

# **TECHNICAL REPORT**

## **Assessment of Land Cover, Land Use, and Microbial Source Tracking Data from 28 Coastal Streams, and 12 Ocean Beaches in the North Coast Region**

**Planning Unit**

**Planning and Stewardship Division**

**North Coast Regional Water Quality Control Board**

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# 1. Introduction

This report presents an analysis of land cover, land use, and microbial source tracking (MST) data, collected from 28 coastal streams and 12 ocean beaches in the North Coast Region.

The goal of this technical report is to characterize the potential sources of fecal pollution to all the waterbodies analyzed in the report using three lines of evidence – land cover data, land use data, and MST data. Along with the findings from other Coastal Pathogen Project reports, the findings of this report will be used to develop recommendations for source control strategies to address fecal pollution detected in these waterbodies.

This report does not include determination of the impairment of beneficial use in any of the streams or beaches analyzed. Impairment of beneficial use will be determined through the Integrated Report, and all fecal indicator bacteria data collected from the streams and beaches analyzed through the Coastal Pathogen Project is currently being assessed for reporting in the 2026 Integrated Report.

The waterbodies analyzed in this report include 26 Humboldt County coastal streams, six Humboldt County ocean beaches, five Mendocino County ocean beaches, and one Sonoma County ocean beach. Six of the coastal streams, and all 12 ocean beaches, analyzed in this report are currently included on the 2020-2022 Clean Water Act Section 303(d) List of Impaired Waters (Section 303(d) List) for impairment of Water Contact Recreation (REC-1) and/or Shellfish Harvesting (SHELL) beneficial use (State Water Resources Control Board, 2022). The 2020-2022 Section 303(d) List reflects assessments conducted for the North Coast Region during 2012 Integrated Report cycle, which was the last time data from the region were evaluated (new data assessments are in progress for the 2026 Integrated Report). The assessments found beneficial use impairment based on fecal indicator bacteria (FIB) data collected from these 18 waterbodies (six streams and 12 ocean beaches) (State Water Resources Control Board, 2015a, 2015b). The remaining 20 coastal streams are currently being evaluated for the 2026 Integrated Report.

The 28 coastal streams assessed in this report were sampled under the Coastal Pathogen Project of the North Coast Regional Water Quality Control Board (Regional Board), and the Advanced Protection Management Program (APMP) Surface Water Monitoring Study (Humboldt County APMP Study) conducted by the Humboldt County Division of Environmental Health (DEH). The 12 ocean beaches assessed in this report were sampled under the Coastal Pathogen Project. Further details on the multiple Coastal Pathogen Project studies and the Humboldt County APMP Study are provided in Section 1.1 of this report.

This technical report focuses solely on the land cover, land use, and MST data collected from the waterbodies assessed, and a description of all the studies under which those data were collected are described in Section 1.1 below. A brief description of the other reports developed by the Regional Board on the analysis of FIB data collected as part of

the Coastal Pathogen Project is provided in the Technical Memorandum entitled “Technical Reports and Memoranda of the Coastal Pathogen Project” (North Coast Regional Water Quality Control Board, 2024).

## **1.1. Summary of Studies Considered in this Technical Report**

### **1.1.1. Coastal Pathogen Project Studies Overview**

The Coastal Pathogen Project was conducted by the North Coast Regional Water Quality Control Board staff (Regional Board staff) to identify and assess the presence and source of fecal contamination in North Coast coastal streams and ocean beaches that had been identified on the 2012 Section 303(d) List (North Coast Regional Water Quality Control Board, 2015) and remain on the most current 2020-2022 Section 303(d)List. These waterbodies were listed due to the impairment of REC-1 and/or SHELL beneficial use. Listing decisions were based on FIB data collected from these waterbodies which indicated pathogen contamination (State Water Resources Control Board, 2022).

The Coastal Pathogen Project aims to 1) assess the water quality of the North Coast coastal streams and ocean beaches sampled, 2) associate likely sources of fecal contamination with the coastal streams and ocean beaches, and 3) identify potential fecal pollution control strategies for waterbodies where data indicates a need.

The data assessed in this technical report were collected under the following five studies of the Coastal Pathogen Project:

#### **Impaired Streams Monitoring Study:**

Six REC-1 impaired Humboldt County coastal streams were sampled between February 2016 and January 2018. Samples were collected during both wet and dry weather periods. FIB (enterococcus and Escherichia coli [*E. coli*]), and MST (dog-, gull-, human-, and ruminant-specific markers) data were collected from all coastal streams sampled.

#### **Impaired Ocean Beaches Monitoring Study:**

Four REC-1 and SHELL impaired ocean beaches, and eight SHELL impaired ocean beaches located in Humboldt, Mendocino, and Sonoma counties were sampled between July 2016 and October 2017. Samples were collected only during the dry weather period. FIB (enterococcus and total coliform) data were collected from 11 of the 12 ocean beaches, and MST (dog-, gull-, human-, and ruminant-specific markers) data were collected from all ocean beaches sampled.

#### **Source Assessment Study:**

Seventeen Humboldt County coastal streams, and two roadside ditches, representing four suspected fecal source categories (cattle, onsite wastewater treatment systems [OWTS], sewered areas, and wildlife) within the watersheds encompassing the Humboldt County waterbodies, were sampled between December 2016 and January 2018. The sampling stations were selected from watersheds representing suspected

sources of fecal pollution (cattle, OWTS, sewered areas, and wildlife) based on preliminary field assessment conducted by Regional Board and Humboldt Waterkeeper staff prior to sample collection. Samples were collected during both wet and dry weather periods. FIB (enterococcus and *E. coli*), and MST (dog-, gull-, human-, and ruminant-specific markers) data were collected from all the coastal streams and roadside ditches sampled.

#### Jolly Giant Creek Monitoring Study:

Analysis of samples collected under the Impaired Streams study identified consistent human-source fecal pollution near the terminus of Jolly Giant Creek at the Samoa Boulevard sampling station. Therefore, Regional Water Board staff conducted a follow up study from 2021 to 2022 to collect FIB (enterococcus and *E. coli*), and MST (dog-, gull-, human-, and ruminant-specific markers) data from the Jolly Giant Creek at Samoa Boulevard sampling station as well as four stations upstream along Jolly Giant Creek. Sampling stations were selected along Jolly Giant Creek at locations where it is above ground and near potential human fecal pollution sources (leaking sewage pipes, illegal sewage dumping and/or houseless population inputs).

#### Land Use and Land Cover Assessment:

In order to identify potential fecal waste sources, staff conducted geospatial analyses to delineate the watershed area draining to each waterbody sampling location. Staff then identified the land use and land cover types within a 5-kilometer radius above the sample location, meaning that data from that sample site represented instream conditions influenced by the runoff from those land uses and land cover types. Land cover data were derived from the 2012 United States Department of Agriculture Cropland Data Layer (United States Department of Agriculture, 2012). Land use data were derived from the most recent publicly available county parcel data, for which each Assessor Parcel Number (APN) (a unique number assigned to each parcel), was assigned a “Developed Sewered”, “Developed Unsewered,” “Undeveloped,” or “Grazing” land use.

### **1.1.2. Humboldt County Advanced Protection Management Program Study Overview**

The Humboldt County APMP Study was developed by the Humboldt County DEH “in response to the requirement set forth by statewide Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy) section 9.3.2. Part of this section requires Local Agency Management Program (LAMP) local agencies to assess the extent to which groundwater and local surface water quality may be adversely impacted by OWTS as a component of their water quality assessment program.” (personal communication, J. Whittlesey, February 7, 2023). “To accomplish this task, [Humboldt County DEH] have focused their assessment efforts on the surface waters within their APMP – the watersheds upstream of 303(d) impaired beaches – with ongoing FIB and MST sampling. Ongoing sampling

efforts will help [Humboldt County DEH] determine where in these watersheds contamination is originating from and better evaluate the extent of OWTS impact to water quality impairment.” (personal communication, J. Whittlesey, February 7, 2023).

Under this study, samples were collected from eight coastal streams, within the Humboldt County APMP. Sampling for data that has been assessed within this technical report was conducted between April 2019 and November 2022 “after the first rain of the year and during the wet weather season” (personal communication, M. Kalson, March 23, 2022). FIB (enterococcus and *E. coli*), and MST (dog-, gull-, human-, and ruminant-specific markers) data were collected from all coastal streams sampled.

### **1.1.3. Humboldt Waterkeeper Study**

The Humboldt Waterkeeper Organization collected water grab samples from four sampling stations in Little River, and one sampling station in Janes Creek, and four sampling stations in McDaniel Slough, from March 2016 to October 2016. Little River drains to the Pacific Ocean, whereas Janes Creek and McDaniel slough drain to Humboldt Bay. These samples were analyzed for the presence of four MST markers (dog-, gull-, human-, and ruminant-specific markers). Regional Water Board staff received the Humboldt Waterkeeper Study MST data after the land cover and land use data analysis for the Source Assessment Report was complete. Therefore, the analysis of the Humboldt Waterkeeper Study MST data was conducted separately, and the results of this analysis are provided in Appendix F of this report. Appendix F also includes recommended source control actions for these sampling stations, which is in line with the general recommendations provided in Section 5.2, since the results of the analysis of the MST data collected under the Humboldt Waterkeeper Study are similar to the results of other streams draining to Humboldt Bay and the Pacific Ocean. Results from the analysis of the MST data collected under the 2016 Humboldt Waterkeeper study were included in the grouped assessment of the MST data collected from all streams draining to Humboldt Bay, and the grouped assessment of the MST data collected from all streams draining to the Pacific Ocean.

## **2. Known Sources of Fecal Waste in the Sampled Areas**

Fecal waste can enter waterbodies directly from point sources or in runoff from nonpoint sources or subsurface flow. The key point sources of fecal waste discharge include wastewater treatment plants, aging or failing sewer infrastructure, and sanitary sewer overflows (United States Environmental Protection Agency, 2023). Major nonpoint sources of fecal waste include onsite waste treatment systems (OWTS) leachate, runoff from land which includes agricultural runoff, and the feces of domestic pets and wildlife (United States Environmental Protection Agency, 2023), as well as feces from unhoused populations. During events of heavy rainfall, fecal waste can enter waterbodies via sanitary sewer overflow, stormwater runoff can transport feces associated with particulate matter, and remobilization and transport of sediment contaminated with fecal waste and associated pathogens may occur (United States Environmental Protection Agency, 2023).

For the Coastal Pathogen Project, preliminary field assessment was conducted by Regional Board and Humboldt Waterkeeper staff prior to instream sample collection to identify potential fecal waste sources and appropriate sample locations. Preliminary assessment identified the suspected sources of fecal pollution upstream of both stream and beach areas sampled as - cattle, OWTS, sewer areas, and wildlife. In addition, staff noted that significant portions of the upper watersheds are covered by forests, and the downstream sections tend to be more densely populated urban areas. A small number of the project watersheds host cattle grazing, with dairy cattle grazing being more prevalent than non-dairy cattle grazing. Staff confirmed these preliminary assessments during the data analysis process by evaluating the land cover and land use in the sampling station watersheds, and calculating the actual coverage of each land cover and land use category present in these watersheds. This evaluation process is described in Section 3.

The forested areas of the watersheds of both the streams and oceans sample locations support several species of wildlife – fox, deer, elk, squirrels, mountain lions, and bears (California Department of Fish and Wildlife, 2024); whereas the urban developed areas are inhabited by livestock, humans and their pets. In addition, urban developed areas contain sanitary sewers for the conveyance of fecal waste. Septic systems (OWTS) are prevalent in urban developed areas without sewer systems. All beach samples were collected from the surf zone which is the main foraging habitat for several species of shorebirds – gulls, curlews, sandpipers etc. (California Department of Fish and Wildlife, 2024). Dogs are also very common at beaches since they often accompany beachgoers. A majority of the sampled streams are close to the Pacific Ocean or to Humboldt Bay, therefore, gulls and other shorebirds may also be a potential source of fecal waste to these streams.

Based on these potential sources of fecal waste, all samples collected under the Coastal Pathogen Project were analyzed for the presence of dog-, gull-, human-, and ruminant-specific MST markers. No other species-specific markers were evaluated, and

the ruminant-specific marker detects both non-bovine ruminant wildlife (deer, elk, etc.) feces as well as bovine ruminant (cattle) feces. The MST assessment process is described in Section 3.



### **3. Methods**

The methods for the MST analyses and assessment of land use/land cover are detailed below.

#### **3.1. Sample Collection for Microbial Source Tracking**

Microbial Source Tracking Study sample collection details for the Coastal Pathogen Project and the Humboldt County APMP Study are provided below.

##### **3.1.1. Coastal Pathogen Project – Coastal Streams**

Water grab samples were collected from coastal streams from February 2016 to January 2018 by Regional Board staff under two studies of the Coastal Pathogen Project – the Impaired Streams Monitoring Study and the Source Assessment Study. Samples were also collected from Jolly Giant Creek from October 2021 to November 2022 under the Jolly Giant Creek Monitoring Study. Samples were collected in the dry as well as wet weather periods. Sampling dates were selected to best represent the typical range of hydrologic conditions expected at each sampling station. For the Coastal Pathogen Project, a “dry” weather sample is defined as a sample “collected after 72 hours of dry weather”, and a wet weather sample is defined as a sample collected “during, or following, storm events that were predicted to generate 0.2 inches or greater of rainfall” (North Coast Regional Water Quality Control Board, 2015). Further details on sample collection can be found in the Quality Assurance Project Plan developed for this project – “Coastal Watershed Pathogen Indicator Study Quality Assurance Project Plan” (North Coast Regional Water Quality Control Board, 2015).

Impaired Streams Monitoring Study: Six REC-1 impaired streams were sampled from February 2016 to January 2018 during the dry and wet weather periods. Dry weather period samples were collected in February, May, August, and September of 2016, and July, and October of 2017. Wet weather period samples were collected in February, October, November, and December of 2016, December 2017, and January 2018. Samples were collected from one sampling station per impaired stream. Replicate samples were not collected from any of the six sampling stations. Details of all the Impaired Streams Monitoring Study sampling stations analyzed in this report are provided in Table 1 and Figure 1.

**Table 1 Sample Collection Details of the Impaired Streams Monitoring Study**

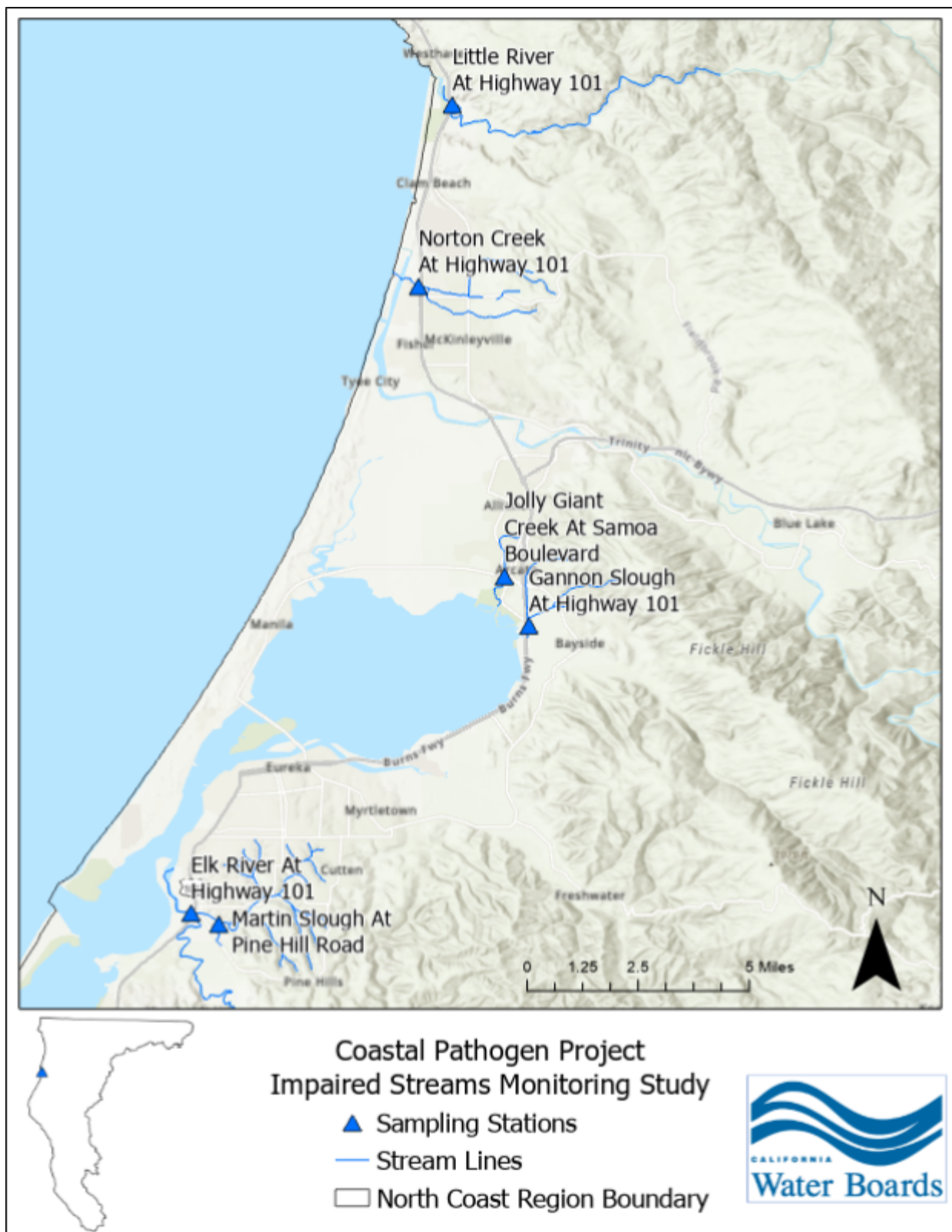
<b>Station Name<sup>a</sup></b>	<b>Station Code<sup>b</sup></b>	<b>Sampling Period</b>	<b>Number of Samples Collected</b>
Elk River at Highway 101 <sup>c</sup>	110EL1278	Dry	6
Elk River at Highway 101 <sup>c</sup>	110EL1278	Wet	5
Gannon Slough at Highway 101 <sup>c</sup>	110GS1625	Dry	5
Gannon Slough at Highway 101 <sup>c</sup>	110GS1625	Wet	6
Jolly Giant Creek at Samoa Boulevard <sup>c</sup>	110JG0264	Dry	5
Jolly Giant Creek at Samoa Boulevard <sup>c</sup>	110JG0264	Wet	6
Little River at Highway 101 <sup>d</sup>	108LR0663	Dry	5
Little River at Highway 101 <sup>d</sup>	108LR0663	Wet	6
Martin Slough at Pine Hill Road <sup>c</sup>	110MS1481	Dry	6
Martin Slough at Pine Hill Road <sup>c</sup>	110MS1481	Wet	5
Norton Creek at Highway 101 <sup>d</sup>	109NR1488	Dry	5
Norton Creek at Highway 101 <sup>d</sup>	109NR1488	Wet	6

<sup>a</sup>All the sampling stations are located in Humboldt County.

<sup>b</sup>The sampling station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the stream being sampled followed by a random 6-digit code, which, in Region 1, consists of a 2-letter code for the stream name, and a 4-digit code signifying the distance of the sampling station from the mouth of the stream. Codes for unnamed streams required an adjustment to the commonly used naming convention, resulting in a seven-letter code.

<sup>c</sup>Stream drains into Humboldt Bay.

<sup>d</sup>Stream drains into the Pacific Ocean.



**Figure 1 A map of the Impaired Streams Monitoring Study sampling stations**

Source Assessment Study: Samples were collected from 22 streams and two roadside ditches, from December 2016 to January 2018 during the dry and wet weather periods. Dry weather period samples were collected in July, and October of 2017. Wet weather period samples were collected in December 2016, December 2017, and January 2018. Samples were collected from 26 sampling stations in total from the 22 streams – one sampling station was sampled per stream for 18 coastal streams, two sampling stations were sampled per stream for three coastal streams, and one sampling station was sampled per roadside ditch for the two roadside ditches. Replicate samples were not collected from any of the 26 sampling stations. Although samples were collected from a total of 26 sampling stations, MST data from only 22 sampling stations have been included in this technical report – specifically, data from 20 sampling stations from 17 streams, and from two sampling stations from two roadside ditches. Data from four sampling stations of the Source Assessment Study have been excluded from analysis because only one sample was collected from each of these four sampling stations and the sample size is not sufficient for analysis purposes (North Coast Regional Water Quality Control Board, 2023d). The four excluded sampling stations are Hookton Slough at Hookton Road, Unnamed Slough at Hunt Check Station, Unnamed Slough at Long Pond, and Unnamed Slough at Visitor Center. Further details about the excluded sampling stations are provided in the Technical Memorandum entitled “Exclusion of Specific Source Assessment Study Sampling Stations from Fecal Indicator Bacteria and Microbial Source Tracking Data Assessment” (North Coast Regional Water Quality Control Board, 2023d). Details of all the Source Assessment Study sampling stations analyzed in this report are provided in Table 2 and Figure 2 (sampling stations in the northern Humboldt Bay area), and Figure 3 (sampling stations in the southern Humboldt Bay area). Please note that details of the four excluded sampling stations described above are not included in these tables and figures.

**Table 2 Sample Collection Details of the Source Assessment Study**

Station Name <sup>a</sup>	Station Code <sup>b</sup>	Sampling Period	Number of Samples Collected
Campbell Creek at 7th Street <sup>c</sup>	110GS5000	Dry	1
Campbell Creek at 7th Street <sup>c</sup>	110GS5000	Wet	3
Campbell Creek at 14th Street & Union Street <sup>c</sup>	110GS6500	Dry	1
Campbell Creek at 14th Street & Union Street <sup>c</sup>	110GS6500	Wet	3

Station Name <sup>a</sup>	Station Code <sup>b</sup>	Sampling Period	Number of Samples Collected
Cooper Gulch at Myrtle Avenue & 8th Street <sup>c</sup>	110CG5000	Dry	2
Cooper Gulch at Myrtle Avenue & 8th Street <sup>c</sup>	110CG5000	Wet	2
Elk River South Fork at Headwaters Forest <sup>c</sup>	110SF1612	Dry	2
Elk River South Fork at Headwaters Forest <sup>c</sup>	110SF1612	Wet	2
Elk River at Zanes Road <sup>c</sup>	110ER6642	Dry	2
Elk River at Zanes Road <sup>c</sup>	110ER6642	Wet	2
Freshwater Creek at County Park <sup>c</sup>	110FR4642	Dry	2
Freshwater Creek at County Park <sup>c</sup>	110FR4642	Wet	2
Graham Gulch at Pacific Lumber Camp Road <sup>c</sup>	110GG0100	Dry	2
Graham Gulch at Pacific Lumber Camp Road <sup>c</sup>	110GG0100	Wet	2
Grotzman Creek at Bayside Road <sup>c,e</sup>	110GR0500	Dry	2
Grotzman Creek at Bayside Road <sup>c</sup>	110GR0500	Wet	2
Jacoby Creek at Jacoby Creek Road <sup>c</sup>	110JC6316	Dry	2
Jacoby Creek at Jacoby Creek Road <sup>c</sup>	110JC6316	Wet	2

Station Name <sup>a</sup>	Station Code <sup>b</sup>	Sampling Period	Number of Samples Collected
Jacoby Creek at Old Arcata Road <sup>c</sup>	110JC0966	Dry	2
Jacoby Creek at Old Arcata Road <sup>c</sup>	110JC0966	Wet	2
Liscom Slough at Jackson Road <sup>c</sup>	110UNSJXN	Dry	1
Liscom Slough at Jackson Road <sup>c</sup>	110UNSJXN	Wet	3
Martin Slough at Campton Street & Fern Street <sup>c</sup>	110MS6750	Dry	2
Martin Slough at Campton Street & Fern Street <sup>c</sup>	110MS6750	Wet	2
McDaniel Slough at Q Street <sup>c</sup>	110MD3750	Dry	1
McDaniel Slough at Q Street <sup>c</sup>	110MD3750	Wet	3
Mill Creek at Stagecoach Road <sup>d</sup>	108MC1250	Dry	2
Mill Creek at Stagecoach Road <sup>d</sup>	108MC1250	Wet	2
Roadside Ditch at Foster Road and Seidel Road	110DSEIDL	Dry	0
Roadside Ditch at Foster Road and Seidel Road	110DSEIDL	Wet	3
Roadside Ditch at Jackson Ranch Road	110DJXNRD	Dry	1
Roadside Ditch at Jackson Ranch Road	110DJXNRD	Wet	3

Station Name <sup>a</sup>	Station Code <sup>b</sup>	Sampling Period	Number of Samples Collected
Salmon Creek at Eel River Drive <sup>c</sup>	110SA1720	Dry	2
Salmon Creek at Eel River Drive <sup>c</sup>	110SA1720	Wet	2
Strawberry Creek at Highway 101 <sup>d</sup>	108SC0550	Dry	2
Strawberry Creek at Highway 101 <sup>d</sup>	108SC0550	Wet	2
Swain Slough at Elk River Road <sup>c</sup>	110SS9000	Dry	2
Swain Slough at Elk River Road <sup>c</sup>	110SS9000	Wet	2
Unnamed Slough at Lanphere Road <sup>c</sup>	110UNSLPHR	Dry	1
Unnamed Slough at Lanphere Road <sup>c</sup>	110UNSLPHR	Wet	3
Unnamed Slough at Ranch Road <sup>c</sup>	110UNSRNCH	Dry	2
Unnamed Slough at Ranch Road <sup>c</sup>	110UNSRNCH	Wet	2
Unnamed Stream at Anker Road <sup>d</sup>	109UNTANKR	Dry	2
Unnamed Stream at Anker Road <sup>d</sup>	109UNTANKR	Wet	2

<sup>a</sup>All the sampling stations are located in Humboldt County.

<sup>b</sup>The sampling station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the stream being sampled followed by a random 6-digit code, which, in Region 1, consists of a 2-letter code for the stream name, and a 4-digit code signifying the distance of the sampling

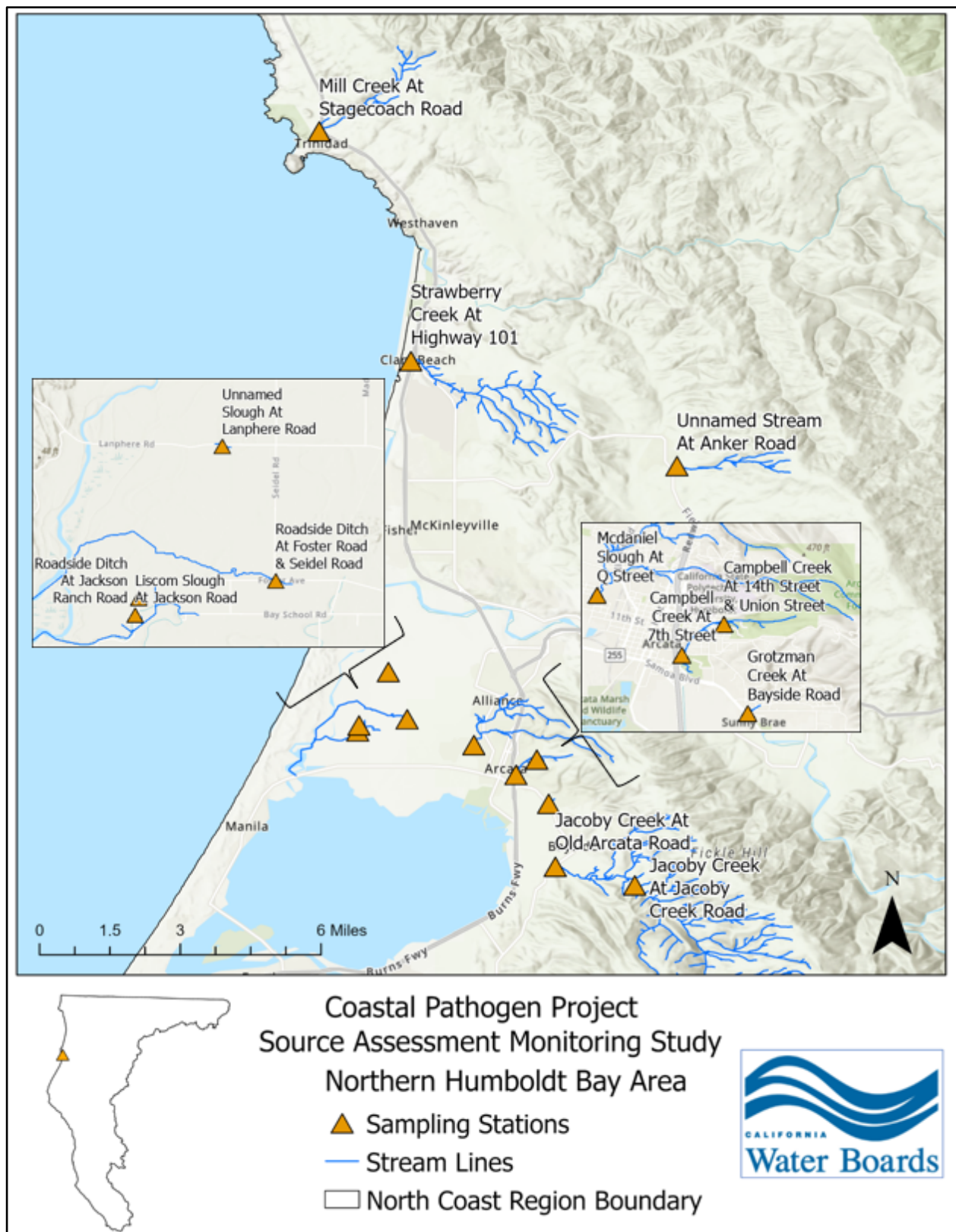


station from the mouth of the stream. Codes for unnamed streams required an adjustment to the commonly used naming convention, resulting in a seven-letter code.

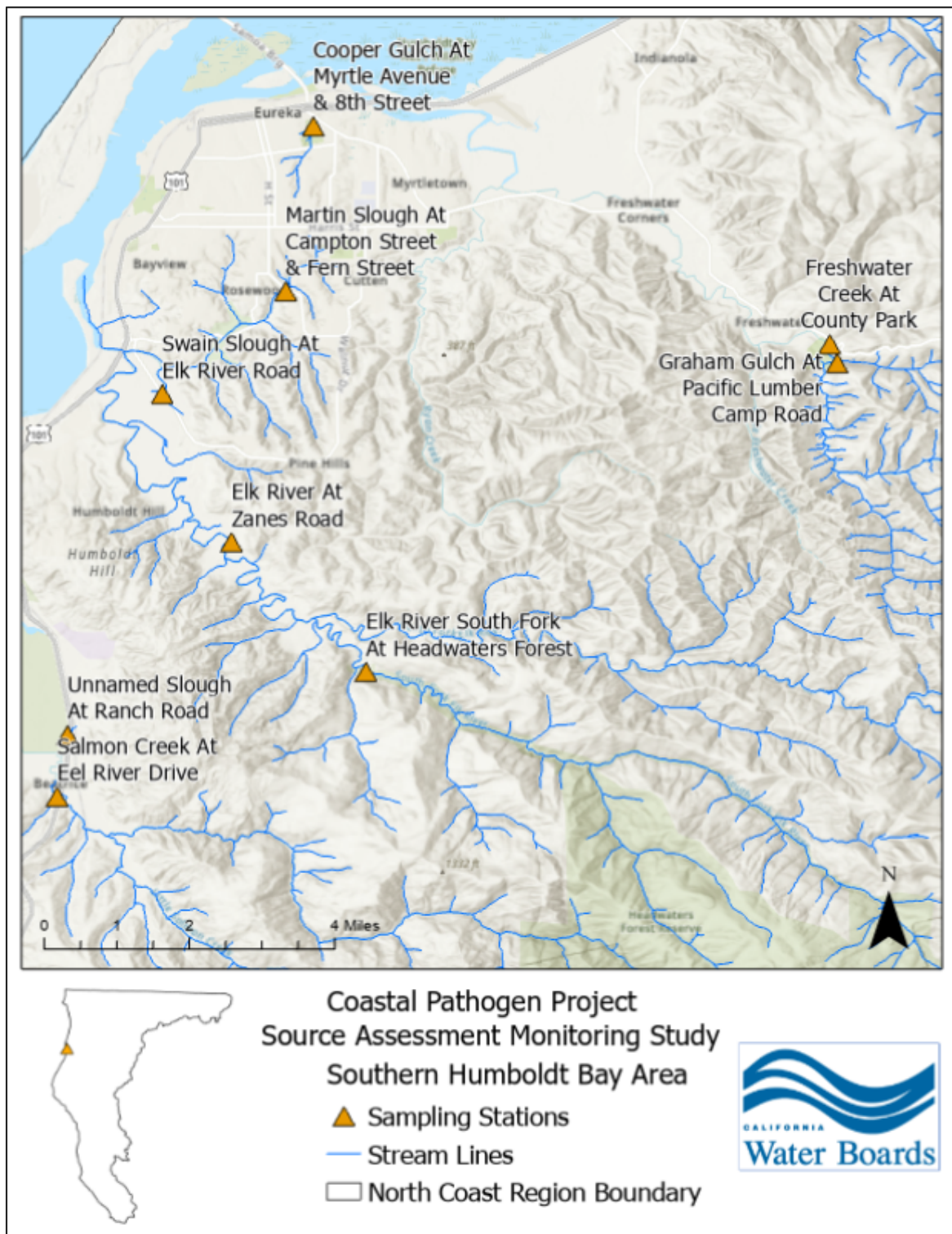
<sup>c</sup>Stream drains into Humboldt Bay

<sup>d</sup>Stream drains into the Pacific Ocean

<sup>e</sup>The MST marker presence and concentration assessment results from one dry weather sample collected in October 2017 from this sampling station are missing.



