F and July average temperatures range from 56.1°F to 97.7°F (Desert Research

Institute, 2016), and temperature swings of 50°F or more in a single day are not uncommon (Danskin, 1998).

2.3 Hydrology

Bishop Creek receives approximately 85% of its flow from spring snowmelt (Space, 1988). The system is fed by a series of three lakes in the northern, western and southern headwaters area: North Lake, Lake Sabrina, and South Lake respectively. Meltwater increases discharge from April until August. The maximum monthly average flow observed at USGS gauge #10271060, which is located at the upstream end of the Vision Plan study area near SCE Powerhouse 6, is 147.1 cubic feet per second (cfs) recorded in July 2017 after a recorded setting winter of snow in the Sierra Nevada. Average monthly flows at this gauge are generally consistent however, ranging from 19 to 21 cfs most years (Kleinschmidt, 2019). Flow to the study area is highly regulated by SCE powerhouses and is subject to the 1922 Chandler Decree, a court decision stipulating mandatory water delivery from Bishop Creek to the City of Bishop and landowners in the Bishop area.

Within the Vision Plan area Bishop Creek is subject is many water diversions, both for agricultural and residential purposes. Figure 2-3 depicts a schematic of many of the irrigation channels in the project area, although this figure is likely not an exhaustive representation. LADWP has three water rights at or directly downstream of Powerhouse 6 which authorizes 45 cfs, 175 cfs, and 8 cfs respectively (Kleinschmidt, 2019).

2.4 Land Use

Land use in the Vision Plan study area is an intermixture of grazing pasture, residential uses, open public spaces (such as parks and public grassy areas), urbanized areas within the City of Bishop, and arable land. Activities occurring on all land use types potentially contribute to the FIB water quality issues in Bishop Creek. Figure 2-4 summarizes land uses.

Figure 2-2 Bishop Creek Vision Plan Study Area.

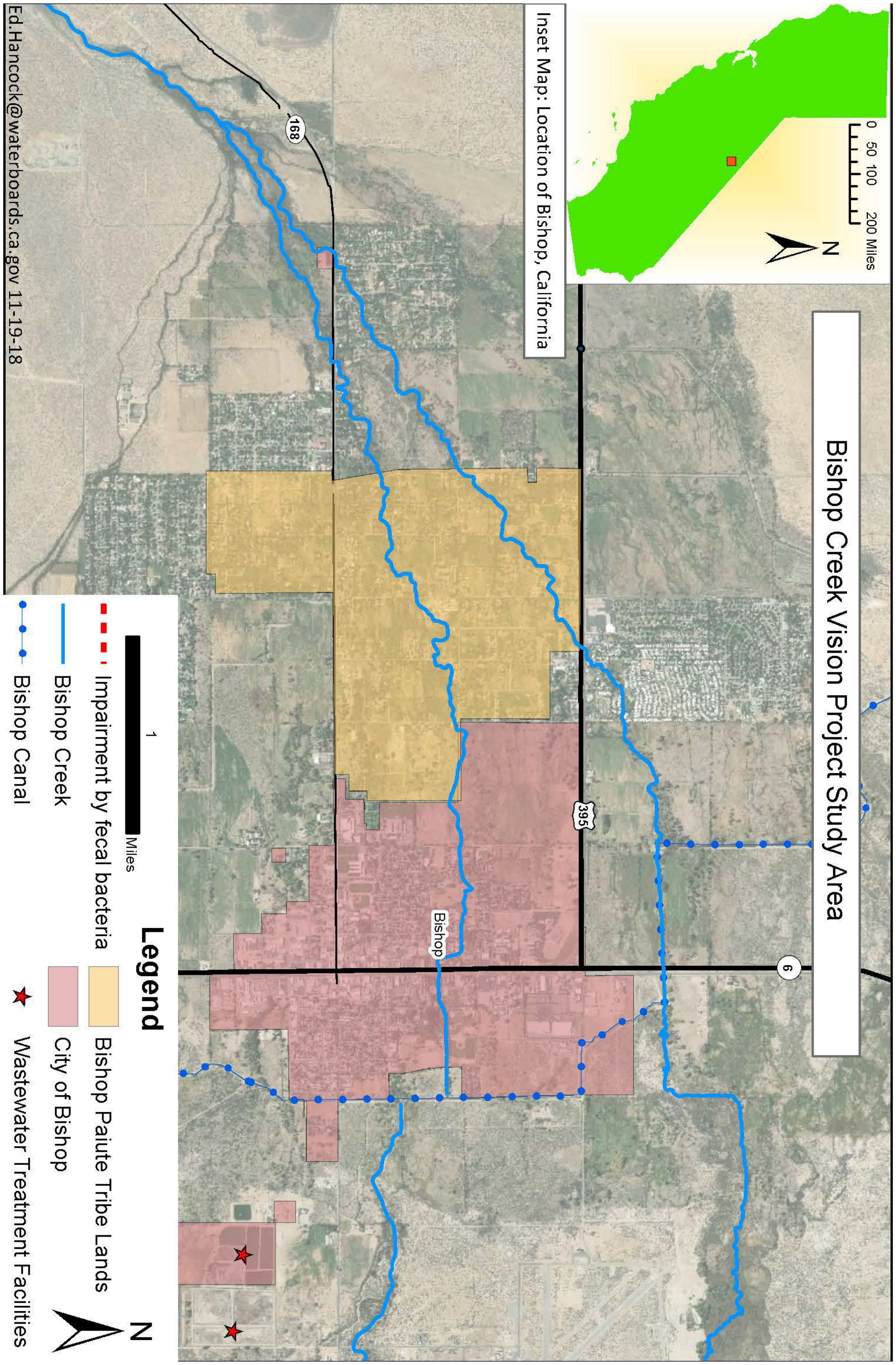


Figure 2-3 Bishop Creek Watershed Assoc. Irrigation Ditch Map, circa. 1968 (provided by Inyo County Water Dept.)

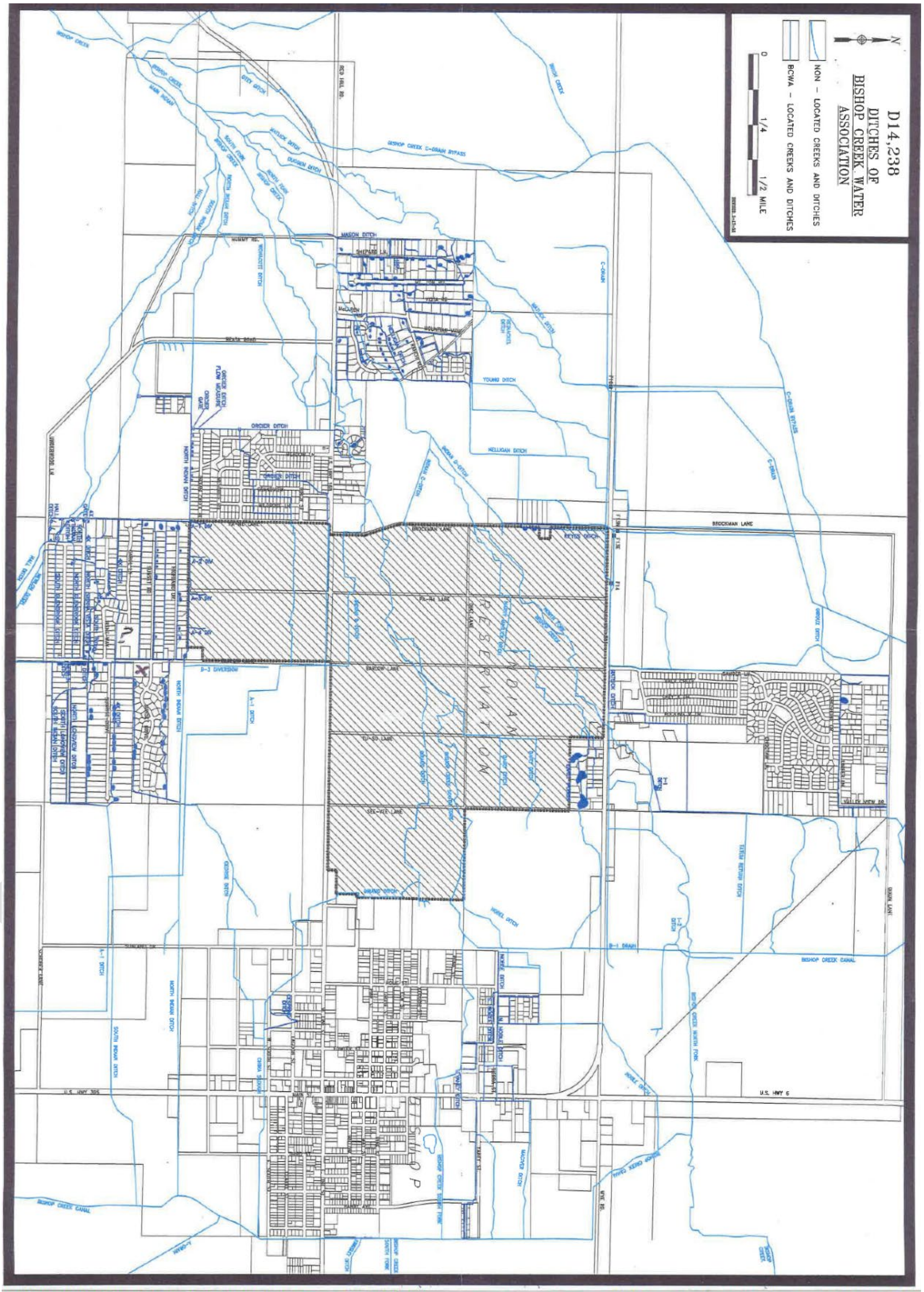
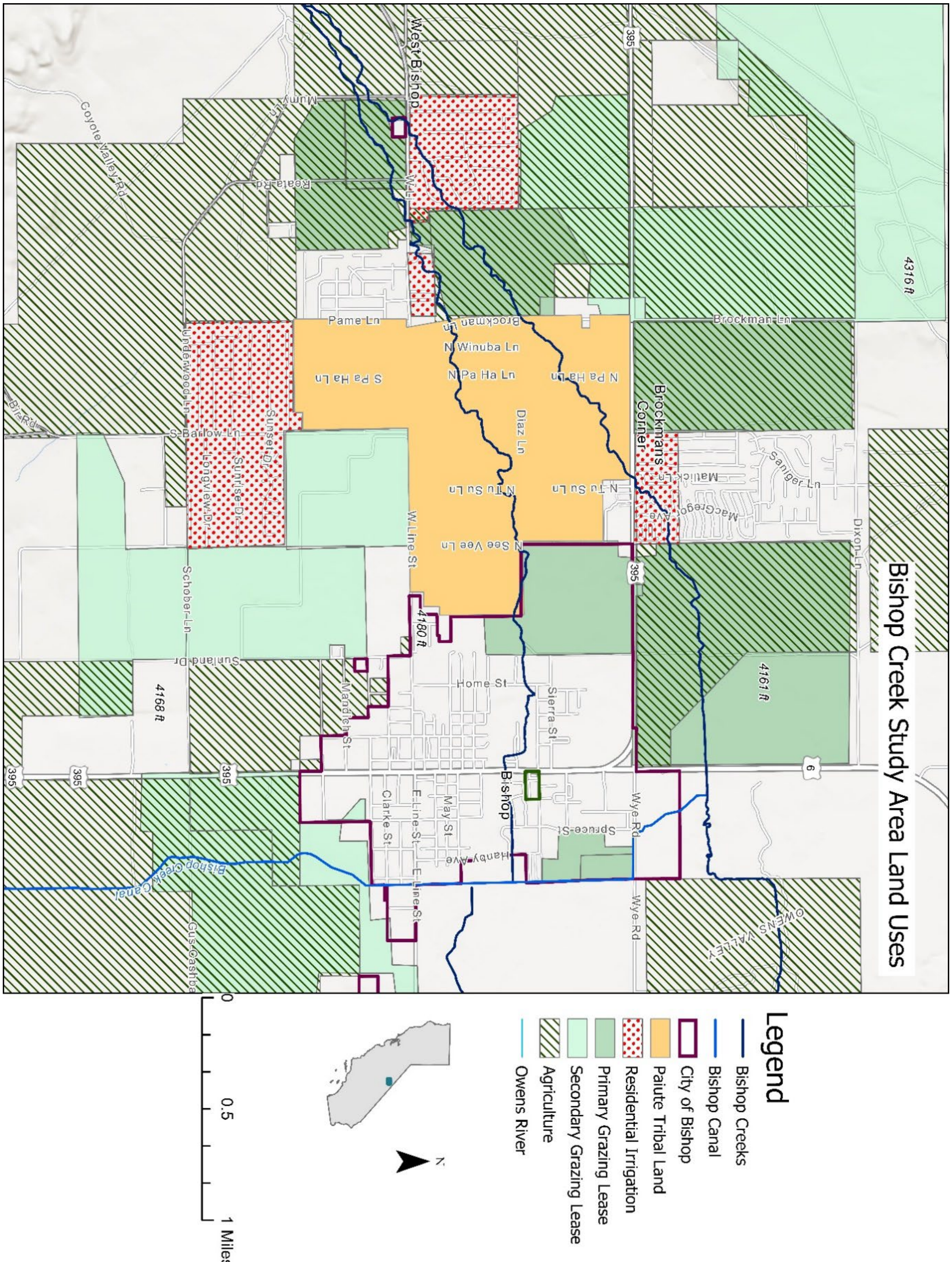


Figure 2-4 Land uses surrounding the project area.



3. Project summary

This section presents a summary of the 303(d) listing information and water quality impairments addressed by this Plan.

3.1 303(d) Listing information

The Water Board is required to routinely assess water quality data for Lahontan Region surface waters to determine if waterbodies are supporting beneficial uses. Surface waters where pollutants exceed WQOs are determined to not support beneficial uses and are placed on the 303(d) List. 303(d) assessments in California are governed by the Water Quality Control Policy For Developing California's Clean Water Act Section 303(d) List.

Bishop Creek Forks (North and South Forks downstream of bifurcation) (Bishop Creek) was assessed and listed as impaired on CWA Section 303(d) during the 2018 Integrated Report because of FIB concentrations which exceed WQOs set to support the REC-1 use and WQOs generally applicable to Lahontan Region waters. A discussion of the data, including the analyses perform for 303(d) assessment purposes, is discussed in Section 5.

During the same Integrated Report, the B-1 Drain and Bishop Creek Canal were assessed for FIB pollutants. Data from these surface waters indicates that the Basin Plan fecal coliform WQO is not attained, and *E. coli* FIB are elevated, however *E. coli* FIB does not rise to the level which exceeds the applicable REC-1 WQO. The B1-Drain and Bishop Creek Canal are 303(d) listed because of exceedances of the fecal coliform WQO are included in this Plan because of their hydrologic connectivity to Bishop Creek; the B-1 Drain conveys water from the South Fork Bishop Creek to the North Fork, and the Bishop Creek Canal is the receiving water in the system. Implementation actions taken to improve FIB water quality in Bishop Creek should also benefit water quality in the B-1 Drain and Bishop Creek Canal.

Table 3-1 shows the project area waterbody segment information. Table 3-2 delineates the extent of each waterbody segment. Figure 3-1 shows the extent of the 303(d) issues associated with this Plan.

***Table 3-1** Bishop Creek waterbody segments impaired by FIB*

Waterbody segment name	Waterbody ID (WBID)	Type of FIB assessed	BUs impaired *(threatened)**
Bishop Creek Forks (North and South Forks downstream of bifurcation)	CAR6032028020170908057813	• *E. coli* • Fecal coliform[1]	• REC-1 • MUN[1]
Bishop Creek B-1 Drain	CAR6032028020171227020994	• *E. coli* • Fecal coliform[1]	• (*REC-1*) • MUN[1]
Bishop Creek Canal	CAR6032000020020528152837	• *E. coli* • Fecal coliform[1]	• *(REC-1)* • MUN[1]

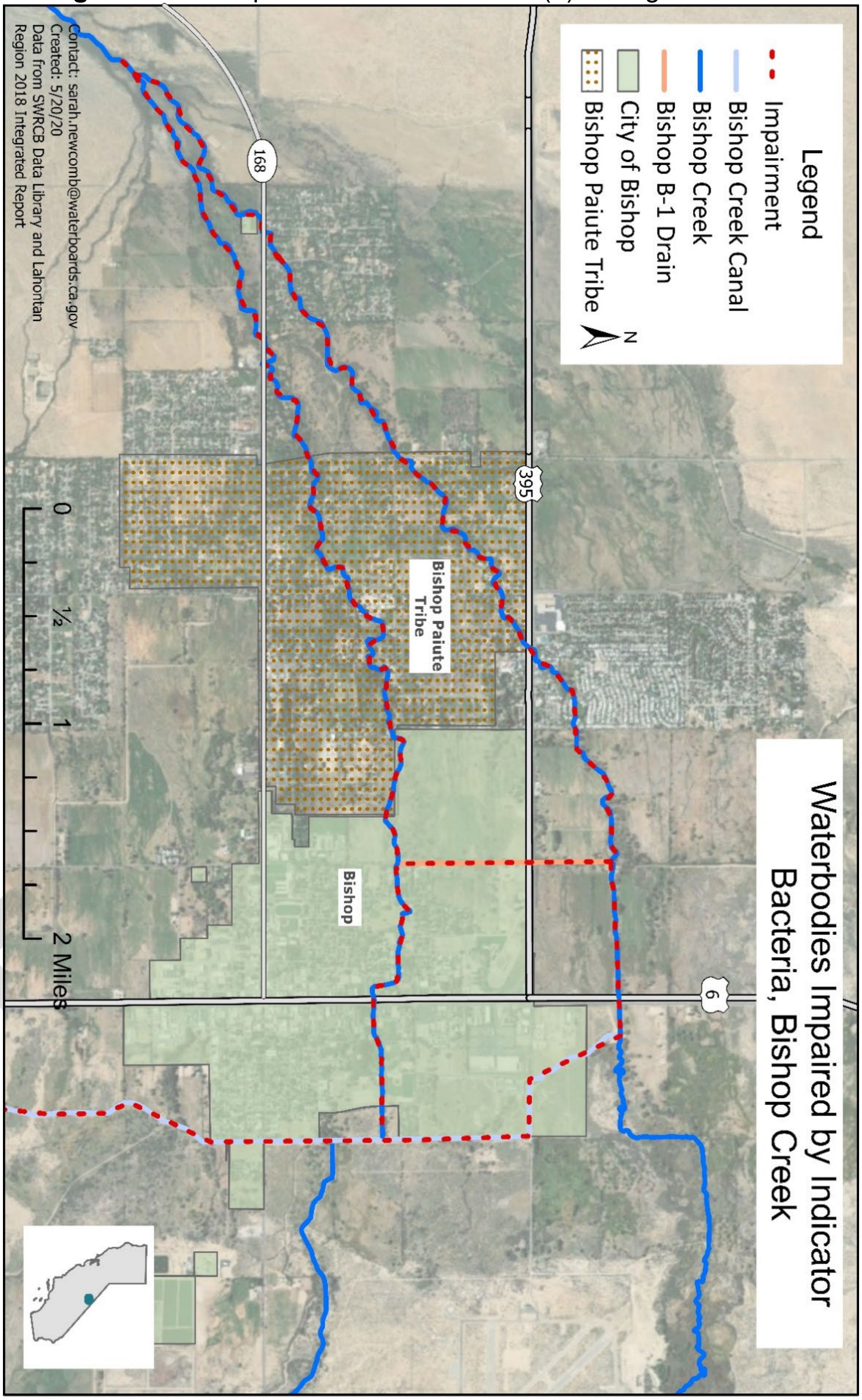
**A threatened BU is determined when water quality data exists to suggest BU impairment, but there is not the requisite amount of data to make a full BU impairment determination per the Water Quality Control Policy for Developing California's Section 303(d) List (Listing Policy).*

[1] Each waterbody segment is also presently 303(d) listed because concentrations of fecal coliform FIB exceed existing Lahontan Basin Plan WQOs. The Water Board is presently engaged in the Fecal Bacteria Water Quality Objectives Basin Plan Amendment to remove the fecal coliform WQO. Completion of this project is expected in early 2023, thus this impairment is not explicitly addressed by this Plan. More information on this topic is included in Section 4.2.2.

Table 3-2 *Delineation of Bishop Creek 303(d) Listed waterbody segments*

Waterbody segment name	Segment begins:	Segment begins latitude/ longitude	Segment ends:	Segment begins latitude/ longitude
Bishop Creek Forks (North and South Forks below bifurcation)	Bifurcation of north and South Forks downstream of Powerhouse 6	37.350786, -118.461704	Each respective channel confluence with Bishop Creek Canal	North channel: 37.380567, -118.393293 South channel: 37.367929, -118.386344
Bishop Creek B-1 Drain	Bishop Creek South Fork near the western end of Rome Drive	37.368658, -118.405917	Confluence with Bishop Creek North Fork near HWY 395	37.380052, -118.404886
Bishop Creek Canal	Terminus of Bishop Creek North Fork	37.380567, -118.393293	Confluence with Lower Rawson Canal near HWY 395	37.292148, -118.373080

Figure 3-1 Bishop Creek Vision Plan 303(d) Listings information



3.2 Water Quality Problem Statement

Surface waters in the Plan area are impaired by FIB thatoriginate in warm blooded animal waste, including but not limited to humans, cattle, dogs, horses, etc. The presence of FIB organisms in surface waters indicates that pathogens harmful to human health are likely also present. Recreational uses of surface waters where elevated FIB concentrations exist have been associated with adverse public health outcomes such as gastroenteritis, skin rash, pulmonary illness, hepatitis, cholera, typhoid fever, etc. (U.S. EPA 2012). National epidemiological studies conducted by U.S. EPA have demonstrated a causal relationship between adverse public health effects and recreational waters containing elevated *E. coli* and Enterococci FIB (*Ibid*, 2012).

The goal of this Plan is to restore and maintain protection of the REC-1 use in Bishop Creek and its adjacent surface waters. An emphasis on the protection of human health is especially important during the spring and summer months when FIB contamination is highest, and incidence of REC-1 uses are greatest. Success of the project will be demonstrated by a reduction in *E. coli* concentrations.

3.3 Project elements

This Plan constitutes a Water Quality Improvement Plan to address FIB impairments of the REC-1 use in Bishop Creek. The Water Board is obligated under CWA Section 303(d) to address impairments. Once addressed, waterbody impairments may be removed from the 303(d) List. The following components define this project:

- Applicable water quality objectives for FIB water quality.
- A source assessment to determine the sources of FIB affecting Bishop Creek.
- Implementation actions to reduce FIB contamination of Bishop Creek waters and achieve the numeric targets of the FIB WQOs.
- The framework for a monitoring program to evaluate Plan progress and gather the requisite FIB data to support a delisting recommendation for Bishop Creek.
- A framework for Plan evaluation and adaptive management.

4. Water Quality Standards

This section includes information about FIB, Beneficial Uses, FIB WQOs and describes how these topics apply to Bishop Creek.

4.1 Fecal Indicator Bacteria (FIB) as indicators of the presence of fecal pollution

Surface waters contaminated with fecal material are a human health hazard (Pachepsky and Shelton, 2011). Pathogens and viruses which can cause illnesses in humans are shed in the feces of humans and other warm-blooded animals, and these agents may be present in surface waters contaminated with fecal material (Ferguson and Signoretto, 2011). People who have physical contact with contaminated surface waters risk infection from fecal pathogens which cause illnesses ranging from gastroenteritis to death (U.S. EPA, 2012). Fecal pollution of surface waters is an important issue for ensuring protection of public health.

Pathogens present in surface waters are difficult to capture in routine water sampling and are time consuming to isolate in a laboratory (U.S. EPA, 2002). Infectious agents derived from fecal material are often heterogeneously distributed in surface waters and occur in low concentrations, complicating their detection via traditional water quality grab sampling. Besides the difficulties with sampling, laboratory analyses for pathogens requires special equipment and trained technicians which are often cost prohibitive and not widely available. These challenges exist alongside the ever-present possibility that a water user may contract an illness derived from fecal contamination. To protect public health in a timely and cost-effective manner, environmental managers use other indicators to determine the likelihood of the presence of pathogens in a surface water. Indicators include but are not limited to fecal indicator bacteria (FIB) such as *Escherichia Coli* (*E. coli*) and Enterococci. Detection of FIB in a water sample can give an approximate risk of human illness should a person contact a fecally contaminated waterbody (Ferguson and Signoretto, 2011).