**Figure 2 A map of the Source Assessment Study sampling stations in the Northern Humboldt Bay Area**



**Figure 3 A map of the Source Assessment Study sampling stations in the Southern Humboldt Bay Area**

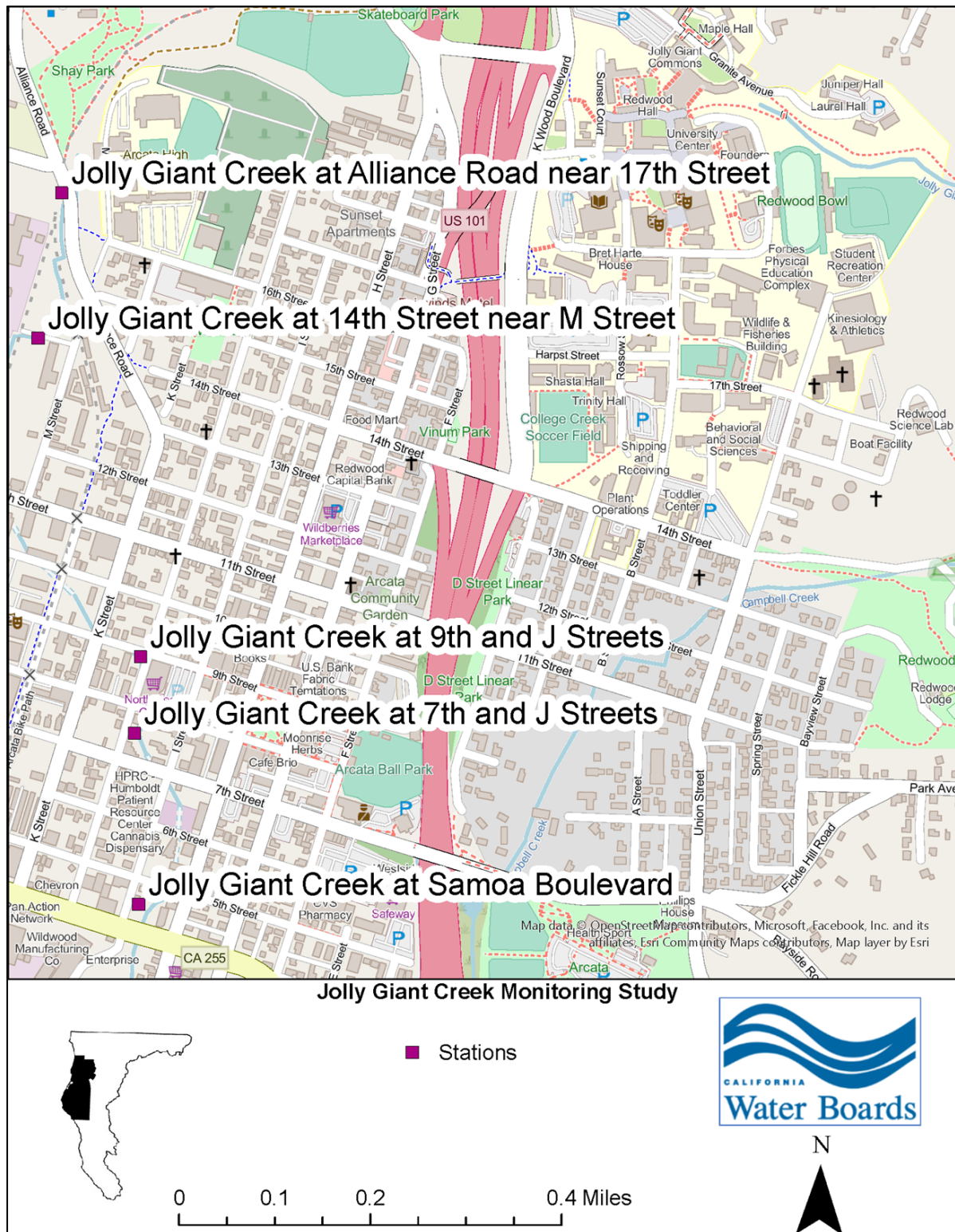
Jolly Giant Creek Monitoring Study: Five stations along Jolly Giant Creek were sampled from October 2021 to November 2022 during the dry and wet weather periods. Dry weather period samples were collected in October 2021, and January and November of 2022. Wet weather period samples were collected in March, April, and May of 2022. Details of all the Jolly Giant Creek Monitoring Study sampling stations analyzed in this report are provided in Table 3 and Figure 4.

**Table 3 Sample Collection Details of the Jolly Giant Creek Monitoring Study**

Station Name	Station Code <sup>a</sup>	Sampling Period	Number of Samples Collected
Jolly Giant Creek at Alliance Road near 17 <sup>th</sup> Street	110JG0580	Dry	3
Jolly Giant Creek at 14 <sup>th</sup> Street near M Street	110JG0516	Wet	3
Jolly Giant Creek at 9 <sup>th</sup> and J Streets	110JG0378	Dry	3
Jolly Giant Creek at 7 <sup>th</sup> and J Streets	110JG0331	Wet	3
Jolly Giant Creek at Samoa Boulevard	110JG0264	Dry	3

<sup>a</sup>The sampling station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the stream being sampled followed by a random 6-digit code, which, in Region 1, consists of a 2-letter code for the stream name, and a 4-digit code signifying the distance of the sampling station from the mouth of the stream. Codes for unnamed streams required an adjustment to the commonly used naming convention, resulting in a seven-letter code.





**Figure 4 A map of the Jolly Giant Creek Monitoring Study sampling stations**

### 3.1.2. Coastal Pathogen Project – Ocean Beaches

Water grab samples were collected from surf zones at 12 ocean beaches. Six ocean beaches are located in Humboldt County, five in Mendocino County, and one in Sonoma County. Of the 12 ocean beaches that were sampled, four beaches are impaired for REC-1 and SHELL beneficial use, while eight beaches are impaired for SHELL beneficial use only (State Water Resources Control Board, 2022). Samples were collected from one sampling station per ocean beach. Replicate samples were not collected from any of the 12 sampling stations. Samples were collected in July, August, September, and October of 2017 from the six Humboldt County ocean beach sampling stations, in July, August, and September of 2017 from the five Mendocino County ocean beach sampling stations, and in July, August, and September of 2016 as well as 2017 the one ocean beach sampling station in Sonoma County.

Precipitation status was not noted at the time of sampling. However, Regional Board Staff have retrospectively determined the precipitation status for all samples collected at all 12 ocean beaches to be dry using historic precipitation data available for gauging stations in the river basin and hydrologic area corresponding to each ocean beach sampling station (California Department of Water Resources, 2023a). The dry weather period definition described in Section 2.1.1 was used to determine precipitation status. For the six Humboldt County ocean beach sampling stations the Eureka Woodley Island gauging station was used to determine precipitation status, for the five Mendocino County ocean beach sampling stations the South Fork Eel River at Leggett gauging station was used to determine precipitation status, and for the one Sonoma County ocean beach sampling station the Sonoma County Airport (Santa Rosa) gauging station was used (California Department of Water Resources, 2023b).

Details of the Coastal Pathogen Project ocean beach sampling stations analyzed in this report are provided in Tables 4, 5, and 6 for Humboldt, Mendocino, and Sonoma counties respectively, and Figures 5, 6, and 7 for Humboldt, Mendocino, and Sonoma counties, respectively.

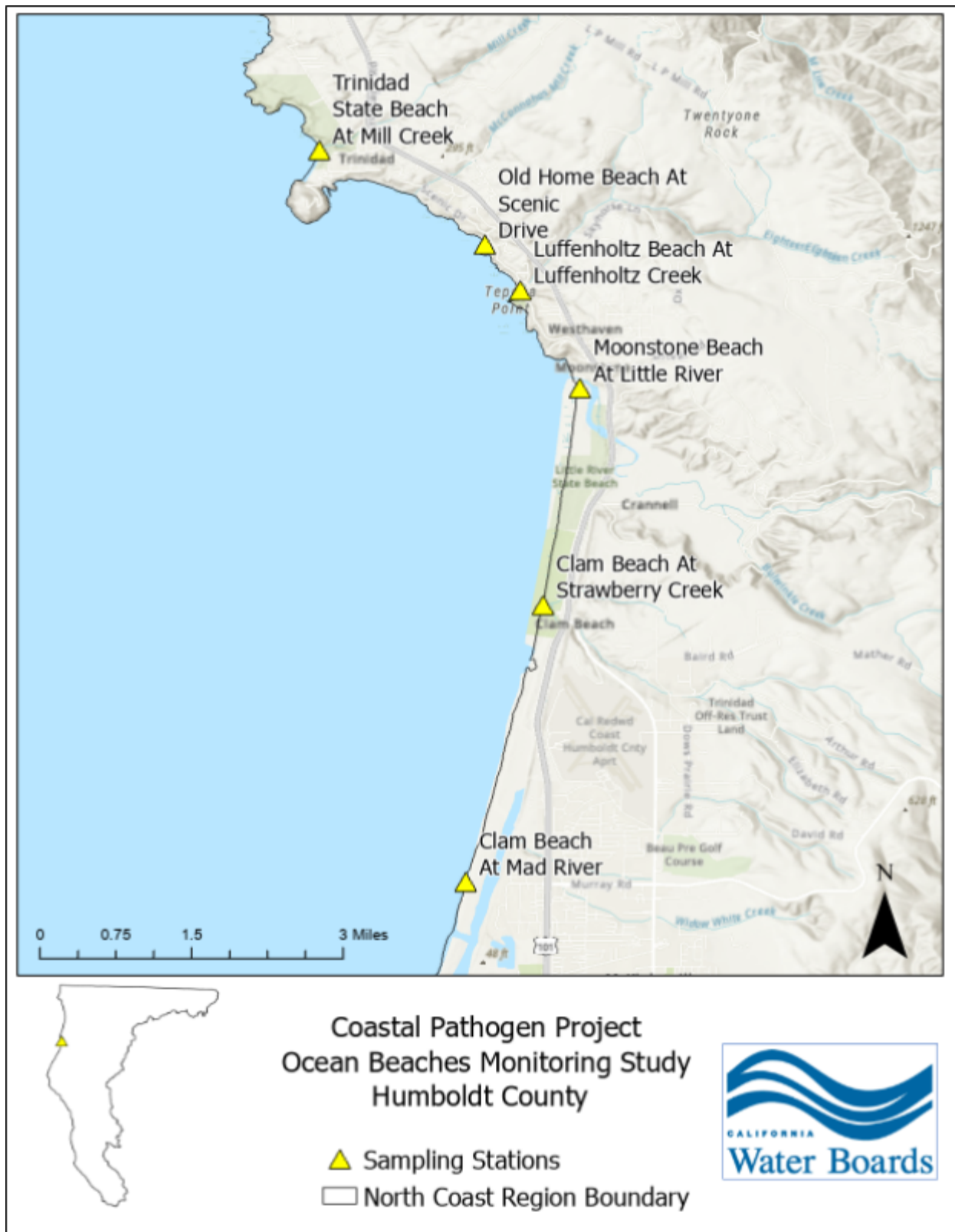
**Table 4 Number of Samples Collected from Humboldt County Ocean Beaches**

Station Name	Station Code <sup>a</sup>	Sampling Period <sup>b</sup>	Number of Samples Collected
Clam Beach at Mad River	109MA0001	Dry	6
Clam Beach at Strawberry Creek	109SW0001	Dry	6

Station Name	Station Code <sup>a</sup>	Sampling Period <sup>b</sup>	Number of Samples Collected
Luffenholtz Beach at Luffenholtz Creek	108LF0001	Dry	6
Moonstone Beach at Little River	108LR0001	Dry	6
Old Home Beach at Scenic Drive	108HBOHB1	Dry	6
Trinidad State Beach at Mill Creek	108ML0001	Dry	6

<sup>a</sup>The station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the beach being sampled followed by a random 6-digit code.

<sup>b</sup>No samples were collected during the wet weather sampling period.



**Figure 5 A map of the Ocean Beach sampling stations in Humboldt County (Ocean Beaches Monitoring Study)**

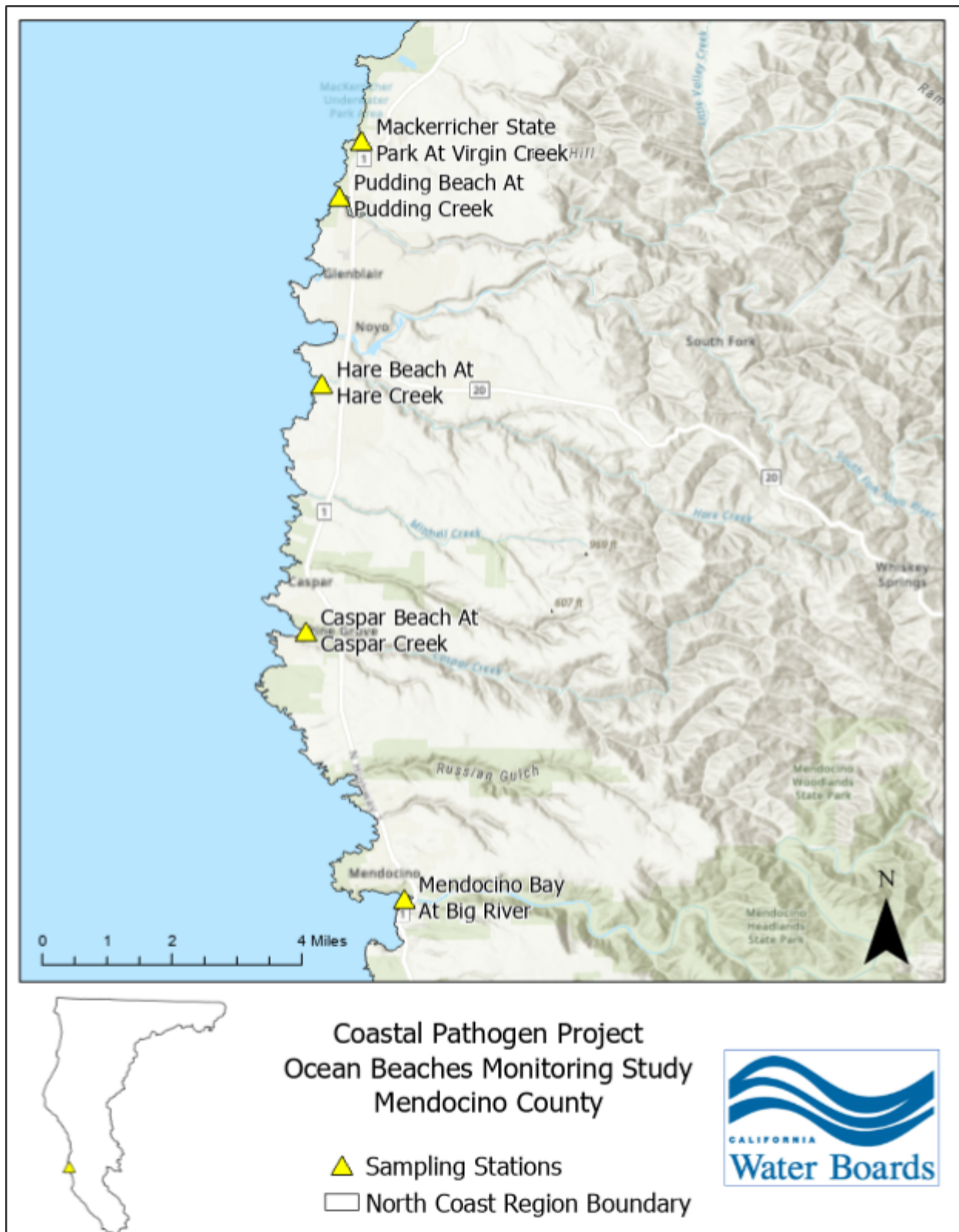


**Table 5 Number of Samples Collected from Mendocino County Ocean Beaches**

<b>Station Name</b>	<b>Station Code<sup>a</sup></b>	<b>Sampling Period<sup>b</sup></b>	<b>Number of Samples Collected</b>
Caspar Beach at Caspar Creek	113CA0001	Dry	5
Hare Beach at Hare Creek	113HC0001	Dry	5
MacKerricher State Park at Virgin Creek	113VR0001	Dry	4
Mendocino Bay at Big River	113BI0001	Dry	5
Pudding Beach at Pudding Creek	113PD0001	Dry	5

<sup>a</sup>The station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the beach being sampled followed by a random 6-digit code.

<sup>b</sup>No samples were collected during the wet weather sampling period.



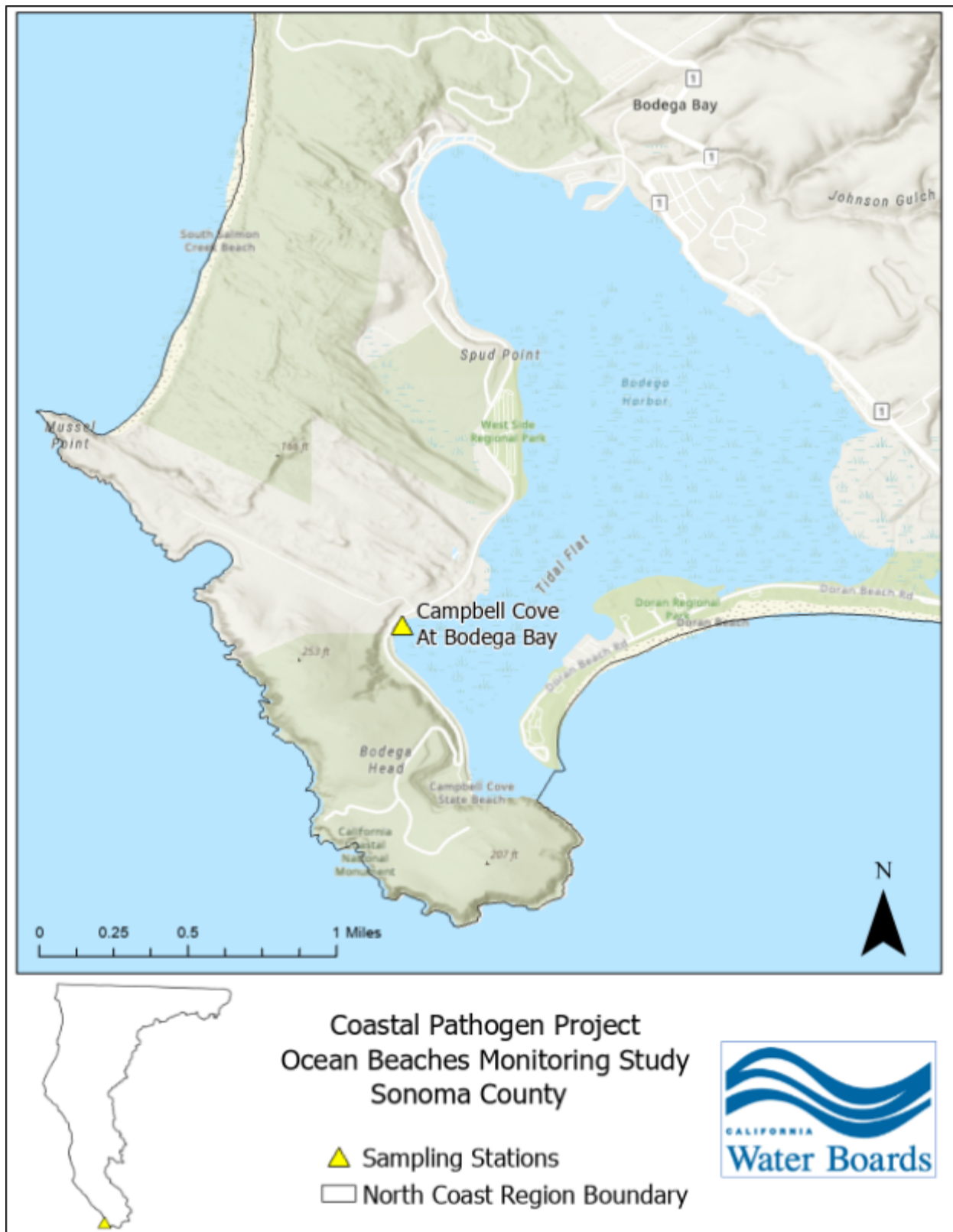
**Figure 6 A map of the Ocean Beach sampling stations in Mendocino County (Ocean Beach Monitoring Study)**

**Table 6 Number of Samples Collected from the Sonoma County Ocean Beach**

<b>Station Name</b>	<b>Station Code<sup>a</sup></b>	<b>Sampling Period<sup>b</sup></b>	<b>Number of Samples Collected</b>
Campbell Cove at Bodega Bay	115BBCCB1	Dry	8

<sup>a</sup>The station code has been developed according to the Surface Water Ambient Monitoring Program (SWAMP) naming convention for sampling stations. SWAMP requires a numeric 3-digit code for the hydrologic unit of the beach being sampled followed by a random 6-digit code.

<sup>b</sup>No samples were collected during the wet weather sampling period.



**Figure 7 A map of the Ocean Beach sampling station in Sonoma County (Ocean Beaches Monitoring Study)**

### 3.1.3. Humboldt County APMP Study

Water grab samples were collected by Humboldt County DEH staff from eight Humboldt County coastal streams from April 2019 to November 2022. Specifically in April and December of 2019, November 2020, October 2021, and March and November of 2022. Samples were collected from 13 sampling stations from these eight streams in total – one sampling station was sampled per coastal stream for five streams, two sampling stations were sampled per stream for two streams, and five sampling stations were sampled per stream for one stream. Replicate samples were not collected from any of the 13 sampling stations.

All samples were collected in the wet weather period. No samples were collected during the dry weather period. The samples collected from all 13 sampling stations for Humboldt County APMP study were collected “after the first rain of the year”, and “once during the wet weather season” (personal communication, M. Kalson, March 23, 2022, April 11, 2022).

A Quality Assurance Project Plan (QAPP) for the Humboldt County APMP Study was not available at the time of writing this report. However, the samples collected under the Humboldt County APMP Study were analyzed by the Humboldt County Public Health Laboratory using the same procedures detailed in the Coastal Pathogen Project QAPP, and the MST data collected under the Humboldt County APMP are being used solely for source identification.

Details of the 13 sampling stations of the Humboldt County APMP Study are provided in Table 7 and Figure 8 below.

**Table 7 Number of Samples Collected from Coastal Streams (Humboldt County APMP Study)**

Station Name <sup>a,b</sup>	Station Code <sup>c</sup>	Sampling Period <sup>d</sup>	Number of Samples
Joland Creek	JOLANDSCENIC	Wet	5
Little River	LITTLERIVER101	Wet	6
Luffenholtz Creek at City of Trinidad	LUFFHLTZWTP	Wet	6
Luffenholtz Creek at Mouth	LUFFHLTZSCENIC	Wet	6

<b>Station Name<sup>a,b</sup></b>	<b>Station Code<sup>c</sup></b>	<b>Sampling Period<sup>d</sup></b>	<b>Number of Samples</b>
Mill Creek at Mouth	MILLCRWOODBRIDGE	Wet	6
Parker Creek at Mouth	PARKERCRBEACH	Wet	6
Parker Creek at Westhaven Drive	PARKERCRWSTHVN	Wet	6
Patrick Creek <sup>e</sup>	PATRICKCLAM	Wet	6
Strawberry Creek at Dows Prairie	STRAWDOWSPRAIRIE	Wet	5
Strawberry Creek at Duke Creek <sup>e</sup>	DUKECREEK	Wet	5
Strawberry Creek East of Highway 101 <sup>e</sup>	STRAWCENTRAL	Wet	6
Strawberry Creek at Rose Creek <sup>e</sup>	STRAWARTHUR	Wet	6
Two Creeks	TWOCREEKSSCENIC	Wet	5

<sup>a</sup>All sampling stations are located in Humboldt County.

<sup>b</sup>All streams drain into the Pacific Ocean

<sup>c</sup>Sampling station codes were developed by the Humboldt County Division of Environmental Health.

<sup>d</sup>No samples collected during the dry weather sampling period.

<sup>e</sup>The sample collected in April 2019 from this sampling station was analyzed for the presence and concentration of the human-specific marker only, and not for the presence and concentration of the dog-, gull-, or ruminant-specific markers.





### **3.2. Data Analysis – Land Cover and Land Use**

The watershed upstream of each sampling station has a unique combination of geomorphology, hydrology, habitat, land uses, and land covers, so that each assessment area is unique. To identify fecal pollution sources to each sampling station, individual watersheds were delineated in ArcGIS Pro (Wilhelm et al., 2013).

Land cover data were derived from the 2012 United States Department of Agriculture Cropland Data Layer (United States Department of Agriculture, 2012). Land use data were derived from the most recent publicly available county parcel data, for which each Assessor Parcel Number (APN) (a unique number assigned to each parcel), was assigned a “Developed Sewered”, “Developed Unsewered,” “Undeveloped,” or “Grazing” land use. If any portion of a parcel showed evidence of human development such as business, commercial, residential, or any other evidence that would suggest human activity was occurring on that parcel, then that entire parcel was identified as “Developed”. If a “Developed” parcel fell within a community service district that provides sewer services, it was placed in the “Developed Sewered” category. If not, it was categorized as “Developed Unsewered”. Parcels were categorized as “Grazing” if cattle fields or dairies were identified on any part of that parcel. Parcels that were not classified as developed or grazing were categorized as “Undeveloped”.

Land use was assigned using 1) the use code associated with each APN in the county parcel data, 2) best professional judgement through a desktop assessment of GIS parcel shapefiles with confirmation via aerial imagery, and 3) the Electronic Water Rights Information Management System (eWRIMS) (State Water Resources Control Board, 2023b).

Land cover and land uses within a 5-kilometer radius of the upstream watershed of each sampling station from all the studies included in this report, were analyzed as per the Stream Pollution Trends Monitoring (SPoT) program under California’s Surface Water Ambient Monitoring Program (SWAMP) (State Water Resources Control Board, 2023c). This method allows for the assessment of the land cover and land uses that are most likely to influence the samples that were collected at each sampling station. This method will assist Regional Board permitting staff, state, county, and local management agencies to address the sources most likely contributing to fecal pollution. If pollution persists in these locations after new source control management practices are in place, further assessment of a greater upstream radius may be conducted for those sites to gather more information.

Six sampling stations were not included in the land cover and land use data assessment due to technical limitations. These sampling stations are: Grotzman Creek at Bayside Road (110GR0500), Liscom Slough at Jackson Road (110UNSJXN), Unnamed Slough at Lanphere Road (110UNSLPHR), Unnamed Slough at Ranch Road (110UNSRNCH), Roadside Ditch at Jackson Ranch Road (110DJXNRD), and Roadside Ditch at Foster Road and Seidel Road (110DSEIDL). The watershed delineations of these sampling stations could not be processed because either the topography of the station being



assessed was too level to define a drainage basin with available elevation data, or the creek being assessed had been channelized and partially moved to an underground storm drain system. In the absence of watershed delineations, narrative descriptions of upstream land cover and land uses have been provided for these seven sampling stations. For each sampling station for which a watershed could be delineated the percentage of the sampling station watershed containing each land cover and land use category was calculated.

### **3.2.1. Identification of Cattle Grazing Type**

Since the ruminant-specific marker used during sample analysis is unable to differentiate between non-bovine ruminants (wildlife such as deer, elk etc.) and bovine ruminants (cattle), Regional Board staff used APN parcel ownership information and the facility information for dairies under the dairy permit provided in the California Integrated Water Quality System Project (CIWQS) [database](https://www.waterboards.ca.gov/ciwqs/) (<https://www.waterboards.ca.gov/ciwqs/>) to confirm grazing land use and determine whether the grazing use was by dairy cattle or non-dairy cattle.

## **3.3. Data Analysis – MST Markers**

### **3.3.1. Laboratory Analysis of Samples**

Samples collected under the Coastal Pathogen Project as well as the Humboldt County APMP Study were analyzed for the presence and concentration of dog-, gull-, human-, and ruminant-specific markers. These four markers correspond to the suspected fecal source categories of cattle, wildlife, OWTS, and sewers, in the watersheds where the samples were collected. All coastal stream samples (Impaired Streams Monitoring Study, Source Assessment Study, Jolly Giant Creek Monitoring Study, and Humboldt County APMP Study) were collected in Humboldt County, and were analyzed by the Humboldt County Public Health Laboratory. Samples collected in Humboldt County under the Ocean Beaches Monitoring Study were also analyzed by the Humboldt County Public Health Laboratory. Samples collected under the Ocean Beaches Monitoring Study in Mendocino and Sonoma counties were both analyzed by the Sonoma County Public Health Laboratory. The DogBact, LeeSeaGull, HF183, and Rum2Bac markers were used to detect and quantify dog, gull, human, and ruminant fecal waste respectively.

Two samples were collected from the Grotzman Creek at Bayside Road (110GR0500) in the dry weather period (July and October of 2017); however, data from the October 2017 dry weather sampling event are missing. Missing data have not been included in the data analysis.

One sample collected in April 2019, from the following four sampling stations – Strawberry Creek at Duke Creek (DUKECREEK), Strawberry Creek at Rose Creek (STRAWARTHUR), Strawberry Creek East of Highway 101 (STRAWCENTRAL), and Patrick Creek (PATRICKCLAM) were only analyzed for the presence and concentration of the human-specific marker and not for the dog-, gull-, or ruminant-specific markers.

Therefore, these four samples can only be analyzed for the presence of human-specific markers.

The Rum2Bac marker is used to detect and quantify both bovine (cattle-related) and non-bovine (deer, goats, etc.) fecal sources. Therefore, for sampling station watersheds with significant ruminant-marker findings, land cover and land use patterns can be used to differentiate potential ruminant fecal sources, such as cows from non-bovine ruminant wildlife such as deer, goats, etc. Specifically, areas with forest cover and undeveloped land use will likely be the drivers of wildlife-associated ruminant marker detections, and areas with grassland/shrub forest cover and grazing land use will likely be the drivers of cattle-associated ruminant marker detections.

The MST markers and identification techniques used for analysis were developed by the Southern California Coastal Water Research Project (SCCWRP) (Griffith et al., 2013). Further details about the analytical methods used for MST marker detection can be found in the guidance document developed by SCCWRP – “The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches” (Griffith et al., 2013). Specific details of the standard operating procedures used for sample analysis as part of the Coastal Pathogen Project are provided in the QAPP developed for the Coastal Pathogen Project (North Coast Regional Water Quality Control Board, 2015). Quality control information about the MST analytical techniques used by the Humboldt County Public Health Laboratory is provided in the document entitled “Microbial Source Tracking (MST) Study Quality Control (QC) Report for the Coastal Pathogen Project” (Corrigan & Akre, 2019). A QAPP for the Humboldt County APMP Study was not available at the time of writing this report.

MST data for all samples of the Coastal Pathogen Project, (Impaired Streams Monitoring Study, Source Assessment Study, Jolly Giant Creek Monitoring Study, and Ocean Beaches Monitoring Study), and all sample results from the Humboldt Bay APMP Study are publicly available in the California Environmental Data Exchange Network (CEDEN) [database \(https://ceden.org/\)](https://ceden.org/) (State Water Resources Control Board, 2023a), under the project names “Coastal Pathogen Project 2016-2018”, and “Humboldt Co DEH APMP Surface Water Monitoring”, respectively.

### **3.3.2. Evaluation of MST Marker Data**

Prior to conducting data analysis, Regional Board staff evaluated MST marker data to determine the most efficient data analysis technique.

The analytical results from one dry weather sample collected from Grotzman Creek at Bayside Road sampling station are missing, and one sample each, from the Patrick Creek, Strawberry Creek at Duke Creek, Strawberry Creek at Rose Creek, and Strawberry Creek East of Highway 101 sampling stations underwent laboratory analysis for the human-specific marker only. Therefore, no information on dog-, gull-, or ruminant-marker detection is available for these sampling stations. Marker data that

were missing (“missing” data or “collected but not tested” data) were excluded from the assessment.

In order to determine the most efficient data analysis technique Regional Board staff identified the percentage of each MST marker “detected” and the percent of each marker that could be “quantified”. Analytical laboratories classify MST marker analysis results based on the method limit of quantification (LoQ) for each MST marker being measured in a sample. Markers are classified as “detected and quantified,” “detected below limit of quantification”, or “not detected” based on their presence in a sample in relation to the LoQ of the MST marker being measured. In the case of markers that are classified as “detected and quantified” both presence and concentration of the marker in a given sample is known. In the case of markers that are classified as “detected below limit of quantification”, the only information available is that the marker is present in the sample, however the concentration at which it is present is not known. Therefore, marker concentration data are available only for MST markers that are classified as “detected and quantified”, whereas marker detection data are available for MST markers that are classified as either “detected and quantified” or “detected below limit of quantification”.

An analysis of detected and quantified data from the samples assessed in this report indicates that in the case of each MST marker analyzed, marker detection (presence), data is available for a much greater percentage of samples analyzed compared to the availability of marker concentration data. The percentage of samples in which marker detection and marker concentration data are available are provided in Table 8 for coastal stream samples, and in Table 9 for ocean beach samples.

**Table 8 Marker Detection and Marker Concentration Data Availability for each Species-specific Marker in Coastal Stream Samples**

Data Type	Percentage of samples in which data are available			
	Dog	Gull	Human	Ruminant
Marker Detection	45%	23.2%	23.2%	50%
Marker Concentration	12.7%	6.8%,	11.8%	22.7%

**Table 9 Marker Detection and Marker Concentration Data Availability for each Species-specific Marker in Ocean Beach Samples**

Data Type	Percentage of samples for which data are available			
	Dog	Gull	Human	Ruminant
Marker Detection	29.4%	91.2%	5.9%	10.3%
Marker Concentration	2.9%	51.5%	0%	2.9%

In order to make the maximum use of all available MST marker data, Regional Board staff selected a qualitative detection-based technique, using the presence or absence of a particular MST in a given sample, rather than a quantitative concentration-based technique, using the concentration of a particular MST marker in a given sample. The decision to use a qualitative method, rather than a quantitative method, was made because:

- 1) analytical limitations of the current MST techniques result in the priority of detection frequency (marker presence) over the magnitude of signal detection (marker concentration) (Griffith et al., 2013). Therefore, marker detection results may potentially be more reliable than marker concentration results obtained during sample analysis. Further details about these limitations are provided in the guidance document on MST techniques developed by SCCWRP (Griffith et al., 2013).
- 2) marker concentration data are available for a much smaller percentage of samples compared to marker presence data, for both coastal stream and ocean beach samples analyzed, as described above.

### **3.3.3. Analysis of MST Marker Data**

The detection-based data analysis technique was performed in the following manner:

MST markers were classified as “detected” if they were either “detected and quantified” or “detected below limit of quantification”, in a given sample, and classified as “not detected” if they were not detected in a given sample. For each sampling station and sampling period, the number of samples in which each MST marker type was detected was noted, and the percentage of total samples in which that MST marker type was detected was calculated.

MST results from samples collected at the Jolly Giant Creek at Samoa Boulevard station under the Impaired Streams Monitoring Study are provided below to illustrate this methodology:

**Table 10 Example of Marker Detection Percentage Calculation using the Jolly Giant Creek at Samoa Boulevard sampling station**

<b>Marker Type</b>	<b>Number of samples in which the marker was detected</b>	<b>Number of samples collected from the station</b>	<b>Detection Percentage of Marker</b>
Dog	4	5	$100 \times (4/5) = 80\%$
Gull	0	5	$100 \times (0/5) = 0\%$
Human	3	5	$100 \times (3/5) = 60\%$
Ruminant	0	5	$100 \times (0/5) = 0\%$

Please note that since several markers can potentially be detected in each sample collected from a particular sampling station, the total detection percentage of all MST markers at a particular sampling station can exceed 100%.

Comparisons of wet and dry sampling period MST marker data, or comparisons of MST marker data collected from different sampling stations, or suspected source categories could not be performed due to 1) the small number of samples collected from several sampling stations, and 2) large differences in the number of samples collected between sampling periods or sampling stations, or suspected source groups.

Data analysis was conducted using R (version 4.3.1) (R Core Team, 2023).

## **4. Land Cover, Land Use, and MST Marker Analysis Results**

This section presents the results of the assessment of the land cover, land use, and MST marker data collected for the streams and beaches evaluated in this report. This report does not include an evaluation of the impairment of beneficial uses in any of the streams or beaches analyzed. Impairment of beneficial uses will be determined through the Integrated Report, and all fecal indicator bacteria collected from the streams and beaches analyzed in this Project are currently being assessed as part of the 2026 Integrated Report.

In order to identify the most likely sources of fecal pollution at each sampling station, staff evaluated the land cover and land use within the sampling station watershed, as well as the MST markers detected at the sampling station. Staff then compared that information to MST results. Staff conducted this evaluation at each station sampled in the 26 streams and 12 beaches included in this report. Included below is an example of this analytical process using the Gannon Slough station. Analyses of each monitoring station evaluated in the same manner are presented in Appendices A through F.

### **4.1. Single Monitoring Station Analysis Example: Gannon Slough at Highway 101 (110GS1625)**

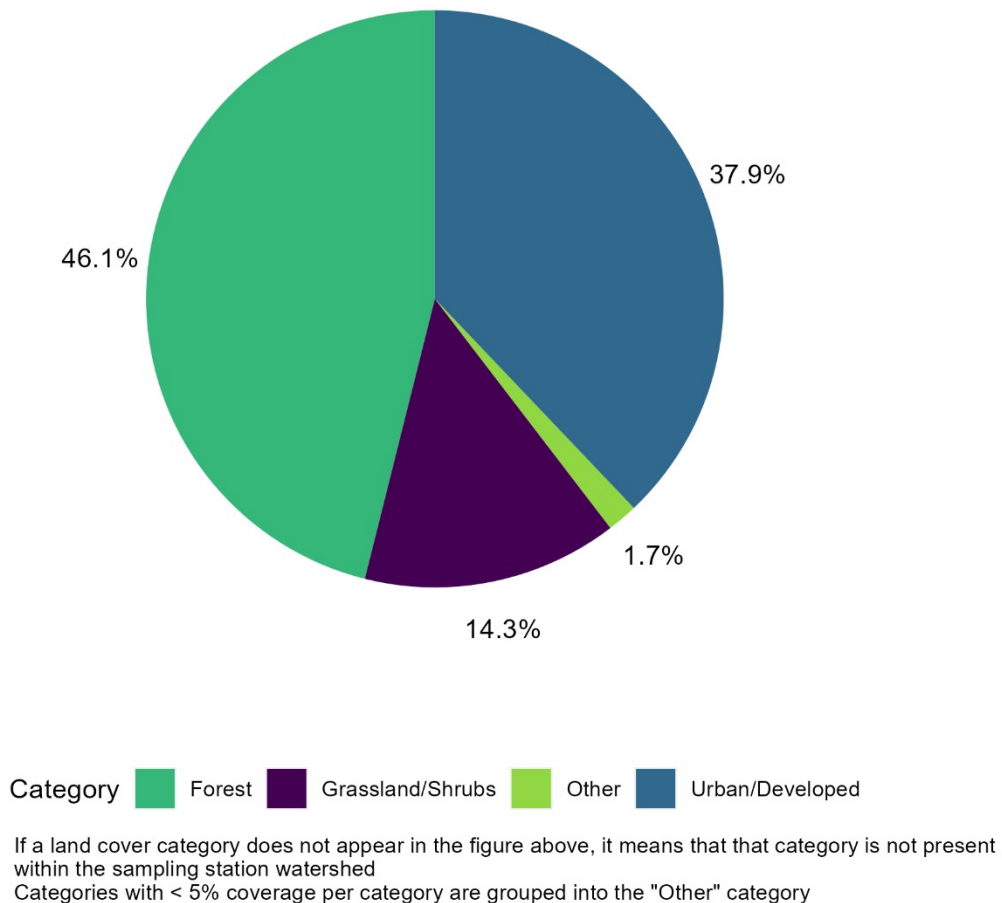
Land cover and land use data across the watershed of the Gannon Slough at Highway 101 sampling station, as well as the dry and wet weather MST marker presence at this sampling station were evaluated to determine the potential sources of fecal waste. Staff developed 1) pie charts to illustrate the percentage of the watershed of this sampling station containing various land cover and land use categories, 2) a map of the sampling station watershed showing the extent of the coverage of various land cover and land use categories, and 3) bar charts to show the percentage of MST markers detected at this sampling station in the dry and wet weather periods. These analyses are displayed in Figures 10 through 13 below.

Figure 9 is a pie chart showing the percentage of each land cover category within the Gannon Slough watershed. Land cover refers to the physical and biological material, artificial or natural, that covers the earth's surface. Land cover includes various elements like vegetation, bodies of water, built-up areas, barren land, and agricultural fields among others. Each land cover category is represented by a different color and the size of each of the sectors of the circle indicates the area of the watershed covered. The percentage of the total watershed covered by each category is listed next to the corresponding sector. For this sampling station, the watershed is comprised of the following land cover categories:

- Forests (46.1%)
- Urban/Developed (37.9%)
- Grassland/Shrubs (14.3%)
- Other (1.7%) - Land cover categories comprising less than 5% of the watershed are grouped together in the "Other" category.

## Land Cover

Humboldt County: Gannon Slough at Highway 101

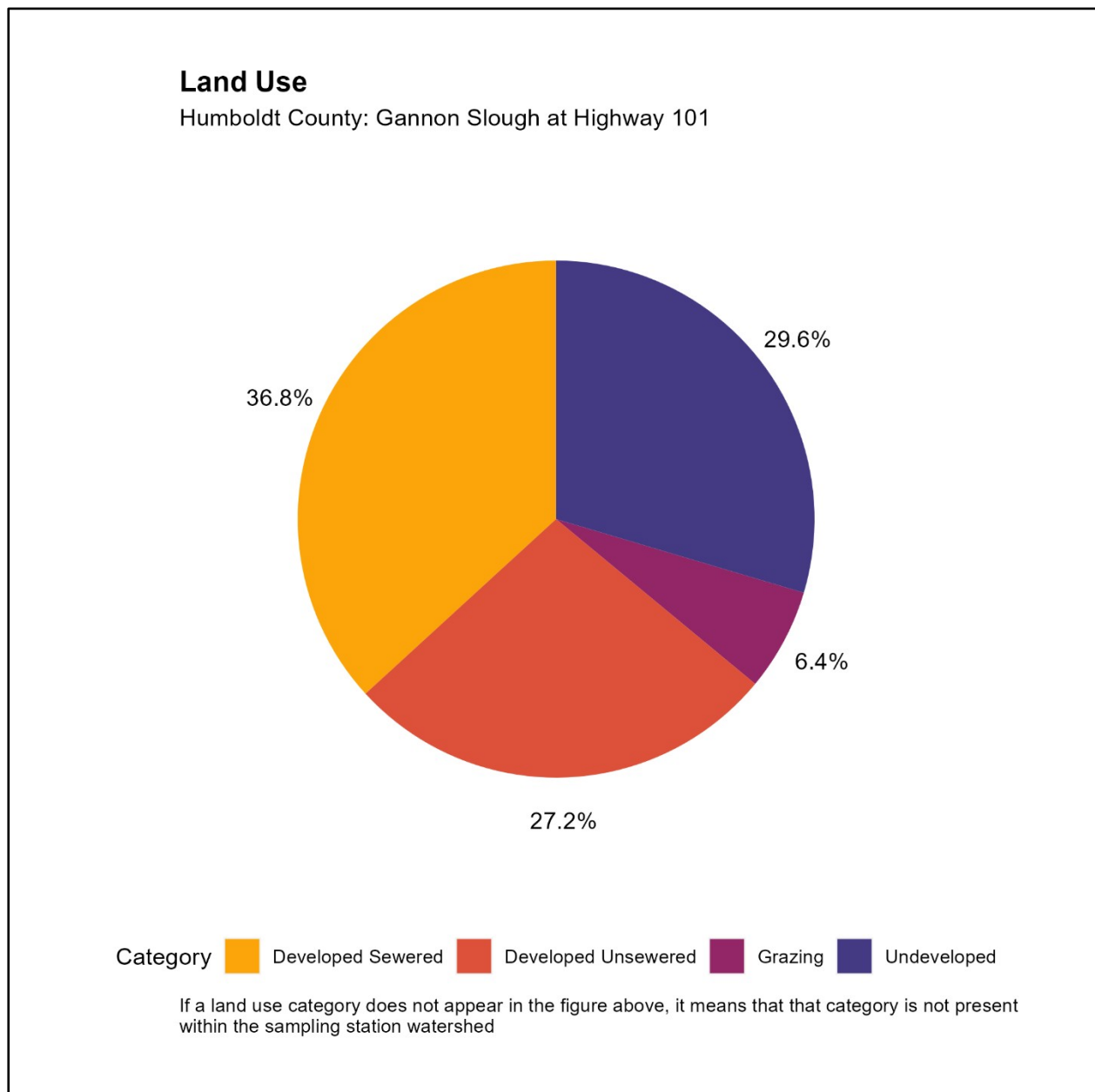


**Figure 9 Percentage coverage by land cover category in the Gannon Slough at Highway 101 watershed**

Land use differs from land cover in that it describes the human use of land. It represents the economic and cultural activities (e.g., agricultural, residential, industrial, mining, and recreational uses) that are practiced at a given place. For this analysis, these types of activities have been grouped into the following categories – Developed Sewered, Developed Unsewered, Grazing, and Undeveloped because these can be most readily associated with the pathogenic sources described in Section 2. Figure 10 is a pie chart showing the percentage of these land use categories in the Gannon Slough watershed. Each land use category is represented with a different color and the size of each sector

indicates the area of that category in the watershed. The percentage of the total watershed containing each land use category is listed next to the corresponding sector. For this sampling station, the watershed mainly contains the following land uses:

- Developed Sewered (36.8%)
- Undeveloped (29.6%)
- Developed Unsewered (27.2%)
- Grazing (6.4%)



**Figure 10 Percentage coverage by land use category in the Gannon Slough at Highway 101 watershed**



Figure 11 combines the land cover and land use information from Figures 9 and 10 into a map. This map of the Gannon Slough sampling station watershed shows the location and extent of the various land cover and land use categories within the watershed. The land cover categories are represented by different colors, and the land use categories are overlaid on these colored sections, and represented with different symbols.

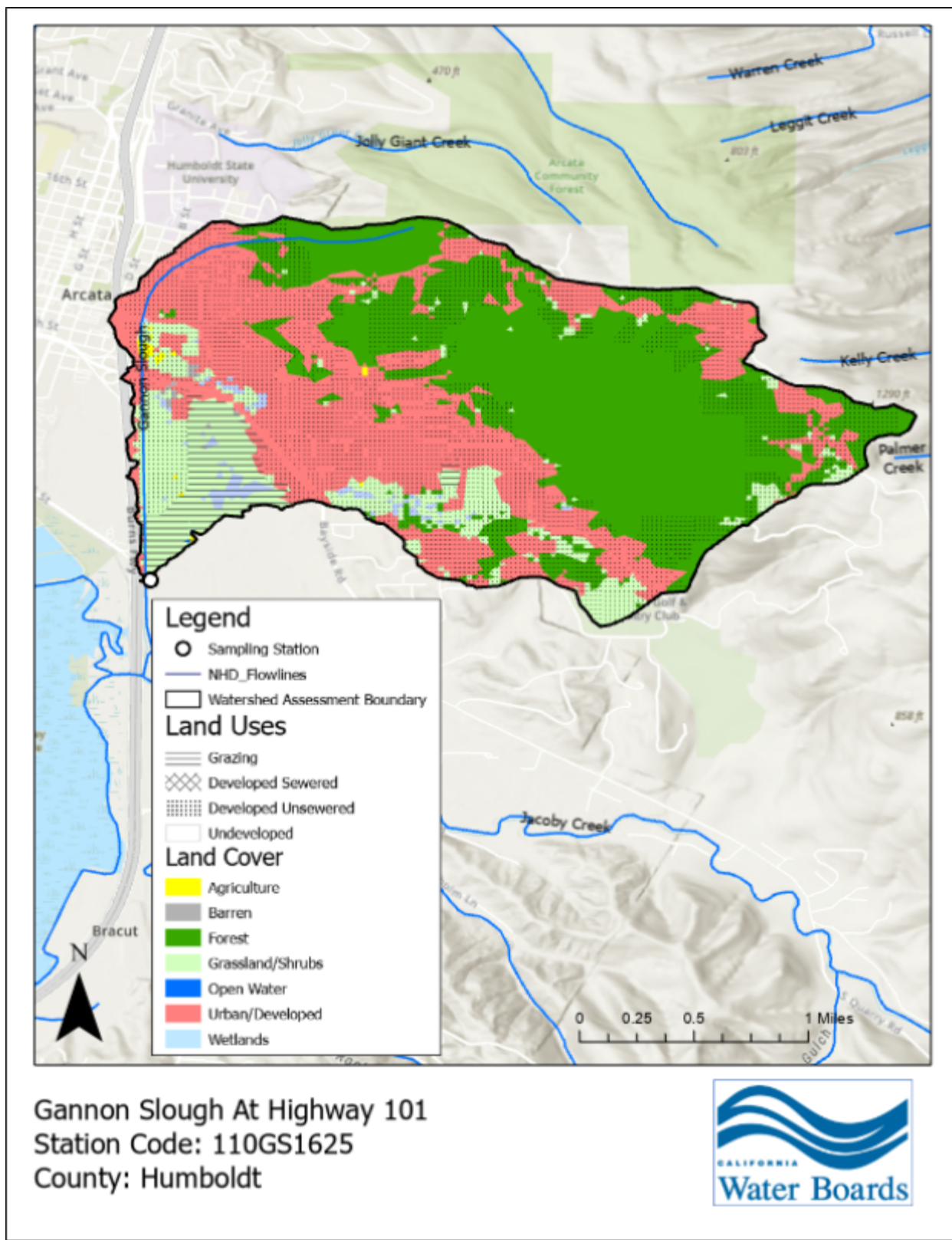
Mapping the land cover and land use also allowed staff to measure and compare the acreage of each of the land use and land cover categories within the sampling station watershed. These measurements are listed below.

The acreage and percentage of each land cover category within the sampling station watershed are listed below (from highest to lowest)

- Forest (868.11 acres [46.1%]),
- Urban/Developed (714.59 acres [37.9%]),
- Grassland/Shrubs (270.27 acres [14.3%]),
- Wetlands (23.22 acres [1.2%]),
- Agriculture (4.78 acres [0.3%]),
- Barren (3.41 acres [0.2%]), and
- Open Water (0.25 acres [0%]).

The acreage and percentage of each land use category within the sampling station watershed are listed below (from highest to lowest)

- Developed Sewered (654.91 acres [36.8%]),
- Undeveloped (526.98 acres [29.6%]),
- Developed Unsewered (482.83 acres [27.2%]), and
- Grazing (113.19 acres [6.4%]).



**Figure 11 Land cover and land use in the Gannon Slough at Highway 101 watershed**

As described in Section 2, land cover and land use within a watershed contribute to the sources of fecal waste in that watershed. The mainly forested and urban developed land cover and undeveloped, developed sewer, developed unsewered, and grazing land use in the Gannon Slough watershed, as well as the proximity of the sampling station to Humboldt Bay indicates that humans, dogs, gulls, deer, elk, and cattle are the most likely species contributing to fecal waste in this watershed. Therefore, staff evaluated the presence of dog-, gull-, human-, and ruminant- (deer, elk, cows) specific markers in the samples collected from this sampling station. Figure 12 is a bar chart that shows the percentage of the MST markers detected in the samples collected from this sampling station in the dry and wet periods.

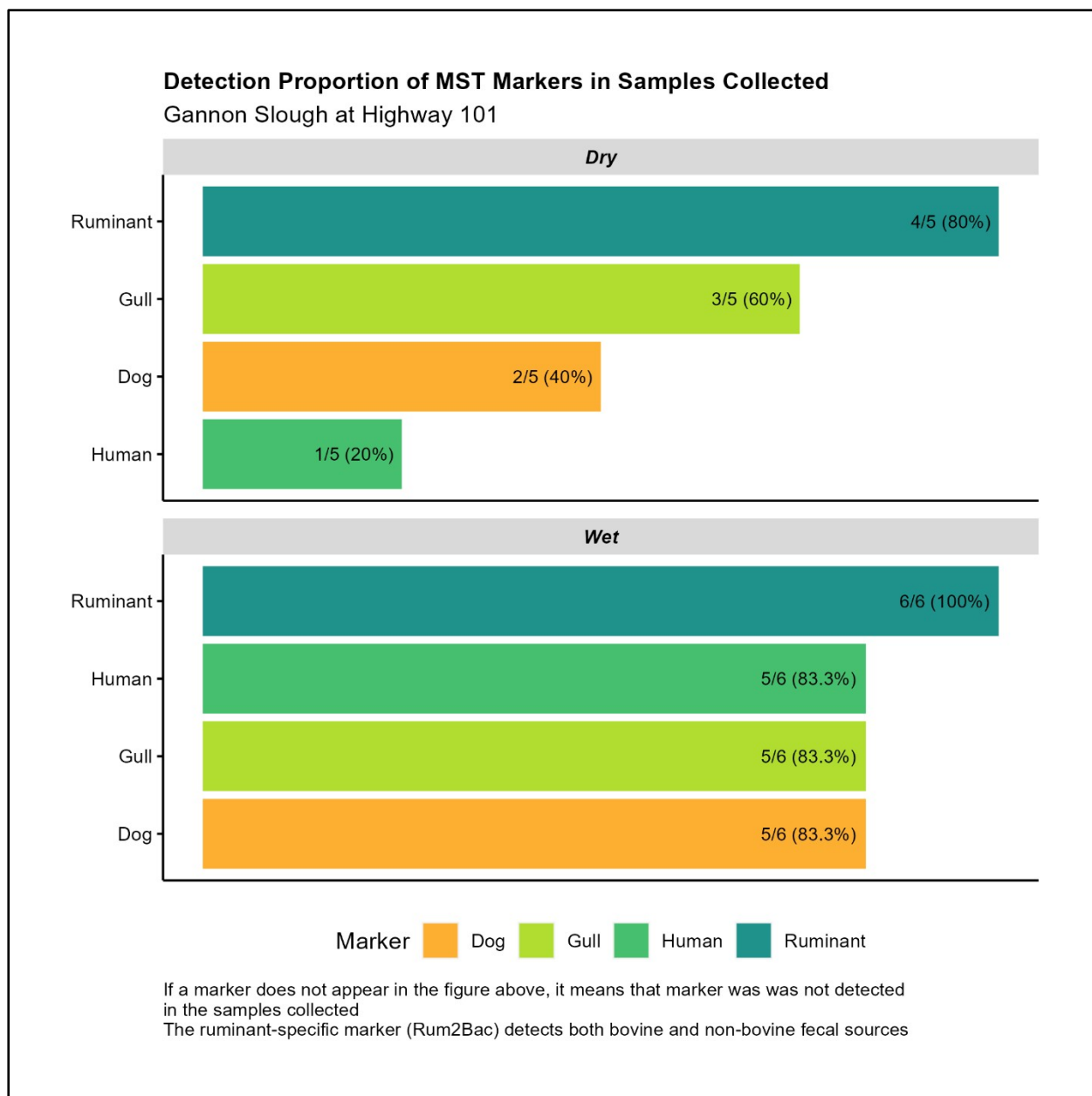
Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in the figure below. Each marker is displayed in a different color. If a marker is not present in the figure, that means that the marker was not detected in the samples collected.

The marker detections percentage in the dry sampling period were:

- Ruminant (4/5 [80%]),
- Gull (3/5 [60%]),
- Dog (2/5 [40%]), and
- Human (1/5 [20%]).

The marker detections percentage in the wet sampling period were:

- Ruminant (6/6 [100%]),
- Dog (5/6 [83.3%]),
- Gull (5/6 [83.3%]), and
- Human (5/6 [83.3%]).



**Figure 12 Detection percentage of species-specific markers evaluated in samples collected from the Gannon Slough at Highway 101 station**

In summary, the most common land cover in the Gannon Slough watershed is forests, followed by urban/developed areas, and the most common land use is developed sewer followed by undeveloped. These land cover and land use categories, along with the proximity of the sampling station to Humboldt Bay are reflected in the most frequent MST markers detected in samples collected from the Gannon Slough at Highway 101 sampling station: namely, ruminant-, dog-, and gull-specific markers.

The land cover, land use, MST and summary assessments described above, were also conducted for each of the stream and ocean beach sampling stations evaluated in this

report. The assessment findings for each sampling station evaluated in this report are provided in Appendices A through F.

#### **4.2. Grouped Assessment of Land Cover, Land Use, and MST data collected from all Streams by Terminus Receiving Water (Humboldt Bay or Pacific Ocean)**

In order to conduct additional analyses for streams, the individual sampling station assessments conducted, such as the Gannon Slough example above, were grouped together by the terminus receiving water of each stream sampled (Humboldt Bay or Pacific Ocean). These grouped results were then analyzed to determine the overall land cover, land use, and MST marker patterns in streams 1) draining to Humboldt Bay and 2) in streams draining to the Pacific Ocean. The grouped assessments conducted are briefly described below:

1. Land Cover and Land Use: Staff calculated the percentage of the total watershed areas of all stations sampled in streams draining to Humboldt Bay (or Pacific Ocean) covered by each of the various land cover and land use categories.
2. MST Markers: Staff calculated the percentage of the total number of samples collected from all stations sampled in streams draining to Humboldt Bay (or the Pacific Ocean) containing each of the four MST markers for the dry and wet weather period.
3. Cattle Grazing: Staff calculated the total number of sampling station watersheds in streams draining to Humboldt Bay (or the Pacific Ocean) containing dairy cattle and/or non-dairy cattle grazing.

The summary assessment for the 17 sampled streams draining to Humboldt Bay is provided in Section 4.2.1, and the summary assessment for the 11 sampled streams draining to the Pacific Ocean is provided in Section 4.2.2.

##### **4.2.1. Coastal Streams Sampled Draining into Humboldt Bay**

This section describes the summary assessment of land cover and land use categories, and MST markers contributing to fecal pollution in all 17 streams sampled that drain to Humboldt Bay. These three lines of evidence evaluated collectively point to the natural/background as well as the controllable anthropogenic sources of fecal pollution in the waterbodies sampled. For all the waterbodies evaluated in this report natural/background fecal waste sources are those resulting from wildlife – deer, elk, gulls, and other shorebirds, and controllable fecal waste sources are those resulting from humans and human activities – humans, dogs, and cattle. Regional Board staff will focus on addressing controllable fecal waste sources since human, dog, and cattle waste are more harmful to public health than ruminant wildlife (deer, elk), or gull and shorebird waste (Griffith et al., 2013; Koskey et al., 2014; Wright et al., 2009).

Land cover, land use, and MST marker patterns detected in the streams draining to Humboldt Bay point to both natural/background as well as controllable anthropogenic fecal waste contributions. Based upon staff's assessment of land cover, land use, and

MST data, controllable sources of fecal pollution show that fecal contributions to Humboldt Bay streams are associated with dogs and humans, and appear to be from the urban developed areas, both sewered and unsewered.

Tables 11, 12, and 13 provide the percentage of each land cover and land use category present, and each MST marker detected, in the Humboldt Bay stream sampling station watersheds evaluated

**Table 11 Grouped Coverage Percentages of Land Cover Categories associated with the 17 Streams draining to Humboldt Bay**

Land Cover Category	Coverage Percentage (%)
Forest	69.1
Urban/Developed	17.6
Grassland/Shrubs	11.3
Other	2.0

**Table 12 Grouped Coverage Percentages of Land Use Categories associated with the 17 Streams draining to Humboldt Bay**

Land Use Category	Coverage Percentage (%)
Undeveloped	61.5
Developed Sewered	17.3
Developed Unsewered	13.6
Grazing <sup>a,b</sup>	7.6

<sup>a</sup>Seven station watersheds contain Dairy Grazing

<sup>b</sup>Two station watersheds contain Non-dairy Grazing

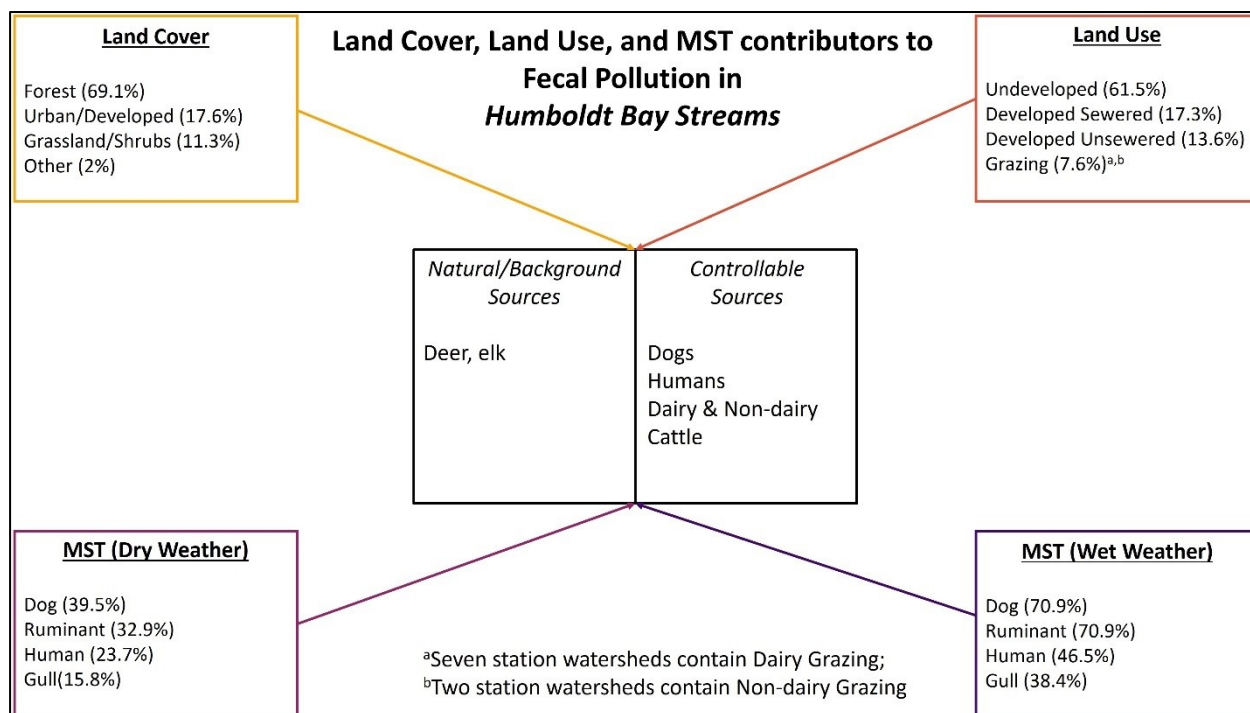
**Table 13 Grouped Detection Percentages of MST Markers associated with the 17 Streams draining to Humboldt Bay**

MST Marker	Sampling Period	Detection Percentage (%)
Dog	Dry	39.5
Ruminant	Dry	32.9
Human	Dry	23.7
Gull	Dry	15.8

<b>MST Marker</b>	<b>Sampling Period</b>	<b>Detection Percentage (%)</b>
Dog	Wet	70.9
Ruminant	Wet	70.9
Human	Wet	46.5
Gull	Wet	38.4

Figure 13 provides a visual representation of staff's analyses that combines the land cover, land use, and MST marker data for streams draining to Humboldt Bay. A description of the figure is provided below.

The percentage of land cover categories summarized across all Humboldt Bay streams is shown in the upper lefthand corner box. This summary indicates that forests are the most dominant land cover in the watersheds of Humboldt Bay streams sampled, followed by urban/developed areas. Moving in a clockwise manner, the percentage of land use categories summarized across all Humboldt Bay streams sampled is shown in the upper righthand corner box. This summary indicates that the dominant land use in the watersheds of Humboldt Bay streams is undeveloped, followed by developed sewerred and then developed unsewerred. The percentage of MST markers detected in wet weather samples collected from the Humboldt Bay streams sampled is shown in the lower righthand corner box. This summary indicates that dog and ruminant fecal waste was detected in the greatest number of wet weather samples, followed by human and then gull fecal waste. Continuing in a clockwise manner, the percentage of MST markers detected in dry weather samples collected from the Humboldt Bay streams sampled is shown in the lower lefthand corner box. This summary indicates that dog fecal waste was detected in the greatest number of dry weather samples, followed by ruminant, then human and then gull fecal waste. When analyzed in combination, these four assessments point to the most likely natural and anthropogenic fecal waste sources (shown in the center) for the sampled streams draining to Humboldt Bay.



**Figure 13 Land Cover, Land Use, and MST Fecal Sources Combined for All Streams Draining to Humboldt Bay**

#### Common Controllable Practices and Mechanisms of Transport

The most likely sources of dog and human fecal matter are the lack of appropriate disposal of pet waste by owners, from underground sewer leaks, or from the unhoused population in the area. Specifically, dog, or human, feces can enter streams via precipitation-driven runoff, either directly if the feces are present on the stream bank, or indirectly via stormwater drains if the feces are present on the street. Dog feces present on lawns and backyards of homes in the area can enter streams via storm drains during precipitation events, or during lawn/backyard irrigation. Human feces can indirectly enter streams via storm drains if there are any leaks present in the sewer pipes directing human waste away from homes towards wastewater treatment facilities. There are no wastewater treatment facilities discharging to the streams sampled. Although a significant percentage of the ruminant-markers detected originate from ruminant wildlife (deer, elk) feces in the forested regions of the watersheds sampled, seven stream watersheds evaluated contain dairy cattle grazing and two stream watersheds evaluated contain non-dairy cattle grazing. Therefore, cattle feces may also be a contributor to fecal pollution in the streams sampled.

#### **4.2.2. Coastal Streams Sampled Draining into the Pacific Ocean**

This section describes the summary assessment of land cover and land use categories, and MST markers contributing to fecal pollution in all 11 streams sampled that drain to the Pacific Ocean. These three lines of evidence evaluated collectively point to the natural/background as well as the controllable anthropogenic sources of fecal pollution



in the waterbodies sampled. For all the waterbodies evaluated in this report natural/background fecal waste sources are those resulting from wildlife – deer, elk, gulls, and other shorebirds, and controllable fecal waste sources are those resulting from humans and human activities – humans, dogs, and cattle. Regional Board staff will focus on addressing controllable fecal waste sources since human, dog, and cattle waste are more harmful to public health than ruminant wildlife (deer, elk), or gull and shorebird waste (Griffith et al., 2013; Koskey et al., 2014; Wright et al., 2009).

Land cover, land use, and MST marker patterns detected in the streams draining to the Pacific Ocean point to both natural/background as well as controllable anthropogenic fecal waste contributions. Based upon staff's assessment of land cover, land use, and MST data, controllable sources of fecal pollution show that fecal contributions to Pacific Ocean streams are associated with dogs and humans, and appear to be from the urban developed areas, both sewered and unsewered.

Tables 14, 15, and 16 provide the percentage of each land cover and land use category present, and each MST marker detected, in the Pacific Ocean stream sampling station watersheds evaluated

**Table 14 Grouped Coverage Percentages of Land Cover Categories associated with the 11 Streams draining to the Pacific Ocean**

Land Cover Category	Coverage Percentage (%)
Forest	74.8
Urban/Developed	14.1
Grassland/Shrubs	10.1
Other	1.1

**Table 15 Grouped Coverage Percentages of Land Use Categories associated with the 11 Streams draining to the Pacific Ocean**

Land Use Category	Coverage Percentage (%)
Undeveloped	60.9
Developed Sewered	27.6
Developed Unsewered	8.1
Grazing <sup>a</sup>	3.5

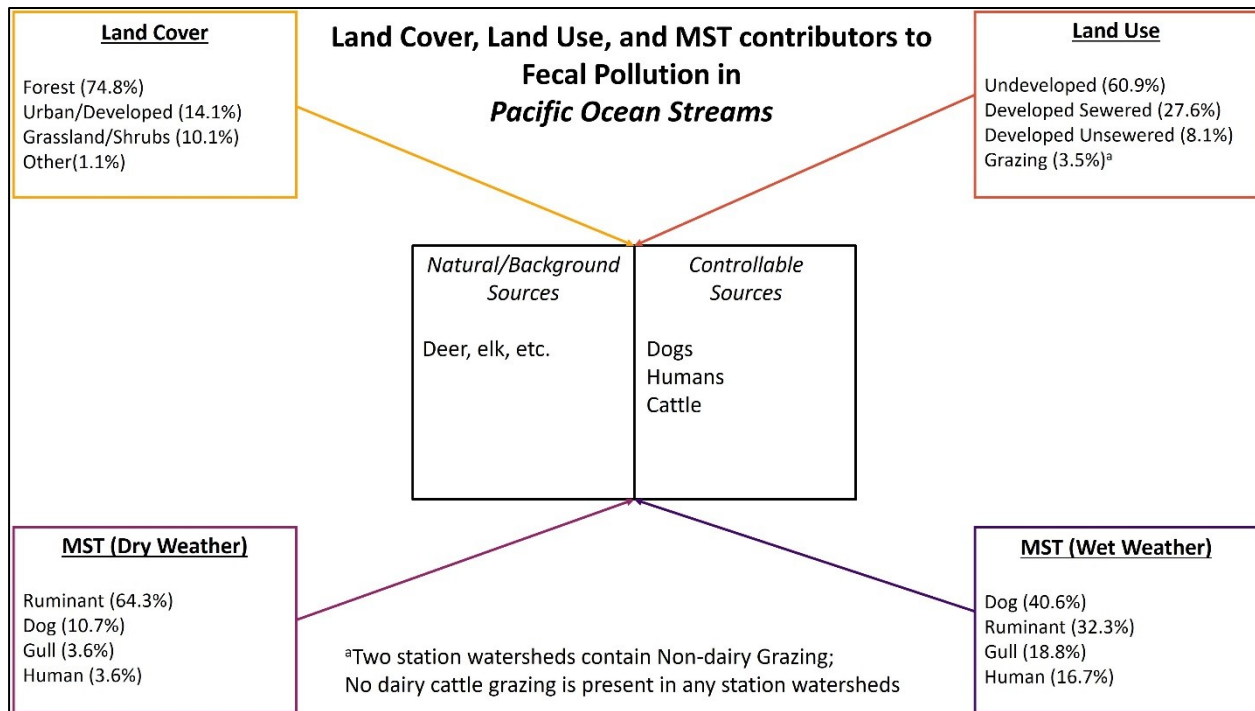
<sup>a</sup>Two station watersheds contain Non-dairy Grazing. No dairy cattle grazing is present in any of the sampling station watersheds.