FIB are ubiquitous in the digestive tract of mammals and are routinely shed in great numbers with fecal material (Pachepsky and Shelton, 2011). FIB are not necessarily pathogenic but such organisms are abundant in fecal wastes and are easily detectable via cheap, easily repeatable tests which can be rapidly completed in a laboratory. Detecting FIB in a water sample indicates that sample was recently contaminated with fecal material. This type of contamination also means that pathogenic organisms or viruses may be present in the sampled surface water (SFRWQCB, 2016).

Commonly used FIB include:

- Total coliforms: these organisms include several genera of bacteria commonly found in the digestive tract of warm-blooded animals. Total coliforms can grow naturally in the environment outside the intestines of warm-blooded animals, precluding their utility as an accurate indicator of recent fecal contamination in fresh surface waters.
- Fecal coliforms: a subset of total coliforms which are more specific to fecal wastes from warm blooded animals.
- *E. coli*: a subset of fecal coliforms. *E. coli* are more closely associated with the presence of pathogens or viruses than fecal coliforms (U.S. EPA, 2012).
- *Enterococci*: a group of bacteria different from coliforms. Enterococci are indicators of fecal contamination in surface waters (U.S. EPA 2012) and are recommended as FIB for saline and marine waters in California (SWRCB, 2018).

To determine the potential for water contact recreators to become sick because of fecal pollution in freshwater surface waters, U.S. EPA recommends *E. coli* or *Enterococci* (U.S. EPA, 2012). U.S EPA supports this recommendation with *E. coli*- and *Enterococci*-based recreational water quality criteria. Water quality objectives utilizing *E. coli* and *Enterococci indicators* were adopted by the State Water Resources Control Board (State Board) in the August 2018 *Bacteria Provisions*. The *Bacteria Provisions* comprise Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries (ISWEBE). The 2018 State Board action set FIB water quality objectives for California specifically to protect the Water Contact Recreation (REC-1) use. The objectives apply to all California surface waters where the REC-1 beneficial use is designated and supersede other FIB objectives that protect the REC-1 use.

4.2 Water Quality Standards

A Water Quality Standard describes a specific beneficial use of water, a WQO to protect that use, and California's antidegradation policy, which requires the continued maintenance of high-quality waters in California. Water Quality Standards define appropriate levels of water quality and may be implemented by permits to control activities that adversely affect aquatic systems. Water Quality Standards applicable to the Bishop Creek Vision Plan and other surface waters in the study area are described below.

4.2.1 Beneficial Uses

The Basin Plan designates beneficial uses for each waterbody in the Lahontan Region and describes WQOs and implementation measures necessary to protect those uses. Bishop Creek is designated with ten (10) beneficial uses, which can be found in Chapter Two of the Lahontan Region Basin Plan. Beneficial Uses are described beginning on page 2-1, and the uses applicable to Bishop Creek are found in Table 2-1 on page 2-22.

In the Plan area, the Water Contact Recreation (REC-1) Beneficial Use is impaired. This impairment is demonstrated by elevated concentrations of *E. coli* gathered during Surface Water Ambient Monitoring Program (SWAMP) monitoring conducted by Lahontan Water Board staff. Impairment to the REC-1 use was identified during the 2018 Integrated Report which was approved by U.S. EPA on June 9th, 2021. Applicability of the REC-1 use to waterbodies in the Vision Plan study are shown in Table 4-1.

Table 4-1 Beneficial Uses of Bishop Creek addressed by the Vision Plan

Beneficial Use	Description	Bishop Creek	Bishop B1-Drain	Bishop Creek Canal
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, white water activities, fishing, and use of natural hot springs.	X	X	X

4.2.2 Water Quality Objectives (WQOs)

The WQO applicable to this Plan is the *E. coli* WQO of the Bacteria Provisions. This objective applies to all California freshwater surface waters where REC-1 uses occur and was adopted with the 2018 State Water Board *Bacteria Provisions.* Table 4-2 contains information about the specifics of this objective.

The Lahontan Basin Plan also includes a regionwide bacteria WQO based on fecal coliform FIB. The Water Board is in process of developing a Basin Plan amendment to remove this WQO and associated language from the Basin Plan because fecal coliforms are no longer a recommended FIB for water quality management (U.S. EPA, 2012). A resolution to remove the fecal coliform objective from the Basin Plan is scheduled to be considered by the Water Board in November 2022. More information on the Basin Plan amendment can be found at the Water Board's Basin Planning webpage.

This Plan is focused on attainment of the *E.* coli WQO because impairment of the REC-1 use in Bishop Creek is an important public health concern for the Water Board. Attainment of the *E. coli* objective will ensure that the REC-1 use is supported in Bishop Creek and will help to ensure that public health is protected.

Table 4-2 Bacteria WQOs that apply for the Bishop Creek Vision Plan

WQO Name	Applicable Beneficial Use	Applicable FIB	Numeric WQO thresholds
E. coli	Water Contact Recreation (REC-1)	*E. coli*	*Geometric Mean*[A]: ≤100 CFU[1]/100 mL in any six-week period *Statistical Threshold Value (STV)*[B]: No more than 10% of samples >320 CFU/100 mL in any calendar month
Fecal coliform[2]	Objective is applicable to all surface waters	Fecal coliform	*Log mean*[C]: ≤20 CFU/100 mL in any thirty-day period *Single sample:* No more than 10% of samples >40 CFU/100 mL in any thirty-day period

A. A geometric mean is a type of mean or average which indicates the central tendency or typical value of a set of numbers. It is defined as the n^{th} root of the product of *n* numbers. For the WQO listed in this table, the geometric mean is calculated on data collected at the same site in the same six-week (42-day) period.

B. The Statistical Threshold Value (STV) is the allowable concentration for a single sample, beyond which is a violation of the WQO. The STV must not be exceeded by more than 10% of all samples collected at the same station in a calendar month.

C. A log mean is calculated by determining the natural logarithms of a set of numbers, calculating the average of the natural logarithms, and then convert this average back to a base 10 number.

1. CFU: Colony Forming Units. This is a unit of measurement of bacteria growth during analysis in the laboratory.

2. Fecal coliform FIB and associated WQOs are scheduled to be removed from the Basin Plan in 2023.

In addition to the FIB WQOs described above, general WQOs applicable to all Lahontan Region surface waters (including Bishop Creek) and site-specific objectives (SSOs) for two reaches of Bishop Creek are described in the Basin Plan. Bishop Creek is not presently 303(d) listed for exceedances of objectives other than the FIB WQOs described above. Site Specific Objectives (SSOs) for Bishop Creek are listed in Table 4-3.

Table 4-3 *Site Specific Objectives for Bishop Creek. All objectives units are mg/L*[1]

Waterbody Reach	TDS	Cl	SO_4	F	B	NO_3-N	Total N	PO_4
Bishop Creek (Intake 2)	27 29	1.9 3.0	-	0.15 0.15	0.02 0.02	0.1 0.2	0.1 0.4	0.05 0.09
Bishop Creek (at Hwy 395)	59 105	2.4 6.0	7.2 12.0	0.12 0.30	0.04 0.10	0.5 0.9	0.7 1.0	0.09 0.18

1. Annual Average value/90th Percentile Value

5. Monitoring Results

This section summarizes FIB monitoring data collected from Bishop Creek used to develop the Vision Plan.

Data summary

FIB data used to develop the Plan were collected by three groups – the Water Board, the Los Angeles Dept. of Water and Power (LADWP), and the Bishop Paiute Tribe (Tribe). Monitoring locations from each organization are shown in Figures 5-1 through 5-4. More information about each dataset is included below.

- Water Board data: *E. coli* and fecal coliform FIB samples collected by the Lahontan Water Board's SWAMP and by the Sierra Nevada Aquatic Research Laboratory (SNARL). SNARL was contracted by the Water Board to perform a series of fecal bacteria pollution studies in Eastern Sierra creeks which included FIB and microbial source tracking (MST) sampling. MST data are described in Chapter 6.
- LADWP data: *E. coli* samples were collected by MBC Aquatic Sciences under contract to LADWP. An MST study was also funded by LADWP, with sample collection performed by MBC Aquatic Science and laboratory analysis performed by Source Molecular Inc. of Florida. MST data from the LADWP contract is described in Chapter 6.
- Tribe collected data: *E. coli* samples are routinely collected by the Bishop Paiute Tribe at the boundaries of their sovereign lands. Tribal sovereign lands are located within the Vision Plan area.

Data show that FIB in Bishop Creek is seasonal from approximately April through September each year. FIB concentrations first exceed WQOs in early-April coinciding with the start of agricultural irrigation water delivery. Generally, FIB concentrations continue to increase through April and May, peaking in late spring and late summer before gradually receding below WQOs by October each year.

Section 5.1 describes Water Board collected FIB data. Assessment of these data support the recommendation to place Bishop Creek on the 303(d) List because REC-1 uses are not supported, as demonstrated by exceedances of the *E. coli* WQO. Sections 5.2 and 5.3 describe the LADWP and the Tribe collected *E. coli* datasets respectively. These data were not available for 303(d) assessment purposes but confirm FIB pollution in the creek and are critical information when determining pollution trends and likely FIB sources in the project area. Additional MST data collected by the Water Board and by LADWP are described in Chapter 6 *Pollutant Source Assessment*.

5.1 Water Board FIB data

In 2010 the Tribe communicated to the Water Board that their water quality monitoring program was detecting *E. coli* in Bishop Creek which exceeded the Tribes *E. coli* WQO[1].

To further investigate the water quality issue, the Lahontan Region's SWAMP began screening Bishop Creek for FIB in 2011. Diagnostic FIB monitoring began in May 2012, lasting approximately five years until 2017. A total of 14 monitoring sites were visited multiple times per month between 2012 and 2015. A summary of FIB data collected by SWAMP is shown in Table 5-1. A map depicting Water Board sampling locations is shown in Figure 5-1. FIB samples were analyzed using membrane filtration (MF) methods (methods SM 9222 G (*E. coli*) & SM 9222 D (fecal coliform)).

SNARL sampled Bishop Creek for FIB from May 2014 to October 2015 under Water Board discretionary contracts 12-067-160 and 13-054-160. Both contracts were designed to investigate fecal bacteria issues in Eastern Sierra creeks, of which Bishop Creek is one. Under these discretionary contracts, Bishop Creek was sampled in 16 locations, many of which overlapped with SWAMP sites. A summary of FIB data collected by SNARL is shown in Tables 5-1 through 5-4. A map depicting SNARL sampling locations are shown in figure 5-2. SNARL analyzed FIB samples using MF methods (methods SM 9222 G (*E. coli*) & SM 9222 D (fecal coliform)).

[1] The Tribe uses a WQO with a less strict risk level which is also based on the U.S. EPA recreational water quality criteria described above. The Tribes' objective is 126CFU *E. coli* per 100mL sample water, which equates to a risk level of 36 illnesses per thousand exposures.

Figure 5-1 Lahontan Water Board SWAMP FIB Sampling Sites

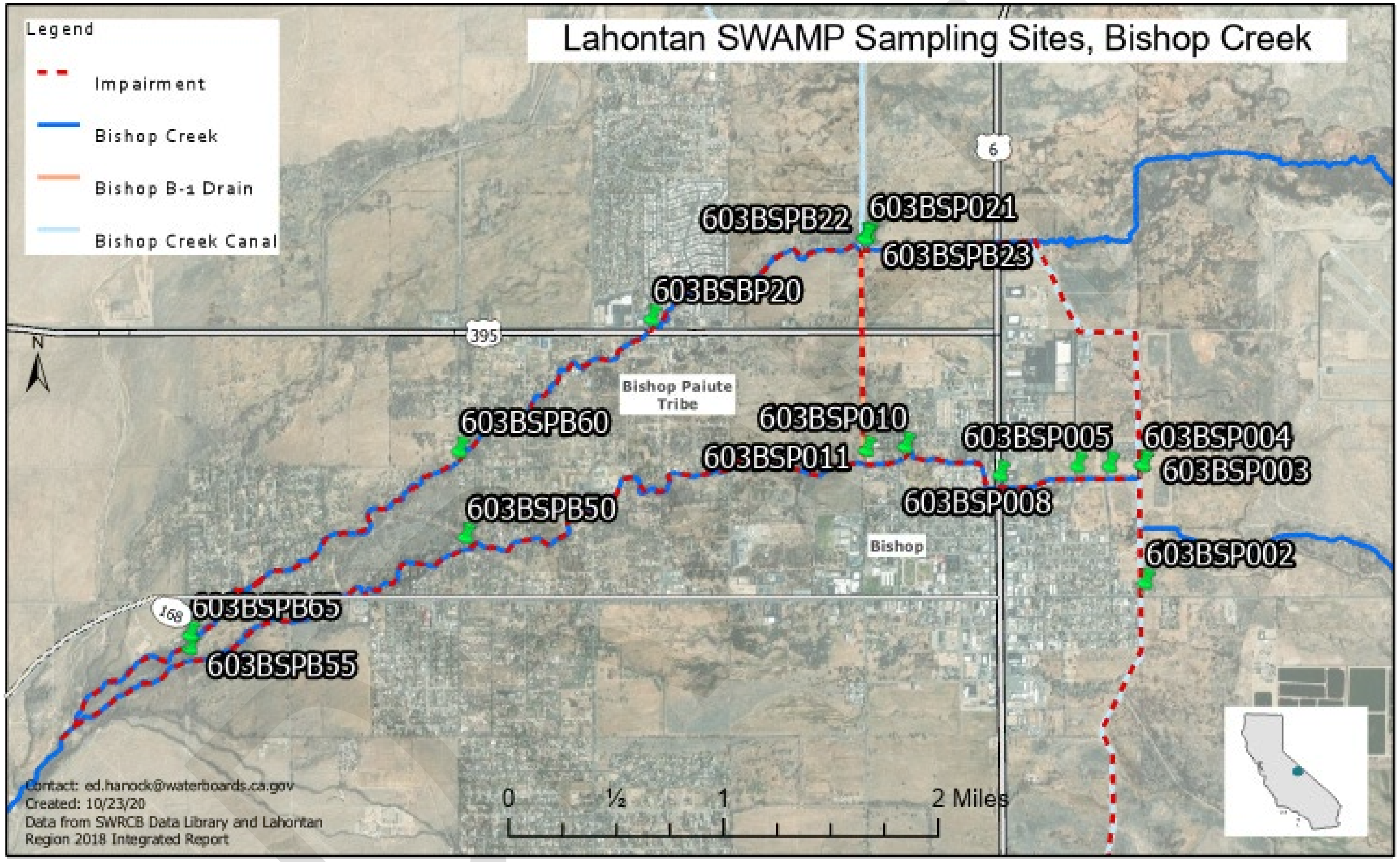
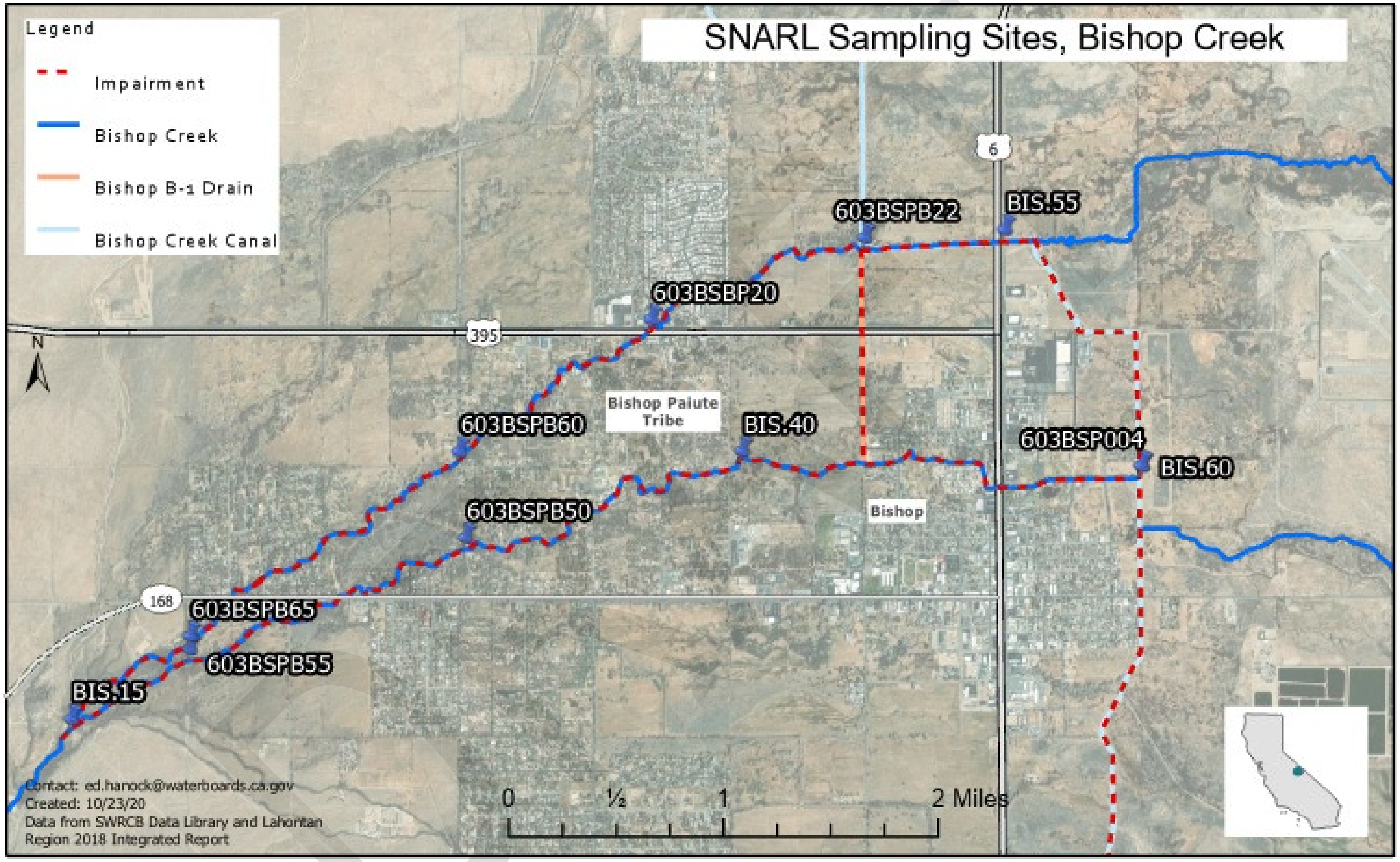


Figure 5-2 SNARL FIB Sampling Sites



Water Board collected FIB data were compared to the applicable bacteria WQOs for Bishop Creek. WQOs are described in Section 4.2.2. To evaluate data for each FIB, data records were compiled to geometric means (*E. coli*) or log means (fecal coliform) according to the duration component of each WQO[2]. The computed means were compared against each applicable numeric WQO to determine support or impairment of beneficial uses. Log or geometric mean evaluations are the primary means of determining beneficial use support. Single samples of FIB collected in each calendar month were compared to the single sample component (fecal coliform) or STV component (*E. coli*) of each WQO as a secondary assessment of attainment of objectives. A summary of Water Board data is described in Table 5-1 (*E. coli*) and 5-3 (fecal coliform). All values exceeding each component of WQOs were counted as exceedances and were divided by the total number of samples calculated for each assessment to determine percent exceedance.

For CWA 303(d) assessments administered during the 2018 Integrated Report[3], exceedances were compared to the allowable frequency of exceedances as stipulated by Table 3.2 of the Water Quality Control Policy For Developing California's CWA Section 303(d) List (Listing Policy). A summary of the data used in 2018 303(d) assessments for FIB in Bishop Creek can be found in Tables 5-2 *(E.* coli) and 5-4 (fecal coliform). For both fecal coliform and *E. coli* datasets, assessment of log or geometric means resulted in recommendations to list Bishop Creek because of impairments to the REC-1 beneficial use, as demonstrated by concentrations of *E. coli*, and because the fecal coliform objective of the Lahontan Region Basin Plan was exceeded as demonstrated by fecal coliform data. For 2018 Integrated Report purposes, the fecal coliform WQO was associated with the MUN use, although the objective is generally applicable to all surface waters and associated beneficial uses in the Region. *E. coli* data assessed for the Bishop B1 Drain show that the REC-1 use is not supported in the surface water and warrants placement of the waterbody on the 303(d) List. Fecal coliform data available for Bishop Creek Canal also support 303(d) listing.

The Water Board continued to sample Bishop Creek beyond the May 2017 data solicitation deadline for the 2018 Integrated Report 303(d) assessment. In addition to

[2] For *E. coli,* a minimum of three samples were required to calculate a geomean. For fecal coliform, a minimum of two samples were required to calculate a log mean. Staff used these thresholds because of the logistical challenges to intensively sample the geographically large Lahontan Region, meaning collecting 5 samples in a 30- or even 42-day period is highly difficult. Regions have discretion to determine a minimum number of samples when applying FIB WQO and flexibility for minimum samples are inherent in the WQO descriptions.

[3] 303(d) assessments for fecal coliform used 1-sample as a minimum sample size for log-mean calculation. This methodology results in a slightly higher exceedance rate. The Vision Project relies on 2-sample minimum log-means.

sampling beyond the data solicitation deadline, Water Board data is subject to a rigorous quality assurance (QA) process which can take several years to complete. The QA process for data collected in 2016 and early 2017 was still ongoing in May 2017 meaning these data were unavailable for the 2018 303(d) assessments. Data from 2016 and 2017 are now available for analysis, and this causes a discrepancy in data tallies reflected in the information displayed in Tables 5-1 through 5-4. Table 5-3 and 5-4 summarize data used for the 2018 Integrated Report assessments. FIB data from the project area, inclusive of the data assessed for the 2018 Integrated Report, demonstrate the presence of unacceptable levels of fecal material which present a health risk to water contact recreators.

Table 5-1 Summary of Water Board *E. COLI* data collected from the Bishop Creek Vision Plan study area. *Data collected by SWAMP and SNARL*

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of samples collected	Number of samples exceeding 320 CFU/100mL	% of samples exceeding 320 CFU/100mL	Number of geometric means calculated[1]	number of geometric means exceeding 100 CFU/100mL	% of geometric means exceeding 100 CFU/100mL WQO
Bishop Creek	17	05/30/2012	6/14/2017	420	27	6%	411	147	36%
Bishop B1 Drain	1	5/14/2014	10/13/2015	14	4	29%	14	7	50%
Bishop Creek Canal	2	3/29/2010	4/23/2014	83	2	2%	82	1	1%

Date accessed from CEDEN 04/17/2020.

[1]*Geometric means calculated with 3 or more samples collected in the same 42-day period.*

Table 5-2 Summary of *E. COLI* data collected from the Bishop Creek Vision Plan study area assessed for 2018 Integrated Report. *Data collected by SWAMP and SNARL*

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of months of sampling (calculated at each monitoring station)	Number of months where more than 10% of samples exceed 320 CFU/100mL WQO	% of monthly data exceeding 320 CFU/100mL WQO	Number of geometric means calculated	*N*umber of geometric means exceeding 100 CFU/100mL WQO	% of geometric means exceeding 100 CFU/100mL WQO
Bishop Creek	16	05/30/2012	12/01/2015	269	27	10%	125	55	44%
Bishop B1 Drain	1	05/14/2014	10/13/2015	14	4	29%	0	0	0%
Bishop Creek Canal	2	12/01/2010	04/23/2014	36	1	3%	39	0	0%

Note: Approx. 16% of samples must exceed WQOs to make the decision to LIST a waterbody on the 303(d) List.

Table 5-3 Summary of Water Board FECAL COLIFORM data collected from the Bishop Creek Vision Plan study area. *Data collected by SWAMP and SNARL*

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of samples collected	Number of samples exceeding 40 CFU/100mL	% of samples exceeding 40 CFU/100mL	Number of log means calculated[1]	number of log means exceeding 20 CFU/100mL	% of log means exceeding 20 CFU/100mL
Bishop Creek	17	05/30/2012	6/14/2017	443	263	59%	428	308	72%
Bishop B1 Drain	1	5/14/2014	10/13/2015	14	11	79%	14	10	71%
Bishop Creek Canal	2	3/29/2010	4/23/2014	88	39	44%	86	63	73%

Date accessed from CEDEN 04/17/2020.