**Table 16 Grouped Detection Percentages of MST Markers associated with the 11 Streams draining to the Pacific Ocean**

MST Marker	Sampling Period	Detection Percentage (%)
Ruminant	Dry	64.3
Dog	Dry	10.7
Gull	Dry	3.6
Human	Dry	3.6
Dog	Wet	40.6
Ruminant	Wet	32.3
Gull	Wet	18.8
Human	Wet	16.7

Figure 14 provides a visual representation of staff's analyses that combines the land cover, land use, and MST marker data for streams draining to the Pacific Ocean. A description of the figure is provided below.

The percentage of land cover categories summarized across all Pacific Ocean streams is shown in the upper lefthand corner box. This summary indicates that forests are the most dominant land cover in the watersheds of the Pacific Ocean streams sampled, followed by urban/developed areas. Moving in a clockwise manner, the percentage of land use categories summarized across all Humbolt Bay streams sampled is shown in the upper righthand corner box. This summary indicates that the dominant land use in the watersheds of Pacific Ocean streams is undeveloped, followed by developed sewerred and then developed unsewerred. Staff determined that there are two watersheds containing non-dairy cattle grazing land use and no watersheds containing non-dairy cattle grazing land use in Pacific Ocean stream watersheds. The percentage of MST markers detected in wet weather samples collected from the Pacific Ocean streams sampled is shown in the lower righthand corner box. This summary indicates that dog fecal waste was detected in the greatest number of wet weather samples, followed by ruminant, then gull, then human fecal waste. Continuing in a clockwise manner, the percentage of MST markers detected in dry weather samples collected from the Pacific Ocean streams sampled is shown in the lower lefthand corner box. This summary indicates that ruminant fecal waste was detected in the greatest number of dry weather samples, followed by dog, then gull and then human fecal waste. When analyzed in combination, these four assessments point to the most likely natural and anthropogenic fecal waste sources (shown in the center) for the sampled streams draining to the Pacific Ocean.



**Figure 14 Land Cover, Land Use, and MST Fecal Sources Combined for All Streams Draining to the Pacific Ocean**

#### Common Controllable Practices and Mechanisms of Transport

The most likely sources of dog and human fecal matter are the lack of appropriate disposal of pet waste by owners, from underground sewer leaks, or from the unhoused population in the area. Specifically, dog, or human, feces can enter streams via precipitation-driven runoff, either directly if the feces are present on the stream bank, or indirectly via stormwater drains if the feces are present on the street. Dog feces present on lawns and backyards of homes in the area can enter streams via storm drains during precipitation events, or during lawn/backyard irrigation. Human feces can indirectly enter streams via storm drains if there are any leaks present in the sewer pipes directing human waste away from homes towards wastewater treatment facilities. There are no wastewater treatment facilities discharging to the streams sampled. Although a significant percentage of the ruminant-markers detected originate from ruminant wildlife (deer, elk) feces in the forested regions of the watersheds sampled, two stream watersheds evaluated contain non-dairy cattle grazing. Therefore, cattle feces may also be a contributor to fecal pollution in the streams sampled.

### **4.3. Grouped Assessment of Land Cover, Land Use, and MST data collected from all Ocean Beaches by County (Humboldt, Mendocino, or Sonoma)**

For ocean beaches, the individual sampling station assessments conducted were grouped together by the county in which the sampled beaches are located (Humboldt, Mendocino, or Sonoma County) and analyzed to determine the overall land cover, land

use, and MST marker patterns in sampled beaches in Humboldt, Mendocino, or Sonoma County. The grouped assessments conducted are briefly described below:

1. Land Cover and Land Use: Staff calculated the percentage of the total watershed areas of all beach sampling stations in Humboldt, Mendocino, or Sonoma County covered by each of the various land cover (or land use) categories.
2. MST Markers: Staff calculated the percentage of the total number of samples collected from beach sampling stations in Humboldt, Mendocino, or Sonoma County containing each of the four MST markers for the dry and wet weather period.
3. Cattle Grazing: Staff calculated the total number of sampling station watersheds of beaches in Humboldt, Mendocino, or Sonoma County containing dairy cattle and/or non-dairy cattle grazing.

The summary assessment for sampled beaches in Humboldt County is provided in Section 4.4, and for sampled beaches in Mendocino County is provided in Section 4.5. There was only one beach sampled in Sonoma County and the assessment results for this beach are provided in Section 4.6.

#### **4.3.1. Ocean Beaches Sampled in Humboldt County**

This section describes the summary assessment of land cover and land use categories, and MST markers contributing to fecal pollution in all six Humboldt County beaches sampled. These three lines of evidence evaluated collectively point to the natural/background as well as the controllable anthropogenic sources of fecal pollution in the waterbodies sampled. For all the waterbodies evaluated in this report natural/background fecal waste sources are those resulting from wildlife – gulls and other shorebirds, deer, and elk, and controllable fecal waste sources are those resulting from humans and human activities – humans, dogs, and cattle. Regional Board staff will focus on addressing controllable fecal waste sources since human, dog, and cattle waste are more harmful to public health than ruminant wildlife (deer, elk), or gull and shorebird waste (Griffith et al., 2013; Koskey et al., 2014; Wright et al., 2009).

Land cover, land use, and MST marker patterns detected in the Humboldt County beaches point to both natural/background as well as controllable anthropogenic fecal waste contributions. Based upon staff's assessment of land cover, land use, and MST data, controllable sources of fecal pollution show that fecal contributions to Humboldt County beaches are associated with dogs, followed by humans, and can be attributed to dogs accompanying beachgoers, and the beachgoers themselves.

Tables 17, 18, and 19 provide the percentage of each land cover and land use category present, and each MST marker detected, in the Humboldt County beach sampling station watersheds evaluated

**Table 17 Grouped Coverage Percentages of Land Cover Categories associated with the Six Humboldt County Beaches**

Land Cover Category	Coverage Percentage (%)
Forest	63.8
Urban/Developed	18.7
Grassland/Shrubs	12.7
Other	4.8

**Table 18 Grouped Coverage Percentages of Land Use Categories associated with the Six Humboldt County Beaches**

Land Use Category	Coverage Percentage (%)
Undeveloped	59.8
Developed Sewered	23.1
Developed Unsewered	9.9
Grazing <sup>a,b</sup>	7.2

<sup>a</sup>One beach watersheds contain Non-Dairy Grazing. None of the beach watersheds sampled contain dairy cattle grazing

**Table 19 Grouped Detection Percentages of MST Markers associated with the Six Humboldt County Beaches**

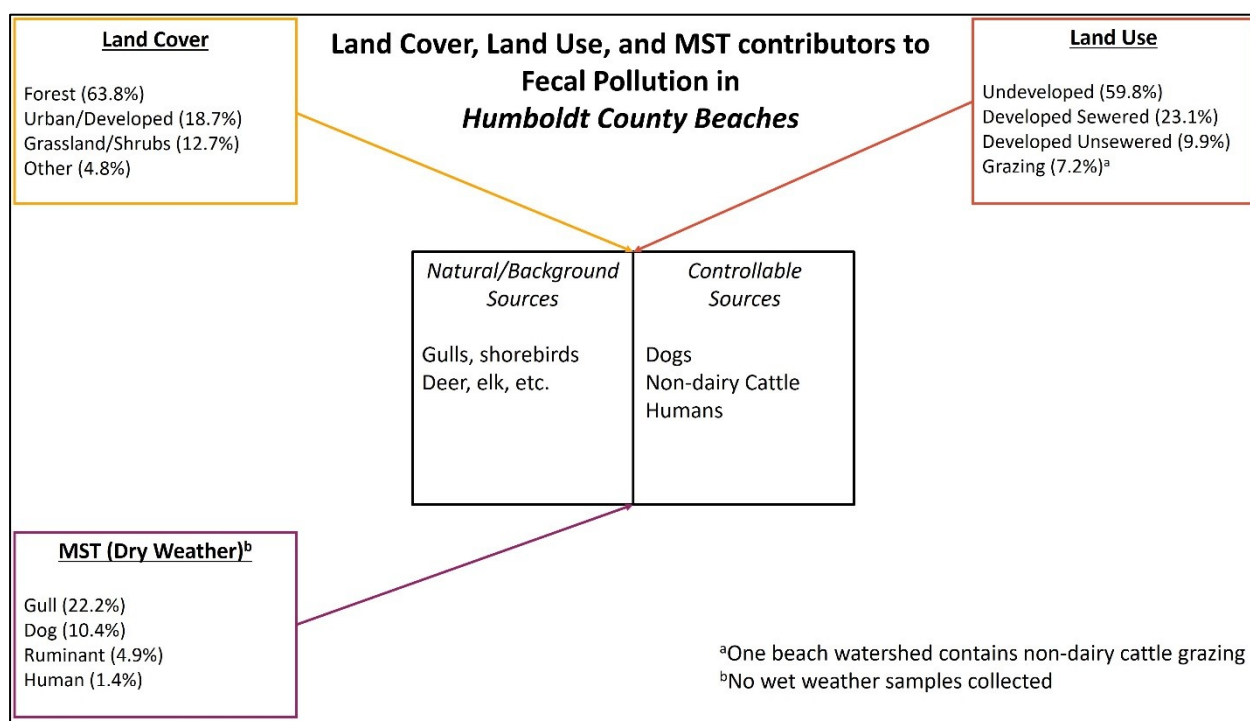
MST Marker	Sampling Period <sup>a</sup>	Detection Percentage (%)
Gull	Dry	22.2
Dog	Dry	10.4
Ruminant	Dry	4.9
Human	Dry	1.4

<sup>a</sup>Samples were collected from all six beach sampling stations only during the dry weather period. No wet weather period samples were collected from any of the beach sampling stations.

Figure 15 provides a visual representation of staff's analyses that combines the land cover, land use, and MST marker data for Humboldt County beaches. A description of the figure is provided below.

The percentage of land cover categories summarized across all Humboldt County beaches is shown in the upper lefthand corner box. This summary indicates that forests

are the most dominant land cover in the watersheds of Humboldt County beaches sampled, followed by urban/developed areas. Moving in a clockwise manner, the percentage of land use categories summarized across all Humboldt County beaches sampled is shown in the upper righthand corner box. This summary indicates that the dominant land use in the watersheds of Humboldt County beaches is undeveloped, followed by developed sewerer and then developed unsewered. Staff determined that there is one watershed containing non-dairy cattle grazing land use and none of the sampled beach watersheds contain dairy cattle grazing. Continuing in a clockwise manner, the percentage of MST markers detected in dry weather samples collected from the Humboldt County beaches sampled is shown in the lower lefthand corner box. This summary indicates that gull fecal waste was detected in the greatest number of dry weather samples, followed by dog, then ruminant and then human fecal waste. No wet weather samples were collected from any of the Humboldt County beaches sampled. When analyzed in combination, these three assessments point to the most likely natural and anthropogenic fecal waste sources (shown in the center) for the sampled Humboldt County beaches.



**Figure 15 Land Cover, Land Use, and MST Fecal Sources Combined for All Humboldt County Beaches**

#### Common Controllable Practices and Mechanisms of Transport

The most likely sources of gull and other shorebird fecal matter are the large number of gulls and other shorebirds that inhabit the shorelines of all the beaches sampled. Beach shorelines are the natural habitat of gulls and shorebirds. The most likely source of dog feces at the beaches sampled is from dog waste deposited by pets accompanying their

owners recreating at the beach, and the lack of proper disposal of the dog fecal waste by the pet owners. Human feces can enter beach water through direct defecation by humans at beaches, or by improper, or non-disposal of diapers, used toilet tissues etc., discarded by beachgoers. Although a significant percentage of the ruminant-markers detected originate from ruminant wildlife (deer, elk) feces in the forested regions of the watersheds sampled, one beach watershed evaluated contains non-dairy cattle grazing. Therefore, cattle feces may also be a contributor to fecal pollution at that particular beach (namely, Moonstone Beach at Little River). Since no wet weather samples were collected, any fecal contributions associated with runoff cannot be determined based on the available data.

#### **4.3.2. Ocean Beaches Sampled in Mendocino County**

This section describes the summary assessment of land cover and land use categories, and MST markers contributing to fecal pollution in all five Mendocino County beaches sampled. These three lines of evidence evaluated collectively point to the natural/background as well as the controllable anthropogenic sources of fecal pollution in the waterbodies sampled. For all the waterbodies evaluated in this report natural/background fecal waste sources are those resulting from wildlife – gulls and other shorebirds, deer, and elk, and controllable fecal waste sources are those resulting from humans and human activities – humans, dogs, and cattle. Regional Board staff will focus on addressing controllable fecal waste sources since human, dog, and cattle waste are more harmful to public health than ruminant wildlife (deer, elk), or gull and shorebird waste (Griffith et al., 2013; Koskey et al., 2014; Wright et al., 2009).

Land cover, land use, and MST marker patterns detected in the Mendocino County beaches point to both natural/background as well as controllable anthropogenic fecal waste contributions. Based upon staff's assessment of land cover, land use, and MST data, controllable sources of fecal pollution show that fecal contributions to Mendocino County beaches are associated with dogs, followed by humans, attributed to dogs accompanying beachgoers, and the beachgoers themselves, and developed unsewered land use.

Tables 20, 21, and 22 provide the percentage of each land cover and land use category present, and each MST marker detected, in the Mendocino County beach sampling station watersheds evaluated

**Table 20 Grouped Coverage Percentages of Land Cover Categories associated with the Five Mendocino County Beaches**

<b>Land Cover Category</b>	<b>Coverage Percentage (%)</b>
Forest	60.7
Urban/Developed	26
Grassland/Shrubs	11

Land Cover Category	Coverage Percentage (%)
Other	2.3

**Table 21 Grouped Coverage Percentages of Land Use Categories associated with the Five Mendocino County Beaches**

Land Use Category	Coverage Percentage (%)
Developed Unsewered	47.7
Undeveloped	45.5
Grazing <sup>a</sup>	6.4
Developed Sewered	0.5

<sup>a</sup>One beach watersheds contain Non-Dairy Grazing. None of the beach watersheds sampled contain dairy cattle grazing

**Table 22 Grouped Detection Percentages of MST Markers associated with the Five Mendocino County Beaches**

MST Marker	Sampling Period <sup>a</sup>	Detection Percentage (%)
Gull	Dry	24
Dog	Dry	3.1
Human	Dry	2.1
Ruminant	Dry	0

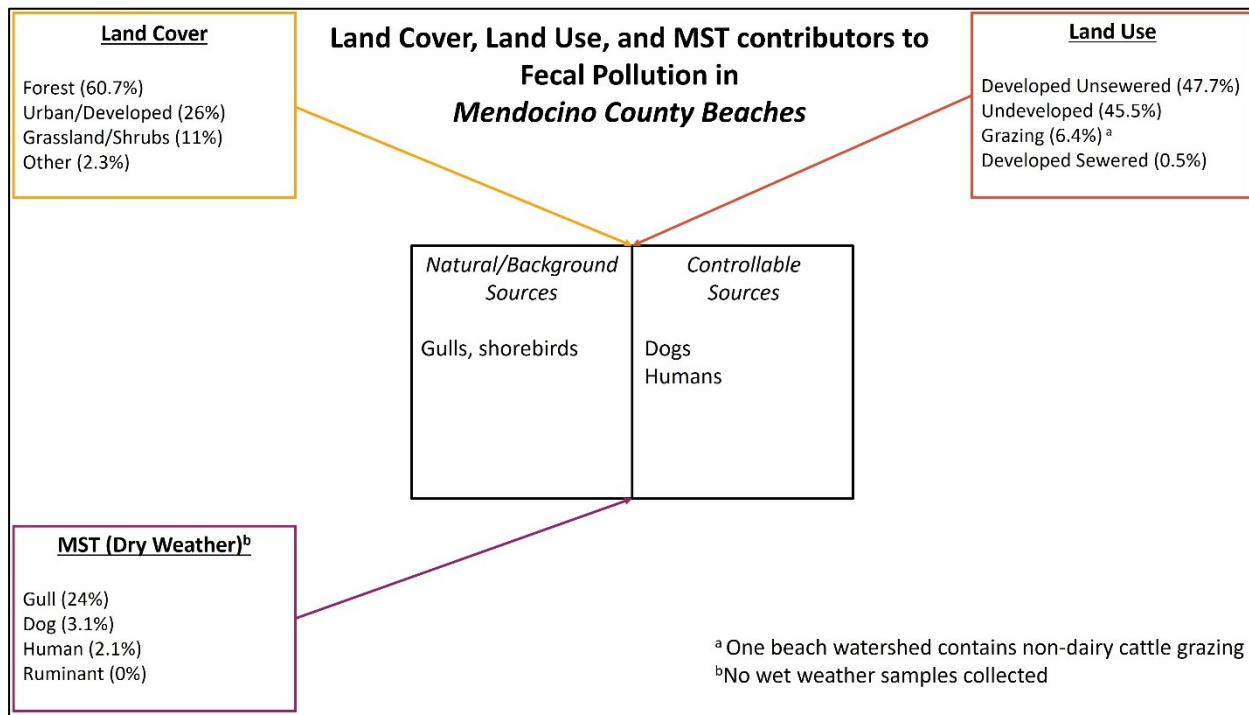
<sup>a</sup>Samples were collected from all five beach sampling stations only during the dry weather period. No wet weather period samples were collected from any of the beach sampling stations.

Figure 16 provides a visual representation of staff's analyses that combines the land cover, land use, and MST marker data for Mendocino County Beaches. A description of the figure is provided below.

The percentage of land cover categories summarized across all Mendocino County beaches is shown in the upper lefthand corner box. This summary indicates that forests are the most dominant land cover in the watersheds of Mendocino County beaches sampled, followed by urban/developed areas. Moving in a clockwise manner, the percentage of land use categories summarized across all Mendocino County beaches sampled is shown in the upper righthand corner box. This summary indicates that the dominant land use in the watersheds of Mendocino County beaches is developed unsewered, followed by undeveloped, followed by grazing, and then developed sewerred. Staff determined that there is one watershed containing non-dairy cattle



grazing land use and none of the sampled beach watersheds contain dairy cattle grazing. Continuing in a clockwise manner, the percentage of MST markers detected in dry weather samples collected from the Mendocino County beaches sampled is shown in the lower lefthand corner box. This summary indicates that gull fecal waste was detected in the greatest number of dry weather samples, followed by dog, then human and then ruminant fecal waste. No wet weather samples were collected from any of the Mendocino County beaches sampled. When analyzed in combination, these three assessments point to the most likely natural and anthropogenic fecal waste sources (shown in the center) for the sampled Mendocino County beaches.



**Figure 16 Land Cover, Land Use, and MST Fecal Sources Combined for All Mendocino County Beaches**

### Common Controllable Practices and Mechanisms of Transport

The most likely sources of gull and other shorebird fecal matter are the large number of gulls and other shorebirds that inhabit the shorelines of all the beaches sampled. Beach shorelines are the natural habitat of gulls and shorebirds. The most likely source of dog feces at the beaches sampled is from dog waste deposited by pets accompanying their owners recreating at the beach, and the lack of proper disposal of the dog fecal waste by the pet owners. Human feces can enter beach water through direct defecation by humans at beaches, or by improper, or non-disposal of diapers, used toilet tissues etc., discarded by beachgoers. Although one beach watershed evaluated contains non-dairy cattle grazing, no ruminant-specific markers were detected in any of the samples collected. Since no wet weather samples were collected, any fecal contributions associated with runoff cannot be determined based on the available data.

#### 4.3.3. Ocean Beach Sampled in Sonoma County

Only one beach (Campbell Cove at Bodega Bay) was sampled in Sonoma County, and this section describes the assessment of land cover and land use categories, and MST markers contributing to fecal pollution at this beach. These three lines of evidence evaluated collectively point to the natural/background as well as the controllable anthropogenic sources of fecal pollution in the waterbodies sampled. For all the waterbodies evaluated in this report natural/background fecal waste sources are those resulting from wildlife – gulls and other shorebirds, deer, and elk, and controllable fecal waste sources are those resulting from humans and human activities – humans, dogs, and cattle. Regional Board staff will focus on addressing controllable fecal waste sources since human, dog, and cattle waste are more harmful to public health than ruminant wildlife (deer, elk), or gull and shorebird waste (Griffith et al., 2013; Koskey et al., 2014; Wright et al., 2009).

Land cover, land use, and MST marker patterns detected at this beach point to both natural/background as well as controllable anthropogenic fecal waste contributions. Based upon staff's assessment of land cover, land use, and MST data, controllable sources of fecal pollution show that fecal contributions to this beach are associated with dogs, and appear to be from pets accompanying their owners recreating at the beach.

Tables 23, 24, and 25 provide the percentage of each land cover and land use category present, and each MST marker detected, at the Campbell Cove at Bodega Bay station watershed evaluated

**Table 23 Coverage Percentages of Land Cover Categories associated with the Campbell Cove at Bodega Bay Beach sampling station**

Land Cover Category	Coverage Percentage (%)
Grassland/Shrubs	76.6
Urban/Developed	17.3
Forest	2.6
Other	3.5

**Table 24 Coverage Percentages of Land Use Categories associated with the Campbell Cove at Bodega Bay Beach sampling station**

Land Use Category	Coverage Percentage (%)
Grazing <sup>a</sup>	60.6
Developed Unsewered	20.7
Undeveloped	18.7

Land Use Category	Coverage Percentage (%)
Developed Sewered	0

<sup>a</sup>This beach watershed contains Non-Dairy Grazing, and does not contain any dairy grazing.

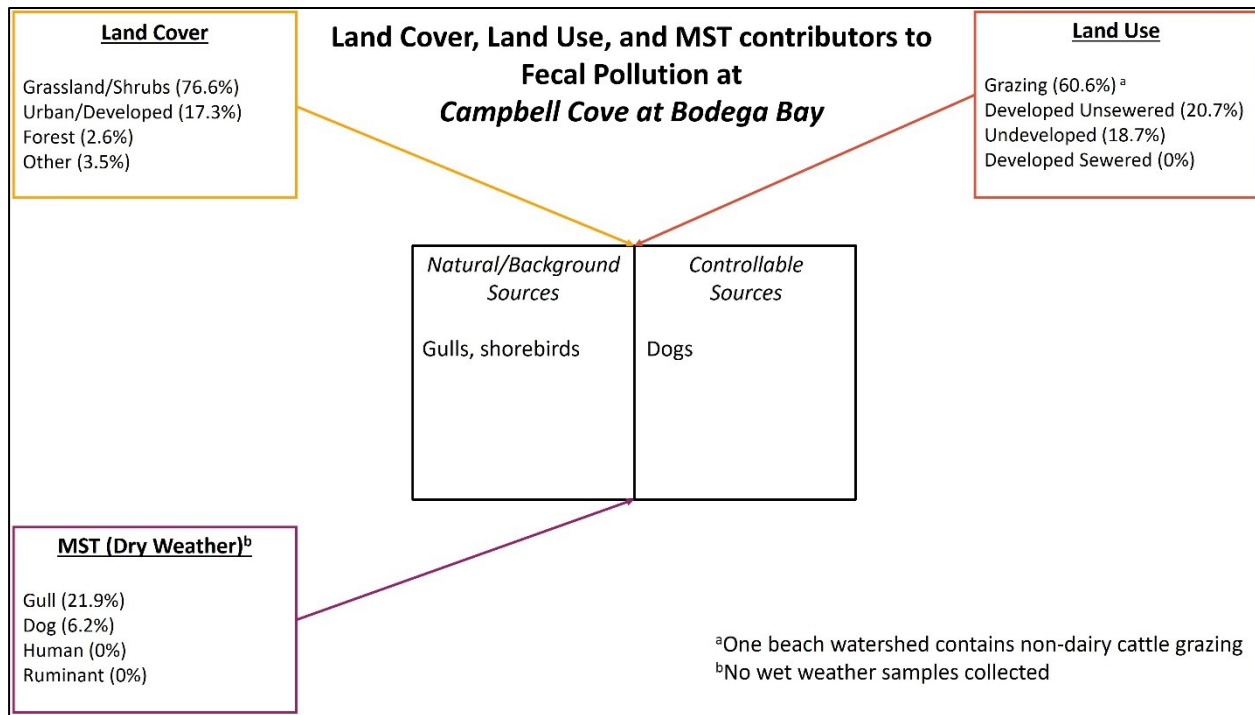
**Table 25 Grouped Detection Percentages of MST Markers associated with the Campbell Cove at Bodega Bay Beach sampling station**

MST Marker	Sampling Period <sup>a</sup>	Detection Percentage (%)
Gull	Dry	21.9
Dog	Dry	6.2
Human	Dry	0
Ruminant	Dry	0

<sup>a</sup>Samples were collected from all five beach sampling stations only during the dry weather period. No wet weather period samples were collected from any of the beach sampling stations.

Figure 17 provides a visual representation of staff's analyses that combines the land cover, land use, and MST marker data for the Campbell Cove at Bodega Bay. A description of the figure is provided below.

The percentage of land cover categories summarized at the Campbell Cove at Bodega Bay is shown in the upper lefthand corner box. This summary indicates that grassland/shrubs are the most dominant land cover in the watershed of this beach, followed by urban/developed areas. Moving in a clockwise manner, the percentage of land use categories summarized across this beach is shown in the upper righthand corner box. This summary indicates that the dominant land use in the watersheds of this beach is grazing, followed by developed unsewered, followed by undeveloped, followed by developed sewerred. Staff determined that this watershed contains non-dairy cattle grazing, and no dairy cattle grazing. Continuing in a clockwise manner, the percentage of MST markers detected in dry weather samples collected from this beach is shown in the lower lefthand corner box. This summary indicates that gull fecal waste was detected in the greatest number of dry weather samples, followed by dog-specific markers. The human-, and ruminant-specific markers were not detected in any of the samples collected. No wet weather samples were collected from this beach. When analyzed in combination, these three assessments point to the most likely natural and anthropogenic fecal waste sources (shown in the center) for this beach.



**Figure 17 Land Cover, Land Use, and MST Fecal Sources at the Campbell Cove at Bodega Bay sampling station**

#### Common Controllable Practices and Mechanisms of Transport

The most likely sources of gull and other shorebird fecal matter are the large number of gulls and other shorebirds that inhabit the shorelines of all the beaches sampled. Beach shorelines are the natural habitat of gulls and shorebirds. The most likely source of dog feces at the beaches sampled is from dog waste deposited by pets accompanying their owners recreating at the beach, and the lack of proper disposal of the dog fecal waste by the pet owners. Although the beach watershed evaluated contains non-dairy cattle grazing, no ruminant-specific markers were detected in any of the samples collected. Since no wet weather samples were collected, any fecal contributions associated with runoff cannot be determined based on the available data.

## 5. Discussion

This technical report presents the findings of an assessment of potential sources of fecal pollution to 28 coastal streams and 12 ocean beaches in the North Coast region using three lines of evidence – land cover, land use, and MST data. This section summarizes the potential sources of fecal pollution in the waterbodies evaluated in this report (Table 26). These sources can be grouped into three categories: those originating from human waste, those originating from animal waste, and those discharged by the stormwater runoff.

The identification of the potential sources of fecal pollution in the watershed is based on the following information:

- Microbial source tracking studies conducted by the Regional Water Board (2016-2018; 2021-2022), the Humboldt County DEH (2019-2022), and Humboldt Waterkeeper (2016).
- The analysis of land cover land use data collected in the watersheds of the sampling stations evaluated in the microbial source tracking studies
- General knowledge that stormwater runoff typically contains high levels of pollutants such as fecal indicator bacteria.

Due to the primarily diffused nonpoint source nature of discharges from these sources this report does not quantitatively estimate loads (i.e., the total number of bacteria discharged by each source per unit time) for the different identified sources in the waterbodies evaluated. However, findings from water quality monitoring and studies in the watershed, as well as other available information, lead to general conclusions about the likelihood, prevalence, and significance of different sources.

**Table 26 Identified Sources of fecal pollution in the waterbodies evaluated**

Source Category	Potential Sources	Examples
Human Waste	Municipal Separate Storm Sewer Systems (MS4s)	<p>Humboldt County (City of Eureka, City of Arcata, City of Trinidad, Portions of Unincorporated Humboldt County, Humboldt State University)</p> <p>Mendocino County (City of Fort Bragg, Portions of Unincorporated Mendocino County)</p> <p>Sonoma County (State of California Department of Parks and Recreation)</p>
Human Waste	Sanitary Sewer Collection Systems	<p>Municipal Stormwater Runoff:</p> <ol style="list-style-type: none"> <li>1) Runoff from residential, commercial, industrial, and recreational areas – Discharges from human waste sources; pet waste in streets and backyards; wildlife waste; waste from recreational areas etc.</li> <li>2) Stormwater infrastructure – Aging or damaged sewer pipes</li> </ol>
Human Waste	Private Sewer Laterals	Sewer laterals serving individual private properties
Human Waste	Onsite Wastewater Treatment Systems	Septic systems
Human Waste	Homeless Encampments	Various encampments in the areas sampled

Source Category	Potential Sources	Examples
Animal Waste	Livestock-Confined Animal Facilities	Cow dairies
Animal Waste	Livestock – Grazing Lands/Operations	Cattle ranches
Animal Waste	Domestic Pets	Pet dogs
Animal Waste	Wildlife	Deer, elk, shorebirds, etc.

### **5.1. Focus on Controllable Fecal Pollution Sources Associated with Human Activity**

Source control should be focused on waste associated with human activity, not natural/background sources of fecal pollution from wildlife. Specifically, the control of human, dog, and cattle waste rather than the control of waste from deer, elk, gulls, shorebirds, etc. This recommendation is based on the fact that the potential human health risks associated with human, and ruminant feces are higher than those associated with gull, or shorebird feces, and that the FIB concentration, and thus potentially the pathogen concentration, in dog fecal waste is also higher than that in shorebird fecal waste.

Specifically, “human fecal matter, followed by cattle fecal matter, is considered as being most pathogenic to humans” (Griffith et al., 2013), whereas potential “human health risks associated with shorebird and waterfowl feces are inherently lower than those from human fecal inputs” (Koskey et al., 2014). Moreover, shorebird feces are a more “concentrated point source of contamination on beaches”, whereas “sewage is more readily dispersed, presenting a larger radius of contamination risk” (Koskey et al., 2014). Furthermore, an eight-month long study conducted to quantify enterococci load contributed by different animals commonly observed at a recreational beach site in Florida determined that the average enterococci concentrations detected in dog feces were an order of magnitude higher than those detected on average in shorebird feces ( $7.4 \times 10^6$  colony forming units (cfu)/g in dogs, compared to  $3.3 \times 10^5$  cfu/g in birds)

(Wright et al., 2009). The study also found that one dog fecal event was equivalent to 6,940 bird fecal events (Wright et al., 2009).

Addressing human-, dog-, and cattle fecal waste will result in the reduction of fecal sources that pose higher risks to human health.

## **5.2. Recommendations for Source Control**

The findings of this report will be used by Regional Board permitting staff in conjunction with management agencies to develop targeted actions to address controllable sources of fecal pollution linked to human activity in the waterbodies analyzed in this report. These controllable sources of fecal pollution can be addressed by developing direct, targeted, source control actions, applying existing regulatory programs, revising, or developing, new nonpoint source permits, issuing waste discharge requirements, requiring corrective actions, and relying on enforcement if needed. In addition, any monitoring of affected areas after implementation of source controls could be used to inform the need for adaptive management and help identify remaining sources, if any, where fecal pollution persists despite initial source control actions. Specific details on source control are provided in the Coastal Pathogen Project Synthesis Report (North Coast Regional Water Quality Control Board, 2024).



## 6. References

- California Department of Fish and Wildlife. (2024). *Conservation and Management of Wildlife and Habitat*. Conservation and Management of Wildlife and Habitat. <https://wildlife.ca.gov/Conservation>
- California Department of Water Resources. (2023a). *California Data Exchange Center*. California Data Exchange Center. <https://cdec.water.ca.gov/>
- California Department of Water Resources. (2023b). *CDEC Station Locator*. California Data Exchange Center. <https://cdec.water.ca.gov/cdecstations>
- Corrigan, J., & Akre, J. (2019). *Microbial Source Tracking (MST) Study Quality Control (QC) Report for the Coastal Pathogen Project*.
- Griffith, J. F., Layton, B. A., Boehm, A. B., Holden, P. A., Jay, J. A., Hagedorn, C., McGee, C. D., & Weisberg, S. B. (2013). *The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches*.
- Koskey, A. M., Fisher, J. C., Traudt, M. F., Newton, R. J., & McLellan, S. L. (2014). Analysis of the Gull Fecal Microbial Community Reveals the Dominance of *Catellibacterium marimammali* in Relation to Culturable Enterococci. *Applied and Environmental Microbiology*, 80(2), 757–765. <https://doi.org/10.1128/AEM.02414-13>
- North Coast Regional Water Quality Control Board. (2015). *Coastal Watershed Pathogen Indicator Study Quality Assurance Project Plan*.
- North Coast Regional Water Quality Control Board. (2018). *Water Quality Control Plan for the North Coast Region*. [https://www.waterboards.ca.gov/northcoast/water\\_issues/programs/basin\\_plan/190204/Final Basin Plan\\_20180620\\_lmb.pdf](https://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/190204/Final_Basin_Plan_20180620_lmb.pdf)
- North Coast Regional Water Quality Control Board. (2023a). *Assessment of Fecal Indicator Bacteria and Microbial Source Tracking Data from Jolly Giant Creek*.
- North Coast Regional Water Quality Control Board. (2023b). *Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches*.
- North Coast Regional Water Quality Control Board. (2023c). *Assessment of Fecal Indicator Bacteria Data from 21 Humboldt County Coastal Streams*.
- North Coast Regional Water Quality Control Board. (2023d). *Exclusion of Specific Source Assessment Study Sampling Stations from Fecal Indicator Bacteria and Microbial Source Tracking Data Assessment*.
- North Coast Regional Water Quality Control Board. (2024). *Technical Reports and Memoranda of the Coastal Pathogen Project*.
- R Core Team. (2023). *R: A Language and Environment for Statistical Computing*. (4.1.0). R Foundation for Statistical Computing. <https://www.r-project.org/>

- State Water Resources Control Board. (2015a). *Final California 2012 Integrated Report (303(d) List/305(b) Report) Supporting Information*.
- State Water Resources Control Board. (2015b). *State Water Resources Control Board Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List*.
- State Water Resources Control Board. (2022). *2020-2022 California Integrated Report*. [https://www.waterboards.ca.gov/water\\_issues/programs/water\\_quality\\_assessment/2020\\_2022\\_integrated\\_report.html](https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2020_2022_integrated_report.html)
- State Water Resources Control Board. (2023a). *CEDEN California Environmental Data Exchange Network*. <http://ceden.org/index.shtml>
- State Water Resources Control Board. (2023b). *eWRIMS - Electronic Water Rights Information Management System*. [https://www.waterboards.ca.gov/waterrights/water\\_issues/programs/ewrims/](https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/)
- State Water Resources Control Board. (2023c). *SPoT Stream Pollution Trends Monitoring Program*. [https://www.waterboards.ca.gov/water\\_issues/programs/swamp/spot/](https://www.waterboards.ca.gov/water_issues/programs/swamp/spot/)
- United States Department of Agriculture. (2012). *USDA National Agricultural Statistics Service Cropland Data Layer {2012}. Published cro-specific data layer [Online]*. <https://nassgeodata.gmu.edu/CropScape>
- United States Environmental Protection Agency. (2023). *Water Quality Topics: Pathogens*. Water Quality and Climate Literature Review. [https://www.epa.gov/wqclr/water-quality-topics-pathogens#:~:text=Surface water and groundwater are,2010\)](https://www.epa.gov/wqclr/water-quality-topics-pathogens#:~:text=Surface water and groundwater are,2010)).
- Wilhelm, J. O., Leinenbach, P., Fore, L., Lester, D., Adams, K., & Hayslip, G. (2013). *Watershed delineation and land cover calculations for Puget Sound stream basins*.
- Wright, M. E., Solo-Gabriele, H. M., Elmir, S., & Fleming, L. E. (2009). Microbial Load from Animal Feces at a Recreational Beach. *Marine Pollution Bulletin*, 58(11), 1649–1656. <https://doi.org/0.1016/j.marpolbul.2009.07.003>

## **Appendix A – Land Cover and Land Use Coverage, and Species-Specific Marker Detection in Coastal Streams Draining into Humboldt Bay**

Results of the assessment of land cover, land use, and MST data collected from each sampling station sampled in 17 Humboldt County coastal streams, and two Humboldt County roadside ditches draining into Humboldt Bay are detailed below. In addition, any exceedances of the REC-1 Objective at these sampling stations are also included.

### **Campbell Creek at 7th Street (110GS5000):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (Statistical Threshold Value [STV] objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/3), and
- Summer (1/1).

An assessment of the exceedance of the geometric mean (GM) threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-1 below illustrates the land cover and land use in the watershed of this sampling station.

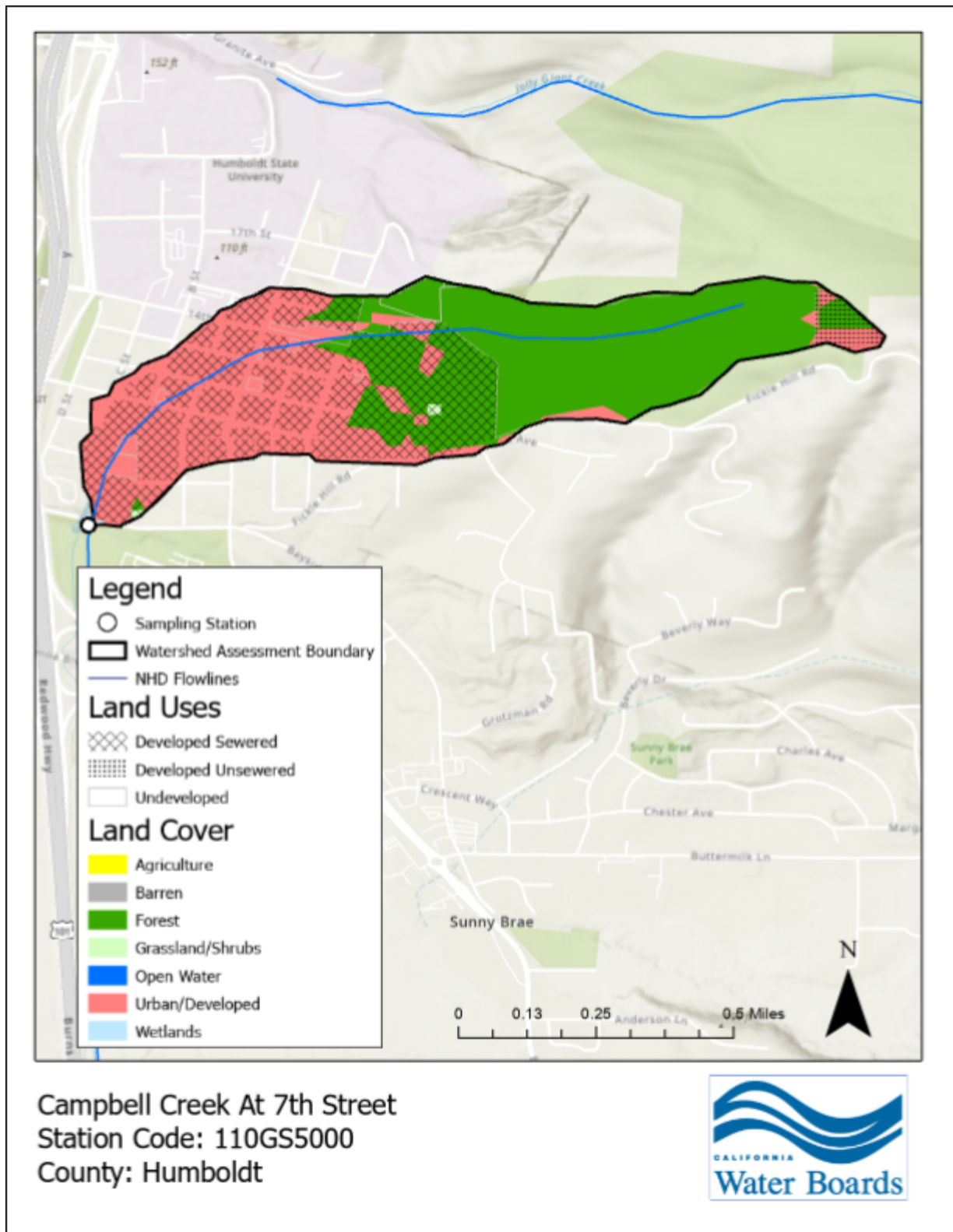


Figure A-1 Land Cover and Land Use in the Campbell Creek at 7th Street watershed

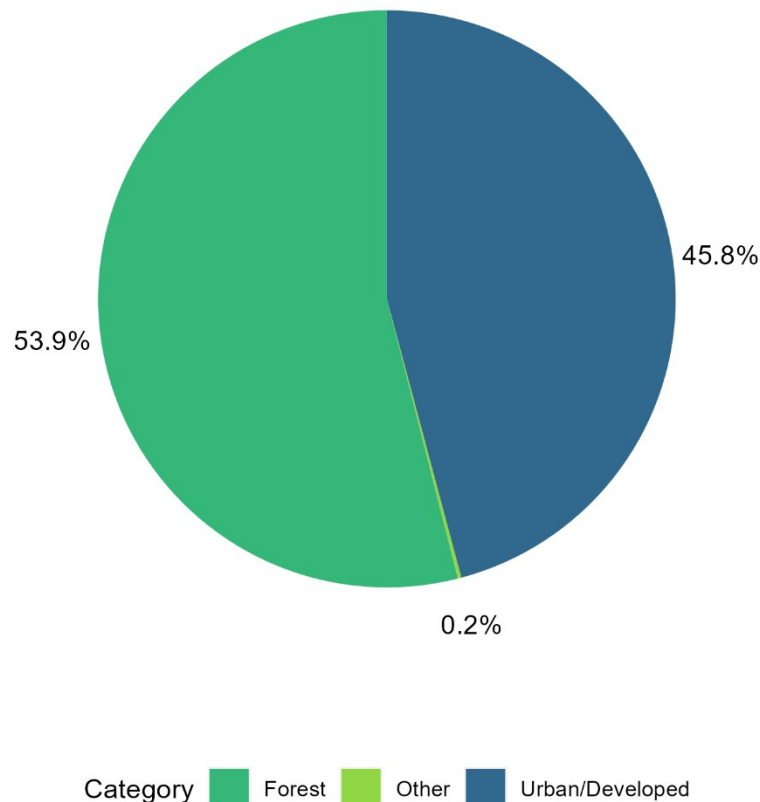
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-2 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (87.03 acres [53.9%]),
- Urban/Developed (74 acres [45.8%]),
- Grassland/Shrubs (0.38 acres [0.2%]),
- Wetlands (0.07 acres [0%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Campbell Creek at 7th Street



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

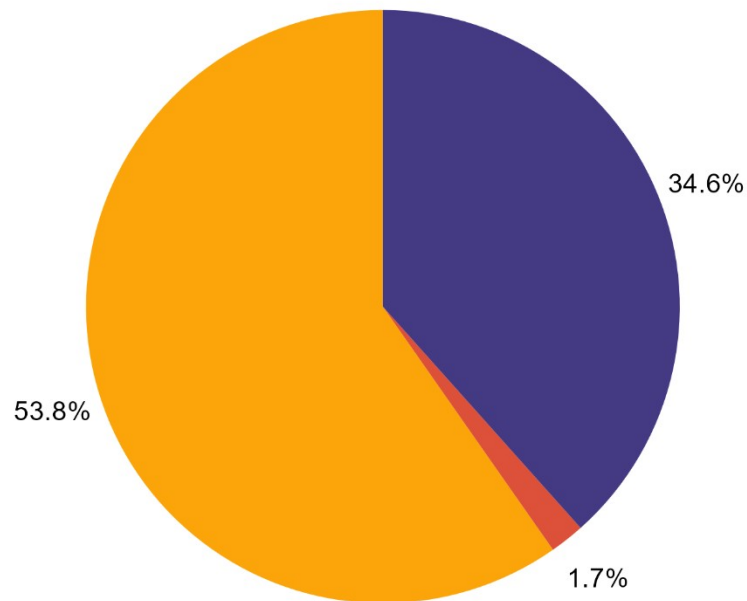
**Figure A-2 Percentage coverage by land cover category in the Campbell Creek at 7th Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-3 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (81.09 acres [53.8%]),
- Undeveloped (67.15 acres [34.6%]),
- Developed Unsewered (2.56 acres [1.7%]), and
- Grazing (0 acres [0%])

## Land Use

Humboldt County: Campbell Creek at 7th Street



Category ■ Developed Sewered ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-3 Percentage coverage by land use category in the Campbell Creek at 7th Street watershed**

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-4 below.

Specifically, the marker detection percentage in the dry sampling period were:

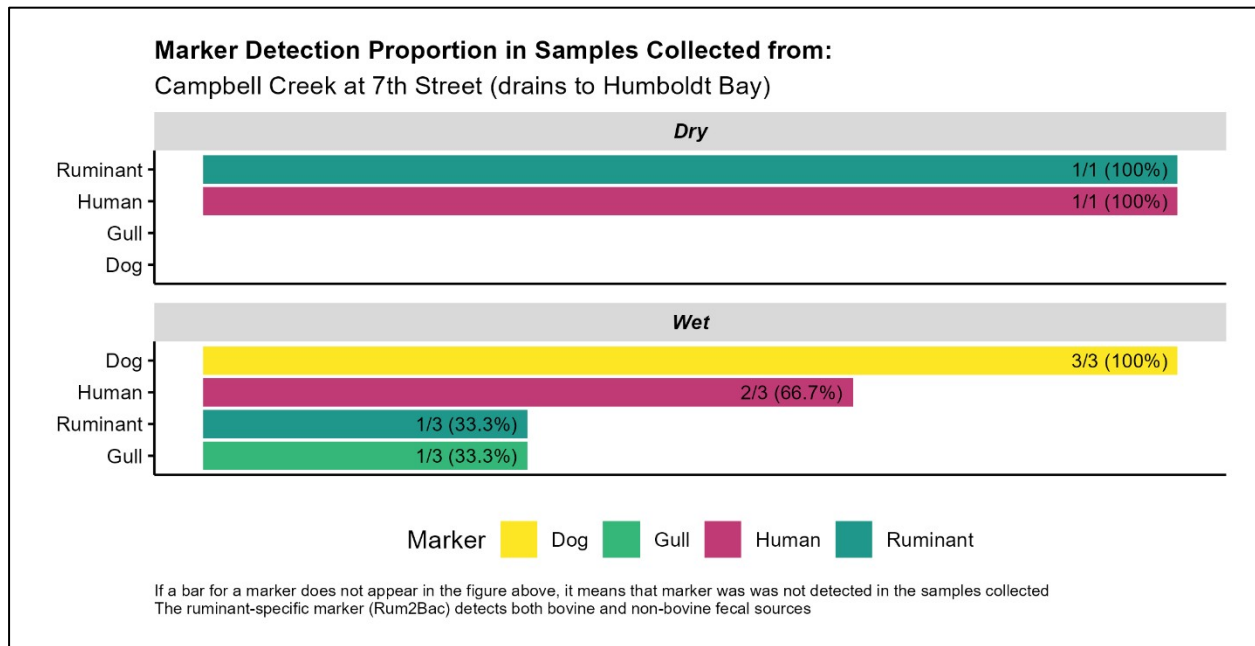
- Human (1/1 [100%]),
- Ruminant (1/1 [100%]),

- Dog (0/1 [0%]), and
- Gull (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/3 [100%]),
- Human (2/3 [66.7%]),
- Ruminant (1/3 [33.3%]), and
- Gull (1/3 [33.3%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-4 Detection percentage of MST markers evaluated in samples collected from the Campbell Creek at 7th Street station**



**Campbell Creek at 14<sup>th</sup> Street & Union Street (110GS6500):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (1/4),
- Winter (1/3), and
- Summer (0/1).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-5 below illustrates the land cover and land use in the watershed of this sampling station.

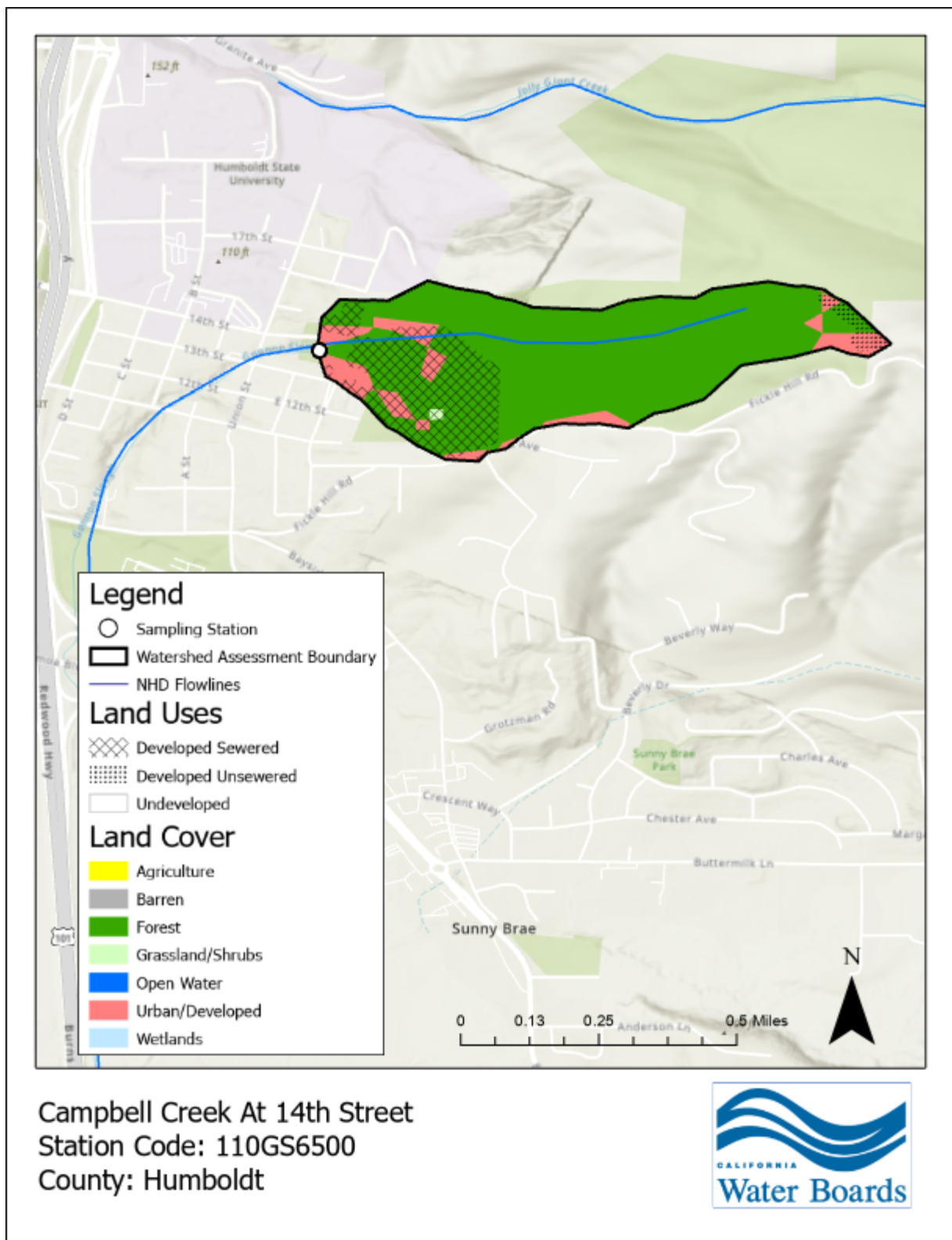


Figure A-5 Land cover and land use in the Campbell Creek at 14th Street and Union Street watershed

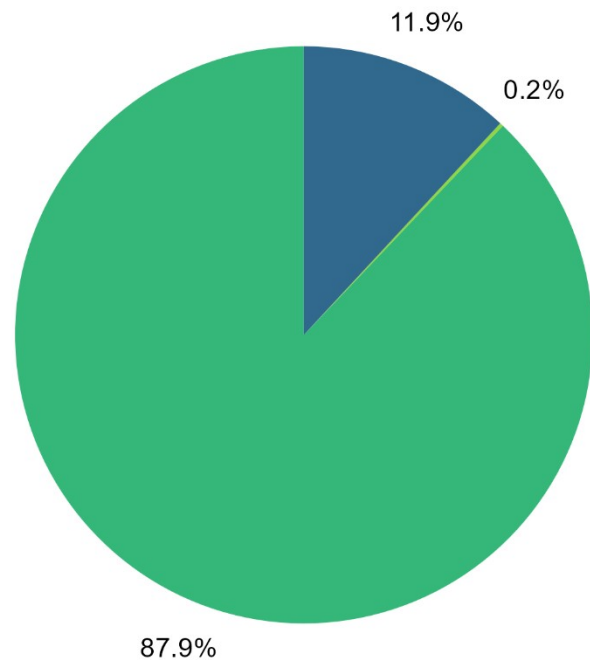
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-6 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (84.86 acres [87.9%]),
- Urban/Developed (11.47 acres [11.9%]),
- Grassland/Shrubs (0.22 acres [0.2%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Campbell Creek at 14th Street & Union Street



Category ■ Forest ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

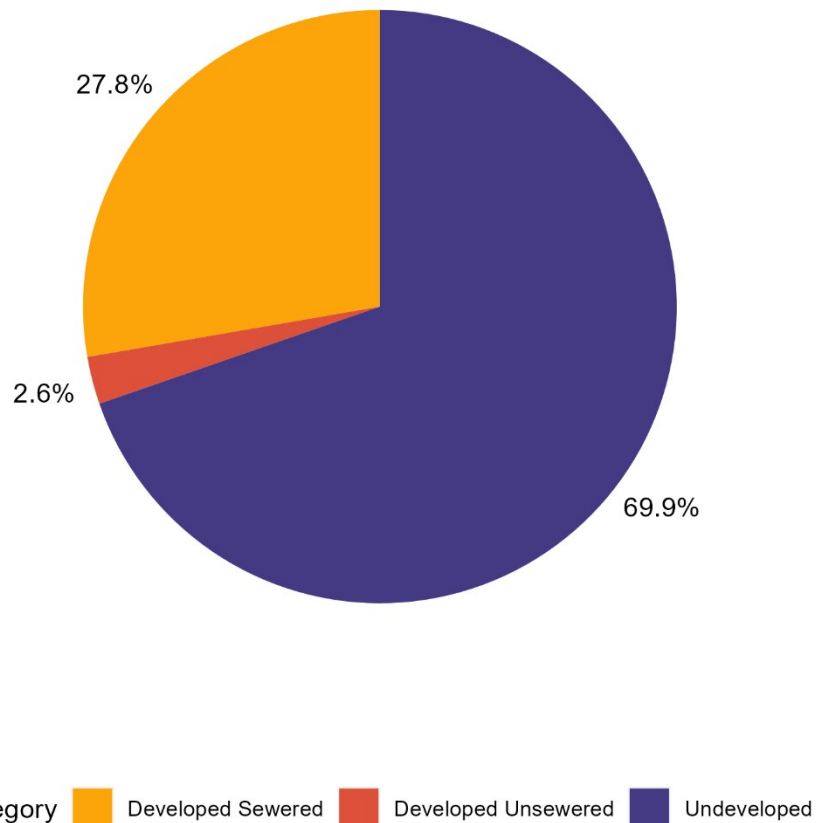
**Figure A-6 Percentage coverage by land cover category in the Campbell Creek at 14th Street & Union Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-7 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (68.24 acres [69.9%]),
- Developed Sewered (27.17 acres [27.8%]),
- Developed Unsewered (2.56 acres [2.6%]), and
- Grazing (0 acres [0%])

## Land Use

Humboldt County: Campbell Creek at 14th Street & Union Street



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-7 Percentage coverage by land use category in the Campbell Creek at 14th Street & Union Street watershed**

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-8 below.

Specifically, the marker detection percentage in the dry sampling period were:

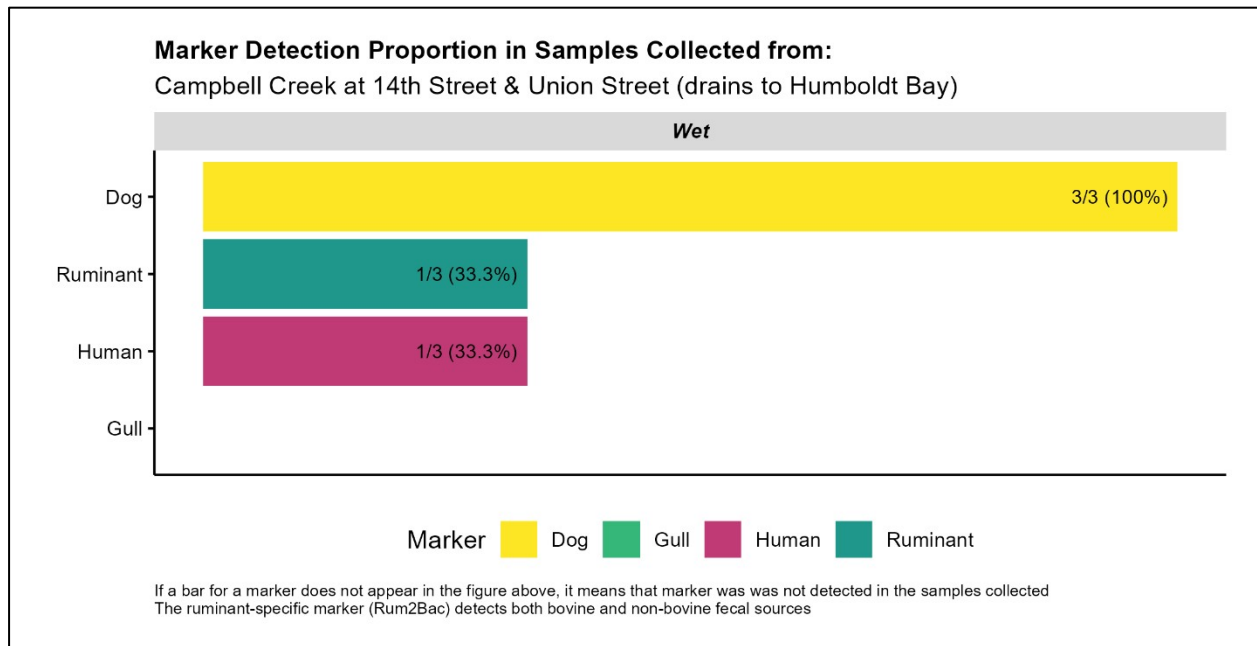
- Dog (0/1 [0%]),
- Gull (0/1 [0%]),

- Human (0/1 [0%]), and
- Ruminant (0/1 [0%])

Specifically, the marker detection percentage in the wet sampling period are:

- Dog (3/3 [100%]),
- Ruminant (1/3 [33.3%]),
- Human (1/3 [33.3%]), and
- Gull (0/3 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-8 Detection percentage of species-specific markers evaluated in samples collected from the Campbell Creek at 14th Street & Union Street station**

**Cooper Gulch at Myrtle Avenue & 8<sup>th</sup> Street (110CG5000):**

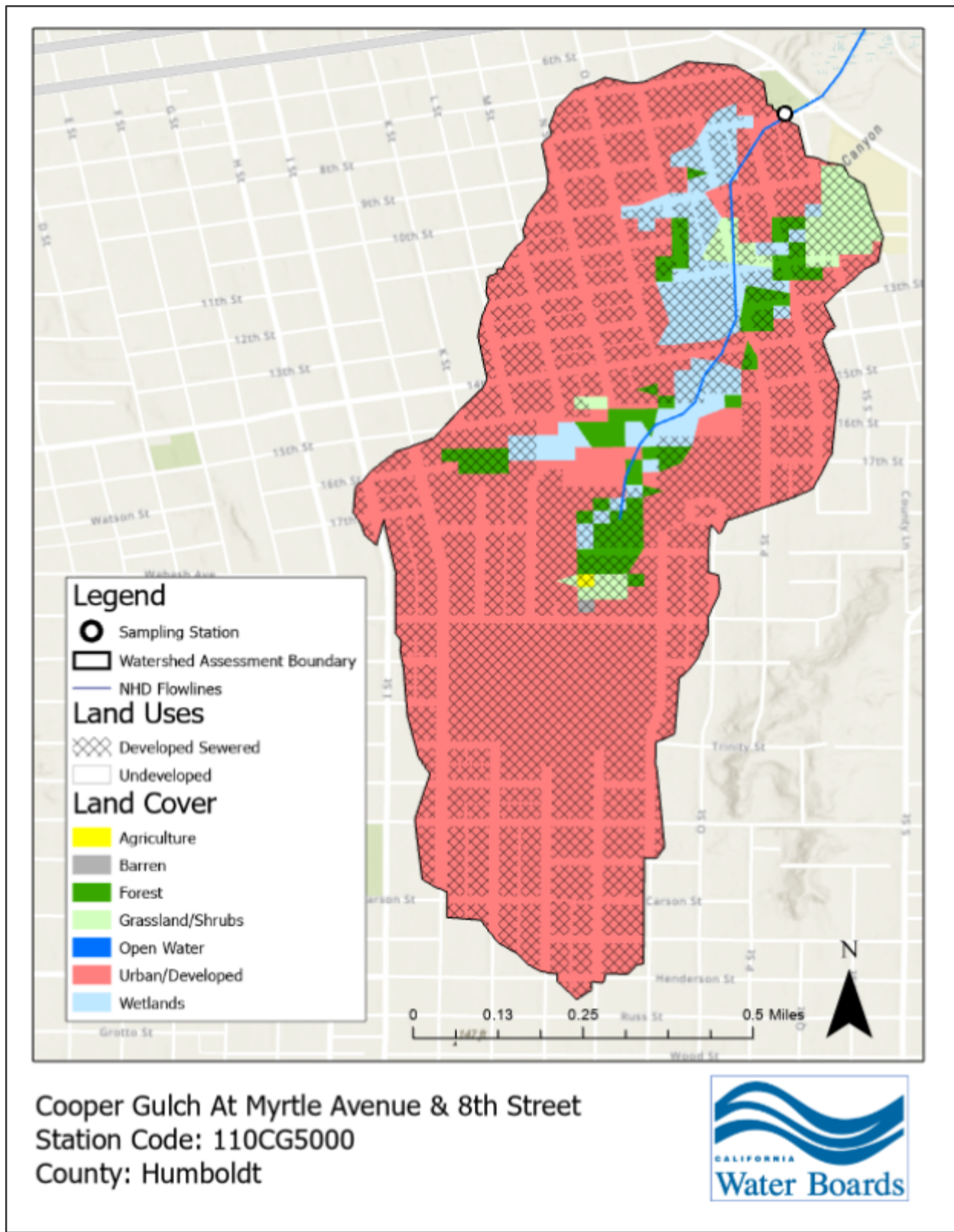
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (4/4),
- Winter (2/2), and
- Summer (2/2)

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-9 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-9 Land cover and land use in the Cooper Gulch at Myrtle Avenue & 8th Street watershed**



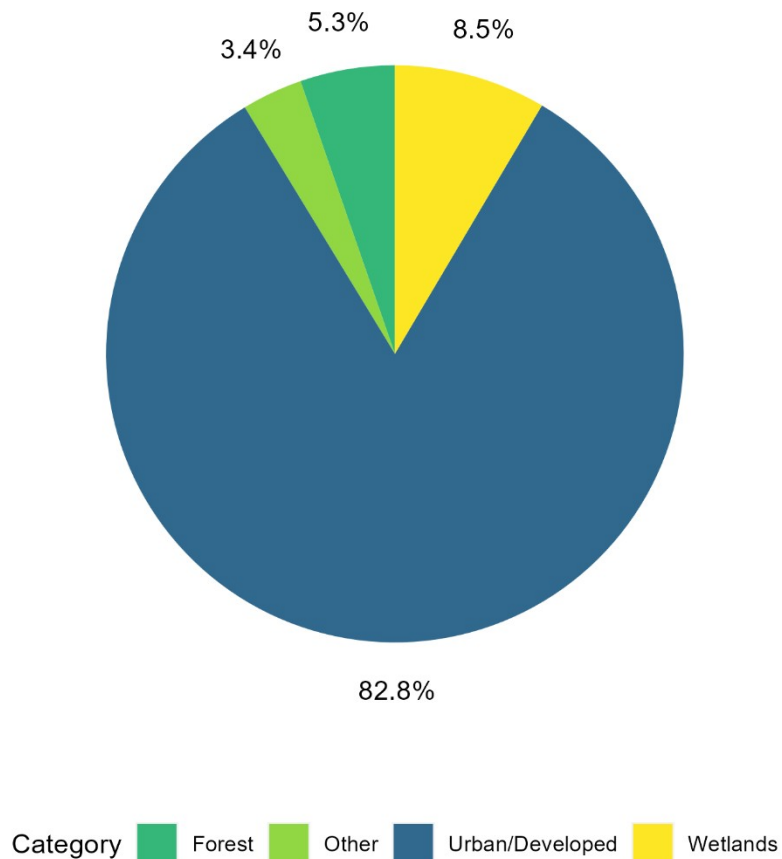
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-10 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (235.15 acres [82.8%]),
- Wetlands (24.22 acres [8.5%]),
- Forest (15.12 acres [5.3%]),
- Grassland/Shrubs (9.09 acres [3.2%]),
- Agriculture (0.22 acres [0.1%]),
- Barren (0.22 acres [0.1%]), and
- Open Water (0 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Cooper Gulch at Myrtle Avenue & 8th Street



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

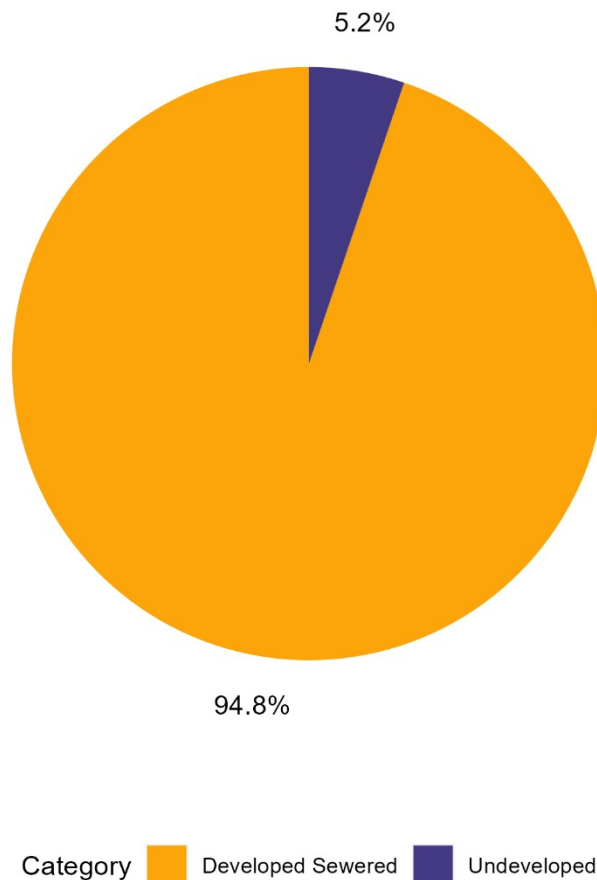
**Figure A-10 Percentage coverage by land cover category in the Cooper Gulch at Myrtle Avenue & 8th Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-11 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (194.68 acres [94.8%]),
- Undeveloped (10.62 acres [5.2%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%])

## Land Use

Humboldt County: Cooper Gulch at Myrtle Avenue & 8th Street



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-11 Percentage coverage by land use category in the Cooper Gulch at Myrtle Avenue & 8th Street watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-12 below.