[1]Log means calculated with 2 or more samples collected in the same 30-day period.

Table 5-4 Summary of FECAL COLIFORM data collected from the Bishop Creek Vision Plan study area assessed for 2018 Integrated Report. *Data collected by SWAMP and SNARL*

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of months of sampling (calculated at each monitoring station)	Number of months where more than 10% of samples exceed 40 CFU/100mL WQO	% of monthly data exceeding 40 CFU/100mL WQO	Number of log means calculated	Number of log means exceeding 20 CFU/100mL WQO	% of log means exceeding 20 CFU/100mL WQO
Bishop Creek	17	05/30/2012	12/01/2015	274	173	63%	382	286	75%
Bishop B1 Drain	1	05/14/2014	10/13/2015	14	11	79%	14	10	70%
Bishop Creek Canal	2	09/29/2010	04/23/2014	37	21	57%	71	58	82%

Note: Approx. 16% of samples must exceed WQOs to make the decision to LIST a waterbody on the 303(d) List.

5.2 LADWP *E. coli* data

In 2014 LADWP contracted MBC Aquatic Sciences to collect *E. coli* FIB samples from Bishop Creek. MBC Aquatic Sciences continues to collect samples from Bishop Creek. Samples are collected from twenty-seven sites[4] on a predominantly weekly basis and analyzed at the Inyo County Public Health Laboratory in Lone Pine, Inyo County, using the multiple tube fermentation/most probable number (MPN) method (method SM 9222 B). A map depicting LADWP sampling locations is shown in Figure 5-3.

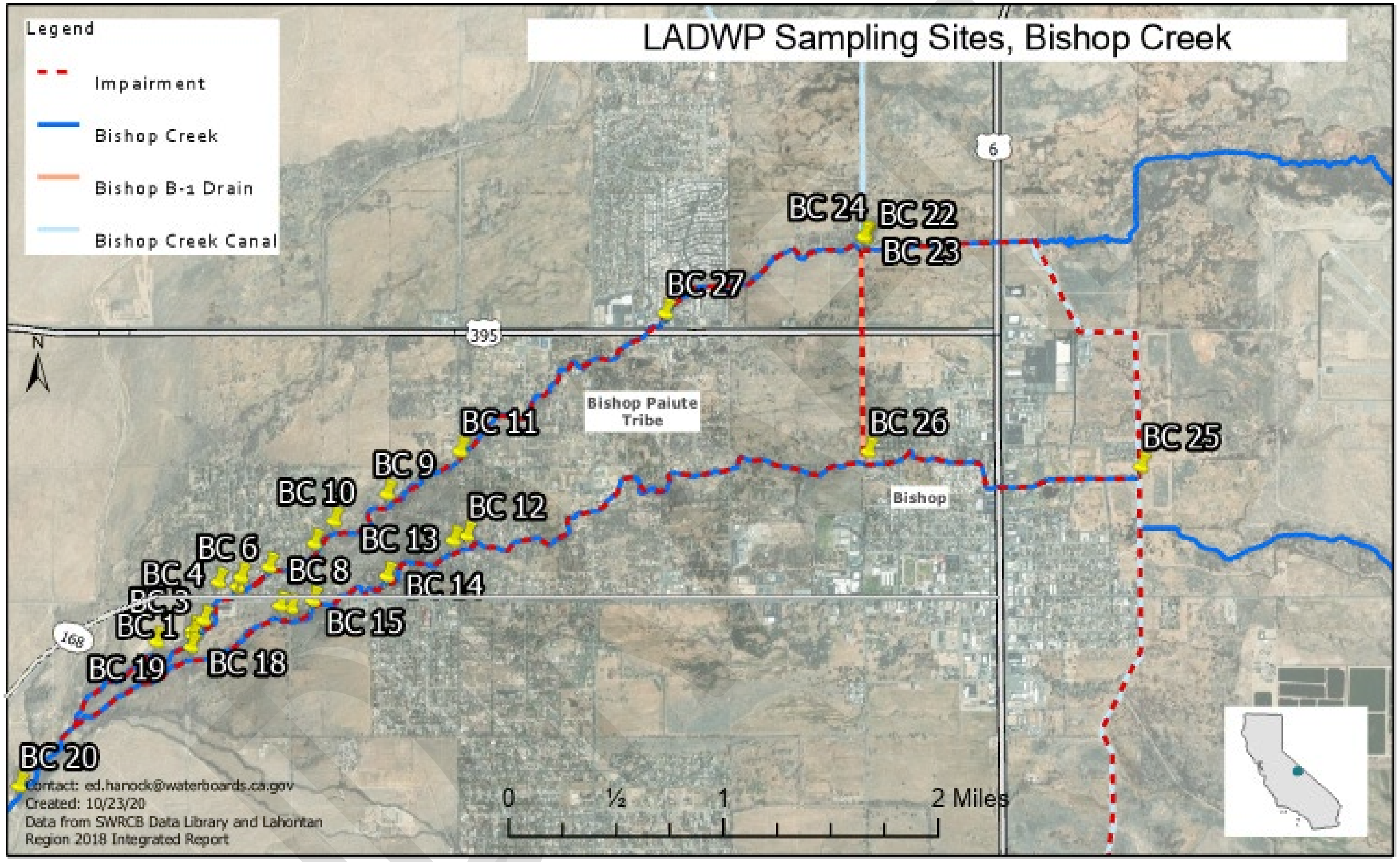
Twenty-three LADWP sampling sites are located on the mainstem of Bishop Creek. One site (BC 22) is located on the Bishop B1 Drain. One site (BC 23) is located on the Bishop Canal which conveys water from the Owens River to the north channel of Bishop Creek. Two more sites (BC 20 and BC 21) are located upstream of the study area near the Cerro Coso Community College. BC 20 and BC 21 provide important data regarding *E. coli* water quality flowing into the Plan area. Data from these sites show that FIB water quality entering the Vision Plan area always meets WQOs and rarely contains any FIB at all.

A summary of all LADWP FIB data analyzed for this Plan is shown in Table 5-5. Table 5-6 summarizes data collected during irrigation season, April 1st through October 1st each year. Table 5-7 summarizes data by land use along Bishop Creek, classifying areas as above suspected impactful land uses, at the first occurrence of suspected impactful land uses, and downstream of suspected impactful land uses.

LADWP *E. coli* data show seasonal and spatial patterns of contamination. Patterns include an increasing bacteria load between spring and fall each year (peaking in late-spring and late-summer), and an accumulation of *E. coli* concentrations in downstream (eastwards) sections of Bishop Creek. The cumulative trend to *E. coli* suggests numerous pollution sources within the study area which impact creek waters during spring and summer months. Identification of the duration and spatial distribution of *E. coli* contamination facilitates selection of appropriate best management practices (BMPs) to improve and maintain water quality. BMPs targeted at land uses known to produce *E. coli* FIB should improve water quality to a level which supports the REC-1 use in Bishop Creek.

[4] At the time of writing, MBC, on behalf of LADWP, and the Water Board are working to revise the LADWP monitoring plan to add sites, predominantly upstream and downstream of LADWP-owned grazing allotments.

Figure 5-3 LADWP E. coli Sampling Sites



E. coli contamination begins approximately at the beginning of April each year, persisting through the summer months until October. In this same period, from approximately April 1st through the end of summer each year, Bishop Creek is diverted for irrigation purposes. Irrigation includes agricultural irrigation for livestock uses and diversion for residential backyard watering. Because irrigation season and peak *E. coli* concentrations occur at the same time, irrigation practices are likely to mobilize *E. coli* deposited on the landscape and carry bacteria to creek waters. *E. coli* concentrations often increase in samples collected downstream of certain land uses such as livestock grazing, which occurs on grazing allotments owned by LADWP, in hobby-ranch settings on residential properties, and in certain areas of the Tribe Reservation. In more developed portions of the study area, such as in and around the City of Bishop on both City-owned lands and on DWP lands, transient populations have increased in recent years and may also contribute to *E. coli* in the creek.

In the spring and summer months, *E. coli* concentrations generally increase at each successive downstream sampling location on both the north and South Forks of Bishop Creek. For example, 3% of geometric means in upstream portions of the project area exceed WQOs, while 16% of geometric means collected in the central portions of the project area exceed objectives. Elevated *E. coli* concentrations coincide with the occurrences of land uses suspected of contributing fecal matter to creek waters. In the lower reaches of the project area, 50% of geometric means exceed WQOs. The cumulative nature of *E. coli* in Bishop Creek suggests FIB is added to the system at multiple locations, likely from the diverse and intermixed set of land uses capable of producing and delivery *E. coli* FIB to creek waters.

Little or no concentrations of *E. coli* are recovered from samples collected throughout the project area during winter months (November 1st through February 28th). Similarly, little or no *E. coli* recovered in samples collected at the upstream (western-most) boundary of the project area throughout the year. Table 5-9 summarizes the data for the relatively unimpacted upstream parts of the project area during irrigation season. These data support the hypotheses that *E. coli* water quality issues are linked to irrigation season and manifest downstream of the alluvial fan.

Between 2014 and 2020 LADWP focused sampling on twenty-three Bishop Creek sites. Sample sites are concentrated in the western, less-impacted portions of the study area with nineteen of the twenty-three sites located upstream of the Tribe Reservation. The remaining four sites are located downstream of Paiute lands in and around the City of Bishop. The distribution of sites and sample frequency must be accounted for during data analyses.

The western-focused distribution of sample sites introduces bias into data analyses because, as demonstrated by *E. coli* samples recovered from LADWPs upstream sampling locations, FIB water quality is much cleaner in the western, upstream portions of Bishop Creek when compared to the eastern, downstream end of the reach. Many of the land uses suspected of delivering bacteria to the creek begin approximately one mile downstream of the bifurcation of Bishop Creek at the western boundary of the project area. Seven of the twenty-three sample locations occur in this upstream zone before suspected land uses, with a further twelve sample locations found over the following mile (for a total of 19 sites found upstream of Tribe lands). When examining the entire dataset, the combination of weekly, year-round sampling and western-focused distribution of sample sites favoring unimpacted areas of the creek serve to minimize the impacts of the worst affected areas on the total number of WQO exceedances. Data summaries provided in Tables 5-5 (summation of the total dataset), 5-6 (summation of irrigation season data), and 5-7 (summation of Forks Reach data based on land use assessment) illustrates how consideration of the entire, year-round dataset serves to mask data patterns and obfuscate pollution trends. When data are analyzed by season, pollution trends become apparent and support the hypothesis that seasonal contamination issues are linked to irrigation water delivery and warmer calendar months.

Data analysis completed for this Plan shows 8% of geometric means calculated using the entire, year-round *E. coli* dataset exceed WQOs for the REC-1 use. Looking at *E. coli* data collected during irrigation season, 14% of geometric means exceed the REC-1 WQO. When geometric means are calculated using *E. coli* data collected from sampling locations downstream of grazing and urbanized land uses during the period of irrigation season, 24% of geometric means exceed the WQO. Calculating *E. coli* geometric means from data collected from the eastern most parts of the project area around the City of Bishop results in a 50% exceedance rate of the REC-1 WQO. Exceedances are depicted in chart 5-1. This analysis reveals the temporal trend of *E. coli* pollution during irrigation season, and the spatial trend of increased *E. coli* concentrations downstream of grazing and urban land uses.

The spatial and temporal patterns of the LADWP-collected *E. coli* illustrate that water quality is compromised by FIB from April to October, coinciding with irrigation water delivery. The concentrations of *E. coli* in this timeframe also indicate the presence of a risk to human health. When the LADWP *E. coli* dataset is analyzed in its entirety the conclusion might be that Bishop Creek generally supports REC-1 uses and there is no *E. coli* impairment. However, if data collected during irrigation season (April 1st-October 1st) is analyzed, Bishop Creek WQOs are exceeded with greater frequency. This frequency ranges from 14% to 50% depending on the timeframe and location applied during analysis. A comparable pattern difference emerges in the Bishop B1 Drain: 44% of year-round vs. 64% of irrigation season geometric means exceed WQOs. Half or more of geometric means exceed REC-1 WQOs in the most downstream (eastern) portions of the project area where REC-1 uses are known to occur with the greatest frequency.

Evaluating data by season illustrates the human health risks posed by Bishop Creek water quality at certain times of the year. Irrigation water delivery begins in April and lasts through the summer, coinciding with the warmest months in the watershed when REC-1 uses are significantly more likely to occur. REC-1 uses coinciding with elevated *E. coli* FIB manifests a risk to recreators. LADWP *E. coli* data is vital to understand the seasonal and spatial nature of FIB contamination to Bishop Creek

Chart 5-1 Temporal distribution of *E. coli* FIB exceedances

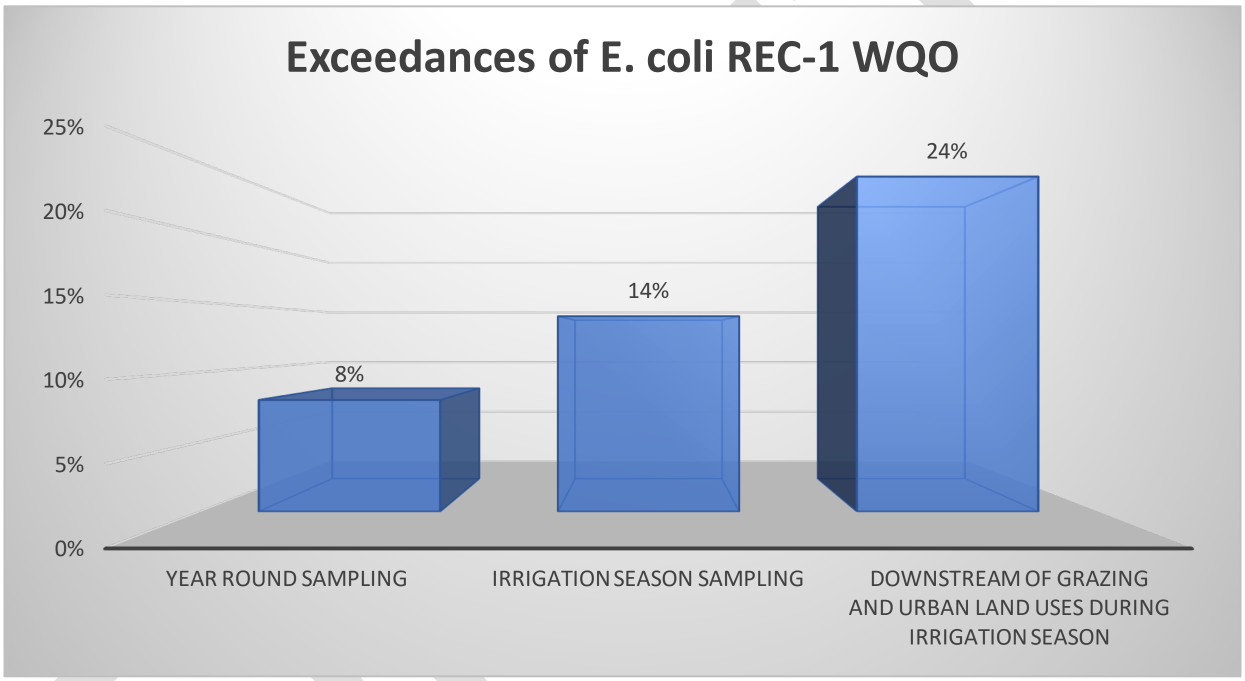


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Table 5-5 Summary of LADWP *E. COLI* data collected from the Bishop Creek Vision Plan study area.
Data collected by MBC

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of samples collected	Number of samples exceeding 320 MPN/100mL	% of samples exceeding 320 MPN/100mL	Number of geometric means calculated[1]	number of geometric means exceeding 100 MPN/100mL	% of geometric means exceeding 100 MPN/100mL WQO
Bishop Creek abv. project area	2	6/4/2014	5/27/2020	544	0	0%	522	0	0%
Bishop Creek	23	6/4/2014	5/27/2020	8212	358	4%	5150	395	8%
Bishop B1 Drain	1	6/3/2015	5/27/2020	167	44	26%	154	67	44%
Bishop Canal	1	6/3/2015	5/27/2020	167	8	5%	154	17	11%

Date accessed from CEDEN 10/7/2020.

[1]*Geometric means calculated with 3 or more samples collected in the same 42-day period*

Table 5-6 Summary of LADWP *E. COLI* data collected from the Bishop Creek Vision Plan study area during irrigation season (April 1st – October 1st).

Data collected by MBC

Waterbody Segment	Number of Stations	Sampling Start Date	Sampling End Date	Number of samples collected	Number of samples exceeding 320 MPN/100mL	% of samples exceeding 320 MPN/100mL	Number of geometric means calculated[1]	number of geometric means exceeding 100 MPN/100mL	% of geometric means exceeding 100 MPN/100mL WQO
Bishop Creek abv. project area	2	6/4/2014	5/27/2020	266	0	0%	235	0	0%
Bishop Creek	23	6/4/2014	5/27/2020	2698	133	5%	2331	334	14%
Bishop B1 Drain	1	6/3/2015	5/27/2020	87	35	40%	74	47	64%
Bishop Canal	1	6/3/2015	5/27/2020	87	6	7%	74	19	26%

Date accessed from CEDEN 10/7/2020.

[1]*Geometric means calculated with 3 or more samples collected in the same 42-day period*

Table 5-7 Summary of LADWP *E. COLI* data collected from BISHOP CREEK during irrigation season (April 1st – October 1st) UPSTREAM, at the OCCURANCE of, and DOWNSTREAM of land uses suspected of delivering bacteria to creek waters

Data collected by MBC

Reach location	Station IDs	Number of stations	Number of samples collected	Number of samples exceeding 320 MPN/100mL	% of samples exceeding 320 MPN/100mL	Number of geometric means calculated[1]	number of geometric means exceeding 100 MPN/100 mL	% of geometric means exceeding 100 MPN/100 mL WQO
Up-stream	BC1 thru BC8, BC18, BC 19	10	1219	17	1%	1069	29	3%
Mid	BC9 thru BC17	9	1080	59	5%	957	154	16%
Down-stream	BC24 thru BC 27	4	349	57	16%	305	151	50%

Date accessed from CEDEN 10/7/2020.

[1]*Geometric means calculated with 3 or more samples collected in the same 42-day period*

5.3 Bishop Paiute Tribe *E. coli* data

The Tribe have Treatment as a State (TAS) from U.S. EPA for water quality criteria and Section 401 Permitting. The Tribes' Environmental Management Office (EMO) has a well-developed water quality program which includes a Water Quality Control Plan (Basin Plan) and monitoring program. The Tribe has been monitoring Bishop Creek water quality for over twenty years and has on-site laboratory facilities which can process environmental and drinking water samples. *E. coli* samples are collected from a variety of locations throughout the Reservation on a weekly basis, and continuous monitoring devices for specific water quality characteristics are deployed at several locations around the Reservation.

The Tribe first raised concerns regarding elevated levels of *E. coli* in Bishop Creek in 2010 when the EMO alerted Water Board staff that *E. coli* concentrations were exceeding Tribal WQOs for REC-1. These concerns precipitated the Water Boards screening and diagnostic sampling efforts in Bishop Creek and led to subsequent LADWP sampling. The Tribe is an important partner in the Vision Plan and Tribal EMO continues to monitor FIB water quality and work to implement nonpoint source BMPs to address *E. coli* issues originating on Tribe lands.

The Tribe does not submit monitoring data to Water Board databases and Tribe-collected data has not been used for 303(d) assessment purposes. Tabular Tribe data is also not available online for public consumption. The Tribe's EMO has shared certain *E. coli* data with Water Board staff periodically but has not granted formal sharing rights to the Water Board, and thus a detailed data summary is not included in this section. *E. coli* water quality data collected from stations at Tribal boundaries is available on the EMO website. Other *E. coli* data are collected from within Tribal boundaries but are not widely publicly available. The Water Board has a responsibility to ensure that surface waters leaving State jurisdiction entering Tribe lands meet all applicable water quality objectives. Similarly, the Tribe is responsible for ensuring water quality leaving their lands meets applicable Water Board WQOs.

Tribe collected data have been instrumental to identify and help understand FIB issues in Bishop Creek. Data collected between 2000 and 2017 have been useful to understand Bishop Creek water quality issues, and some supplemental data for 2020 are included in graphical form accessed directly from the Tribal EMO webpage. A map showing the location of Tribal monitoring sites used in this analysis are shown in Figure 5-4.

Tribe-collected *E. coli* data corroborates the trends revealed in the LADWP dataset. There is a clear seasonal trend to contamination, demonstrated by very low FIB concentrations detected during the winter months with significant peaks in geometric means occurring in the spring and summer each year. Figure 5-5, which was developed from data collected at the most downstream sampling location on the South Fork of Bishop Creek on Tribe lands illustrates the seasonal nature of *E. coli* on Tribe lands. The figure also illustrates elevated *E. coli* concentrations entering State of California waters during the spring and summer months.

Generally, *E. coli* concentrations are elevated in Bishop Creek waters entering Tribe lands, although such concentrations are variable and do not consistently exceed California or Tribe WQOs for *E. coli*. On the South Fork, 19% of geometric means entering Tribe lands (measured at SW-4) exceed the Water Board *E. coli* WQO, while 25% of geometric means leaving Tribe lands (measured at SW-1) exceed the Water Board *E. coli* WQO. On the North Fork of Bishop Creek, 14% of geometric means entering Tribe lands (measured at SW-3) and 19% of geometric means leaving Tribe lands (measured at SW-2) exceed the Water Board *E. coli* WQO. *E.* coli data from SW-4 and SW-1 (upstream/downstream South Fork), and from SW-2 (downstream North Fork) exceed the Water Board *E. coli* WQO with a frequency that shows the REC-1 beneficial use is impaired in State waters. Figure 5-6 illustrates *E. coli* water quality entering Tribe lands on the North Fork of Bishop Creek between 2011 and 2017. In some years (2012-2015), FIB concentrations violate Water Board WQOs before entering Tribe lands.

Figure 5-7 depicts 2020 *E. coli* data collected by the Tribe accessed directly from the Tribe EMO webpage in October 2020. These data show that, in 2020, FIB water quality entering Tribe lands on the North Fork at the beginning of irrigation season generally hovers around the Water Board *E. coli* WQO and then meets objectives for the remainder of the year. In general, *E. coli* water quality leaving Tribe lands on the North Fork meets WQOs throughout the season. For the South Fork, *E. coli* water quality entering Tribe lands tends to meet the California WQO at the beginning of irrigation season but steadily increases through the summer to above the WQO in September. *E. coli* leaving Tribe lands on the South Fork drastically increases through the season and with geometric means increase to as much as four times the California *E. coli* WQO in the late summer, indicating that REC-1 uses downstream of Tribe lands are impaired.

Figure 5-4 Bishop Paiute Tribe *E. coli* Sample Sites

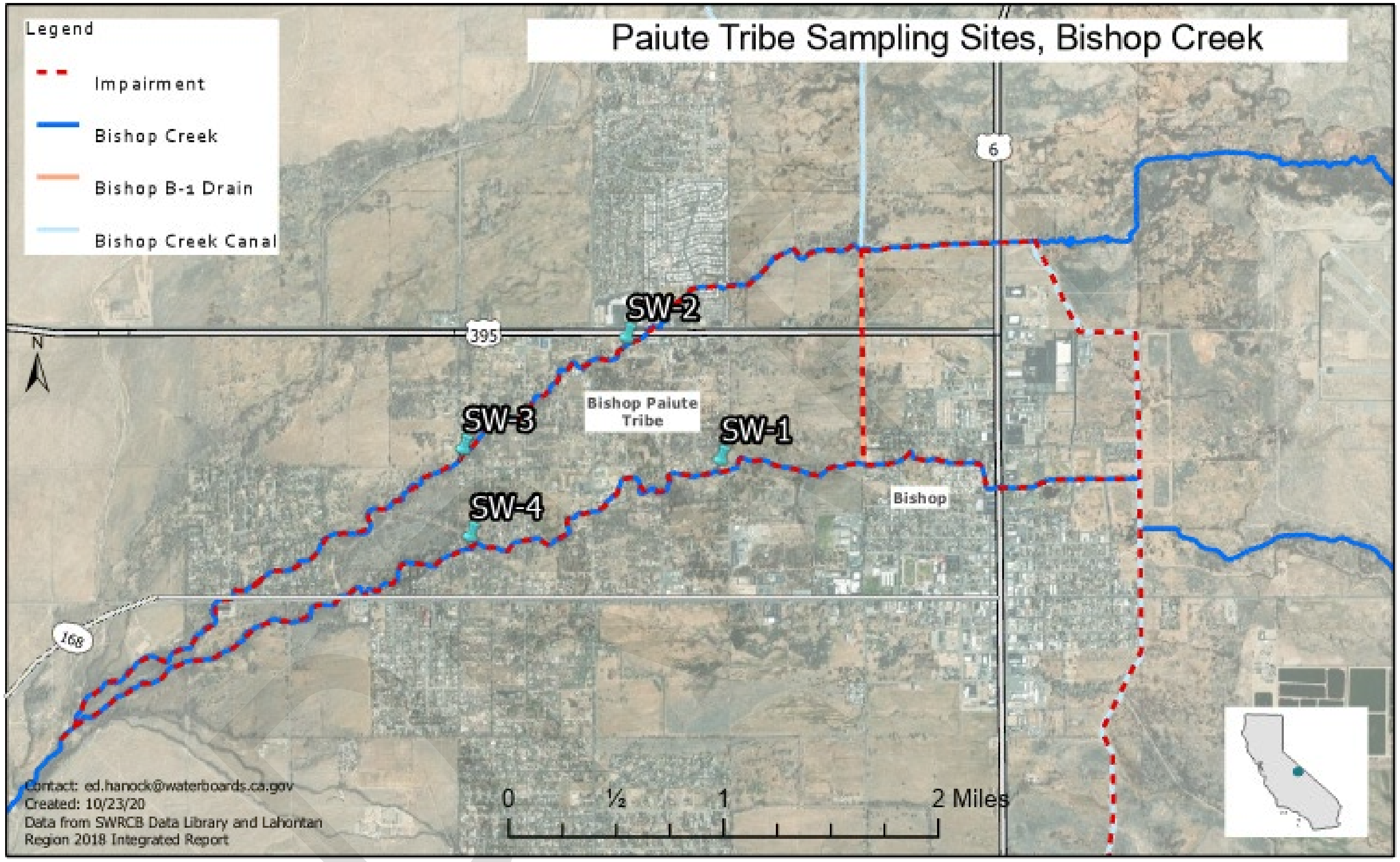


Figure 5-5 *E. coli* geometric means collected from sample site SW-1, South Fork downstream, by the Tribe EMO on the Bishop Paiute Tribe Reservation, 2011-2017. Water Board generated graphic. Data provided via email by Tribe EMO to Water Board staff

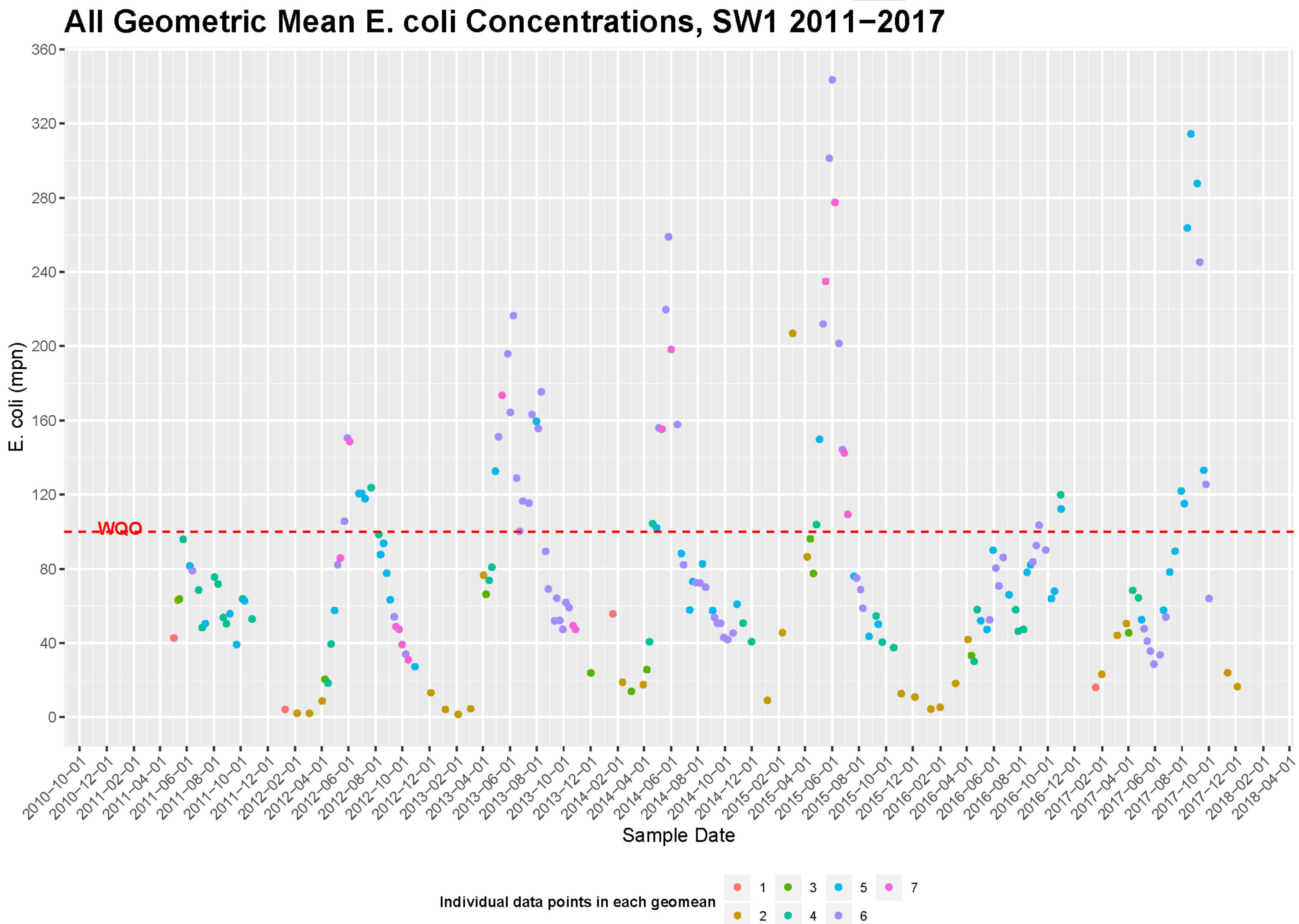


Figure 5-6 *E. coli* geometric means collected from sample site SW-3, North Fork upstream, by the Tribe EMO on the Bishop Paiute Tribe Reservation, 2011-2017. Water Board generated graphic. Data provided via email by Tribe EMO to Water Board staff

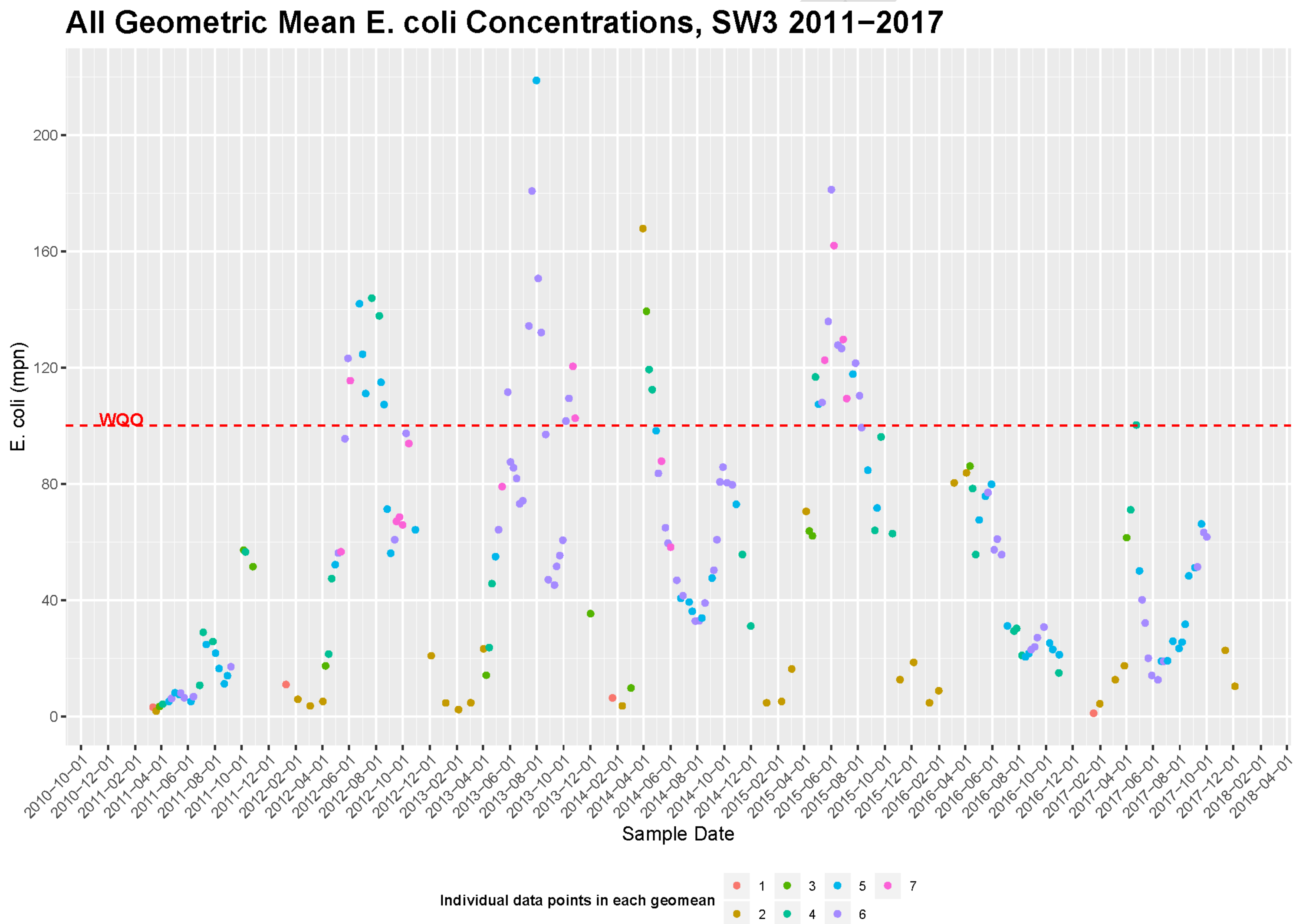
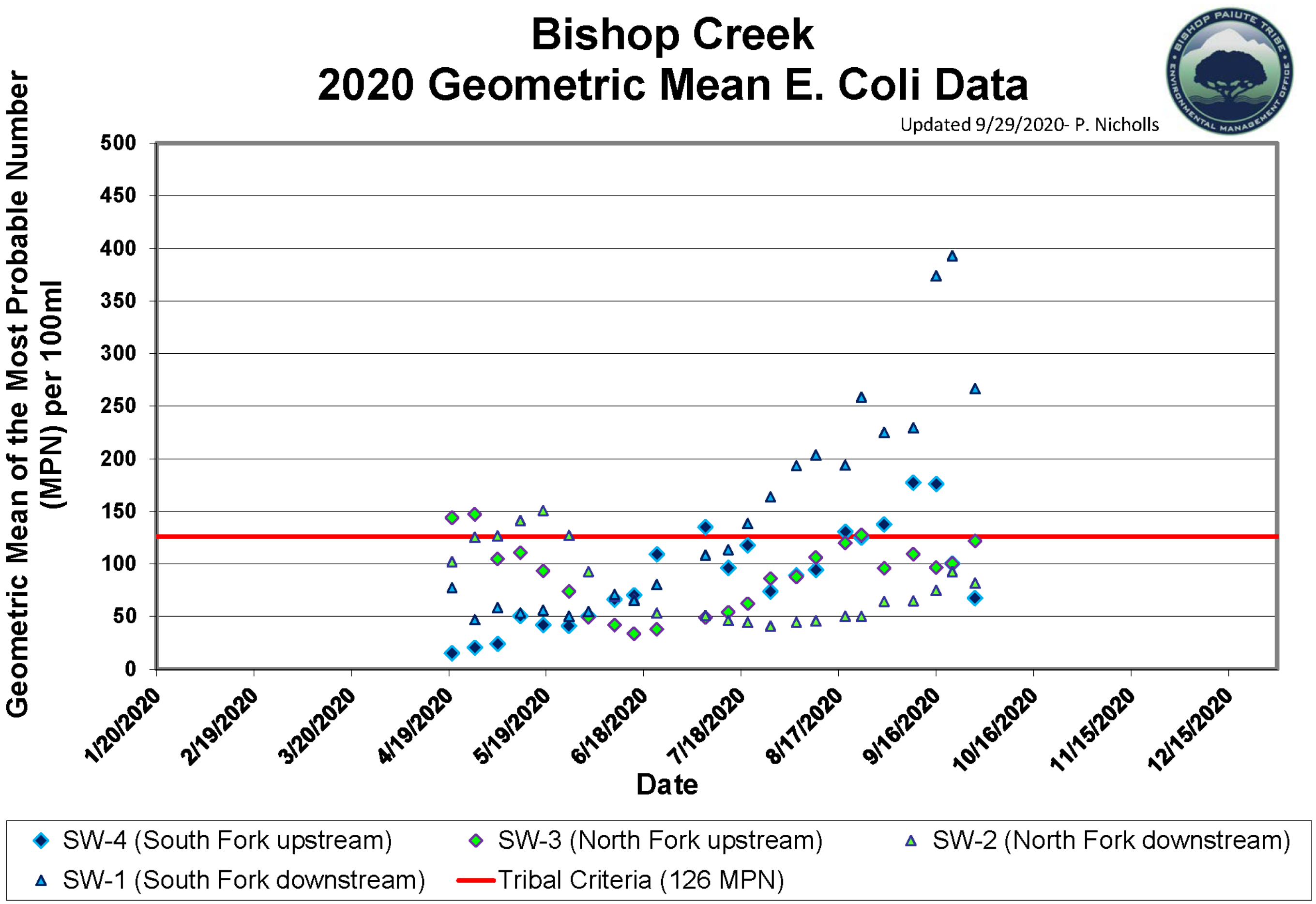


Figure 5-7 2020 *E. coli* geometric means, Bishop Paiute Tribe EMO



5.4 Conclusions

There is a FIB water quality problem in the reaches of Bishop Creek passing through West Bishop, the Paiute Tribe Reservation, and the City of Bishop. The type and magnitude of the water quality problem poses a risk to human health because people could be exposed to fecal pathogens present in fecal waste. The magnitude of the impairment prompted the Lahontan Water Board to place the affected reaches of Bishop Creek on the 303(d) List because the REC-1 beneficial use is not supported.

The 303(d) impaired reach of Bishop Creek, the FIB-impacted Bishop B1 Drain, and the Bishop Creek Canal make up the Vision Plan area. The Bishop Canal, which is not presently 303(d) listed for *E. coli*, delivers water to Bishop Creek and is also impacted by fecal bacteria as demonstrated by *E. coli* and fecal coliform monitoring data. It is possible that the Canal may be added to the 303(d) List in the next assessment cycle.

The water quality problem in Bishop Creek is demonstrated in each of the three FIB datasets. Each dataset offers a slightly different perspective on Bishop Creek water quality conditions enabling a side-by-side evaluation which illuminates the nuances of FIB issues in Bishop Creek. Data show that a seasonal water quality problem exists with a dominant downstream spatial trend. Identification of temporal and spatial trends is an important step in selecting management measures to improve and maintain FIB water quality. Improving and maintaining FIB water quality will manifest support for REC-1 uses and will ultimately enable the Water Board to recommend removal of Bishop Creek from the 303(d) List.

The next section of this document will evaluate the potential sources of bacteria using Microbial Source Tracking (MST) data collected by the Water Board and by LADWP. The goal of source attribution is to identify which sources can reasonably be controlled so that water quality might improve in an efficient and timely manner.

6. Pollutant Source Assessment

This section describes the probable sources of FIB affecting Bishop Creek. Source assessment is based on the available data for the Vision Plan, including the datasets described in Section 5 and Microbial Source Tracking (MST) data collected by SNARL under contract with the Water Board, FIB landscape modelling performed by SNARL under contract with the Water Board, and MST data collected by MBC Aquatic Sciences under contract with LADWP.

Source assessment is complex for two reasons. The first relates to the diverse and intermixed land uses found in the Vision Plan area. Land uses suspected of delivering FIB to creek waters include cattle grazing, hobby ranching, residential diversions for backyard irrigation and ornamental purposes, urban uses, and transient encampments, all of which occur amongst each other. The second reason source assessment is complex is because of irrigation water conveyances which carry water throughout the study area. Irrigation water originates from Bishop Creek and from the Owens River and irrigation water (including return flows) is frequently transported between the North and South Forks of the creek.

6.1 Overview of Sources

Identification and prioritization of sources of FIB polluting Bishop Creek are based on the following:

- FIB monitoring data showing that applicable WQOs are regularly exceeded at various locations throughout the Plan area;
- Weekly LADWP *E. coli* sampling. These data reveal seasonal and spatial trends to FIB pollution;
- A series of two MST studies conducted between 2012 and 2014 by the Sierra Nevada Aquatic Research Laboratory (SNARL) under contract with the Water Board;
- FIB modelling performed by SNARL to determine landscape-scale drivers of fecal pollution in Eastern Sierra creeks of the Lahontan Region. This modeling included Bishop Creek in the Vision Plan area;
- An MST study conducted in 2015 by MBC Aquatic Sciences and Source Molecular Corporation under contract with LADWP;
- Inventory of land uses in the Plan area;
- Visual investigations conducted by Water Board staff during site visits.

Table 6-1 lists sources of FIB in the project area. Sources have been categorized as either high or low priority based on the following factors:

- Results from FIB monitoring performed in the study area with attention to land uses which occur upstream of monitoring locations;
- The prevalence with which each identified source appears in MST study data[5];
- The results of landscape-scale FIB modelling performed by SNARL pertaining to Bishop Creek;
- The degree to which each source is currently regulated or actively managed;
- The practicality of controlling the identified bacteria discharges using existing regulatory tools available to the Water Board in the absence of a Total Maximum Daily Load (TMDL);

[5] Section 6.3 discusses source attribution based on MST data. This discussion is based on evidence that a specific source frequently contributes bacteria and not that it contributes bacteria in a specific amount or concentration.

- The opportunity for pollutant reduction via inexpensive and practicable control methods.

The following sources are categorized “high priority”:

- FIB from commercial cattle grazing operations;
- Human-sourced FIB. Human sources include transient encampments, recreation-related sources, and possible residential sources;
- Horse and other livestock waste from small-scale hobby ranching on residential or private properties;
- Pet wastes from animals such as dogs.

Each of these sources contribute to the FIB impairment in Bishop Creek and each source presents opportunity to implement control actions. Therefore, implementation actions presented in Section 6 focus on these “high priority” sources.

Other sources of FIB have been identified as “low priority”:

- Wildlife, including from beaver, birds, and mule deer;
- Impacts from sanitary sewer overflows and legacy septic systems[6];
- Leaks from private sewer laterals;
- Other incidental contamination from unidentified sources.

“Low priority” sources are identified because they satisfy at least one of the following criteria:

- The source is not identified via MST investigation as a major or consistent pollutant contributor, so they are not likely to cause the chronic FIB contamination observed in Bishop Creek during irrigation season;
- Opportunities for effective control of such sources are difficult or impractical (e.g. wildlife);
- Sources are actively addressed by other existing regulations or permits (e.g. sanitary sewer overflows);
- Sources would require significant effort to evaluate and manage by developing as yet non-existing local regulations, such as leaks from private sewer laterals.

“Low priority” sources are not the primary focus of this Plan but may be revisited in the future after “high priority” sources are addressed and if FIB pollution continues to impact Bishop creek.

[6] Such impacts occur infrequently. When sanitary sewer overflows do occur, the occurrence is regulated by existing Water Boards regulatory programs.

Implementation for this Vision Plan will focus on the readily controllable “high priority” sources through a mixture of existing regulatory tools and BMP implementation. Addressing “high priority” sources is expected to improve FIB water quality to a condition that attains applicable FIB WQOs and supports the REC-1 beneficial use.

Table 6-1 Sources of fecal bacteria to Bishop Creek

Source Category	Source Contributors	Priority
Cattle	- Cattle grazing occurring on allotments owned by LADWP and leased to ranchers - Cattle grazing occurring on privately held lots	High
Human FIB deposited near to creek	- Transient encampments - Incidental shedding during recreational activities	- High (transient camps) - Medium (incidental rec.)
Horse and other livestock (goat, sheep, chicken)	- Small scale horse pasture occurring in West Bishop - Small scale animal husbandry	High
Pet waste	- Dog walking	High
Sewage delivered indirectly to creek waters	- Leaks from private sewer laterals - Sanitary sewer overflows	Low
Wildlife	- Mule deer - Beaver - Birds - Other	Low

6.2 FIB data and landscape-scale modelling

FIB data are described in Section 5. FIB contamination follows two general patterns: 1) temporally driven, demonstrated by seasonal contamination during spring and summer months in conjunction with irrigation water delivery; 2) spatially driven, demonstrated by increases in FIB concentrations downstream of specific land uses, such as grazing allotments. The spatial pattern trends to higher concentrations of FIB in the downstream portions of the study area, suggesting multiple, cumulative, inputs of FIB at various locations along the creek.

FIB are universally present in the digestive tract of all warm-blooded animals (including humans), and these FIB are excreted in great numbers with animal wastes. Thus, FIB water quality monitoring alone is not sufficient to definitively identify specific sources of FIB contamination in surface waters. Rather, FIB monitoring indicates that recent, harmful fecal pollution is present in a surface water. Host sources are determined by other, targeted investigations. Factors such as prevalent land uses, the frequency and magnitude of activities occurring on those land uses, the season FIB sampling is performed, the presence of lakes or reservoirs upstream, and precipitation rates, are all useful information to determine the likely origin of surface water FIB pollution (Knapp and Nelson, 2015). These factors provide water managers with qualitative evidence of likely sources of fecal pollution.

In 2015 SNARL researchers R. Knapp and C. Nelson modelled FIB contamination in a selection of Eastern Sierra creeks, including Bishop Creek, using land use occurrences in those watersheds. The result of this modelling work was a description of spatial and temporal patterns of FIB affecting surface waters in these watersheds. Through statistical analyses of landscape and site-specific scale data, Knapp and Nelson identified the likely drivers of FIB contamination in study area watersheds.

For Bishop Creek, the prevalence of grazing lands, the correlation of elevated FIB with the onset of irrigation water delivery, and the spatial pattern of contamination (from non-detect upstream to violations of the applicable WQOs downstream) are all key factors to determine probable sources of FIB contamination. Bishop Creek data shows that FIB appear in creek waters in conjunction with the first instances of specific land uses such as grazing allotments and residential neighborhoods, and that FIB concentrations increase as Bishop Creek flows through more occurrences of such land uses within the Vision Plan area.

In addition to landscape scale modelling and FIB data patterns, MST data collected from Bishop Creek (described in Section 6.3) helps identify the primary sources of FIB contamination.

The analysis of *Knapp and Nelson, 2015* determined that the primary drivers of *E. coli* contamination in study-area waters were:

- the presence of cattle observed upstream at the time of sample collection,
- the day of the year the sample was collected, and
- the time of sampling.

Secondary drivers were determined to be:

- the presence of lakes upstream,
- the amount of anthropogenic development,
- rainfall in the days preceding sample collection, and
- the elevation of the sample site.

The modeling performed in this study “suggested that if management measures are implemented to effectively address fecal inputs from livestock grazing into streams, virtually all streams in the study area would meet the current standard used by the

Lahontan Region" (Knapp & Nelson, 2015). The findings of this study are applicable to this Plan because the Vision Plan area was included in the modeling exercise.