Specifically, the marker detection percentage in the dry sampling period were:

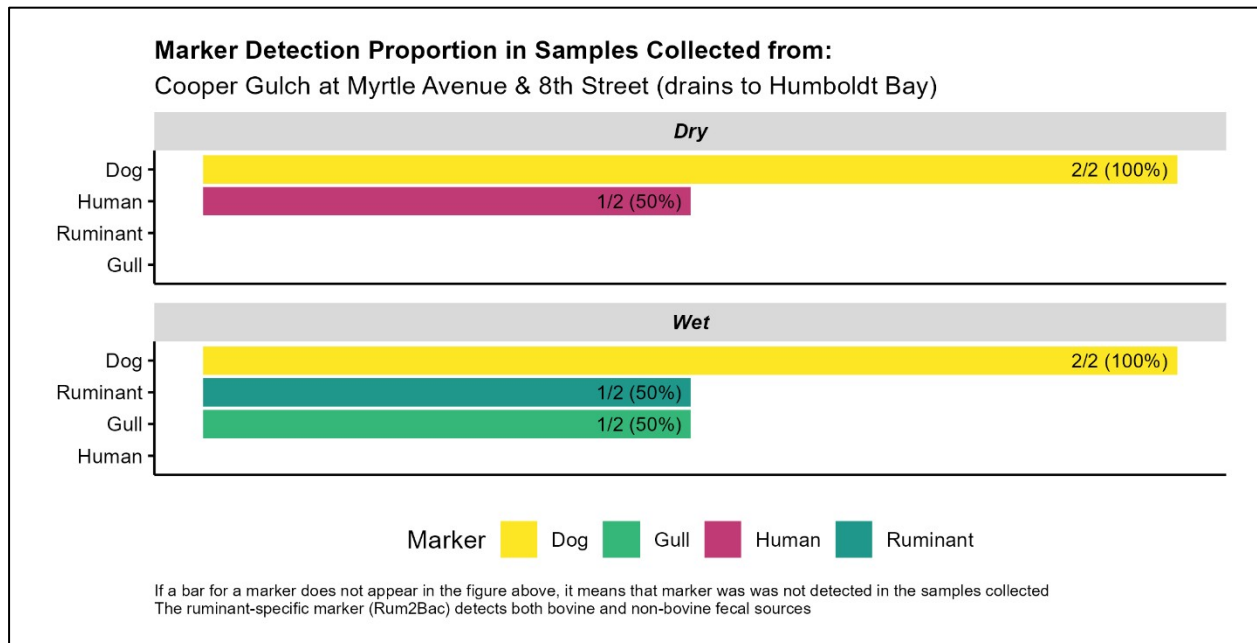
- Dog (2/2 [100%]),
- Human (1/2 [50%]),

- Gull (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%]),
- Gull (1/2 [50%]),
- Ruminant (1/2 [50%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-12 Detection percentage of species-specific markers evaluated in samples collected from the Cooper Gulch at Myrtle Avenue & 8th Street station**

**Elk River at Highway 101 (110EL1278):**

This station was sampled as part of the Impaired Streams Monitoring Study of the Coastal Pathogen Project.

This is a saline sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The enterococcus data collected from this saline sampling station was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (6/11),
- Winter (3/5), and
- Summer (3/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-13 below illustrates the land cover and land use in the watershed of this sampling station.

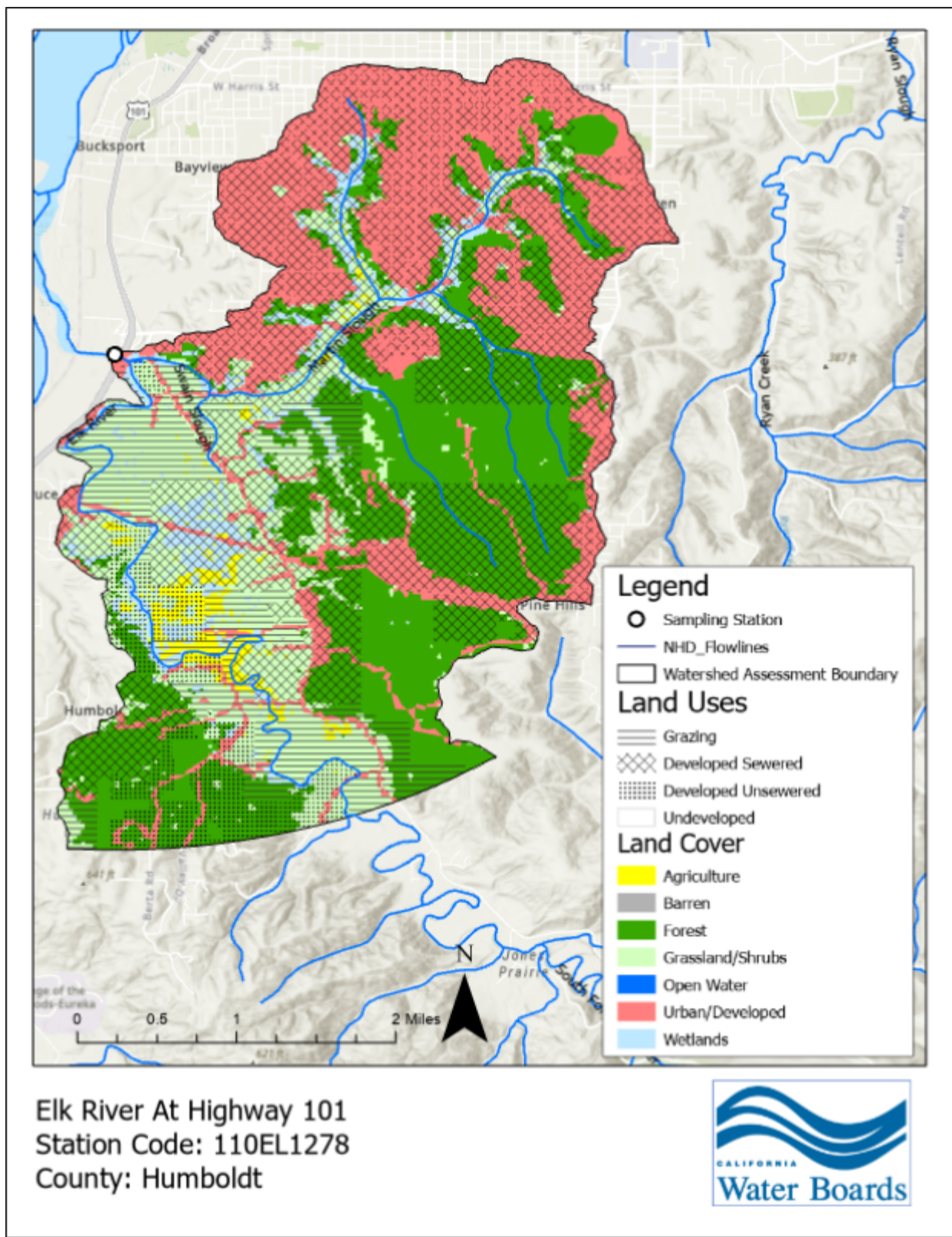


Figure A-13 Land cover and land use in the Elk River at Highway 101 watershed

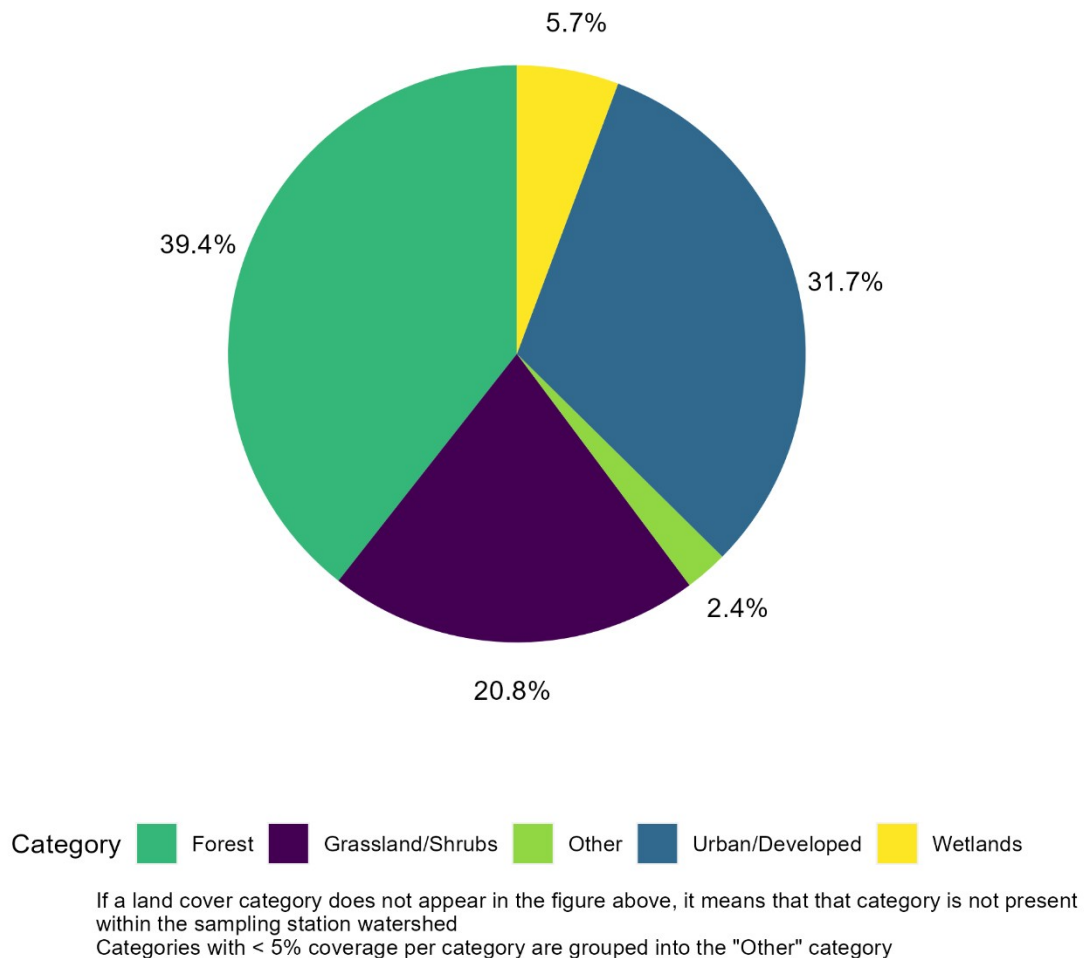
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-14 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (2403.78 acres [39.4%]),
- Urban/Developed (1938.27 acres [31.7%]),
- Grassland/Shrubs (1271.35 acres [20.8%]),
- Wetlands (344.77 acres [5.7%]),
- Agriculture (145.72 acres [2.4%]),
- Barren (1.92 acres [0%]), and
- Open Water (0.93 acres [0%]).

Please note in the figure, that any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Elk River at Highway 101

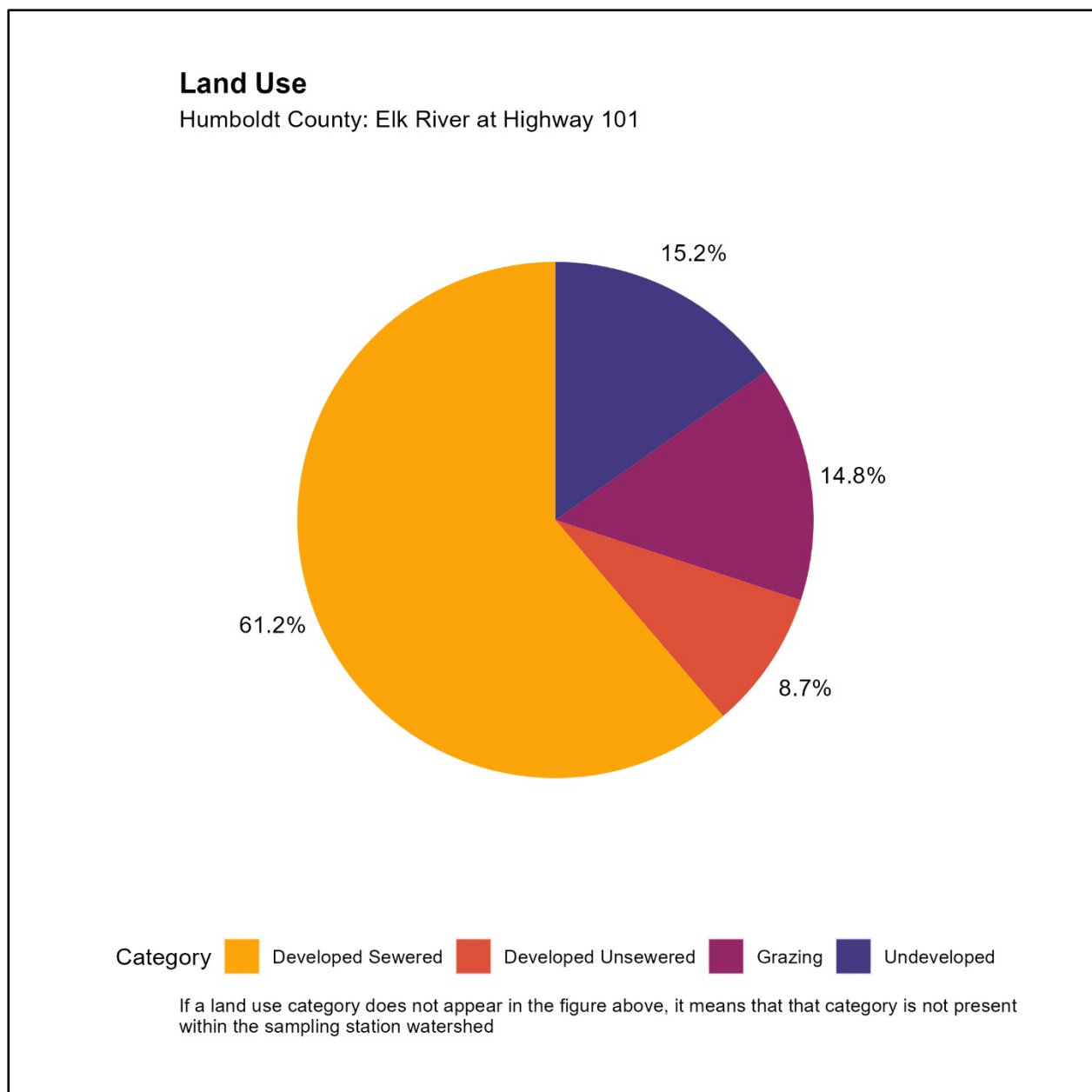


**Figure A-14 Percentage coverage by land cover category in the Elk River at Highway 101 watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-15 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (3508.81 acres [61.2%]),
- Undeveloped (872.6 acres [15.2%]),
- Grazing (850.58 acres [14.8%]), and
- Developed Unsewered (501.36 acres [8.7%]).
- Dairy cattle grazing is present in the watershed of this sampling station.





**Figure A-15 Percentage coverage by land use category in the Elk River at Highway 101 watershed**

Eleven samples (six in the dry period, and five in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-16 below.

Specifically, the marker detection percentage in the dry sampling period were:

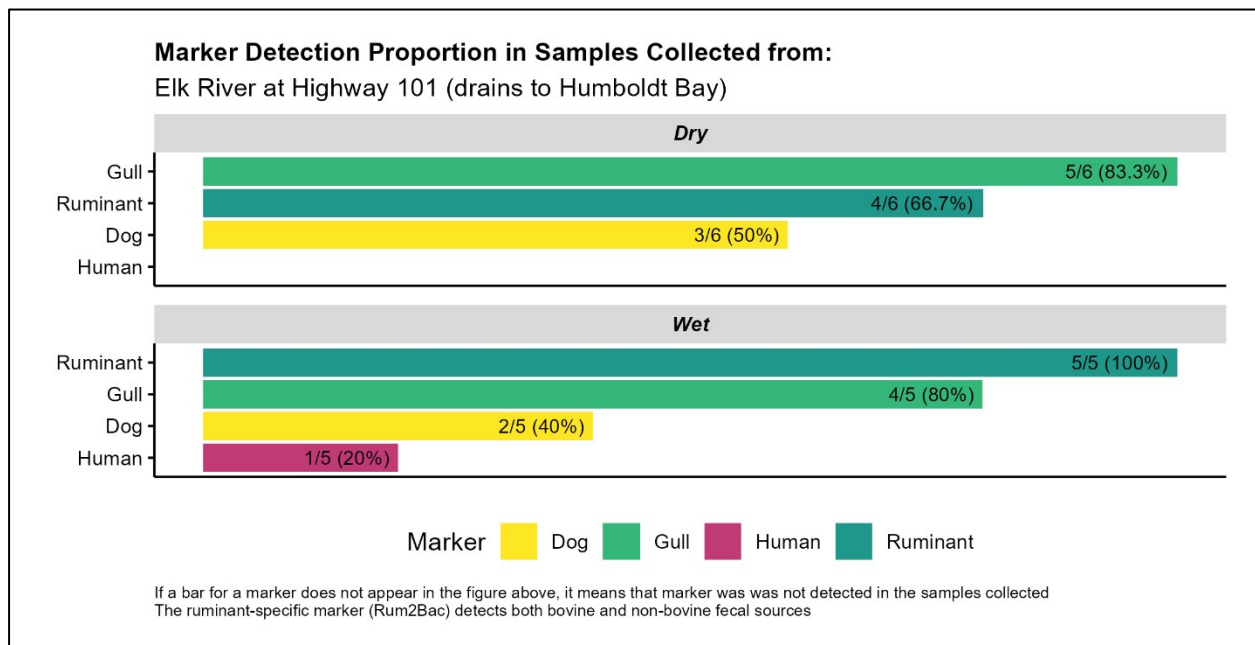
- Gull (5/6 [83.3%]),

- Ruminant (4/6 [66.7%]),
- Dog (3/6 [50%]), and
- Human (0/6 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (5/5 [100%]),
- Gull (4/5 [80%]),
- Dog (2/5 [40%]), and
- Human (1/5 [20%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



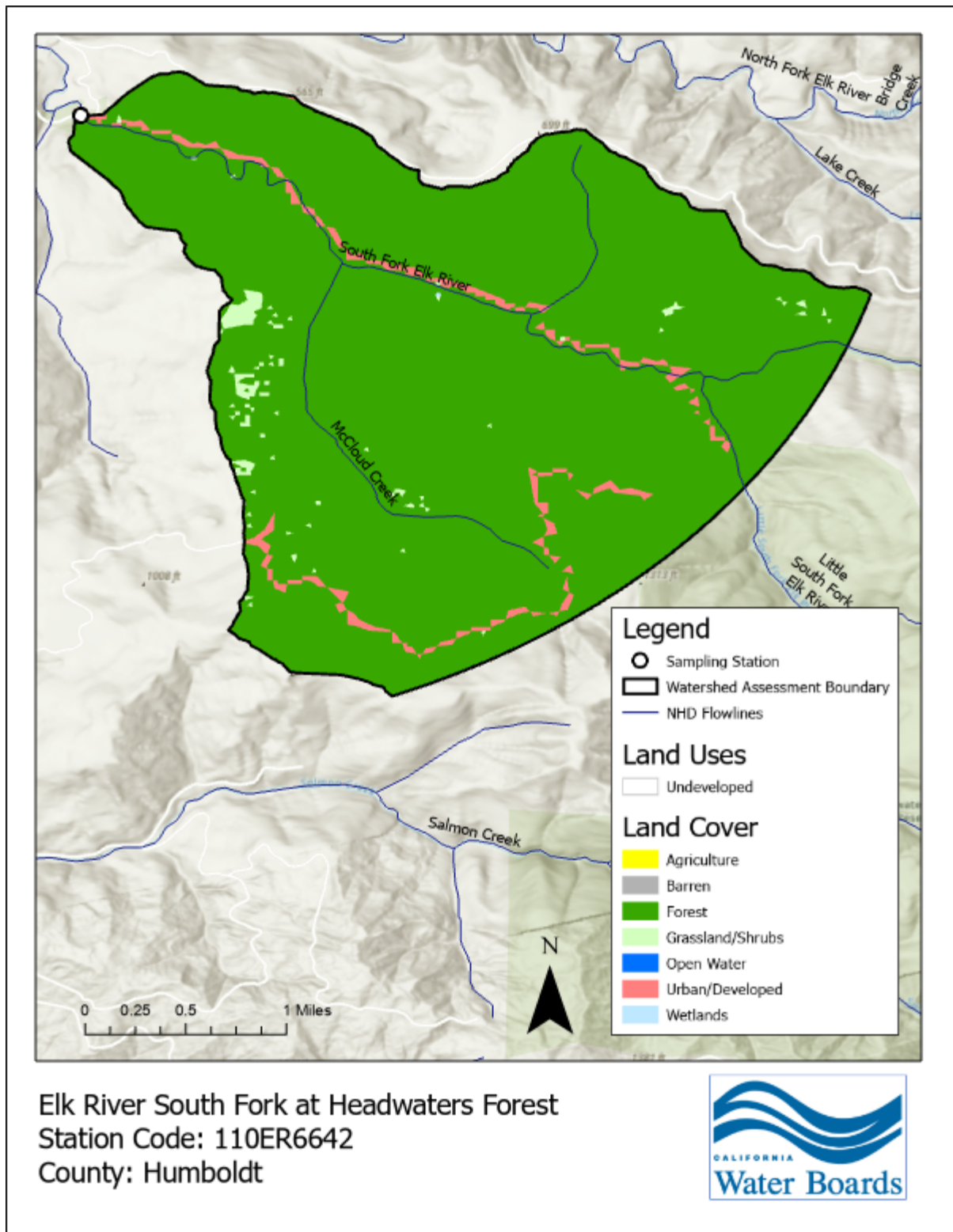
**Figure A-16 Detection percentage of species-specific markers evaluated in samples collected from the Elk River at Highway 101 station**

**Elk River at South Fork at Headwaters Forest (110SF1612):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated – Year-Round (0/4), Winter (0/2), and Summer (0/2). An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-17 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-17 Land cover and land use in the Elk River South Fork at Headwaters Forest watershed**

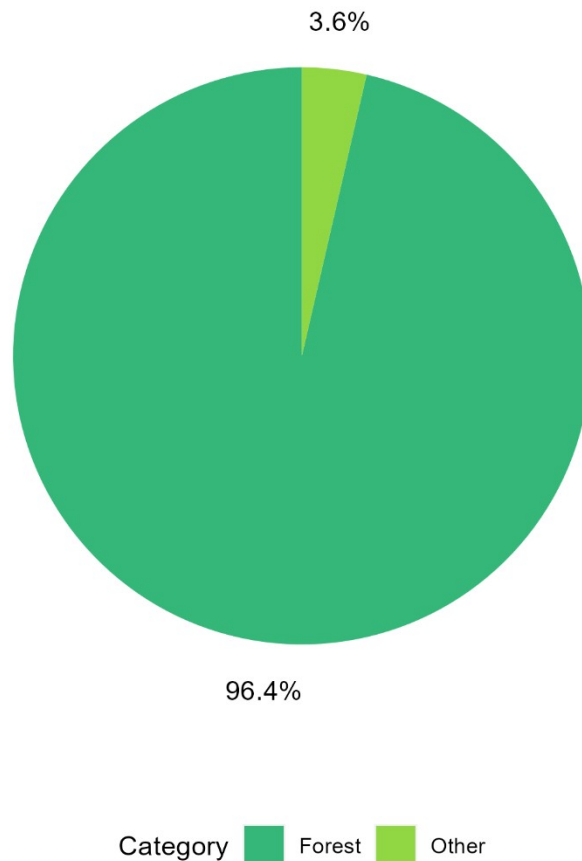
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-18 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (3254.12 acres [96.4%]),
- Urban/Developed (87.61 acres [2.6%]),
- Grassland/Shrubs (32.57 acres [1%]),
- Wetlands (0.22 acres [0%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

Please note in the figure, that any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Elk River South Fork at Headwaters Forest



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

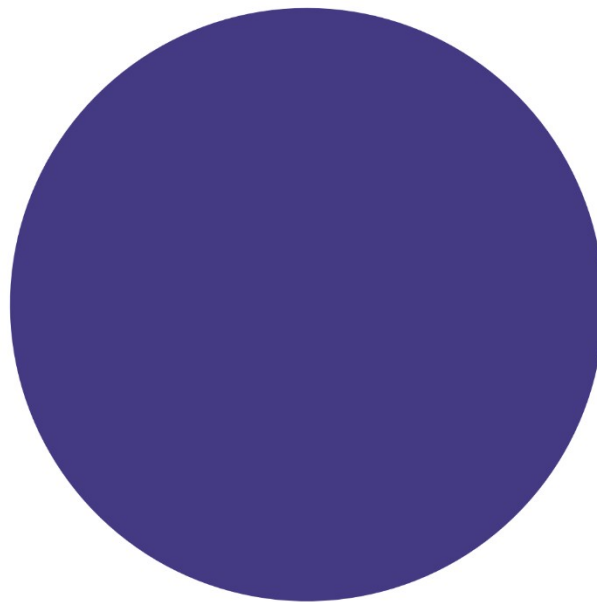
**Figure A-18 Percentage coverage by land cover category in the Elk River South Fork at Headwaters Forest watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-19 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (3376.49 acres [100%]),
- Developed Sewered (0 acres [0%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Elk River South Fork at Headwaters Forest



Category  Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-19 Percentage coverage by land use category in the Elk River South Fork at Headwaters Forest watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-20 below.

Specifically, the marker detection percentage in the dry sampling period were:

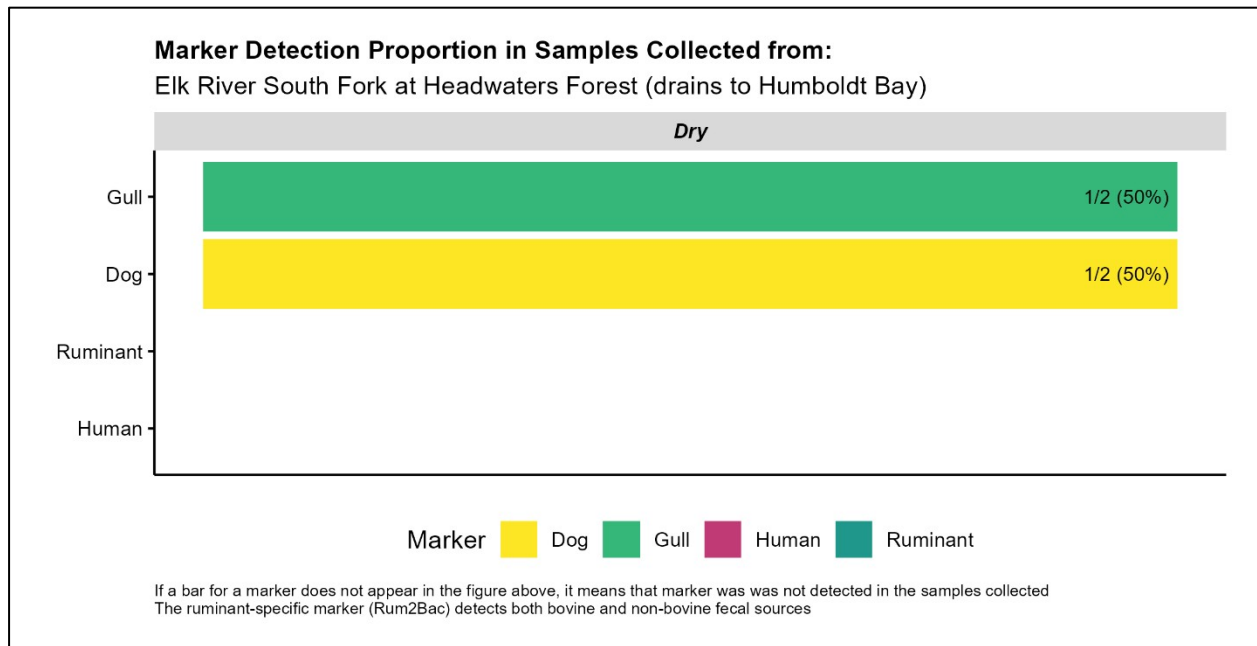
- Dog (1/2 [50%]),
- Gull (1/2 [50%]),

- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (0/2 [0%]),
- Gull (0/2 [0%]),
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-20 Detection percentage of species-specific markers evaluated in samples collected from the Elk River South Fork at Headwaters Forest station**



**Elk River at Zanes Road (110ER6642):**

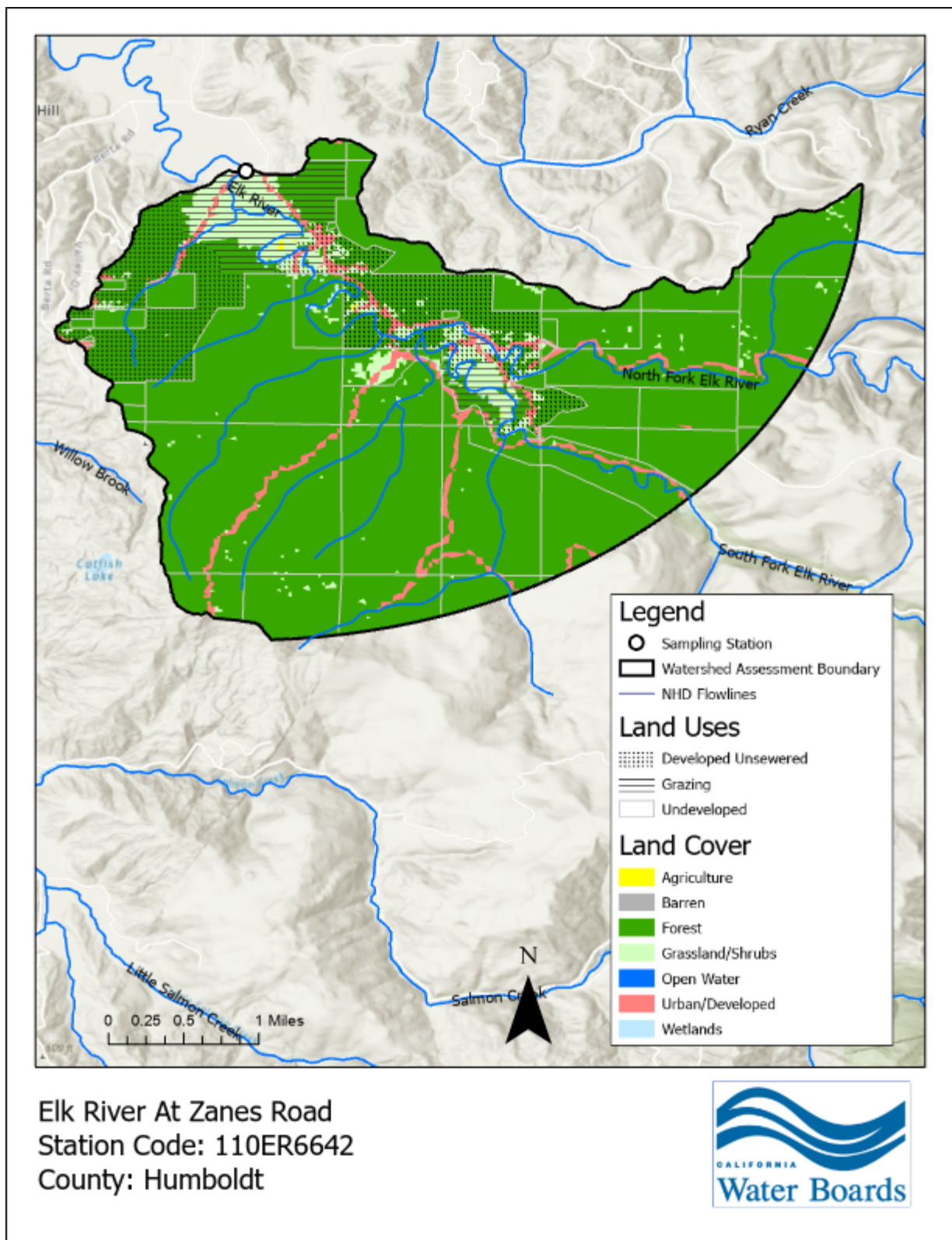
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-21 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-21 Land cover and land use in the Elk River at Zanes Road watershed**

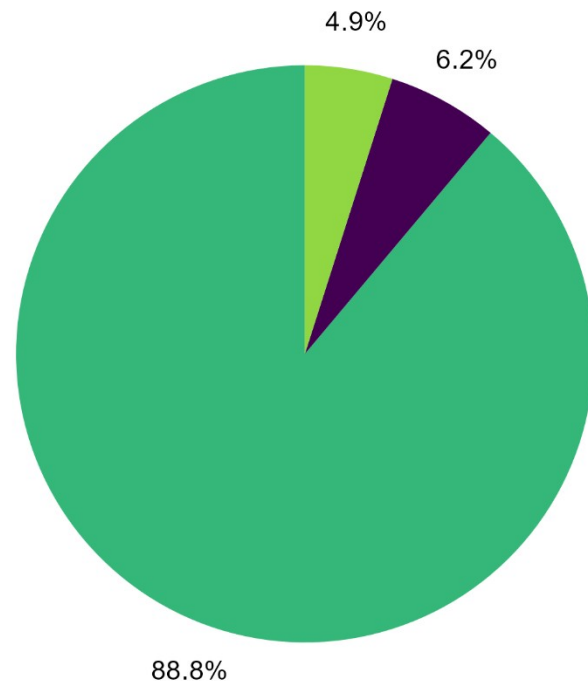
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-22 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (4421.31 acres [88.8%]),
- Grassland/Shrubs (310.06 acres [6.2%]),
- Urban/Developed (219.64 acres [4.4%]),
- Wetlands (24.23 acres [0.5%]),
- Agriculture (1.79 acres [0%]),
- Barren (0.14 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Elk River at Zanes Road



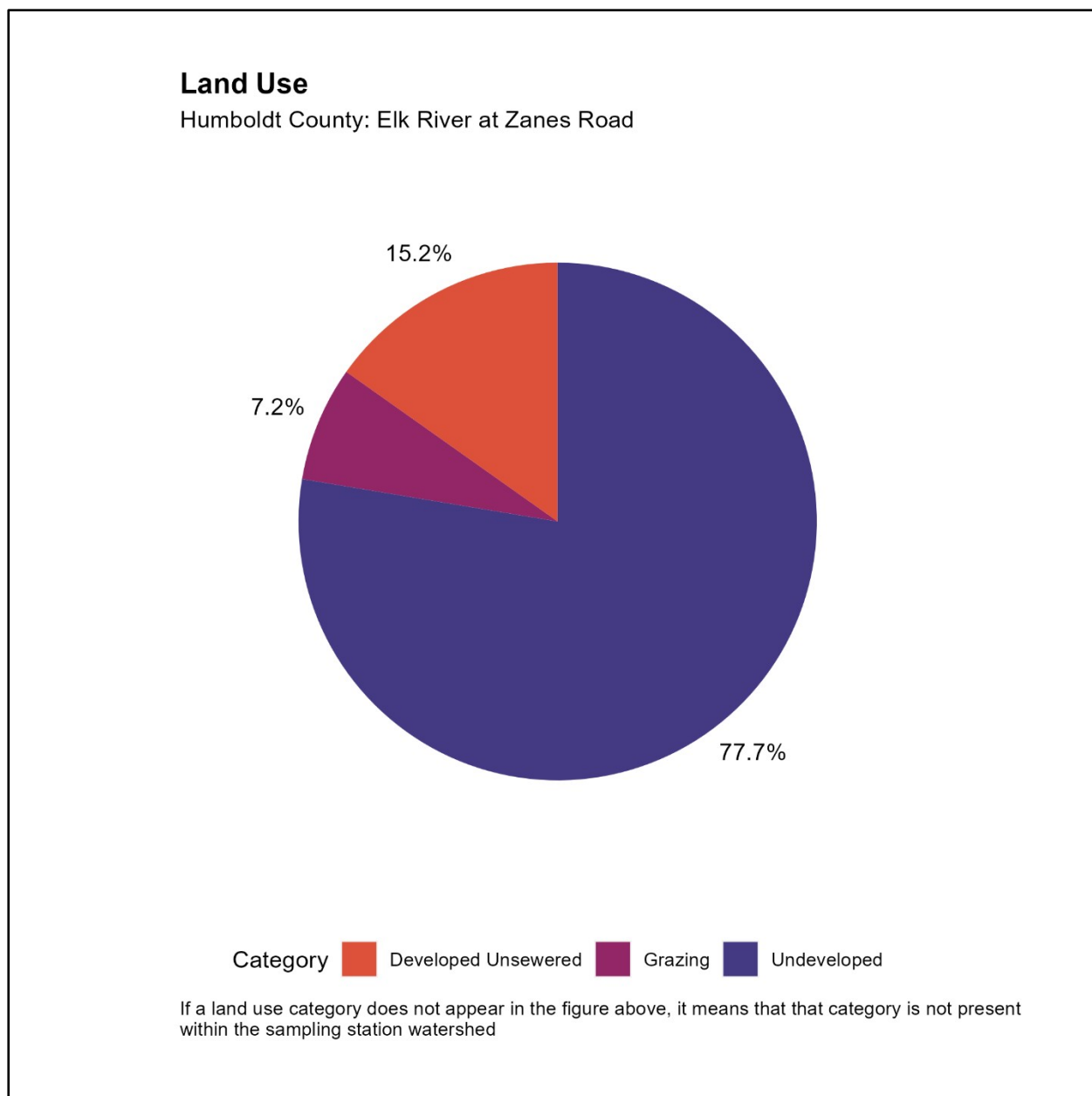
Category ■ Forest ■ Grassland/Shrubs ■ Other

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure A-22 Percentage coverage by land cover category in the Elk River at Zanes Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-23 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (3856.08 acres [77.7%]),
- Developed Unsewered (753.9 acres [15.2%]),
- Grazing (355.65 acres [7.2%]), and
- Developed Sewered (0 acres [0%]).
- Dairy cattle grazing is present in the watershed of this sampling station.