Knapp and Nelson 2016 expanded upon *Knapp and Nelson 2015* with a detailed spatial and temporal investigation of FIB in Inyo and Mono Counties. The effort focused on patterns of fecal contamination in impaired stream reaches in the Inyo/Mono area using FIB and MST data (described in Section 6.3) to determine the likely sources of fecal bacteria. Bishop Creek was included in this study and was "intensively sampled" to better describe FIB patterns and sources. The investigation found very little FIB upstream of the alluvial fan of Bishop Creek and high FIB contamination at successive downstream sampling locations in the middle and downstream reaches of both the South and North Forks of the creek within the Vision Plan area. Like the *2015* research, the *2016* study found that the presence, absence, and abundance of cattle matched the temporal patterns of FIB recovered from the creek and thus are likely the primary driver of FIB contamination in Bishop Creek waters. Additionally, given the propensity for water contact recreation in Bishop Creek, *Knapp and Nelson*, *2016* concludes that the 'potential for waterborne disease transmission is likely to exist'.

6.3 Microbial Source Tracking (MST)

Microbial source tracking (MST) is terminology referring to methods to determine the likely origin of biological matter in a medium. In this case, MST is pursued to identify sources of fecal contamination in Bishop Creek. MST is possible because different vertebrate species, or related groups of species, typically have characteristic bacterial communities in their digestive tracts and feces (Knapp and Nelson, 2015). By quantifying the abundance of source-specific bacteria in water samples containing fecal contamination it is therefore possible to attribute the contamination to vertebrate sources (*Ibid*, 2015).

6.3.1 SNARL collected MST data

SNARL collected two rounds of MST data from Bishop Creek, the first in the summer and fall of 2013 (described in *Knapp and Nelson, 2015*) and the second in the spring and summer of 2014 (described in *Knapp and Nelson, 2016*). These studies concluded that ruminants (including cattle) are the primary sources of FIB in Bishop Creek. The studies also determined a small but significant presence of human FIB in water samples. This section will describe these data in the chronological order of their collection.

6.3.1.a Knapp & Nelson, 2015

One of the three study goals of *Knapp and Nelson 2015* was to use MST assays to identify the primary sources of fecal bacteria contamination of surface waters in the Eastern Sierra, including in Bishop Creek. The MST work complimented the two other study goals which were to describe the spatial and temporal patterns of FIB in Eastern

Sierra surface waters, and to identify the drivers of FIB using statistical analyses of landscape and site-specific scale land use data. The MST portion of the study deployed six MST assays, divided as three general assays and three source-specific, and analyzed the data obtained from these assays to describe the likely relative contributions of ruminant and human sources of fecal bacteria to surface water contamination. Based on the magnitude and frequency that MST markers were detected during the 2015 study, the presence of cattle during sample collection, and the relatively small populations of other ruminants in the Bishop Creek watershed, *Knapp and Nelson 2015* concludes that “cattle appear to be a much more significant source of fecal bacteria in the Bishop Creek watershed than are humans”.

A total of 102 MST samples were collected from Lahontan surface waters during the *2015* study. The three general assays were for *Enterococcus,* Bacteroidales, and *Escherichia* (which includes *Escherichia Coli* (*E. coli*)), known as Entero1a, EC23S857, and GenBac3 respectively. The three specific assays were targeted for human and ruminant derived contamination. Of the three specific assays, two were for specific subgroups of human Bacteroidales, BacHum (Kildare 2007) and HF183 (Haughland, 2010), and one was for ruminant Bacteroidales, BacCow (Kildare 2007). Two human assays were used because of differences in the sensitivity of the assays – BacHum is sensitive to human waste but also occasionally reacts to bacteria which may not be produced by humans, while HF183 is 100% human-specific but is a less sensitive test when compared with BacHum.

The BacCow assay is sensitive to Bacteroidales derived from ruminants. Ruminants in the Bishop Creek Vision Plan area include domestic cattle, domestic sheep, domestic goats, and mule deer. Detections of the BacCow marker thus mean that fecal bacteria from one of these four species is present in sample water. In the *2015* study, Knapp and Nelson found that concentrations of Bacteroidales detected via the BacCow assay were nearly five times greater at sites where cattle were observed at the time of sampling compared to when no cattle were observed at the time of sampling. These observations suggest that the BacCow assay is sensitive to cattle-derived fecal waste and suggests that cattle are often the primary contributor of Bacteroidales detected by the BacCow assay. The findings also highlight the utility of observational data to compliment quantitative data collected during water quality sampling.

Data derived from the specific MST assays were compared to data derived from the general MST assays for a relative contribution analysis. For example, data from the BacCow assay (ruminant Bacteroidales) was compared to data from the total Bacteroidales assay (GenBac3) to give a percentage of ruminant-derived Bacteroidales (%Cow, Equation: (BacCow/GenBac3)*100). In addition to the relative contribution analyses, *E. coli* FIB were compared to the general MST assay for *Escherichia*. These two data streams were strongly correlated, which provides validation that the MST assay and the FIB assay are detecting the same organisms in sample water.

A total of 48 MST samples were collected from Bishop Creek during the summer and fall of 2013. This sampling showed low MST concentrations upstream in the study area (i.e. west of Mumy Lane) and increased markedly in the middle and downstream portions of Bishop Creek. All MST samples were positive for ruminant Bacteroidales (BacCow), with 31 samples (65%) recorded as “high” concentration (>50,000 gene copies/100mL). “High” samples were generally collected from the middle and downstream portions of Bishop Creek below grazing and residential land uses. Human derived Bacteroidales (BacHum & HF183) were found in only five (10%) Bishop Creek samples, and concentrations were always low (<5000 gene copies/100mL). All human-positive samples collected in 2013 were collected from the downstream portion of the South Fork of Bishop Creek in the vicinity of Bishop City Park.

Relative contributions of specific-vs-general MST assays showed that %Cow was low upstream in the study area (i.e. west of Mumy Lane) and increased noticeably at downstream sampling locations. %Cow was recorded as less than 5% upstream of Mumy Lane, increasing to between 20 and 40% in the middle reaches of Bishop Creek and more than 40% in the downstream portions of the study area. The BacCow assay showed similar patterns. Increases in the %Cow and BacCow data in a downstream pattern indicate that both the magnitude and frequency of ruminant derived fecal bacteria and the proportion of ruminant-derived to total-FIB increase from upstream to downstream areas in Bishop Creek.

6.3.1.b Knapp and Nelson, 2016

Knapp and Nelson 2016 had similar goals to the *2015* research. The goals of *Knapp and Nelson 2016* were to provide a detailed spatial and temporal description of FIB in Inyo and Mono Counties, to determine the generality of the *2015* finding that cattle are the primary driver of FIB contamination in Inyo/Mono surface waters, and to use MST assays to identify the relative fecal bacteria contributions from human and ruminant sources. This study concluded that ruminants such as cattle are the primary source of FIB in Bishop Creek.

The 2016 study quantified 3,300 samples collected from many Eastern Sierra streams, including 273 samples analyzed using MST technology. Together with observational data regarding land uses gathered at the time of sampling, *Knapp and Nelson 2016* developed a model to describe the spatial and temporal distribution of FIB in Eastern Sierra streams. The strongest predictor of FIB was the presence or absence of livestock immediately upstream at the time of sampling. The type of livestock recorded during sampling were predominantly cattle, which is to be expected given cattle are the largest livestock group grazed in the Lahontan Region. Sample date and the time of day that samples were collected were the next two strongest predictors of FIB concentrations in *Knapp and Nelson 2016*.

Results of the MST assays performed in *Knapp and Nelson, 2016* indicate that ruminant-derived fecal contamination is common in the surface waters of the Eastern Sierra and is often present in high concentrations. MST assays also occasionally detected human-derived fecal material, although like the results of the *Knapp and Nelson 2015*, detections of human-derived material is relatively rare and concentrations were generally low (Knapp and Nelson, 2016).

The *2016* research also developed a model from the collected MST data. Like the FIB model, the MST model indicated the presence or absence of livestock (predominantly cattle) to be “by far the strongest predictor” of concentrations of Bacteroides detected by the BacCow (ruminant) assay. When cattle were observed directly upstream at the time of sample collection the BacCow assay returned much higher concentrations of Bacteroides. Also like the FIB model, the next strongest predictors of MST-detected bacteria concentrations were the sample date and time of day sampling was performed. The MST model found the presence of upstream lakes to have a significant negative effect on BacCow concentrations, which potentially supports the hypothesis that surface water impoundments help to reduce FIB contamination by allowing FIB suspended in the water column to settle out.

The MST model developed for the *2016* study demonstrates that ruminant-derived Bacteroides detected by the BacCow assay is the best predictor of *E. coli* FIB concentrations. The correlation between ruminant Bacteroides and high concentrations of *E. coli* FIB together with the frequent observations of upstream cattle during collection of samples which displayed high concentrations of fecal bacteria is strong evidence that cattle appear to be the major driver of fecal contamination of surface waters in Eastern Sierra streams.

Knapp and Nelson 2016 collected 60 samples for MST analysis from Bishop Creek. Sample sites are depicted in Figure 6-1. Samples were collected between May and September 2014. Each Bishop Creek sample was processed with two general MST assays (GenBac & Ecoli) and three specific assays (BacCow (ruminant), BacHum (human), HF183 (human)), resulting in total of 300 MST assays performed (60 samples*5 assays).

MST sampling was performed at twelve sites on Bishop Creek (vs. fifteen sites sampled for FIB), one of which (BIS.10) is located just upstream of the bifurcation of the north and South Fork. BIS.10 provides FIB water quality information entering the Vision Plan area. MST analysis at this site corroborates that FIB water quality is excellent as it enters the Plan area – no MST markers were detected in upstream samples and *E. coli* FIB were generally less than ten colony forming units per 100mL of sample water.

6.3.1.b.i Results from North Fork Bishop Creek

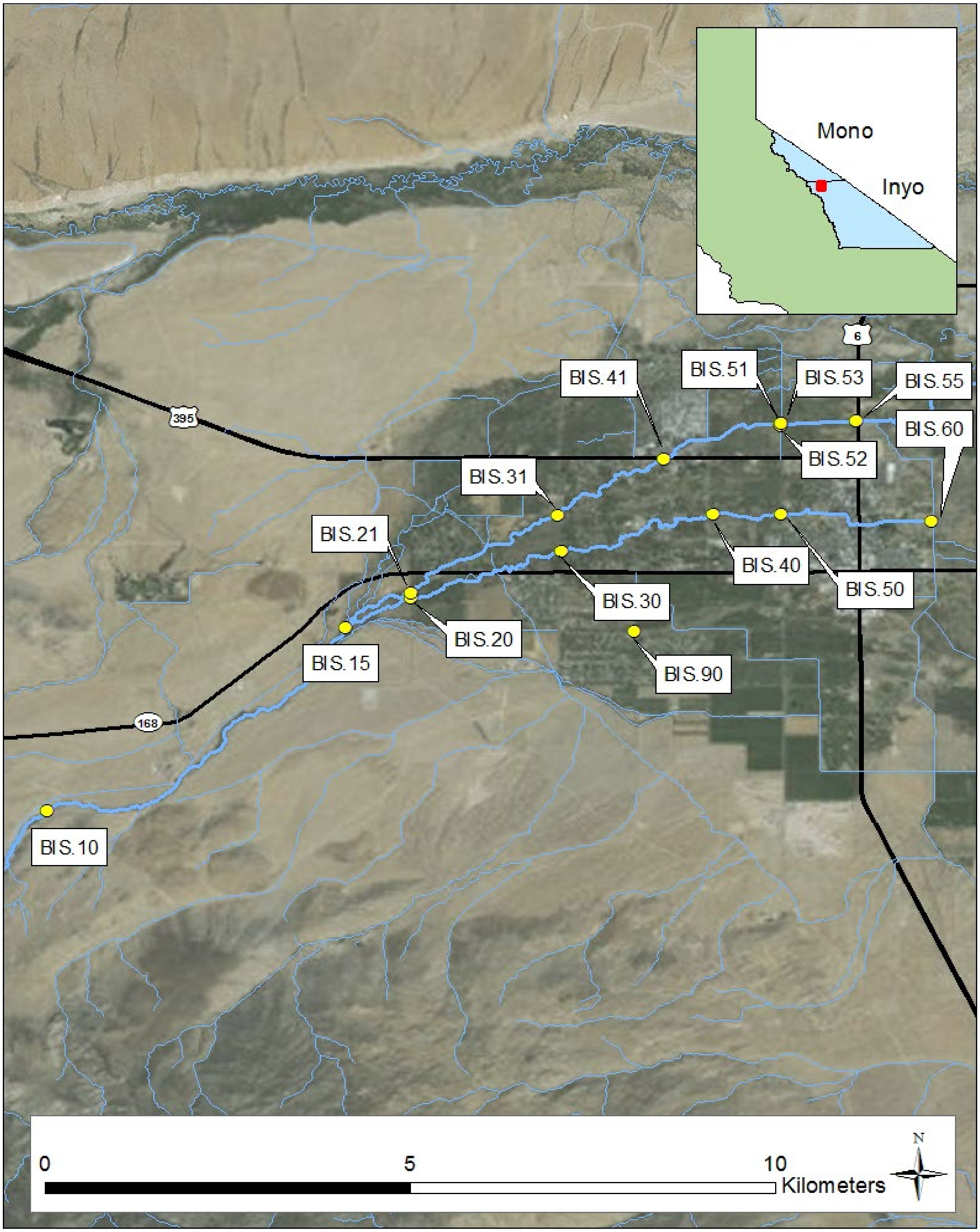
The North Fork of Bishop Creek was sampled for MST in four locations (BIS.21, BIS.31, BIS.41, BIS.51) and the resulting MST data displayed a similar pattern to the results of *Knapp and Nelson 2015* and to FIB data collected for the *2016* study. Two tributaries, the Bishop Canal (site ID BIS.53) and the Bishop B-1 Drain (BIS.52) also flow into the North Fork within the Plan area, and MST samples were also collected from these conveyances.

The *2016* MST data shows a pattern of increasing fecal bacteria contamination at each progressive downstream sample site. At BIS.21 immediately upstream of Mumy Lane, MST markers were low for all assays. Just downstream, at BIS.31 (Brockman Lane) and BIS.41 (upstream of Highway 395 near Tu Su Lane), ruminant markers were regularly detected in moderate concentrations, while human markers were detected at low concentrations on three occasions (two dates at BIS.31, one date at BIS.41). Both these sample sites are downstream from grazing leases and small-scale horse pasture. In the lower portions of the North Fork (BIS.51, upstream of the confluence with Bishop Canal and B-1 Drain), MST assays show high concentrations of the *E. coli* and ruminant markers, and human markers were detected again on three occasions. BIS.51 is situated in the middle of a LADWP grazing lease operated by ST Ranch and is also downstream from a residential neighborhood. The human markers detected at BIS.51 correspond to the dates human markers were detected upstream at BIS. 31 and BIS.41 and human-derived material was detected in similar low concentrations on each occasion.

Sampling at the Bishop B-1 Drain (site ID BIS.52) returned MST assays with high concentrations of the general, *E. coli*, and ruminant markers. No human markers were detected in any samples collected from BIS.52.

Sampling from Bishop Canal, which is a conveyance located in the northeast portion of the study area delivering water from the Owens River to the North Fork of Bishop Creek (site ID BIS.53), shows that MST assays generally failed to detect *E. coli*, ruminant, or human markers, although the general MST assay did detect several thousand gene copies of bacteria on most sampling occasions. At BIS.53, FIB numbers were generally low however (>20 colonies of fecal coliform or *E. coli*), suggesting that water quality entering the northern portion of the study area from this water conveyance is not polluted by fecal material targeted by SNARL assays but does contain another bacteria species.

Figure 6-1 Map of the City of Bishop and outlying areas, showing sampling locations along Bishop Creek (labeled yellow circles). Major highways are shown in black line. (credit Knapp and Nelson, 2016, Figure 4)



6.3.1.b.ii Results from South Fork Bishop Creek

The South Fork of the creek was sampled for MST in five locations (BIS.20, BIS.30, BIS. 40, BIS.50, BIS.60). The data displayed a similar contamination pattern to the data recovered from the North Fork. BIS.20, which is located immediately upstream to the west of Mumy Lane (similar to BIS.21 on the North Fork), was non-detect for all MST assays and *E. coli* FIB was low (<16 CFU/100mL).

At BIS.30 (Brockman Lane) and BIS.40 (See-Vee Lane), which are both downstream from small grazing allotments, low to moderate general and ruminant markers were detected, and no human markers were detected. At BIS.40 FIB were moderate to high in all samples. At BIS.50, which is near Sierra Street downstream of Bishop City Park, general and ruminant markers were detected in moderate-high concentrations and FIB were high.

At BIS.60, located just upstream of the confluence of the South Fork with Bishop Creek Canal, general and ruminant markers were high, and FIB were also recovered at high concentrations. One human assay from BIS.60 indicated human material was present but was recorded at low concentration (HF183, <100 copies/100mL).

6.4 Discussion of *Knapp and Nelson 2016* Bishop Creek data

MST data collected from Bishop Creek during *Knapp and Nelson 2016* show ruminants are a much greater source of fecal material in creek waters compared to those from other sources (e.g. human). Cattle were regularly observed during sampling and often at times and locations where ruminant Bacteroides and FIB concentrations were highest. Furthermore, goats, sheep, and mule deer (which are species also detected by the BacCow ruminant assay) were not observed during any sample collection.

Results of the study show that when cattle are observed at time of sampling, ruminant Bacteroides increases as much as five times beyond background, indicating that the BacCow assay is sensitive to cattle fecal matter. The results of *Knapp and Nelson 2016*, which includes elevated ruminant marker concentrations regularly recovered from areas of Bishop Creek below grazing allotments, supports the conclusion that cattle are the predominant source of fecal contamination in the Vision Plan study area.

Detections of human-derived material are important because of the significant risks to human health posed by the pathogenic potential of human feces. Human derived material was detected via MST at very low (<100 copies/mL) concentrations. Human sources of fecal material to the creek are considered a priority next to fecal material from cattle. However, the correlation between the presence of cattle during sampling and the abundance of the ruminant MST in such samples is evidence that cattle fecal material is the primary driver of the bacteria water quality issues in Bishop Creek. Based on this information, management practices which reduce the volume of cattle-derived fecal material delivered to Bishop Creek waters should be implemented. Cattle-waste best management practices should result in water quality improvements that will help attain FIB water quality objectives. Data showing attainment of FIB water quality objectives will ultimately be used to show that REC-1 uses in Bishop Creek are supported and will support a recommendation to remove Bishop Creek from the 303(d) List.

6.5 LADWP MST data

LADWP contracted Source Molecular Corporation of Florida to perform MST analysis on water samples collected from the Vision Plan study area. Samples for MST analysis were collected by MBC Aquatic Sciences, the in-field contractor for LADWP, beginning in June 2015 for a period of approximately one year[7]. During this period, MBC Aquatic Sciences collected samples at the same times and locations sampled for *E. coli* FIB, as described in Section 5.2 of this document.

A description of the data and a discussion of the results is presented in the *Eastern Sierra Fecal Indicator Bacteria Study (2016)* prepared by MBC Aquatic Sciences for LADWP, which is available from LADWP by request. LADWP have shared this report with Water Board staff; however, the report does not include the complete datasets used to develop the document, instead presenting written analyses and discussion and excerpts of some MST data in the appendices. Water Board staff have requested the full MST dataset but have not received it to date. Therefore, Water Board staff have not been able to independently verify the conclusions of the report for inclusion in the Vision Plan. The following description of the LADWP MST data is based on what is reported in the *Eastern Sierra Fecal Indicator Bacteria Study*.

Source Molecular Corp. tested samples taken from Bishop Creek for the presence/absence of fecal biomarkers from cattle (CowM2), beaver, general bird, human (HumM2 & HF183), dog, and general ruminant. Parentheses indicate the name of the MST assay deployed for this study. The full names and references of all assays used in the study are not provided in the study report. Once developed, MST derived data and *E. coli* data were evaluated together using a Principal Components Analysis (PCA) to derive the underlaying patterns of the data. PCA results were plotted against each other to determine if a linear relationship existed between the datasets. Once plotted, the data did fit a linear model (r^2= 0.55) which indicates that MST assays were a good predictor of the incidence of *E. coli* FIB.

Potential fecal contributions from cattle and other ruminants in the LADWP MST data were elucidated using *E. coli* FIB counts, and ruminant and cattle MST frequency of occurrence. The *Eastern Sierra Fecal Indicator Bacteria Study* ranked FIB counts from

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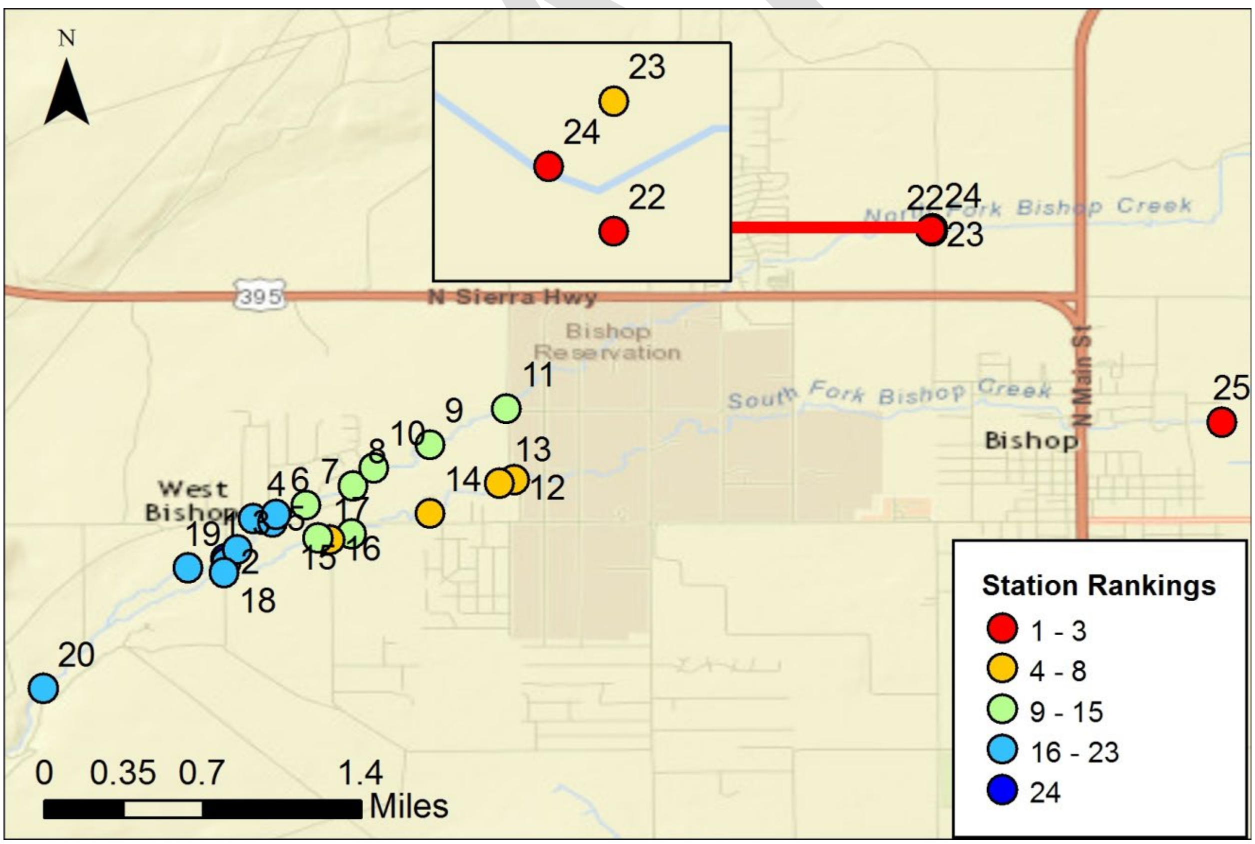
[7] LADWP has not shared the complete MST dataset from this effort, so the sampling period is estimated based on the narrative of LADWP's *Eastern Sierra Fecal Indicator Bacteria Study* report.

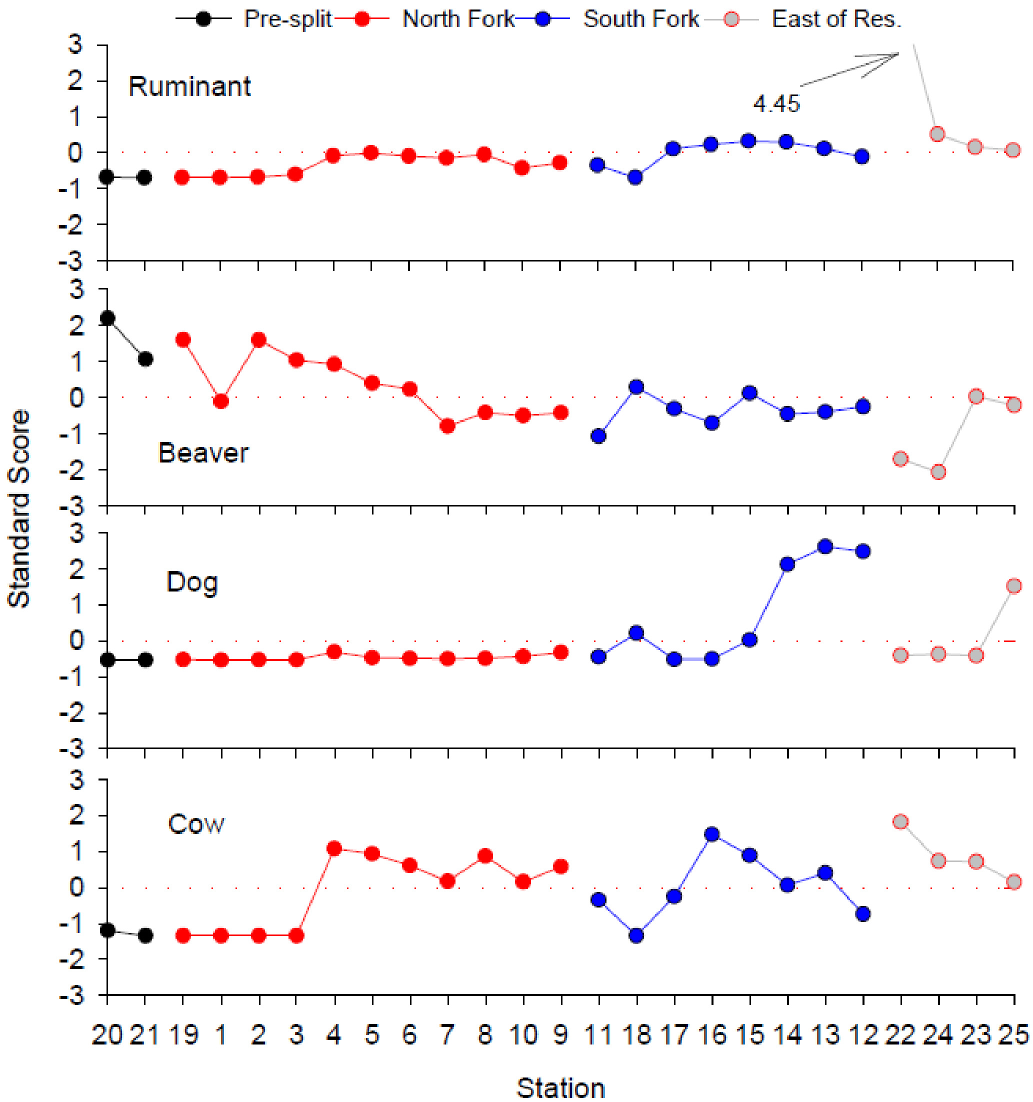
lowest to highest, and categorized MST results as present (score = 1), trace-present (score = 0.5), or absent (score = 0). Categorized scores were summed across all weeks by station and assay and ranked in descending order. This method resulted in a ranking of the highest incidence of *E. coli* likely caused by cattle or other ruminants. Results are shown in Figure 6-2. Stations at the western-most, downstream portions of the study area were most impacted by cattle waste (stations 22, 24, 25), with the next most impacted stations located on the South Fork below the grazing allotment found on Reata Road (stations 12-16). Stations below the Mountain View neighborhood in West Bishop were also impacted (stations 6-11), and minimal cattle impacts were recorded at stations 1 through 4 on the North Fork and 18 and 19 on the South Fork. The distribution of contamination by cattle waste detected in this study was similar to those patterns found by *Knapp and Nelson 2016.*

Figure 6-2 *Stations ranked in order of likely bacterial contamination resulting from cattle. Rank 1 = E. coli contamination most likely derived from cattle or ruminants. LADWP station numbers are indicated on the map; ranking of stations is indicated by the color key (credit: Eastern Sierra Fecal Indicator Bacteria Study (2016), Figure 11)*



The LADWP report compared MST data for relative abundance across stations. This method allows an estimate of where each fecal source may be contributing most to FIB bacteria concentrations. Station-specific values were converted to a standardized score representing the number of standard-deviations from the mean each station's score represented. Positive values represent relatively abundant marker density and negative values represent relatively low marker density. It is important to note that, while the data has been converted to a common score, the scores are only comparable to scores originating from the same assay type. Scores are depicted in Figure 6-3.

Figure 6-3 *Standard score of genetic copies/100mL for each vertebrate non-human assay. Stations are depicted in a west-east progression, with each distinct portion of the creek represented by a different color. Positive values represent above average number of genetic copies and negative values represent below average gene copies. Y-axis values represents the number of standard deviations from the mean (credit: Eastern Sierra Fecal Indicator Bacteria Study (2016), Figure 10)*



Cow and beaver markers were the two markers in the LADWP dataset most frequently detected at higher concentrations (Figure 6-3). Ruminant markers were also detected regularly. Cow markers were detected frequently at all stations downstream of station 4 on the North Fork and station 17 on the South Fork. Ruminant markers tended to increase in concentration moving downstream through the study area, increasing appreciably after the first incidence of grazing lands on both the north (station 3) and south (station 17) forks. Maximum ruminant marker concentrations were more than four standard deviations from the mean detected in the downstream portions of the North Fork. Ruminant markers were also detected in moderately high concentrations in the downstream portions of the South Fork. In comparison, beaver markers were relatively rare in the downstream portions of the study area but were detected in the western-most zones with relatively high abundance in upstream portions of the study area above the bifurcation of North and South Forks, and on the North Fork above grazing lands. It is important to note that *E. coli* FIB counts are generally low in the upstream zone, suggesting that beaver waste likely has relatively small impacts on FIB counts. These data support the conclusion that beaver waste is unlikely to drive the FIB contamination which is responsible for violating WQOs and impairing REC-1 uses.

Dog markers were detected with high abundance in the middle (stations 14-16) and downstream areas (station 25) of the South Fork, possibly related to the residential areas occurring in the middle reach downstream of Reata Lane and upstream of the Tribe, and due to recreational activities associated with pet dogs around Bishop City Park. Dog markers were relatively rare in other areas. Additionally, general bird markers were also detected relatively rarely throughout the study area and were concluded to likely not impact the FIB issues affecting Bishop Creek.

Human markers were uncommon compared to ruminant and beaver but were detected on several occasions on the North Fork of the creek above Tribe lands (stations 5-11). Human markers were also detected on the South Fork downstream of Bishop City Park (station 25). Because of the potential health risks associated with human derived fecal waste, any detection of human material is cause for concern. The distribution of human markers was similar to the pattern found in *Knapp and Nelson 2016.*

6.6 Data Discussion

MST indicates a variety of vertebrate sources are delivering fecal material to Bishop Creek, such as ruminants (including cattle, sheep, goats, and mule deer), humans, pet dogs, and wildlife such as beaver or birds. Several of these sources of fecal material are more readily controllable: cattle, horse, human, and pet dog sources are easier to prevent entering Bishop Creek waters when compared to fecal material from wildlife such as beaver, birds, or mule deer. Specific actions to prevent fecal wastes entering surface waters can be more readily targeted at anthropogenic activities such as cattle grazing, or recreation activities such as camping or dog walking, whereas wildlife are variably distributed and are relatively random and mobile sources of FIB.

The available data indicates that one source, fecal waste from cattle, is a primary driver of the contamination issues in Bishop Creek. This is demonstrated in both the SNARL FIB landscape modelling (described in Section 6.2) and the SNARL MST work (described in Section 6.3.1). The SNARL studies found that the presence of cattle at the time of sampling was the strongest predictor of FIB contamination, that when cattle were present the ruminant MST marker increased as much as five-fold, and that ruminant waste was present throughout the study area and often at high concentrations. Given the regular occurrences of LADWP-leased cattle grazing allotments along Bishop Creek, which begin at Mumy Lane in the western portion of the study area and occur at regular intervals through to Bishop Creek Canal, Water Board staff considers the findings of the SNARL studies to be reliable.

LADWP MST data corroborates the findings of the SNARL studies. Ruminant and cattle markers were found throughout the study area. The top three most impacted sites are in locations downstream of grazing operations on the North Fork and B-1 Drain, with the next most impacted sites found on the South Fork downstream of grazing leases at Reata Lane. Other ruminant impacted sites are located on the North Fork downstream of the Brockman Lane grazing allotment. Given land use data related to the presence of cattle pasture, and observational data related to the presence of cattle and the absence of other grazing livestock such as sheep or goats, it is probable that fecal material shed by cattle is responsible for the fecal contamination detected by the ruminant MST marker. While FIB from mule deer is known to react with ruminant MST markers, the small, non-migratory population of deer in the watershed is not likely to have a noticeable effect on microbial water quality. This assumption is supported by the presence of mule deer populations upstream of the Vision Plan area, with corresponding water quality samples displaying very little or zero FIB contamination.

Detections of human Bacteroidales are important from a public health perspective because of the implications of human fecal material on incidence of illnesses in water contact recreators. This type of fecal material has the potential to carry greater incidence of pathogens which cause illnesses in humans. However, that human markers were detected in Bishop Creek infrequently and at low concentrations in this study is also informative. Bishop Creek is impacted by high FIB concentrations, and infrequent detections of human markers at low concentrations coupled with much more frequent detections of ruminant markers at high concentrations suggests that ruminant derived fecal waste is a bigger driver of FIB contamination in Bishop Creek.

Both the SNARL and LADWP studies detected human sources of fecal contamination. The reach of the North Fork downstream of the Mountain View neighborhoods in West Bishop was found to be impacted by human waste on several occasions in both studies, as was areas downstream of Highway 395 within the City of Bishop. Contamination from human fecal material likely originate from four source types: leaking sewer laterals or failing septic systems, issues with wastewater collected conveyances, incidental shedding during recreational activities such as water contact recreation or dispersed camping, or from transient encampments.

Water Board staff has found no active septic systems remaining in the Vision Plan area, but staff continue to investigate if legacy septic systems remain in place. For leaking sewer laterals, if such conveyances were causing microbial pollution in Bishop Creek human markers would likely be detected during MST sampling with greater frequency than the data shows. In 2018, the Water Board performed an audit of the two wastewater collection systems in the project area, one operated by the City of Bishop and the other by the Eastern Sierra Community Service District (ESCSD). Water Board engineers found both systems to be intact and functioning as expected. As human markers are detected infrequently and at low levels, the conclusion is that human waste is likely delivered to creek waters because of sporadic human shedding associated with transient or recreational communities.

The LADWP MST study found fecal material from dogs at specific areas of Bishop Creek, such as on the South Fork of the creek upstream of the Tribe Reservation and on the South Fork downstream of Bishop City Park. The SNARL study did not use a dog-specific assay and thus no data is available for this source from this study. The upstream portions of the South Fork that show impacts from dog waste are surrounded by residential areas. It is possible that both areas are impacted by local dog walkers, and a targeted education campaign which includes signage and dog waste disposal receptacles could limit the amount of dog waste which impacts creek waters. Water Board staff have also been informed that pet dogs are common along areas of the North Fork in the vicinity of the B1 Drain, although no dog MST markers have been detected on this reach. It is also not presently known if feral dogs and/or coyote populations could be delivering fecal material to creek waters.

The LADWP MST study uncovered impacts from beaver, especially in the more upstream portions of the creek. Beaver waste was usually detected at low levels, but at the sites where bacteria from beaver were detected at higher concentrations *E. coli* FIB was often low. This suggests that beaver are not primary drivers of fecal bacteria pollution in Bishop Creek. Beaver have been classed as a low priority FIB source for the Vision Plan because they are not found to be a primary driver of pollution, nor one easily addressed.

The timing of fecal bacteria contamination is also an important consideration. Generally, fecal bacteria levels increase above regulatory thresholds in the spring corresponding with the beginning of irrigation water delivery in the watershed. Such contamination issues tend to continue through late summer until irrigation delivery ceases. Irrigation water is distributed throughout the watershed for grazing and vegetation management and is also diverted for residential backyard uses. The correlation between irrigation water delivery and fecal contamination is evidence that irrigated return flows likely carry fecal bacteria to Bishop Creek, either from grazing sources, from horse pasture occurring in West Bishop, or from residential properties.

LADWP collected *E. coli* FIB data also shows contamination issues on the South Fork of Bishop Creek directly below the Tribe Reservation. The study area is dissected by the Tribe's sovereign lands, meaning that surface waters leave State of California jurisdiction to Paiute Lands, and then return to State of California jurisdiction several miles downstream. Generally, LADWP FIB data shows that water leaving California lands does not meet water quality objectives, meaning that water quality is already beyond regulatory thresholds when it arrives on the Paiute Tribe Reservation. However, in most years and especially towards the end of the summer season on the South Fork, FIB water quality reentering State jurisdiction is worse when compared to upstream water quality entering Paiute lands.

6.7 Conclusions

The available data shows that ruminant fecal pollution is the predominant source of the fecal material in Bishop Creek. Given cattle grazing is one of the largest land uses to support ruminants in the study area and that SNARL observed the presence of cattle to drive detections of the ruminant MST marker, the conclusion is that the main source of ruminant fecal bacteria detected in Bishop Creek is from cattle. Additionally, the absence of other livestock and the small population of resident mule deer indicate that these vertebrates are unlikely to be major contributors to the bacteria issues in creek waters. The correlation of bacteria pollution with irrigation water delivery also indicates that cattle grazing is a large contributor of fecal material to creek waters. Actions aimed at reducing the delivery of cattle fecal material to creek waters will result in improvements in water quality in Bishop Creek. Such water quality improvements will help attain regulatory thresholds for fecal bacteria pollution and protect water contact recreators from the risk of illness.

E. coli FIB data shows that bacteria water quality is often poor when each fork of Bishop Creek enters Tribe lands. Data collected downstream of the Tribe Reservation on the South Fork also indicates that bacteria contamination is often worse when it returns to California lands. Poor water quality returning to California suggests FIB may also be associated with activities occurring on Tribe lands. The Water Board is working in partnership with the Tribe to ensure that bacteria water quality is improved both upstream and downstream of the Tribe Reservation.

Human and canine fecal waste is detected in creek waters relatively rarely and usually at several specific locations. When human MST markers are detected it is at low concentrations. However, any detection of the human fecal wastes is cause for concern because of the risks this type of material poses to water contact recreators.

There is not yet source tracking data specific to horses and the effects of horse manure to the bacteria issues in Bishop Creek waters. However, during visits to the watershed Water Board staff have observed several locations in West Bishop where horses and horse pasture are present. There is potential for these locations to negatively impact fecal bacteria water quality, especially on the North Fork of Bishop Creek near Highway 168, if proper best management practices are not implemented to deal with manure.

7. Implementation Plan

The desired outcome of the Bishop Creek Vision Plan is to improve and maintain FIB water quality in Bishop Creek to a level which is protective of public health and ensures that REC-1 uses are supported by the surface water. The Vision Plan goal will be achieved by attaining the numeric thresholds for the *E. coli* WQO, which are established as a geometric mean (GM) of 100 colony forming units (CFU) per 100 milliliters of sample water or a statistical threshold value (STV) of 320 CFU per 100 milliliters of sample water[8]. Once the water quality achieves these thresholds with the requisite frequency, the Lahontan Water Board can recommend the U.S. EPA remove the 303(d) listing for Indicator Bacteria which presently applies to the creek.

7.1 Legal Authorities

The Water Board has responsibility and authority for regional water quality control of point and nonpoint sources of pollution. The Water Board uses their permitting authorities (waste discharge requirements and waivers of waste discharge requirements) to implement the requirements of applicable State policies and state and regional water quality control plans. The Water Board regulates point sources with National Pollutant Discharge Elimination System (NPDES) permits, which regulate pollutant discharges into waters of the United States, and Clean Water Act section 401 certifications for discharges of dredge or fill material to waters of the United States. The Water Board's approach to nonpoint source regulation is guided by the State Water Resources Control Board's Policy for Implementation and Enforcement of the Nonpoint Source Program (State Water Board 2004), which allows flexibility in regulation of nonpoint source discharges. Tools to regulate nonpoint source discharges are discussed in section 7.2. For the Bishop Creek Vision Plan, a combination of voluntary, collaborative, non-regulatory actions designed to reduce FIB delivered to Bishop Creek waters will be deployed to help improve and maintain water quality. Should these actions be unsuccessful in reducing *E. coli* FIB to within WQOs by September 2032

[8] The STV is used to ascertain compliance with the *E. coli* WQO during periods when the requisite number of samples needed to calculate a GM are not available.

(see Section 7.3, Section 10 for more information), regulatory actions such as a TMDL, WDR, waiver, or alternative regulatory action for the Vision Plan area will be utilized.

7.2 Regulatory Tools

This plan relies on local stakeholders and property owners to implement necessary actions to reduce FIB delivered to Bishop Creek. Doing so will improve and maintain FIB water quality to a level which protects public health and helps to support REC-1 uses. If the necessary voluntary actions are not taken to accomplish the Vision Plan goal, then the Water Board may use one or more of the following regulatory tools, as needed, to achieve water quality objectives:

- Basin Plan Section 4.1 Regionwide Prohibitions:
  1. The discharge of waste that causes violation of any narrative or numeric water quality objective contained in this Plan is prohibited.
  2. Where any numeric or narrative water quality objective contained in this Plan is already being violated, the discharge of waste that causes further degradation or pollution is prohibited.
  3. The discharge of waste that could affect the quality of waters of the state that is not authorized by the State or Regional Board through waste discharge requirements, waiver of waste discharge requirements, NPDES permit, cease and desist order, certification of water quality compliance pursuant to Clean Water Act section 401, or other appropriate regulatory mechanism is prohibited.
  4. The discharge of untreated sewage, garbage, or other solid wastes into surface waters of the Region is prohibited. (For the purposes of this prohibition, “untreated sewage” is that which exceeds secondary treatment standards of the Federal Water Pollution Control Act, which are incorporated in this plan in Section 4.4 under “Surface Water Disposal of Sewage Effluent.”).
- California Water Code section 13267, which authorizes the Regional Water Board to require technical or monitoring program reports from dischargers.
- California Water Code section 13263 and 13383, which authorize the Regional Water Board to issue individual WDRs to regulate discharges of waste.
- California Water Code section 13304, which authorizes the Water Board to require cleanup of unauthorized discharges to waters of the state.
- California Water Code section 13261, which allows the Water Board to issue waivers of WDRs.
- Development of a Total Maximum Daily Load (TMDL) for FIB in the Bishop Creek watershed, including a program of implementation.

7.3 Implementing Parties and timeline

Implementation actions from multiple stakeholder groups are needed to achieve *E. coli* FIB WQOs. These groups are shown in the list below. Stakeholder groups may be assisted by external organizations such as UCCE, NRCS, the local Resource Conservation District (RCD), and the Water Board. Collaboration is necessary not only to attain WQOs but also to avoid duplicative actions, such as monitoring and reporting.

The primary implementing parties include:

- LADWP
- Cattle ranch operators who lease land from LADWP
- Private agricultural landowners, including those keeping livestock, on private lands
- Inyo County
- City of Bishop
- Private landowners with horse or small-scale hobby pasture on their properties
- Bishop Paiute Tribe[9]

In addition, UCCE and NRCS are recognized for their role in assisting landowners to reach FIB water quality goals by providing technical assistance and funding. UCCE and NRCS themselves do not bear responsibility for achieving FIB water quality objectives. However, these organizations' roles in helping landowners is important to the success of this Vision Plan. The Water Board (and other federal, state, and local agencies) play a critical role in facilitating implementation actions through their regulatory authorities. Cooperation between regulators and implementing parties will be important in reaching the Plan's goals and overall success.

The Water Board is committed to working with all stakeholders to identify solutions and implement this Vision Plan. The timeline for implementing parties to collectively meet FIB water quality objectives is 10 years from the date this Plan is accepted through Resolution by the Water Board. More information about the implementation schedule is included in Section 7.11 below.

7.4 Overview of implementation actions

The general implementation plan for lands under jurisdiction of the Water Board (i.e. non-Tribal lands) is to:

- **Step 1**: Focus implementation actions on known and controllable sources of FIB identified as "high" and "medium" priority in Chapter 6 (i.e. cattle fecal waste,

[9] The Bishop Paiute Tribe is a federally recognized Tribe with governance over tribal lands. The Water Board will partner with the Paiute Tribe to help address the FIB water quality impairment in Bishop Creek.

transient encampments, horse and other small-scale pasture, creek side recreation, residential wastes from pet dogs, etc.).

- **Step 1a**: For cattle grazed lands, including irrigated pasture, promote and facilitate voluntary implementation of grazing best management practices (BMPs) focused on reducing FIB delivery to Bishop Creek. Voluntary implementation will be facilitated through *Ranch Water Quality Planning* in conjunction with the University of California Davis Cooperative Extension (UCCE) and the Natural Resources Conservation Service (NRCS). Further details regarding addressing ranch water quality issues are provided in Basin Plan Chapter 4.9-19 *Resources Management and Restoration* Range Management section.
- **Step 1b**: To address FIB sources from transient encampments, convene a workgroup to include the Water Board, LADWP, City of Bishop, Inyo County, and Inyo Mono Advocates for Community Action (IMACA). The mission of the workgroup is to reduce human FIB from transient communities entering Bishop Creek waters. The group will identify specific actions to be implemented to address and reduce the FIB sources.
- **Step 1c**: Promote and facilitate voluntary waste management practices on horse and other small-scale livestock (mules, sheep, goats) located in the Vision Plan area. Stakeholder groups such as the Bishop Creek Watershed Association (BCWA) or homeowner associations may be community-leaders and mobilize their members to achieve FIB reductions from this source.
- **Step 1d**: Provide educative resources to promote community-led watershed health. Engage specific groups such as creek-side recreators, pet owners, and residents of the watershed. Educational resources may be signage or other physical infrastructure, public service announcements, or seminars aimed to teach people how to properly dispose of fecal wastes in a manner that does not impact Bishop Creek water quality. The BWCA, City of Bishop, and Inyo County are key stakeholder groups to help achieve this step.

➢ **Step 2**: If implementation monitoring finds that FIB water quality in Bishop Creek is not improving within 10 years of the date of this Vision Plan, the Water Board may utilize regulatory methods such as a Total Maximum Daily Load (TMDL), Waste Discharge Requirement (WDR), or a Conditional Waiver (which must be renewed every five years) to address FIB pollution.

Note on Wildlife

Wildlife (i.e. beaver, birds, mule deer, others) are not considered a readily controllable source of FIB pollution and thus will not be addressed in this Implementation Plan.

Note on implementation actions already in effect

Several implementation actions are already in progress in the Vision Plan area. A description of actions is described in Section 7.5 of this chapter.

7.4.1 Tribal Sovereign Lands

A proposal for a general implementation framework for Tribal Sovereign Lands is to:

- **Step 1**: Summarize monitoring performed by the Tribe (completed in Chapter 5.3 of this Vision Plan document).
- **Step 2**: Recognize implementation actions that the Paiute Tribe has already completed or plans to complete in the coming years (Section 7.8).
- **Step 3**: Coordinate with the Tribe & U.S. EPA on next appropriate steps for Tribal Sovereign lands (Section 7.8).

A description of actions occurring, or planned, on Tribal Sovereign Lands is included in Section 7.7 of this chapter.