**Figure A-23 Percentage coverage by land use category in the Elk River at Zanes Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-24 below.

Specifically, the marker detection percentage in the dry sampling period were:

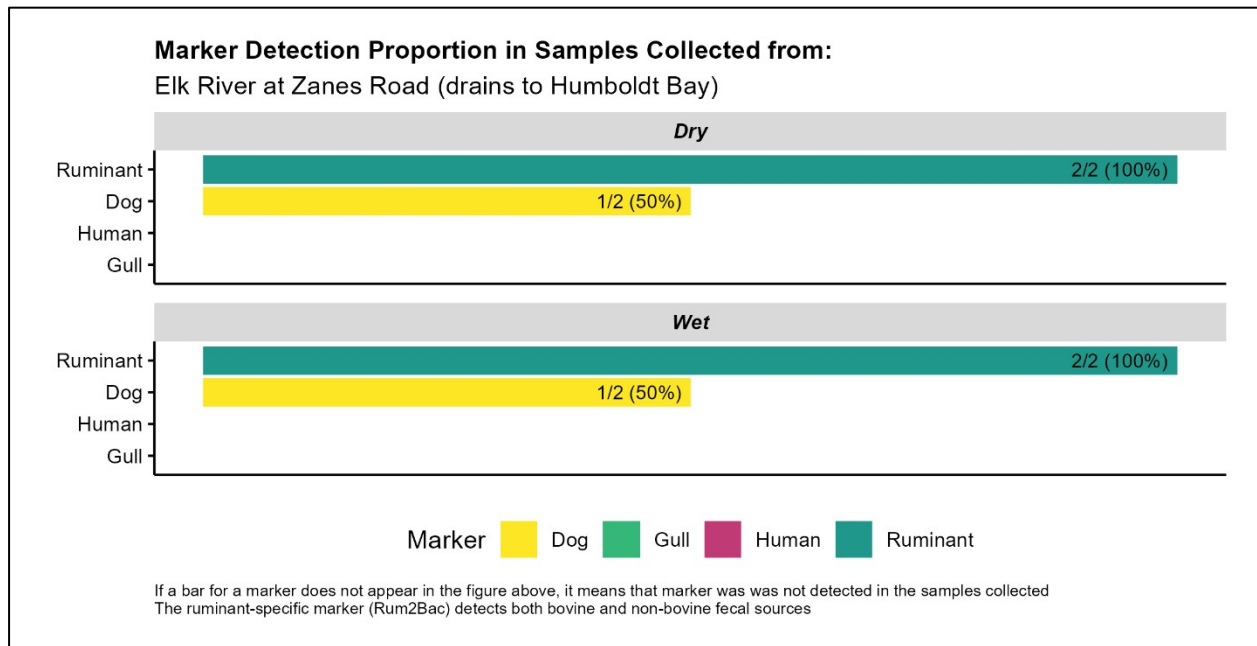
- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),

- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-24 Detection percentage of species-specific markers evaluated in samples collected from the Elk River at Zanes Road station**

**Freshwater Creek at County Park (110FR4642):**

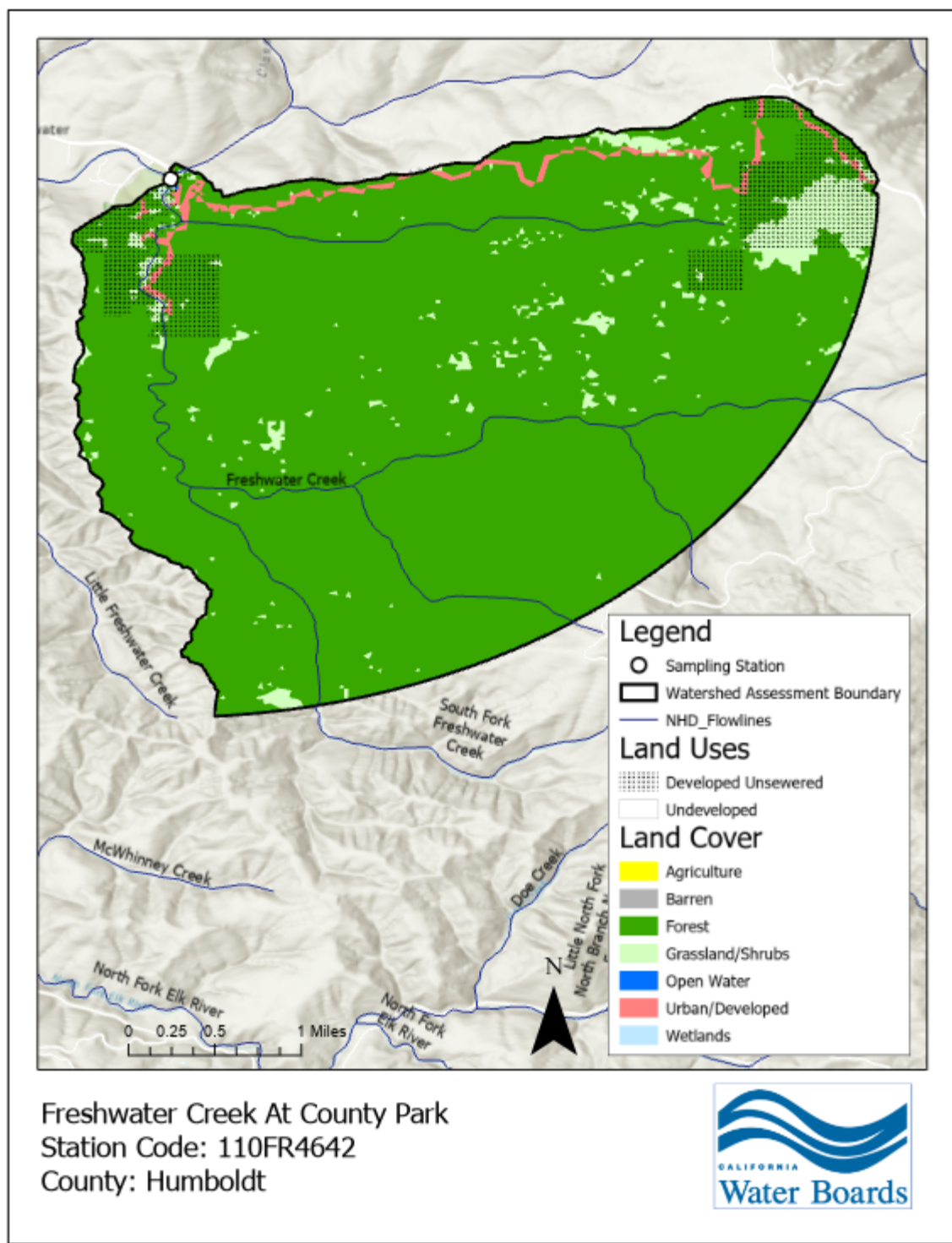
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-25 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-25 Land cover and land use in the Freshwater Creek at County Park watershed**

Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-26 below. Specifically, the coverage of land cover categories in this watershed are:

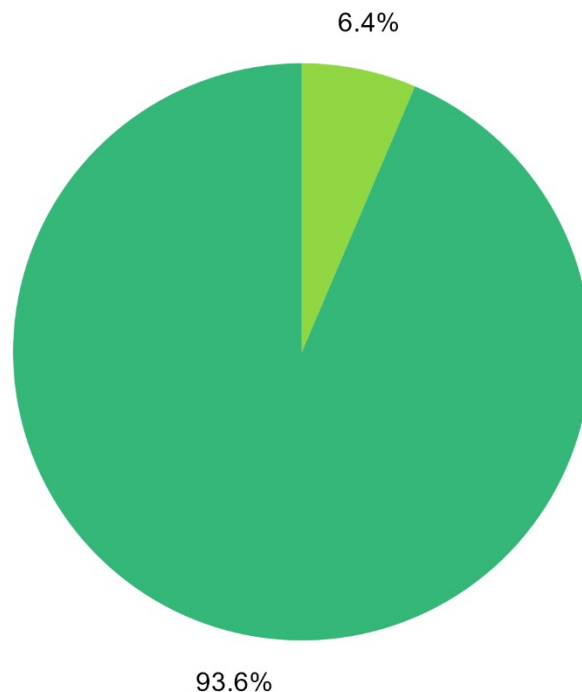


- Forest (5211.63 acres [93.6%]),
- Grassland/Shrubs (270.88 acres [4.9%]),
- Urban/Developed (81.95 acres [1.5%]),
- Wetlands (1.94 acres [0%]),
- Barren (0.67 acres [0%]),
- Open Water (0.22 acres [0%]), and
- Agriculture (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Freshwater Creek at County Park



Category ■ Forest ■ Other

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

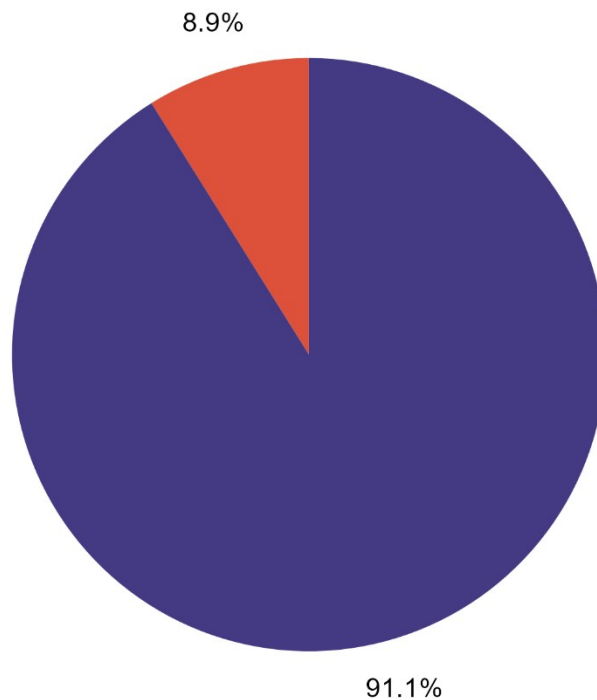
**Figure A-26 Percentage coverage by land cover category in the Freshwater Creek at County Park watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-27 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (5076.72 acres [91.1%]),
- Developed Unsewered (493.97 acres [8.9%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Freshwater Creek at County Park



Category  Developed Unsewered  Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-27 Percentage coverage by land use category in the Freshwater Creek at County Park watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-28 below.

Specifically, the marker detection percentage in the dry sampling period were:

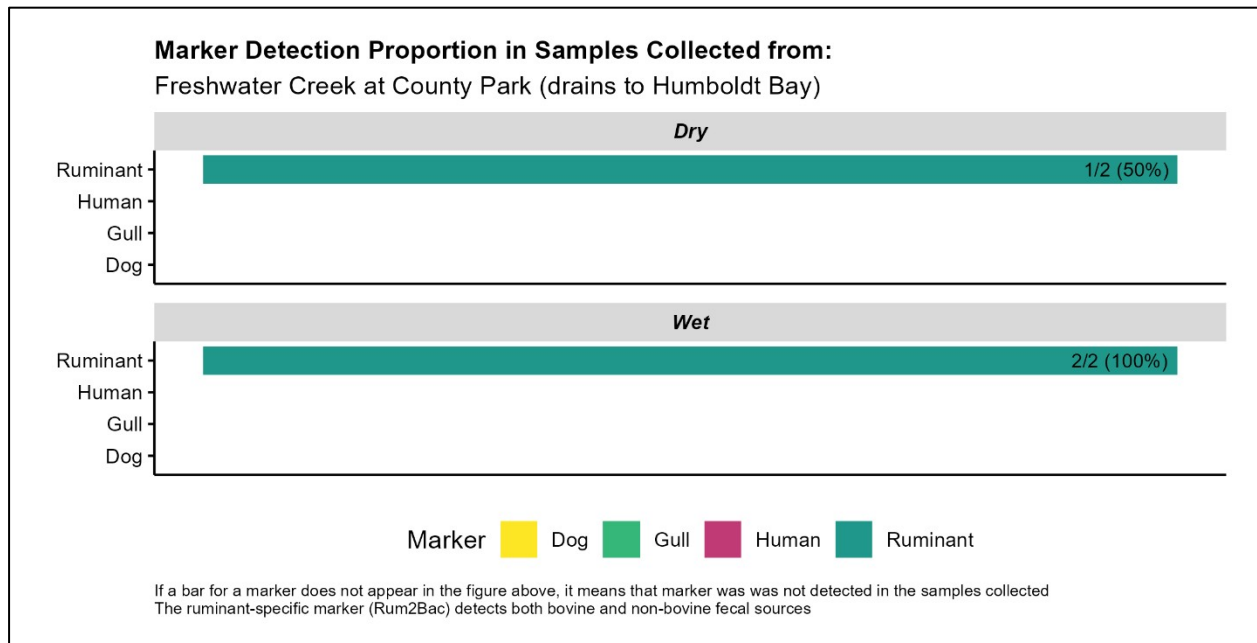
- Ruminant (1/2 [50%]),
- Dog (0/2 [0%]),

- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (0/2 [0%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-28 Detection percentage of species-specific markers evaluated in samples collected from the Freshwater Creek at County Park station**

**Gannon Slough at Highway 101 (110GS1625):**

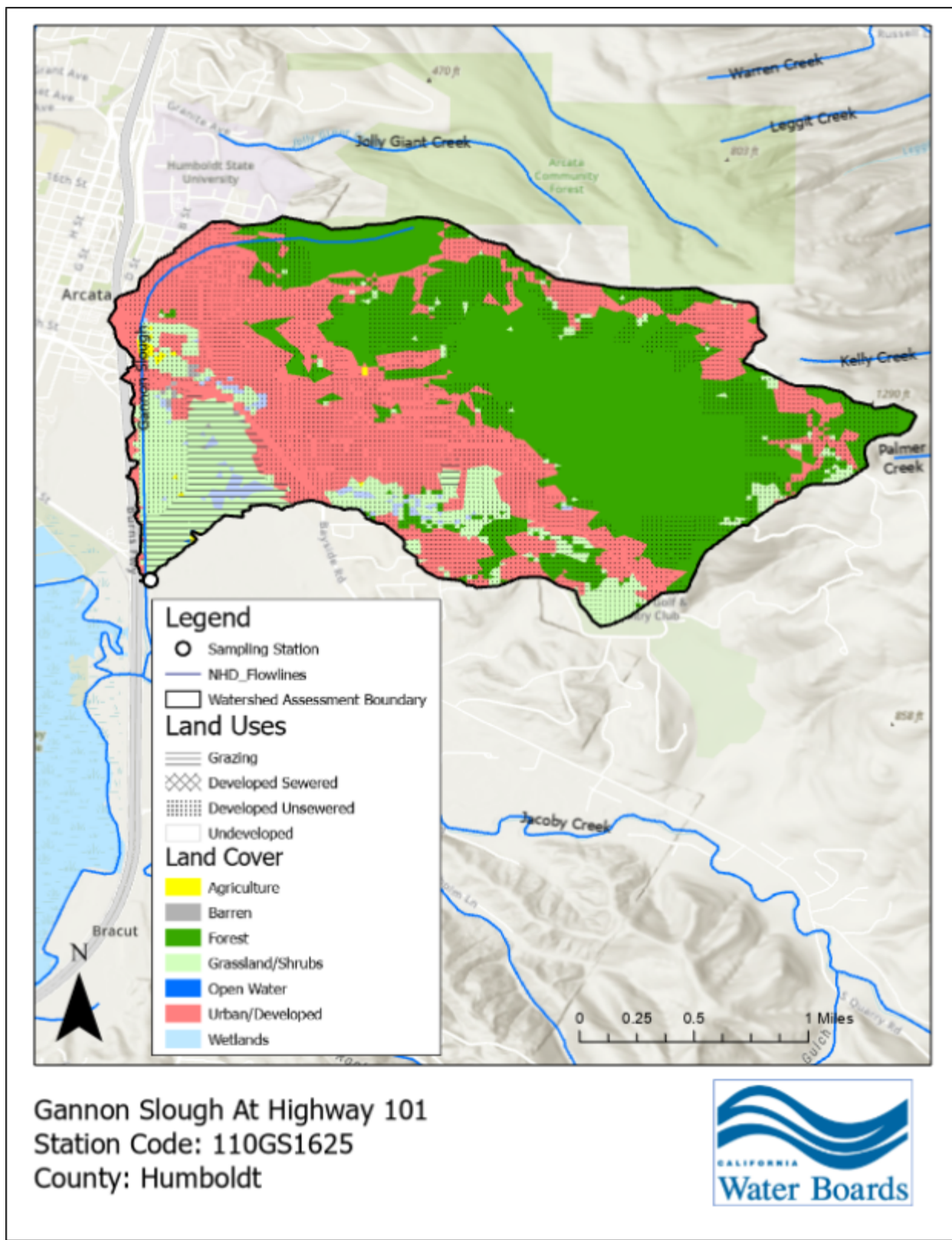
This station was sampled as part of the Impaired Streams Monitoring Study of the Coastal Pathogen Project.

This is a saline sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. This station has not been assessed for impairment of beneficial use. The enterococcus data collected from this saline sampling station was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (3/11),
- Winter (1/5), and
- Summer (2/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-29 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-29 Land cover and land use in the Gannon Slough at Highway 101 watershed**

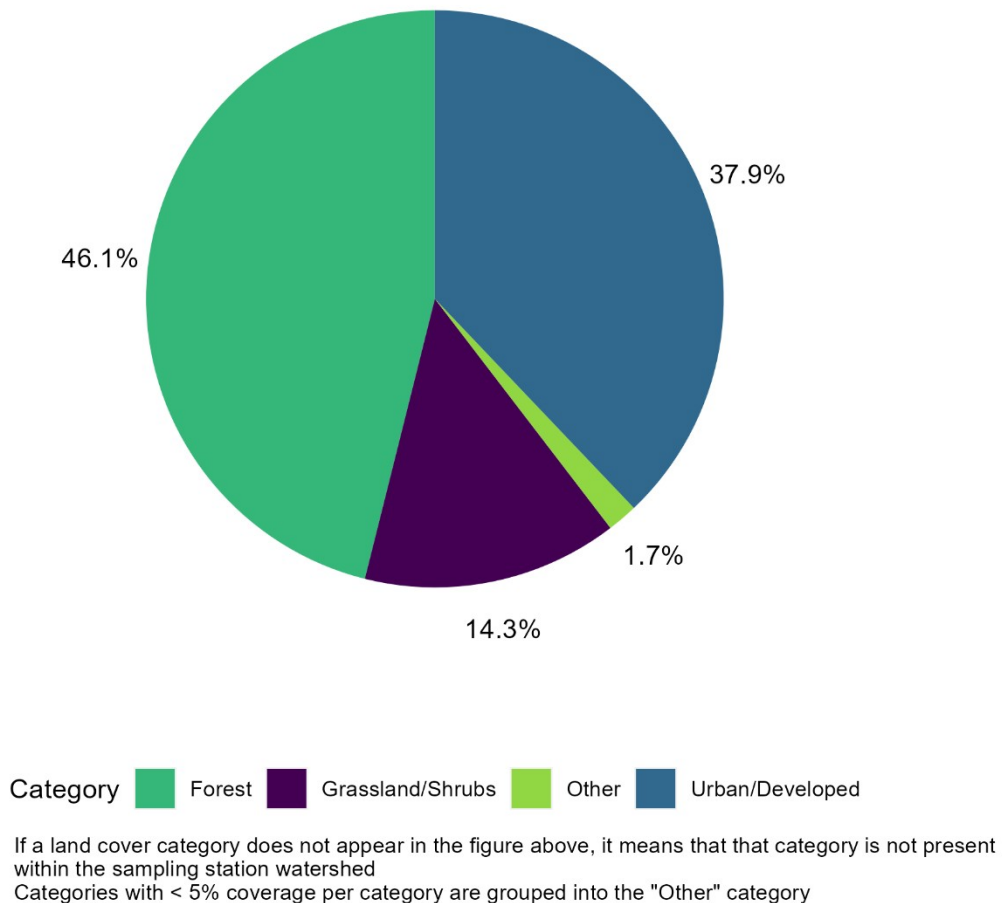
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-30 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (868.11 acres [46.1%]),
- Urban/Developed (714.59 acres [37.9%]),
- Grassland/Shrubs (270.27 acres [14.3%]),
- Wetlands (23.22 acres [1.2%]),
- Agriculture (4.78 acres [0.3%]),
- Barren (3.41 acres [0.2%]), and
- Open Water (0.25 acres [0%]).

Please note in the figure, that any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Gannon Slough at Highway 101



**Figure A-30 Percentage coverage by land cover category in the Gannon Slough at Highway 101 watershed**

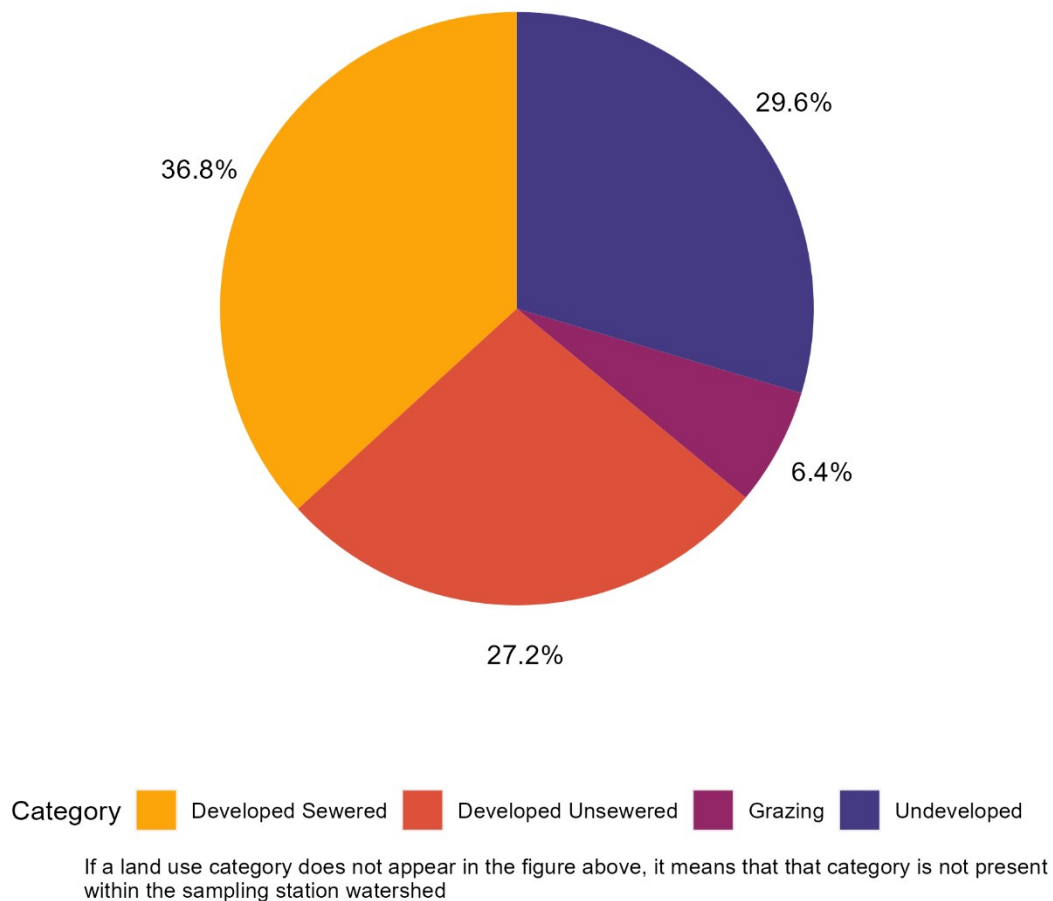
Land use categories observed in the watershed of this sampling station are illustrated in Figure A-31 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (654.91 acres [36.8%]),
- Undeveloped (526.98 acres [29.6%]),
- Developed Unsewered (482.83 acres [27.2%]), and
- Grazing (113.19 acres [6.4%]).



## Land Use

Humboldt County: Gannon Slough at Highway 101



**Figure A-31 Percentage coverage by land use category in the Gannon Slough at Highway 101 watershed**

Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-32 below.

Specifically, the marker detection percentage in the dry sampling period were:

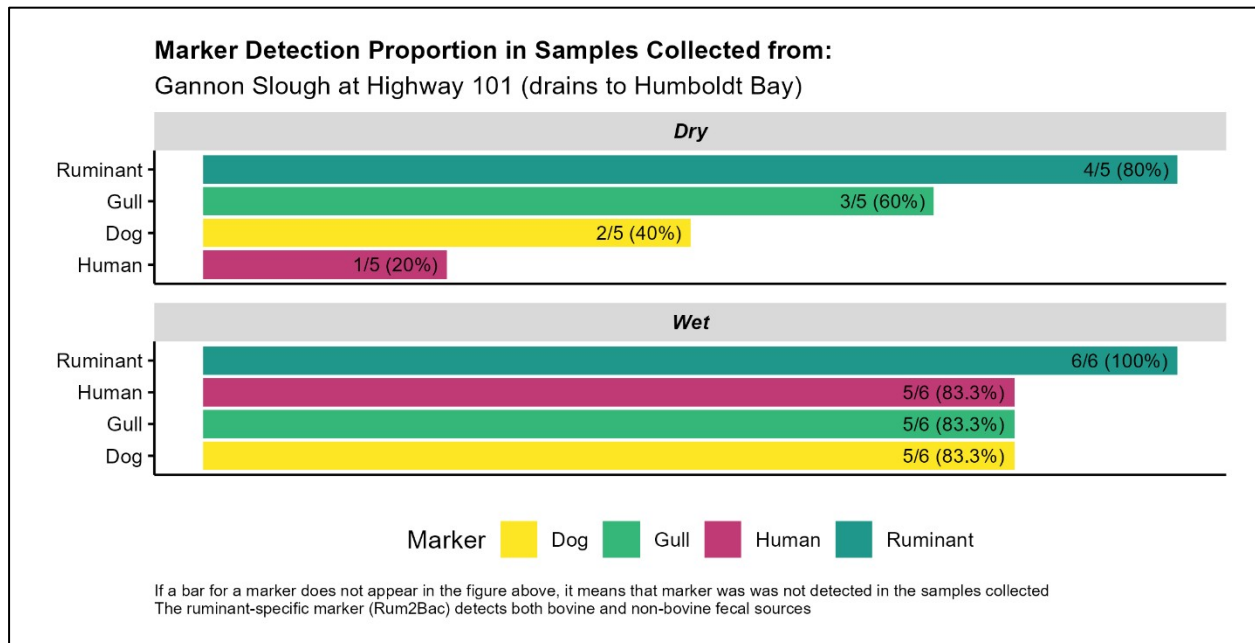
- Ruminant (4/5 [80%]),
- Gull (3/5 [60%]),

- Dog (2/5 [40%]), and
- Human (1/5 [20%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (6/6 [100%]),
- Dog (5/6 [83.3%]),
- Gull (5/6 [83.3%]), and
- Human (5/6 [83.3%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-32 Detection percentage of species-specific markers evaluated in samples collected from the Gannon Slough at Highway 101 station**

**Graham Gulch at Pacific Lumber Camp Road (110GG0100):**

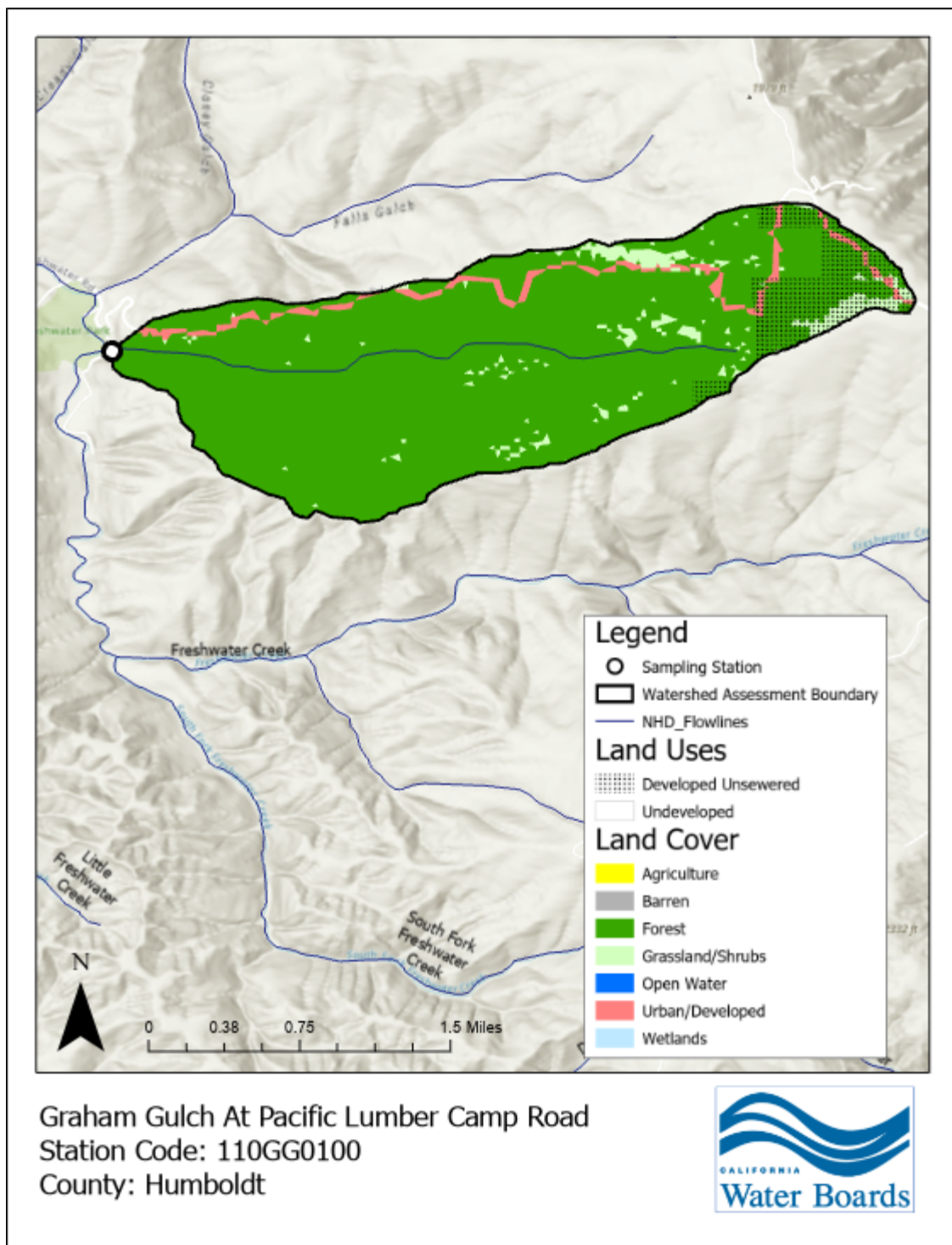
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-33 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-33 Land cover and land use in the Graham Gulch at Pacific Lumber Camp Road watershed**

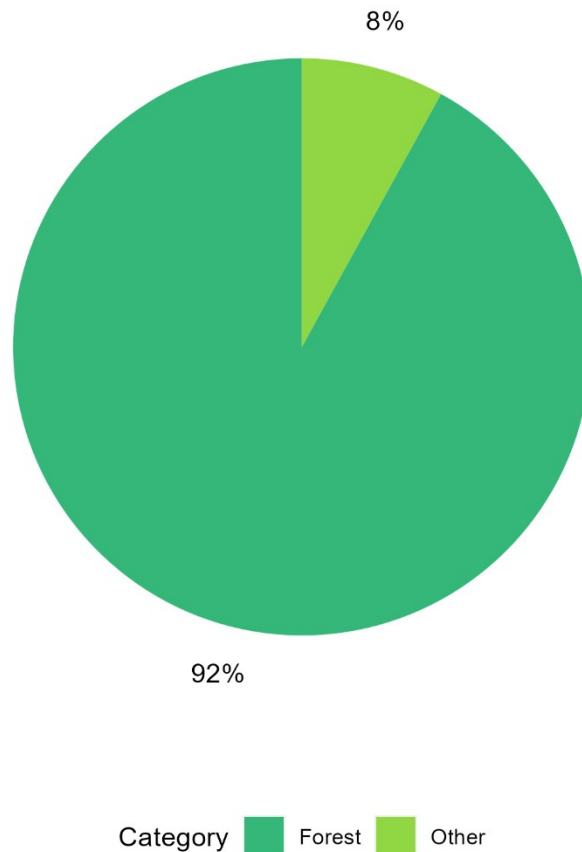
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-34 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1476.11 acres [92%]),
- Grassland/Shrubs (68.81 acres [4.3%]),
- Urban/Developed (59 acres [3.7%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Graham Gulch at Pacific Lumber Camp Road



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

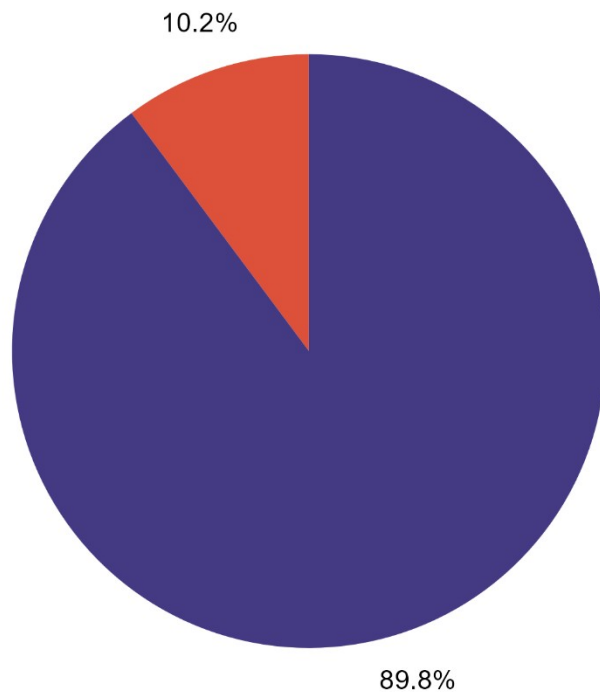
**Figure A-34 Percentage coverage by land cover category in the Graham Gulch at Pacific Lumber Camp Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-35 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (1441.68 acres [89.8%]),
- Developed Unsewered (163.21 acres [10.2%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Graham Gulch at Pacific Lumber Camp Road



Category  Developed Unsewered  Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-35 Percentage coverage by land use category in the Graham Gulch at Pacific Lumber Camp Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-36 below.