7.5 Recognition and summaries of water quality-related actions taken within the last five years

Several activities related to FIB delivery to Bishop Creek have already been implemented or are currently ongoing in the Vision Plan area. The following section recognizes and summarizes these actions, which benefit Bishop Creek FIB water quality.

7.5.1 Sanitary Sewer Audit

On April 25 and 26, 2018, Water Board staff performed a compliance inspection audit of the sanitary sewer collection systems for the City of Bishop and the Eastern Sierra Community Service District (ESCSD). The purpose of the audit was to evaluate the City of Bishop's and ESCSD's compliance with the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems specified in the State Water Resources Control Board General Order No. 2006-0003-DWQ. Staff completed the audits to assess if the systems were functioning as designed and to determine if either wastewater collection system could be contributing to the FIB pollution issues in Bishop Creek.

The inspection audits were divided into three parts. Part one consisted of the pre-field inspection conference, where staff performed an in-depth review of treatment plant records and conducted interviews with key plant personnel. Points discussed were: 1) staff resources and training, 2) service calls and emergency responses, 3) collection system maintenance, 4) closed circuit television video inspection program, 5) root intrusion program, 6) fats, oils, and grease program, 7) sanitary sewer overflow preparation and notification procedures, and 8) budget, service fees, and capital improvement plans.

Part two of the audit consisted of a field inspection, where key locations of the sewer collection system were inspected, such as: 1) lift stations, 2) automatic system controls to alert personnel of any sewer system emergency, 3) siphons and stream crossings, 4) main trunk line replacement due to root intrusions, and 5) grease interceptors from food establishments. Part three of the audit consisted of a post-field inspection wrap-up, where Water Board staff summarized findings of the audit with plant operators.

7.5.1.1 City of Bishop Audit Summary

The City of Bishop treatment plant currently serves a population of 3,879 residents and operates with an annual budget of $381,000. The sewer collection system contains 16.5 miles of gravity-fed pipeline that is, on the average, 70 years old. The City of Bishop has actively worked to eliminate all possibilities of having any sanitary sewer overflows using regular evaluations and maintenance activities, including the use of industry tools and technology such as “Smart” covers on manholes that detect and alert staff if water rises in manholes.

The City of Bishop sewer system has adequate capacity for current and future flows. One pending capital improvement is the initiation of a pipeline improvement canal crossing project (described in Section 7.5.3) that will replace the existing clay pipeline with a new and larger plastic pipeline that will connect one manhole to another across the canal.

Photo 7-1 Concrete encased clay pipe submerged in water at a canal crossing. City of Bishop planned to replace this 15-inch clay pipe with a new 18-inch plastic pipe (more

information contained in Section 7.5.3). *Photo credit: John Morales/Lahontan Water Board*

7.5.1.2 ESCSD Audit Summary

ESCSD has 2,592 connected customers with a total population of 6,303 plus one connection to the Tribe Reservation. The wastewater treatment capacity is 850,000 gallons per day and an average flow from Tribe into the collection system of approximately 210,000 gallons per day. The collection system has 516 manholes and mostly clay pipes ranging from 8- to 36-inches in diameter. Most of the system was constructed in 1978. The system crosses beneath nine stream locations. The system also has two pump stations, one at South Valley View and the other one at Brockman Corner. There has been no recorded sewer overflow since 2008.

ESCSD has a program in place to visually inspect five miles of line per year using closed-circuit television video (CCTV). As of the audit they had inspected 95 percent of the system using CCTV. ESCSD has an issue with inflow and infiltration because of a high-water table in the area of West Bishop. Inflow and infiltration after rain events and during snow melts account for as much as 30 percent of the system's flow. ESCSD believes that most inflow and infiltration is caused by the older clay pipes and manholes. Therefore, in 2017, it allocated $100,000 to repair and refurbish 100 manholes. Between June 2017 and February 2018, the District repaired or refurbished 35 manholes with seepage issues. This resulted in reduction of 125,000 gallons per day of inflow into the system during and after rain events/snow melt.

Despite the issues with inflow and infiltration affecting ESCSD, Water Board staff found the wastewater collection system to be functioning properly. It is unlikely that leaks from the collection system are contributing to FIB issues in Bishop Creek.

7.5.2 Local Area Management Plan (LAMP)

The Inyo County LAMP was approved on July 19th, 2018. The purpose of the LAMP is to allow the continued use of Onsite Wastewaters Treatment Systems (OWTS) within the jurisdiction of Inyo County while protecting public health and water quality. The LAMP is designed to protect groundwater and surface waters from contamination through the proper design, placement, installation, maintenance, and assessment of OWTS. This plan develops minimum standards for the treatment and ultimate disposal of sewage using OWTS in Inyo County.

Existing, new and replacement OWTS that are near impaired waterbodies, such as Bishop Creek, must meet the applicable specific requirements found in Tier 3 of the State Water Board's OWTS Policy. The Inyo County LAMP was approved before Bishop Creek was 303(d) listed as impaired for Indicator Bacteria, meaning that no Tier 3 program requirements are yet applicable to the Inyo County LAMP. The State Water Board's OWTS policy required LAMPs to be reassessed every five years both by the county and the regional board to evaluate the effectiveness of implementation and review water quality data. The Inyo County LAMP is due for reassessment in 2023, which provides opportunity to develop Tier 3 treatment objectives for OWTS in the Vision Plan area. Development of new treatment objectives will help protect Bishop Creek water quality and achieve the goals of this Vision Plan. The existing Inyo County LAMP is available on the website for the Inyo County Department of Environmental Health.

7.5.3 City of Bishop Sewer Trunk Line Replacement

On November 18th, 2018, Board Order R6V-2018-0052 granted a Section 401 Water Quality Certification to the City of Bishop to replace 2,500 linear feet of sewer trunk line, a portion of which crosses beneath Bishop Creek Canal on the eastern boundary of the Vision Plan area. The existing pipe that would be replaced by this project is shown in photo 7-1. Implementation of this project would improve the City of Bishop's wastewater collection system infrastructure and help to prevent wastewater exfiltration to Bishop Creek Canal. Wastewater exfiltration is a possible source of FIB to surface waters.

On September 13th, 2019, a consultant acting on behalf of the City of Bishop submitted additional plans related to the proposed project. The Water Board has not yet received notice from the City of Bishop that the project is completed.

7.5.4 Bishop Area Wastewater Joint Powers Agreement (JPA)

For several decades, domestic wastewater collected in the Bishop area has been separately managed by either the City of Bishop or the ESCSD. These facilities are co-located south of the Bishop Airport. Periodically, the practicality behind two separate wastewater treatment facilities located adjacent to one another treating very similar discharges and with similar treatment processes has been questioned. Water Board staff voiced these questions during recent meetings with the City of Bishop and ESCSD (April 1, 2019), and with LADWP (May 8, 2019). At these meetings, Water Board staff explored the opportunities available to the City of Bishop and ESCSD to combine their wastewater treatment efforts, with assistance from LADWP as a major landowner near the facilities. The planning horizon for a joint facility would be between 50 and 100 years.

On August 5, 2019, Water Board staff received a letter, signed jointly by the City of Bishop, ESCSD, and LADWP establishing the JPA, known as the Bishop Area Wastewater Authority (BAWA). As the landowner, LADWP will transfer an adequate quantity of land to the new JPA that will enable the continued beneficial reuse of treated wastewater (recycled water). In July 2021 during an inspection of the City of Bishop wastewater treatment plant, Water Board staff were informed that land surveying and boundary delineation for the JPA were nearly complete, and LADWP would issue a right to enter and begin the first phase of construction under BAWA by the end of 2021. Construction is expected in summer 2022.

Combination of the two wastewater treatment plants will benefit Bishop Creek water quality by bringing wastewater collection and treatment under one jurisdiction. One jurisdiction will be better able to respond to issues at the treatment plant or with the collection system, will ensure that infrastructure upgrades consider the system in its entirety, and will enable a more streamlined regulatory process. Water Board staff have found no evidence that either treatment system is presently impacting Bishop Creek FIB water quality, but BAWA is a positive step to help prevent future FIB water quality issues from this source and thus fosters good water quality.

7.5.5 LADWP BMPs completed to date

On February 1st, 2022, LADWP submitted information to the Water Board regarding implementation of voluntary BMPs including installation of fences and vegetation management via mowing. Both practices are focused on mitigating potential impacts from transient populations, including illegal camping which can adversely affect FIB water quality. LADWP began fence installation and mowing practices in August 2021 and has spent 200 manhours on fence installation and 1,280 hours on mowing over this period. These practices are intended to restrict access to waterways and eliminate vegetative cover, with the intent of making LADWP lands less attractive to transient habitation. Maps depicting the locations of new fencing and mowed areas are shown in Appendix C and a report on BMP activity is provided in Appendix D.

7.6 Implementation actions for the Vision Plan (Step 1)

7.6.1 Cattle-grazed lands: ranch water quality planning and implementation (Step 1a)

Voluntary ranch water quality planning (RWQP) is the preferred strategy to address cattle-sourced FIB affecting Bishop Creek. A conceptual model of the RWQP process for the Vision Plan is shown in Figure 7-1. Basin Plan Chapter 4.9-19 includes details of RWQP and other strategies to address ranch-related water quality issues.

The intent of RWQP is to support grazing land managers effectively comply with water quality regulations by identifying the most appropriate water-quality focused best management practices (BMPs) at an individual ranch level. Completion of a RWQP facilitates access to financial and technical resources for BMP implementation, in turn helping to improve and maintain FIB water quality.

A RWQP is developed at the individual lease scale. Drafting the plan includes assessment of lease specific conditions and infrastructure which helps to identify and prioritize water quality BMPs. NRCS can provide technical and financial assistance for implementation of BMPs. Financial assistance is also available for the Water Board

Nonpoint Source 319(h) program[10], and LADWP has indicated their willingness as a source of implementation assistance.

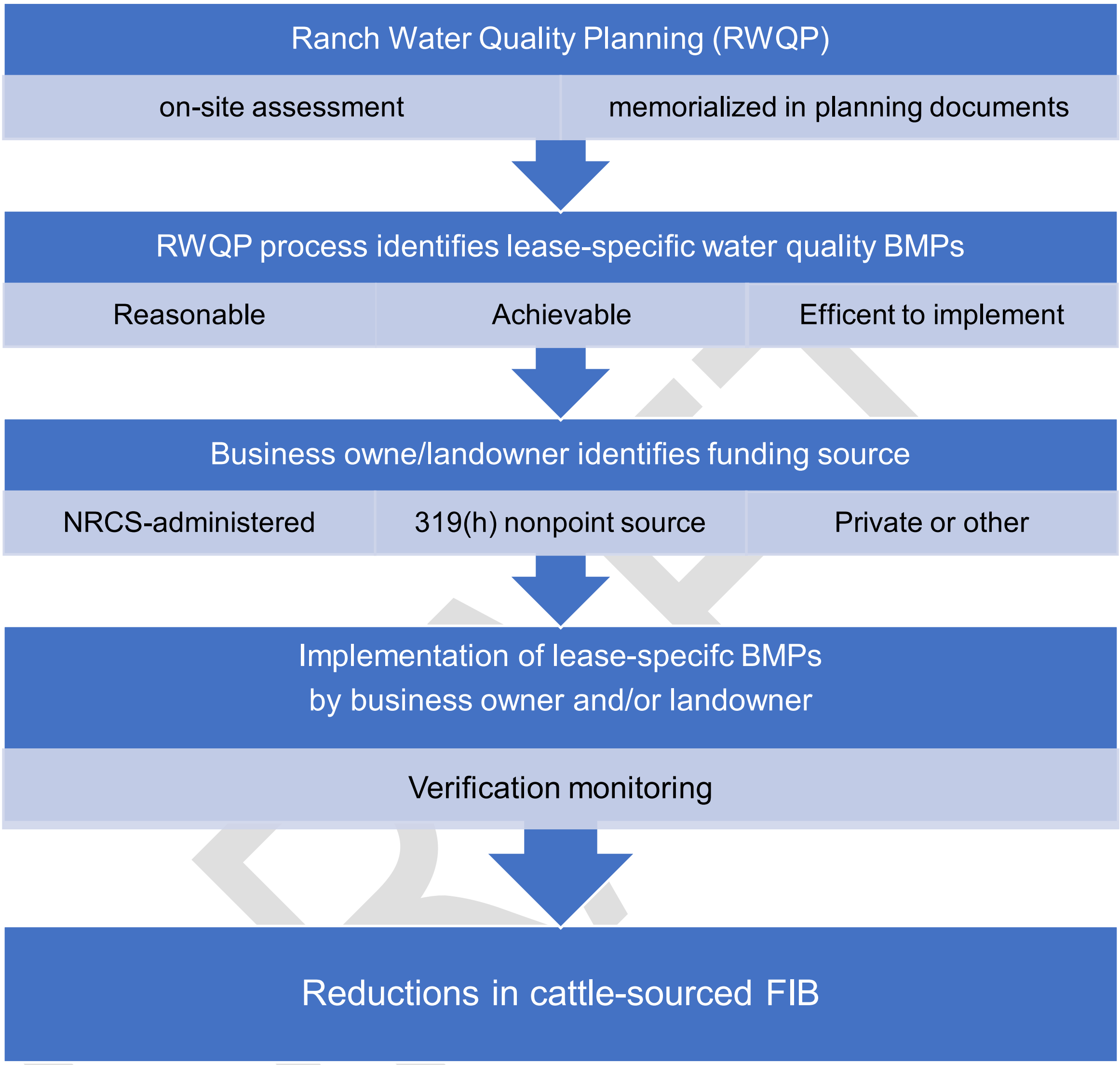
The University of California Cooperative Extension (UCCE), with support from NRCS, has developed guidance for developing RWQPs, which is available on the UCCE Rangelands website.

Cattle grazed properties in the Vision Plan area have been divided into two groups: Tier 1 and Tier 2. Maps of grazing properties are shown in Appendices A (Tier 1) and B (Tier 2). Tier 1 properties are those which are directly adjacent and hydrologically connected to Bishop Creek accounting for approximately 820 acres of the project area; Tier 2 properties are those which are not directly adjacent to Bishop Creek but share some form of hydrological connection because of irrigation practices. Tier 2 properties account for approximately 1000 acres of grazed lands in the vicinity of the Plan area.

The first round of RWQP in the Vision Plan area will focus on Tier 1 gazing properties because these properties are directly adjacent to Bishop Creek and present a straightforward opportunity to reduce FIB produced by cattle entering creek waters. The RWQP process for Tier 1 properties began in December 2021. Tier 2 properties will be addressed after Tier 1 properties.

[10] 319(h) funds must be secured through a 501 3(c) organization.

Figure 7-1 Conceptual design for RWQP process



7.6.2 Transient communities (Step 1b)

FIB from human sources account for a small but significant contribution to the FIB water quality issues in Bishop Creek. Transient encampments in the Vision Plan area have grown over the last several years, especially in 2020 because of the COVID-19 pandemic. LADWP staff have reported taking actions to break up transient encampments near Highway 6 in the northeastern corner of the project area, and Water Board staff have often observed evidence of transient living spaces during sampling and other project area visits.

Transient populations occur because of societal issues beyond the jurisdiction of the California Water Boards. The Water Boards may build partnerships with local governments and agencies to address water quality issues related to transient populations. However, these types of water quality issues present complex challenges: first and foremost for those experiencing homelessness, and also for local governments, residents, businesses and landowners.

Actions can be taken to provide education and resources to reduce fecal wastes originating from transient sources (as well as from recreation, see Section 7.6.4), such as provision of bathroom facilities, hydration facilities and homelessness services. Transient encampments have increased in frequency and size in the last several years, with notable impacts in the downstream areas of both the North and South Forks. Water Board staff have also found evidence of small encampments along the South Fork near Mumy Lane. The available MST data does not corroborate these locations however, largely because transient issues have become more pronounced since the conclusion of each study. The Water Board will partner with local authorities and landowners with a goal of actions that will help reduce fecal wastes from transient encampments entering Bishop Creek.

7.6.3 Horse pasture and other small-scale animal husbandry (Step 1c)

Some non-commercial, small-scale animal husbandry occurs within the Vision Plan area, specifically in West Bishop in the western portions of the Plan area, and near the South Fork of Bishop Creek downstream of Bishop City Park in the eastern portion of the study area. Staff have observed several horses and small fowl kept on such properties and have heard from stakeholders already engaged in the project that other livestock including goats and sheep may be kept on other private properties within the Project area.

Public service announcements via local media may be effective to raise the profile of Bishop Creek FIB water quality issues. Such media resources can also be used to identify best practices for manure management and identify further educational and financial resources. Drawing attention to FIB pollution may empower residents and visitors to the watershed to be water quality stewards and take steps to stop FIB from entering Bishop Creek.

Small-scale animal husbandry on private properties will further be addressed through collaboration with the appropriate stakeholder groups who govern how irrigation water is delivered to private residences in West Bishop. At private residences engaging in animal husbandry, each individual landowner should determine the types of actions or practices to reduce FIB entering Bishop Creek and implement some of those practices. Water Board staff are available to provide technical assistance, and NRCS may provide technical and financial assistance to landowners.

Landowners with properties where hobby ranching occurs should follow a process similar to Step 1a beginning with an inventory of each property to determine FIB-focused BMPs likely to improve water quality. Once appropriate BMPs have been identified and selected, the landowner is expected to implement and maintain those measures on their property. Water Board staff are available to support landowners through implementation and to ensure that property owners are taking steps to help improve water quality. Landowner-led reporting of BMP implementation is strongly encouraged. The Water Board may pursue other regulatory measures should FIB attributed to hobby ranching continue to impact Bishop Creek.

7.6.4 Watershed education for dispersed recreation and residential pet owners (Step 1d)

MST work in Bishop Creek has identified small but significant amounts of human-sourced and canine-sourced FIB in creek waters. FIB from transient communities is being addressed in Step 1b. Other sources of human FIB, such as from dispersed recreation, and canine-sources (i.e. pet dogs) of FIB may respond to installation of educational signage and other small infrastructure, such as pet waste stations, at specific locations in the project area.

Camping in the Vision Plan area is common and increased with the Covid-19 pandemic as many people have more time to travel and use public lands. The Water Board will coordinate with the City of Bishop, Inyo County, and LADWP to determine areas which are frequently used for dispersed camping. At such locations, the installation of signage may help to educate recreators about how to help steward Bishop Creek water quality and indicate where dispersed camping is prohibited. At high traffic areas, the provision of portable bathroom facilities may be the most effective pollution reduction measure. Camping restrictions may ultimately be required should FIB water quality issues from dispersed camping persist in the future.

Canine-sourced FIB is specific to several parts of the Vision Plan area, including near the Desiderata Lane and West Line Street area west of the Paiute Tribe and at confluence of the North Fork Bishop Creek with the B-1 Drain. In these communal areas, the installation of water quality-related signage and dog waste disposal stations can help the correct disposal of pet waste.

Besides physical infrastructure, public service announcements via local media may be effective to increase awareness of water quality issues and promote best practices for animal waste. Making the connection between pet waste and public health risk from FIB pollution may engage residents and visitors towards understanding, supporting, and practicing responsible waste to stop FIB from entering Bishop Creek.

Water Board staff and the Tribe have discussed holding water quality seminars in a classroom setting aimed at providing information to residents about Bishop Creek FIB water quality problems and steps that are being taken to address those problems. Provision of water quality education will help raise the profile of Bishop Creek water quality and may help residents take steps to improve and maintain Bishop Creek water quality into the future.

7.7 Expected FIB load reductions from implementation of Step 1

A traditional approach for estimating FIB load reductions is by calculating load duration curves following U.S. EPA's *An Approach for Using Load Duration Curves in the Development of TMDLs* (U.S. EPA, 2007). Such an approach involves calculating the allowable loadings over a range of flow conditions in an impaired stream segment, and subsequently estimating the percentage of pollutant reductions required to meet water quality objectives and protect beneficial uses.

Developing load duration curves for this Vision Plan is problematic for three reasons. First, the complex hydrology of the mainstem of Bishop Creek, which is interconnected by a variety of irrigation water conveyances punctuated by small surface water impoundments, means that determining reasonable flow duration curves throughout the system is an overly complex task.

Second, irrigation water is used in a manner that significantly reduces water in Bishop Creek since irrigation practices spread water to land, both on commercial livestock parcels and in residential settings. The volume of water in Bishop Creek varies from location to location depending on irrigation practices occurring throughout the year.

The third reason relates to the availability of requisite data, including instream flow and livestock (both commercial and small-scale private) grazing data. LADWP collects high resolution flow data throughout the project area, partly to monitor the volume of water in the system and partly to regulate water delivery to their lease holders. Water Board staff have requested such flow data, however LADWP are unwilling to share such information at this time citing reasons related to proprietary business practices. To preserve the Vision Plan's collaborative, voluntary approach, Water Board staff are not currently pursuing this avenue with LADWP further.

In addition, cattle ranchers operating in the Vision Plan area have previously been reticent to share cattle stocking rates, also citing propriety business practices. This situation is changing as ranch water quality plans are developed for each lease, however a data gap still exists. As well as commercial cattle, private, small-scale animal husbandry also occurs in the project area, but very little information is available at this time regarding animal numbers, specific species types, and locations in the project area. The result of this situation is significant uncertainty preventing the development of even-semi accurate load duration curves.

Instead of load duration curves, this Vision Plan presents the estimated *E. coli* reductions required from two representative LADWP monitoring sites within the project area. Sites are selected based on location within the project area, period of monitoring, and because they are indicative of the most problematic *E. coli* water quality issues affecting Bishop Creek. Site BC25, which is located on the South Fork downstream of City of Bishop Park, is chosen because it represents the total loading of *E. coli* in the South Fork and illustrates the potential threat to water contact recreators using Bishop Creek within city limits. Site BC22 is located on the B1-Drain within the ST Ranch lease and is illustrative of irrigation water return flows which carry *E. coli* FIB to the North Fork of Bishop Creek. Table 7-7 contains information on the average geometric means for these stations during irrigation seasons 2015 to 2019, which are the most recent and complete seasons of LADWP *E. coli* data available at the time of writing. Estimated load reduction percentages are calculated by comparing the *E. coli* geometric mean WQO numeric threshold to the average geometric means during these monitoring years. Table 7-7 illustrates the largest reductions of *E. coli* required to protect water contact recreators.

Table 7-7 Load Reductions required to meet REC-1 geometric mean WQO

Station #	Station location	Monitoring years	Average *E. coli* geometric mean during irrigation season (April-October)	% *E. coli* reduction required to protect REC-1 beneficial use
BC22	Bishop B1-Drain 37.38, -118.4049	2015-2018	250	60%
BC25	South Fork Bishop Creek, 37.3678, -118.3863	2015-2019	249	60%

60% *E. coli* load reductions in Bishop Creek are achievable via coordinated implementation of targeted management actions at each controllable source of fecal material. Grazing-related sources make up the largest proportion of *E. coli*. Several recent examples from other, similar grazed watersheds indicate that the overall mean reductions of 60% are achievable for Bishop Creek.

In coastal watersheds near Point Reyes, Marin County, CA 85% FIB reductions were reported in the first seven years of targeted management implementation including limiting or excluding cattle access to creek waters, installation of hardened creek crossings, and provision of off-stream water systems for livestock (Tate et al, 2019). During the following decade, FIB in creek waters were further reduced for a total of 95% FIB reductions compared to pre-management concentrations (*IBID,* 2019). The authors of this study noted that implementation of targeted measures made the fastest and most economical improvements to in-stream FIB water quality, which supports this Vision Plan implementation approach of treating specific problem areas to achieve maximum water quality benefits.

Another recent success in reducing livestock-related FIB in surface waters comes from the Bridgeport Valley in Mono County, CA. Over a ten-year period from 2006 to 2017 FIB declined 73% below grazed lands where targeted management measures were implemented (Tate et al. presentation to Lahontan Water Board, 3/2022). Management measures include stream channel and riparian zone fencing, fencing of tailwater return ditches, installation of vegetative filter strips designed to filter FIB from entering creek waters, provision of off-stream livestock drinking water, installation of irrigation control structures, hardened livestock creek crossings, and livestock distribution via herding and provision of minerals. Implementation of these types of livestock management measures on both commercial and private livestock lands in the Bishop Creek watershed can be reasonably predicted to achieve the required *E. coli* reductions necessary to protect beneficial uses and address the 303(d) listings affecting Bishop Creek.

For human (transient) and recreation-related (human, pet) sources of *E. coli* affecting the creek, targeted measures at known hot-spots in the project area are likely to reduce the volume of *E. coli* delivered from these sources. Human and pet *E. coli* represents a small yet significant volume of the water quality issue, however it is difficult to estimate the load reductions that will be achieved by targeting these sources. Provision of water supply, sanitation, and hygiene facilities to individuals experiencing homelessness will reduce transient sources of *E. coli* (Verbyla et al., 2021) but is unlikely to result in 100% reductions of human-sourced *E. coli.* Installation of public service signage, pet waste stations, and community education is similarly likely to reduce recreation and pet sourced *E. coli*, but is similarly unlikely to reduce *E. coli* from these sources by 100%. However, as noted earlier, targeted actions at problem areas for these types of *E. coli* sources are likely to result in reductions of *E. coli* to within WQOs, resulting in protection of public health and water quality support for water contact recreation beneficial uses.

7.8 Tribal Sovereign Lands

Section 7.4.1 details a proposal for a general implementation framework for Tribal Sovereign Lands. The Paiute Tribe is a sovereign nation responsible for addressing water quality issues on their lands. The Water Board is responsible for ensuring water leaving State jurisdiction meets applicable water quality objectives.

The Water Board and the Paiute Tribe EMO have been working in partnership to address Bishop Creek FIB water quality. Monitoring work performed by the Tribe is summarized in Chapter 5.3 of this Vision Plan document.

7.8.1 Summary of implementation actions already deployed or planned by the Paiute Tribe

Since 2010, the Tribe has implemented a variety of nonpoint source focused management measures, such as excluding cattle access to the creek, performing riparian vegetation and streambank erosion management, pursuing irrigation tailwater management, installing hardened stream crossings, and upgrading and maintaining the wastewater collection system on Tribe lands. More information on this work is available from the Tribes' EMO.

7.8.2 Coordination with the Paiute Tribe and U.S. EPA on appropriate next steps

As a sovereign nation, the Tribe holds responsibility to address FIB issues originating on their lands and coordinates with U.S. EPA on those issues. Water Board staff have, and will continue to, communicate with both entities about Bishop Creek and the FIB issues currently impacting it. Water Board staff met with U.S. EPA in 2021 to summarize the status of the project. Board staff will be available to help the Tribe determine the range of next steps for the project and will continue to be in contact with U.S. EPA as the Vision Plan moves from planning phase to implementation phase.

7.9 Regulatory backstop (Step 2)

Should the actions described in Step 1 not be effective to improve and maintain FIB water quality by September 2032, the Water Board will prioritize addressing Bishop Creek FIB water quality issues with other regulatory tools, such as a TMDL or through orders (e.g. Investigative Order, Waste Discharge Requirement, Waiver of WDR). Tools available to the Water Board are described in Section 7.2. The effectiveness of Step 1 actions will be measured with a combination of self-reporting of implementation measures taken by stakeholders, inspections of livestock and other properties by Water Board staff, and *E. coli* water quality monitoring. Monitoring and reporting requirements are described in detail in Chapter 9.

7.10 Technical assistance

Technical assistance is available from a variety of sources including but not limited to NRCS, UCCE, the Water Board's California Grazing Water Quality Guidance, and U.S. EPA. For the RWQP process (Step 1a), NRCS and UCCE will be primary sources of technical assistance, supported by the Water Board; for Steps 1b through 1d, the Water Board, U.S. EPA, and other entities such as local government and non-governmental organizations may be the primary sources of technical information. Technical assistance will be provided on an ad hoc basis depending on the situation. Water Board staff will serve as technical assistance coordinator.

Water Board staff estimate that a significant amount of technical assistance is required related to implementation of Steps 1a, 1b and 1c, although presupposing the volume of such assistance is not possible at this time because implementation actions for each specific step have not yet been finalized. Technical assistance is dependent on the types of actions implemented but such assistance is expected to be required at each commercial grazing lease, on private grazed lands, at transient community hotspots, and at certain recreation areas in the watershed.

7.11 Financial assistance

Implementation actions taken in accordance with this plan are the responsibility of the implementing party. Securing funding is the responsibility of the implementer, either via a financial assistance program or via private funds. Financial assistance is available from two primary sources: NRCS and the Water Board. LADWP has indicated to Water Board staff that they may be able to provide in-kind material and services to support implementation actions on grazing leases that they administer. Below is a general description of financial assistance available from NRCS and the Water Board. Documentation specific to funding source should be consulted for more in-depth information:

- NRCS financial assistance is available from two funds: the Environmental Quality Incentives Program (EQIP), and the Conservation Stewardship Program (CSP), both of which also serve as sources of technical assistance.
- Water Board financial assistance is available from the Nonpoint Source (NPS) Grant Program, which supports projects to reduce and mitigate the effects of nonpoint source pollutants to waters of the state. The funding for this grant program comes from a grant to the State Water Resources Control Board (State Water Board) from U.S. EPA under Clean Water Act (CWA) section 319 (CWA 319h grant). More information on CWA 319 grants can be found at the Water Board's Nonpoint Source Program webpage, and the guidelines for 2022 applications can also be accessed online.
- The Tribe has access to a separate amount of CWA 319 funds. The Tribe EMO indicated the ability to use these funds to address water quality sources located directly upstream of tribal lands. Several Tier 1 ranching leases located upstream of Tribe lands could potentially benefit from such funding.

An accurate estimate of financial assistance required to implement this Vision Plan are presently unavailable. Estimates are unavailable because implementation planning for each Vision Plan step is still in process and costs will vary depending on the type and location of implementation actions. NRCS has estimates for grazing related BMPs, which are available online. Water Board staff cannot presuppose the actions that each commercial cattle rancher will implement. No cost estimates are presently available for implementation of transient community focused actions, private landowner actions, or recreation focused implementation because these fine-scale implementation action plans are yet to be developed.

7.12 Implementation milestones

This Vision Plan has a ten-year timeframe to improve FIB water quality in Bishop Creek. This timeframe will begin on the date the Water Board adopts the applicable resolution, which is scheduled to occur in September 2022. By September 2032, FIB water quality should attain the applicable WQOs. Attainment of WQOs will demonstrate that REC-1 uses are supported in the creek, that the unacceptable risk to public health is minimized, and will ultimately enable the Water Board to recommend U.S. EPA removes the 303(d) listing for FIB in Bishop Creek. Projected Implementation milestones are shown in Table 7-12.

Table 7-12 Implementation milestones

Implementation step	Implementation strategy	Start date	Responsible party	Milestones
Step 1a	Commercial cattle lands Ranch Water Quality Planning (RWQP); RWQP implementation	December 2021	Cattle ranchers, LADWP	1: Completion of RWQPs - Tier 1 leases 12/2022 - Tier 2 leases 12/2023 2: RWQP funding - Tier 1 2023-2024 - Tier 2 2024-2025 3: RWQP implementation - Tier 1 2024 onwards - Tier 2 2025 onwards 4: RWQP effectiveness assessment begins: - Tier 1 10/2025 - Tier 2 10/2026 5: RWQP adaptive management 2026 onwards

Step 1b	Transient Community workgroup	October 2022	City of Bishop, Inyo County, LADWP, others	1: Workgroup formation by 3/2024 2: Workgroup action plan by 1/2025 3: Action plan implementation begins Spring 2025
Step 1c	Small-scale hobby ranching and residential BMP implementation	October 2022	Private landowners, Inyo County, others	1: Contact with private landowners by 6/2023 2: Landowner action plan by 6/2024 3: Landowner implementation by 6/2025
Step 1d	Community led watershed health	2023	Inyo County, City of Bishop, Bishop Paiute Tribe, Water Board	1: Formation of workgroup by 12/2023 2: Workgroup action plan 12/2024 3: Action plan implementation begins 5/2025

Work related to Step 1a started in December 2021 when UCCE and Water Board staff began the planning process with Tier 1 ranch properties. Tier 2 ranch properties will be addressed beginning in 2022. Once a RWQP is complete for a property, the business owner may apply for technical and financial assistance to support implementation of the RWQP. Business owners must have completed a RWQP by December 2023 so that they may begin funding applications in a timely manner. All RWQP implementation actions identified in the initial plans should be deployed prior to September 2027 so that effectiveness monitoring may occur. RWQP adaptive management is set to begin from 2025 onwards.

Planning work for Steps 1b, 1c, and 1d will begin in October 2022. Applicable entities (local governments, private landowners) must submit plans to the Water Board detailing how their specific sources of FIB will be controlled by December 2024. Water Board staff will be available to help facilitate development of such plans. Implementation actions ideally should occur prior to September 2029 to allow at least two years for effectiveness monitoring.

All controllable sources of FIB identified in this Vision Plan must be controlled by September 2032. Chapter 9 details the monitoring and reporting requirements associated with successful completion of this plan.

8. Stakeholder Outreach and Communication

This section describes communication between project staff and project stakeholders. Section 8.1 provides details about communication completed to date, and Section 8.2 provides a framework for future communications.

Public information about the project is kept at the project website, and includes staff contact information, factsheets, maps, water quality report cards and other documents related to the project. Site users may also sign up for the Water Board's email subscription service.

8.1 Communications completed to date

2014 through 2016

In April 2014 Water Board staff attended a community meeting convened by Inyo Dept. of Public Health to discuss FIB monitoring results from Bishop Creek. Monitoring results indicated a fecal bacteria water quality problem which posed risks to human health in creek waters. The meeting was attended by representatives from several organizations including:

- The City of Bishop
- Inyo County (Dept. of Public Health, Water Dept.)
- LADWP
- Bishop Paiute Tribe
- Eastern Sierra Community Services District (ESCSD)
- Sierra Nevada Aquatic Research Lab (SNARL)

At the meeting Water Board staff presented the findings of FIB monitoring and gave details of plans for further monitoring, including MST work led by SNARL. Details of all Water Board monitoring can be found in Chapter 5 and Chapter 6. The April 2014 meeting was followed by a letter dated May 30th, 2014 from Water Board staff to meeting participants. A copy of the letter can be found in Appendix E.

The following years, in April 2015 and May 2016, similar meetings were held to discuss results from FIB sampling in Bishop Creek. Copies of sign-in sheets from each of the 2014, 2015, and 2016 meetings can be found in Appendix F.

2017 – 2018

Based on results from the ongoing FIB monitoring in Bishop Creek, Water Board staff identified development of a Vision Plan as the best approach to address FIB water quality issues. In the fall of 2017, Water Board staff met separately with representatives from LADWP and Inyo County Water Dept. to discuss possible approaches to develop the Plan.

In February 2018 Water Board staff presented a concept for a Vision Plan and a summary of latest monitoring results to the Inyo-Mono Integrated Regional Water Management (Inyo-Mono IRWM) group. A copy of the presentation from this meeting can be found in Appendix H.

In April 2018 Water Board staff completed sanitary sewer audits for the City of Bishop and ESCSD wastewater treatment facilities. Information about these audits can be found in Chapter 7.5.1. During these visits to the project area, staff also met with representatives from the Tribe, Inyo County Water Dept., and Eastern Sierra Land Trust to discuss possible implementation actions for the Vision Plan.

LADWP, 2019 onwards

Water Board staff and representatives from LADWP have been in frequent communication about Bishop Creek beginning in 2014 and continuing during the development of the Vision Plan. In-person and remote meetings have been convened as needed, including in-person in May 2019 in Sacramento, in-person in February 2020 in South Lake Tahoe and multiple times via remote meeting since the COVID-19 pandemic began including July 2020, April and October 2021, and January 2022. Topics discussed have included monitoring data, ranch properties leased to cattle ranchers, transient communities, and irrigation practices in the Vision Plan area.

Bishop Paiute Tribe

Water Board staff have met with representatives from the Tribe frequently beginning in October 2017 and remain in regular contact regarding Bishop Creek. The Tribe play a central role in the Vision Plan, both physically because of their location in the project area, and figuratively because they were the entity who first recognized that a FIB water quality issue existed in Bishop Creek.

Water Board staff and the Tribe have delivered joint presentations about the Vision Plan to the National 303(d) Conference State-Tribe interactions workgroup and to the California-Pacific Section of the Society for Range Management (CalPac SRM) in May and June of 2020. A copy of the presentations can be found in Appendix G.

The Tribe also hosted Water Board staff and members of the ranching community in July 2021 during a tour of ranch properties in the Vision Plan area. Representatives from the Tribe gave information about FIB-focused nonpoint source management measures that have been implemented on Paiute lands since 2011. More information about such measures can be found in Section 7.8.

Ranching community

Water Board staff have met with cattle ranchers operating in the project area on several occasions since March 2021, including two online meetings in March and April 2021, in-person at ranch properties in July 2021, and at select leases for ranch water quality planning in December 2021. As well as ranch managers, representatives from the Tribe, LADWP, NRCS, and UCCE have also attended these meetings, which have proved an important step to build partnerships and foster collaboration for Vision Plan implementation.

The first meeting, held online in March 2021, was a forum for project staff to share information about the FIB water quality issues affecting Bishop Creek and explain why such issues are problematic for public health. This meeting also provided opportunity for cattle ranchers to ask questions and share concerns with project staff. Dustin Blakey, of UCCE, provided information about ranch water quality planning (explained in Section 7.6.1) as a tool to help ranchers comply with water quality regulations. Meeting participants agreed that a ranch planning approach was preferable to address FIB water quality issues.

In late April 2021, the informal ranch water quality workgroup met again, this time to discuss U.S. EPA's Vision and discuss the likely contents of a Vision Plan for Bishop Creek. Project staff also provided details on the likely schedule for the Vision Plan document.

In July 2021, the ranch water quality workgroup met in person in Bishop to tour several ranch leases and discuss likely FIB-focused implementation actions on ranching lands. As well as visiting three grazing leases, the tour also stopped on Tribe lands to learn about measures the Tribe has taken to reduce FIB delivered to creek waters. Meeting in person helped build relationships amongst participants and fostered a mutual understanding amongst the group that the FIB water quality issues are addressable via a suite of targeted, specific management actions. To determine the type and location of management actions, the group agreed to begin the process of ranch water quality planning.

In December 2021, Water Board staff, lease managers, and representatives from UCCE met in Bishop on specific Tier 1 leases to begin ranch water quality planning. The group inventoried the physical attributes of each lease (such as water conveyances, irrigation structures, fences, livestock usage, etc.) and gathered information about potential water quality impacts at each property. The group drafted a list of possible management measures to improve water quality and lease condition. Such measures are detailed in Ranch Water Quality Management Plans for each lease, which are proposed as addendums to the 2006 Ranch Management Plans developed by LADWP for their grazed properties. Ranch water quality planning is set to continue in 2022. More information is available in Section 7.6.1.

8.2 Stakeholder outreach in 2022 and beyond

Water Board staff will continue to engage stakeholders in 2022 and beyond. Staff will meet with implementing parties on a regular basis, including LADWP, cattle ranchers, Inyo County, City of Bishop, etc. Ranch water quality planning on Tier 2 properties is also scheduled for spring 2022. Water Board staff are in process of developing a story map for this project which will be published on the project webpage. A story map is a web -based mapping tool that can be used to provide a narrative description of a landscape or project. The Bishop Creek story map will include information about water quality data and implementation goals.

9. Monitoring and Reporting Plan

This section details the monitoring and reporting requirements associated with this Vision Plan. Both monitoring and reporting are critical components to determine the success of the Vision Plan, and to help adaptively manage Plan activities in the future.

Monitoring and reporting includes:

- *E. coli* water quality monitoring and reporting of those data to the California Environmental Data Exchange Network (CEDEN) and other appropriate databases;
- Reporting the installation and maintenance of BMPs associated with implementation of Steps 1a, 1c, and 1d of this Plan;
- Reporting of activities associated with implementation of Step 1b of the Plan, such as workgroup meetings and collaboration with external organizations;
- Reporting of other activities undertaken to help improve and maintain Bishop Creek FIB water quality not covered in Steps 1a through 1d.

The goal of this Plan is to reduce *E. coli* affecting Bishop Creek to achieve the REC-1 WQO numeric thresholds (100 *E. coli*/100mL geometric mean; 320 *E. coli*/100mL single sample max.) and maintain *E. coli* beneath these thresholds into the future. The Plan will be successful when *E. coli* water quality is maintained to such levels, allowing the Water Board to recommend that U.S. EPA remove the 303(d) listings applicable in the project area. Water Board staff will review *E. coli* data yearly at the end of each field season to determine year-by-year progress. A 5-year review of *E. coli* data will be presented to the Water Board by Water Board staff in the first quarter of 2028. The Water Board will assess *E. coli* data for 303(d) purposes at six-year intervals, with the next assessment scheduled for completion in 2026. Milestones for monitoring and reporting are shown in Table 9-1.

Table 9-1 Monitoring and reporting milestones

Report type	Reporting party	Due date	Reported to	Reviewed by
E. coli monitoring data	LADWP	November 1st each year	CEDEN	Water Board staff
BMP installation	Implementing party	December 1st each year	Water Board staff	Water Board staff
Workgroup progress	Workgroup leadership	When appropriate	Water Board staff	Water Board staff
5-year status report to Water Board	Water Board staff	Q1 2028	Lahontan Water Board	Project stakeholders
Integrated Report 303(d) assessments	Lahontan Water Board	June 2026; June 2032; June 2038	State Water Board	U.S. EPA
10-year status report to Water Board	Water Board staff	September 2032	Lahontan Water Board	Lahontan Water Board, U.S. EPA

9.1 *E. coli* water quality monitoring and reporting

E. coli water quality monitoring is the most important metric to determine the success of this Plan. *E. coli* data is important for three reasons: first, *E. coli* data is a primary metric to determine if Bishop Creek waters continue to pose a risk to public health during spring and summer months. Second, *E. coli* data will show the effectiveness of implementation actions taken in accordance with the Plan. Third, comparing *E. coli* data to the WQO shows if the 303(d) listing for Indicator Bacteria has been addressed and that REC-1 beneficial uses are again supported in the project area. If supported by the data, the Water Board may recommend that U.S. EPA remove Bishop Creek from the 303(d) List of Impaired Waters.

The Water Board has partnered with LADWP to tailor an *E. coli* monitoring program to suit the needs of this Vision Plan. LADWP have committed considerable resources to *E. coli* monitoring in Bishop Creek and will continue to do so (personal communications with LADWP staff 10/29/21 & 1/28/22). Water Board staff and LADWP consultants reviewed and adjusted existing LADWP monitoring plans in 2022 to satisfy the monitoring needs of the Vision Plan in an efficient, cost-effective manner. For example, LADWP originally sampled year-round throughout the project area at considerable resource cost. Cost savings measures have been implemented to focus FIB monitoring during irrigation season above and below the known problem areas in the project area. Monitoring activities will likely be revised after stakeholders have implemented BMPs on specific properties.

A priority of the *E. coli* monitoring plan is to collect samples above and below grazing properties before, during, and after livestock are on those properties. To achieve this task Water Board staff and LADWP staff have coordinated to amend the sampling program. The RWQP process described in Section 7.6 of this plan will help inform monitoring activities. An above/below monitoring design enables Water Board staff to give credit to ranchers who have installed BMPs and helped reduce FIB delivered to Bishop Creek. Monitoring upstream of grazing properties provides baseline data for each property. When upstream and downstream data are paired, the efficacy of implementation actions may be shown, and credit may be given to ranchers for work that benefits FIB water quality. This type of monitoring design will also provide information to help adaptively manage the implementation plan and ensure overall project success.

Another priority of the *E. coli* monitoring plan is to develop a dataset which shows FIB water quality leaving State of California jurisdiction (i.e., flowing onto Bishop Paiute Tribe lands) meets applicable WQOs. The *E. coli* monitoring plan will also collect samples from known recreation areas. These data will provide information to understand if public health risks are still present in Bishop Creek.

E. coli monitoring data will be uploaded to CEDEN at the end of each field season. Inclusion of data in CEDEN ensures that such data is publicly accessible and ensures that those data are included in future 303(d) assessments. Including *E. coli* data collected for this Vision Plan in future 303(d) assessments is a critical step to removing Bishop Creek for the U.S. EPA 303(d) List. All data collections should be supported by an approved Quality Assurance Project Plan (QAPP). Water Board staff are available to assist LADWP with this process.

9.2 Reporting the installation and maintenance of BMPs associated with implementation of Steps 1a, 1c, and 1d

E. coli monitoring provides the quantitative data required to show if public health is protected and REC-1 uses are supported in Bishop Creek, and to support a recommendation to remove Bishop Creek from the 303(d) List. Implementation of BMPs is required to reduce FIB delivery to Bishop Creek. Vision Plan participants, such as cattle ranchers, private livestock holders, LADWP, the City of Bishop, Inyo County, and others should report activities taken to reduce FIB in Bishop Creek waters. Reporting includes a summary of action taken, associated costs, volume of materials used (if applicable), and photographs of the finished BMP.

Beginning in 2023, BMP activity reports are due to the Water Board each December 1st until the completion of the project. Reporting BMP activity helps track progress towards Plan goals and may be used to verify the success of the cooperative approach. Yearly reports should include the status of each BMP, any associated maintenance activities, and/or issues with BMP function. Submission of implementation reports is required for the success of this Vision Plan and will help Water Board staff track progress of implementation at a project-level scale. Should an implementing party fail to report BMP activity, the Water Board may use its regulatory and enforcement authorities to require implementation and reporting. Self-reporting will help implementing parties demonstrate and memorialize actions taken and will help Water Board staff focus efforts of parts of the project area where responsible parties are not meeting commitments. Tracking implementation costs will help implementing parties develop a record of costs that can be used to match outside funding sources.

Together with self-reporting, Water Board staff will schedule site visits with each implementing party. The goal of the site visits, or inspections, is to verify the contents of each implementation report. Water Board staff will work with each implementing party to schedule a time to access each property. Water Board staff will use a combination of field notes and photo-point monitoring at each implementation site.

9.3 Reporting of activities associated with implementation of Step 1b

Activities associated with implementation of Step 1b (addressing FIB pollution associated with transient communities) will be reported by the City of Bishop, Inyo County, and LADWP. Water Board staff will be responsible for collating and circulating a report of activities as part of the five-year review of Vision Plan progress.

9.4 Reporting for all other activities

Implementation of activities not covered under Steps 1a through 1d of this Vision Plan may be reported to Water Board staff by the implementing party at their convenience. Reporting such activities provides a record of action the Water Board will acknowledge if other regulatory measures be pursued to help Bishop Creek attain FIB WQOs.

10. Plan evaluation and adaptive management

The Plan relies on *E. coli* monitoring data and BMP activity reporting to assess progress towards attaining Plan goals (protecting public health, attaining WQOs and supporting beneficial uses, and removing Bishop Creek from the 303(d) List). Plan progress will be reviewed yearly each January after the submission of implementation reporting and *E. coli* monitoring data from the preceding year. At approximately five-year intervals, Water Board staff will collate all submitted reports and data to produce a status update for the Water Board. The update will include a review of progress implementing BMPs identified in pursuit of Steps 1a through 1d and a summary of *E. coli* data from the implementation period. The update will also summarize strategies to improve water quality, if needed, including additional or different implementation measures or increased focus on other source categories. The first status update will be due to the Board in the first quarter of 2028 and will account for information and data collected at least through November 2026.

Regularly evaluating the status of implementation actions alongside recent *E. coli* water quality will determine the level of progress towards Vision Plan goals and help determine if additional BMP actions are needed to achieve water quality objectives. Should implementation actions not achieve the predicted *E. coli* reductions, Water Board staff will reassess pollutant reduction opportunities and partner with the necessary implementing parties.

Key questions that may be considered as part of the adaptive management process include:

- Is *E. coli* water quality improving between April and October each year?
- Has progress been made to implement the necessary BMPs?
- Have other FIB problem areas been identified during the *E. coli* monitoring program?
- Are there new or emerging issues associated with implementation of the Plan?

Adaptive implementation entails modifying actions, as needed, as new information becomes available. If the implementation actions in this Vision Plan do not resolve the impairments from Indicator Bacteria within 10 years from the date this Plan is accepted through Resolution by the Water Board, then development of a TMDL or other regulatory action may be pursued.

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