Specifically, the marker detection percentage in the dry sampling period were:

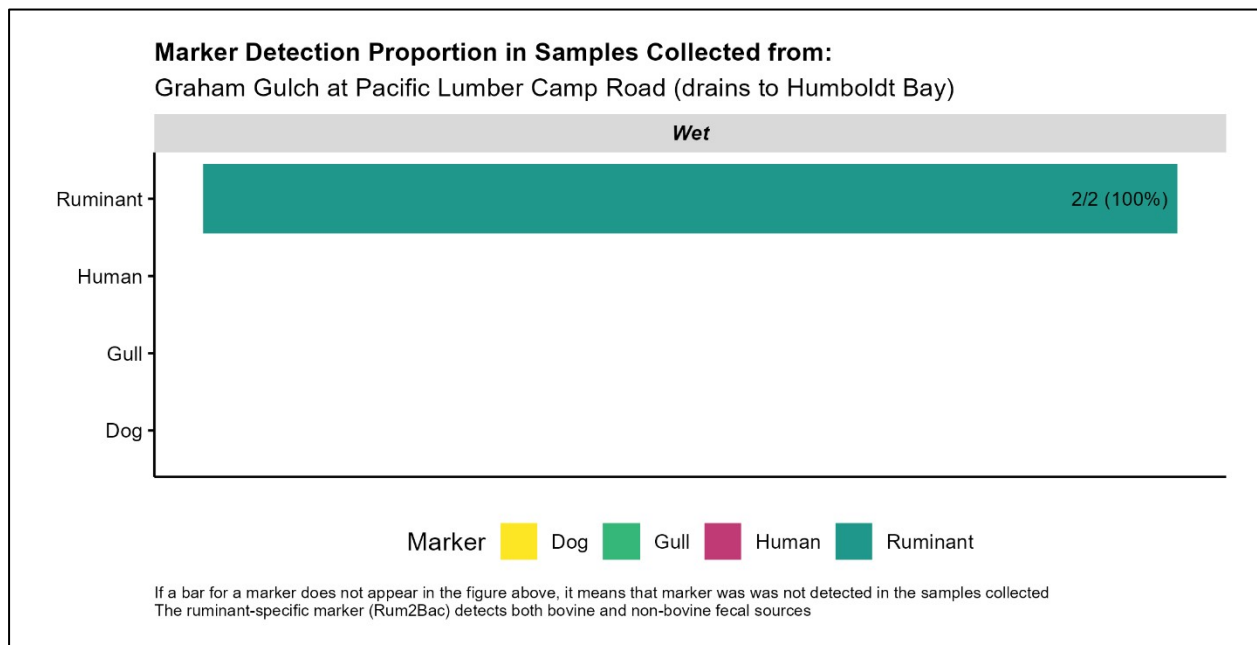
- Dog (0/2 [0%]),

- Gull (0/2 [0%]),
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (0/2 [0%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Please note that if a marker does not appear in the figure below then that marker was not detected in the samples collected.



**Figure A-36 Detection percentage of species-specific markers evaluated in samples collected from the Graham Gulch at Pacific Lumber Camp Road station**



### **Grotzman Creek at Bayside Road (110GR0500):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/2), and
- Summer (1/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. The Grotzman Creek at Bayside Road sampling station is located in the unincorporated community of Sunny Brae. The headwaters of the creek are primarily a forested land covered area, then flows through an urban and developed land covered area where the sampling station is located. Other land cover types are not well represented in the upstream area of the sampling station. This sampling station is located in a sewer district and was selected to assess the impacts of sewers.

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. However, FIB, and MST data from one dry weather sample collected at this station are missing. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-37 below.

Specifically, the marker detection percentage in the dry sampling period were:

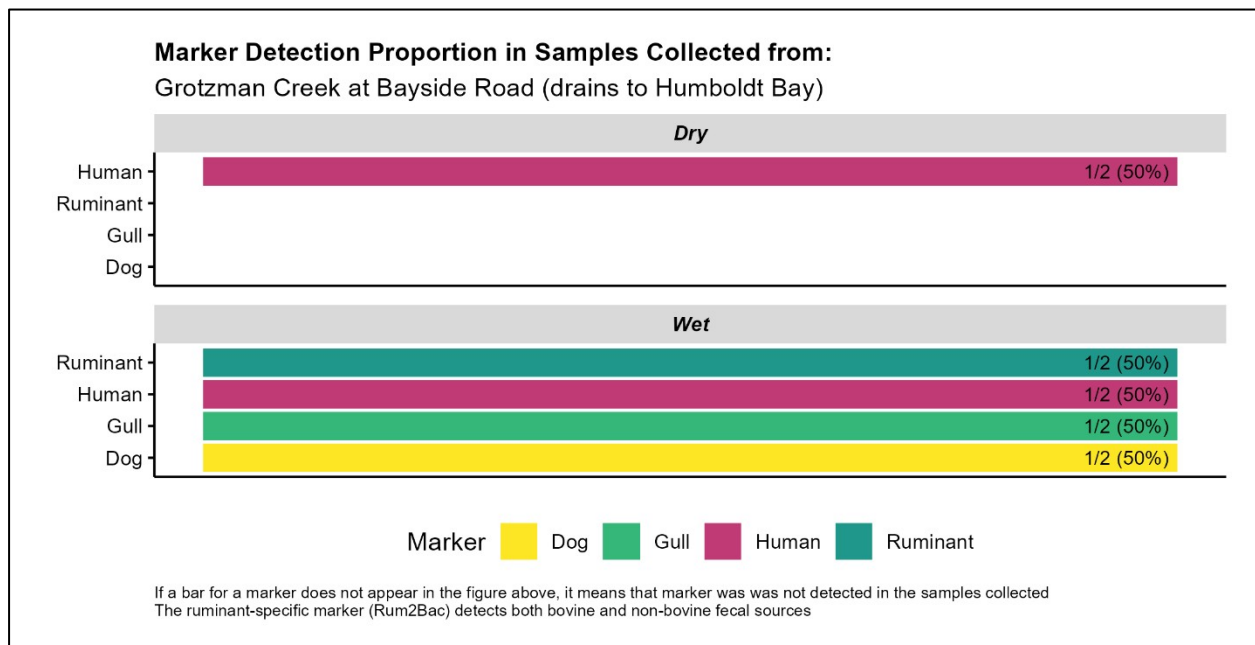
- Human (1/1 [100%]),

- Dog (0/1 [0%]),
- Gull (0/1 [0%]), and
- Ruminant (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Gull (1/2 [50%]),
- Human (1/2 [50%]), and
- Ruminant (1/2 [50%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-37 Detection percentage of species-specific markers evaluated in samples collected from the Grotzman Creek at Bayside Road station**

**Jacoby Creek at Jacoby Creek Road (110JC6316):**

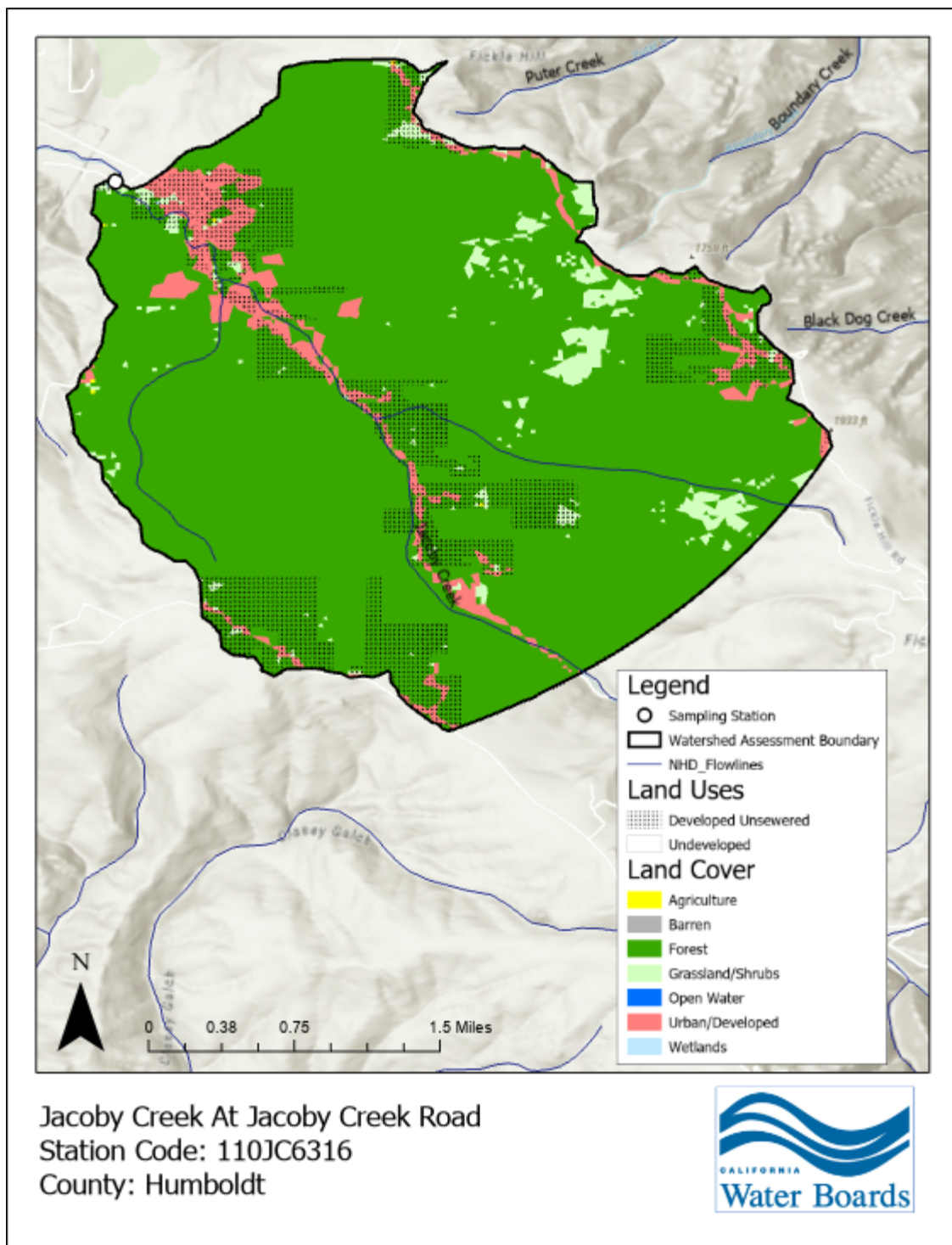
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-38 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-38 Land cover and land use in the Jacoby Creek at Jacoby Creek Road watershed**

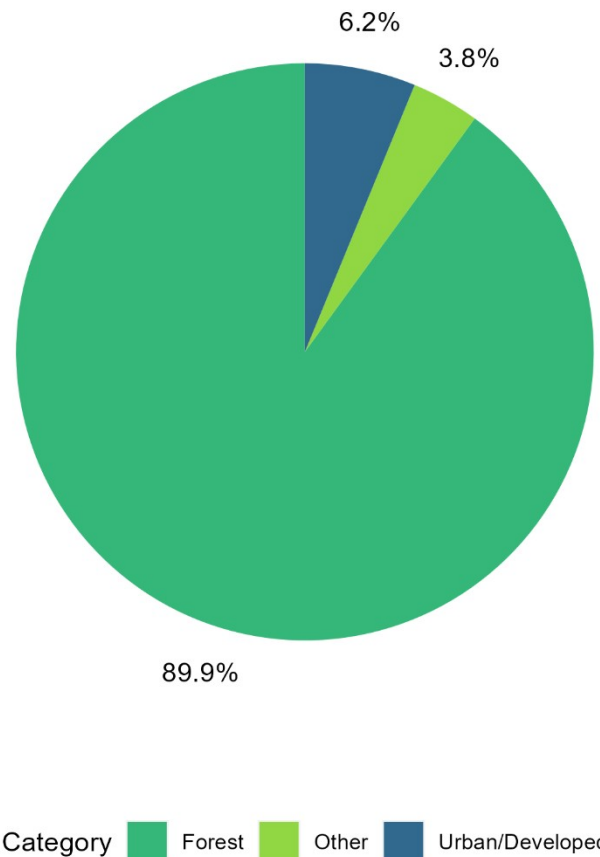
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-39 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (3757.42 acres [89.9%]),
- Urban/Developed (260.22 acres [6.2%]),
- Grassland/Shrubs (158.6 acres [3.8%]),
- Agriculture (1.47 acres [0%]),
- Wetlands (0.36 acres [0%]),
- Barren (0.06 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jacoby Creek at Jacoby Creek Road

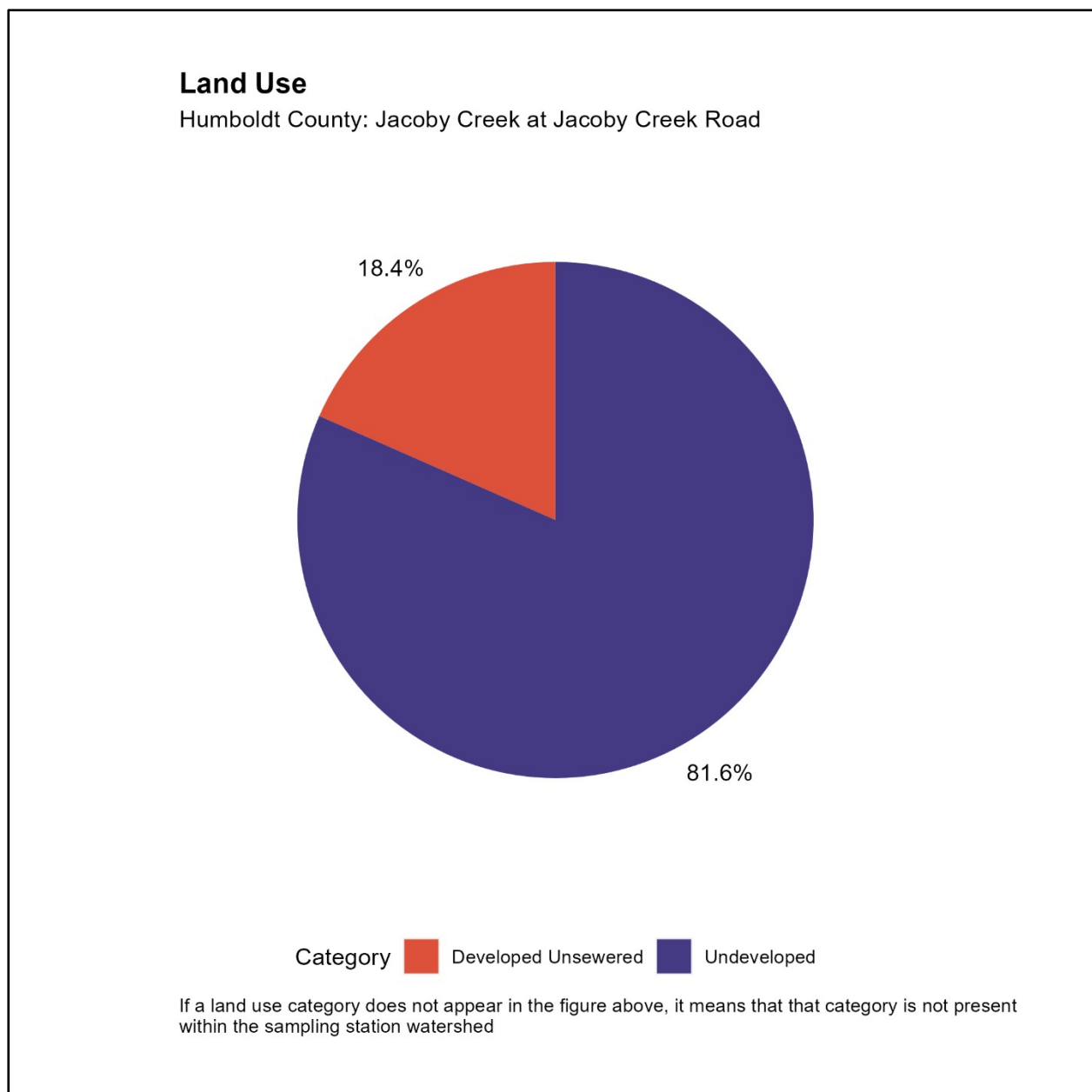


If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure A-39 Percentage coverage by land cover category in the Jacoby Creek at Jacoby Creek Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-40 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (3407.29 acres [81.6%]),
- Developed Unsewered (767.81 acres [18.4%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).



**Figure A-40 Percentage coverage by land use category in the Jacoby Creek at Jacoby Creek Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-41 below.

Specifically, the marker detection percentage in the dry sampling period were:

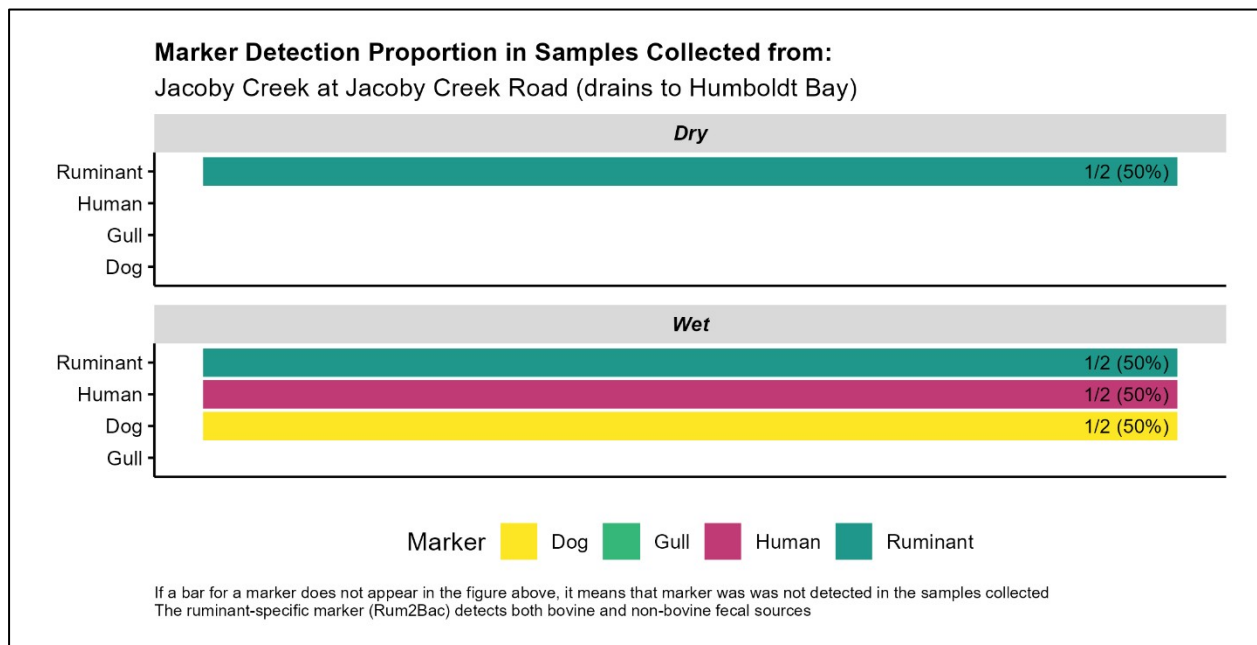
- Ruminant (1/2 [50%]),

- Dog (0/2 [0%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Human (1/2 [50%]),
- Ruminant (1/2 [50%]), and
- Gull (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-41 Detection percentage of species-specific markers evaluated in samples collected from the Jacoby Creek at Jacoby Creek Road station**



**Jacoby Creek at Old Arcata Road (110JC0966):**

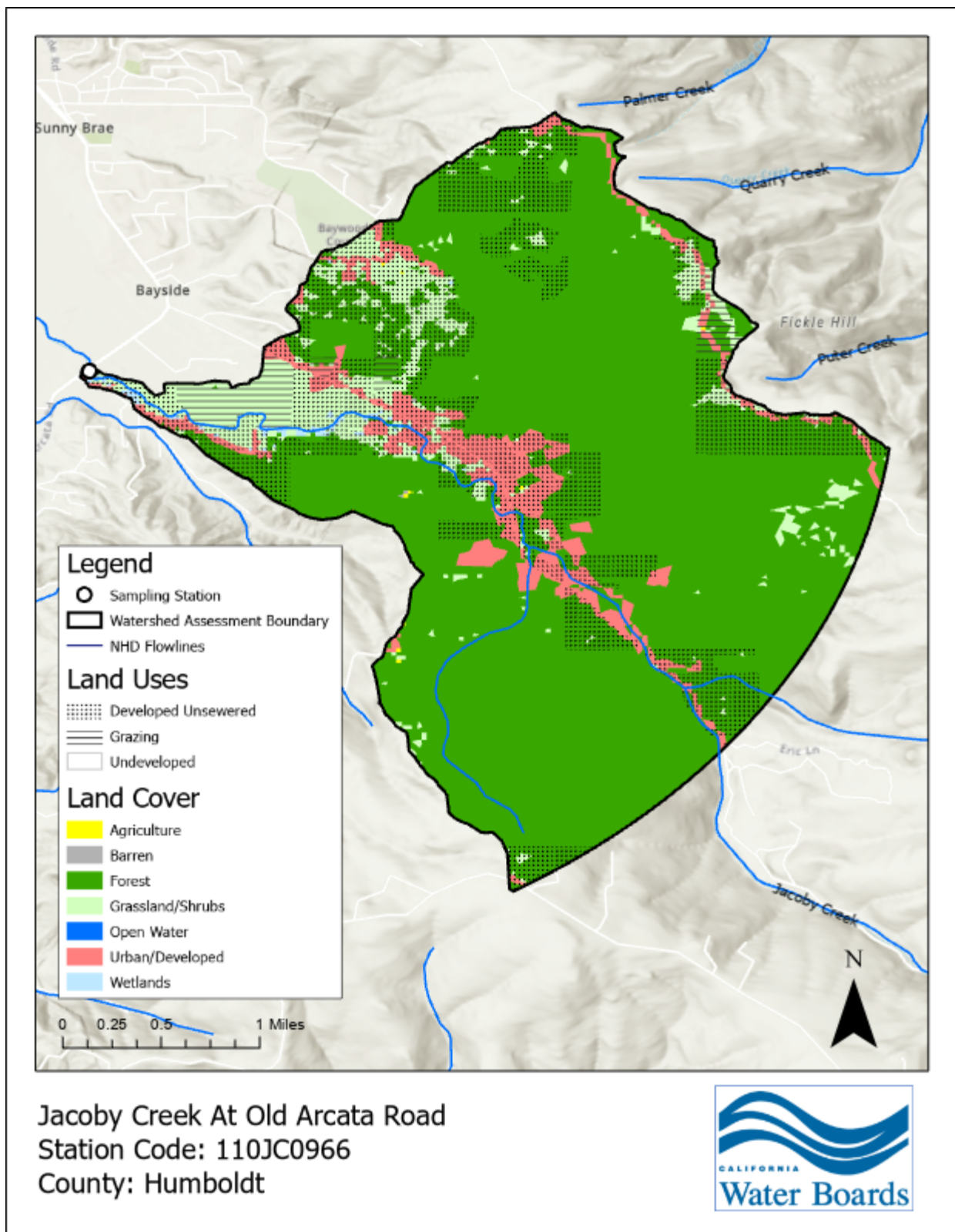
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/2), and
- Summer (1/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-42 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-42 Land cover and land use in the Jacoby Creek at Old Arcata Road watershed**

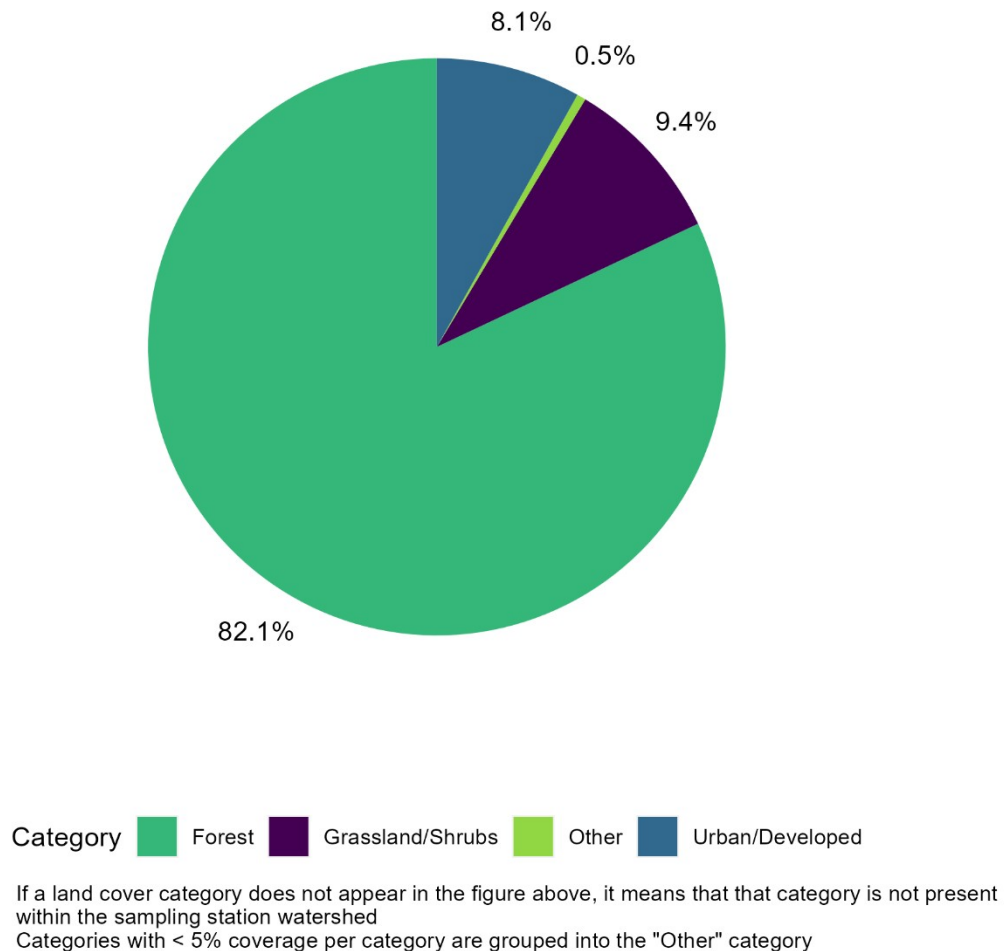
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-43 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (3003.47 acres [82.1%]),
- Grassland/Shrubs (345.35 acres [9.4%]),
- Urban/Developed (294.8 acres [8.1%]),
- Wetlands (13.88 acres [0.4%]),
- Agriculture (1.78 acres [0.1%]),
- Barren (0.62 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jacoby Creek at Old Arcata Road



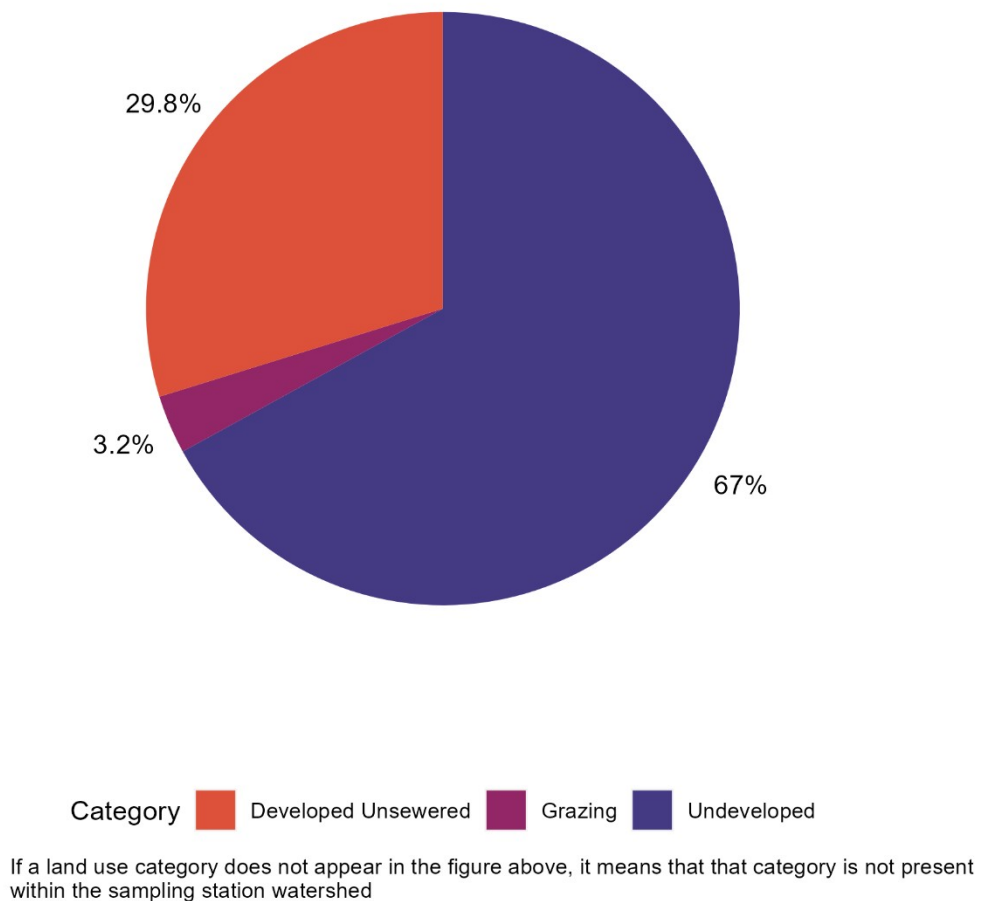
**Figure A-43 Percentage coverage by land cover category in the Jacoby Creek at Old Arcata Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-44 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (2443.03 acres [67%]),
- Developed Unsewered (1085.19 acres [29.8%]),
- Grazing (116.64 acres [3.2%]), and
- Developed Sewered (0 acres [0%]).

## Land Use

Humboldt County: Jacoby Creek at Old Arcata Road



**Figure A-44 Percentage coverage by land use category in the Jacoby Creek at Old Arcata Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-45 below.

Specifically, the marker detection percentage in the dry sampling period were:

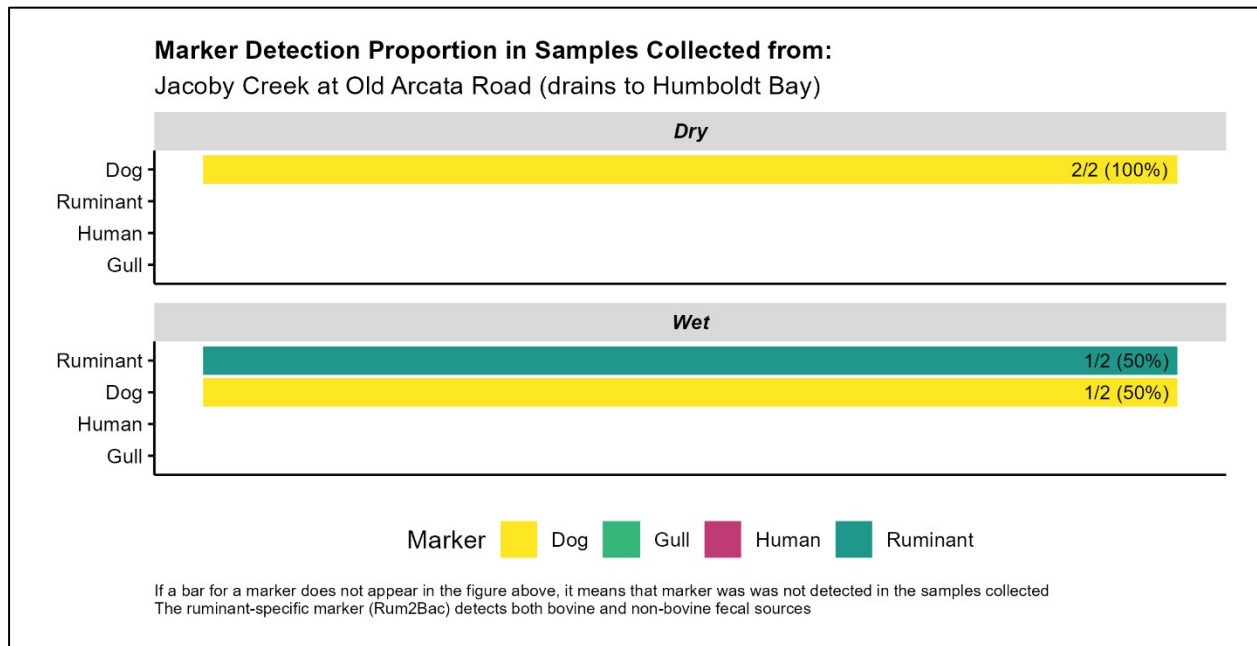
- Dog (2/2 [100%]),
- Gull (0/2 [0%]),

- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Ruminant (1/2 [50%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-45 Detection percentage of species-specific markers evaluated in samples collected from the Jacoby Creek at Old Arcata Road station**

**Jolly Giant Creek at Samoa Boulevard (110JG0264) (Impaired Streams Monitoring Study):**

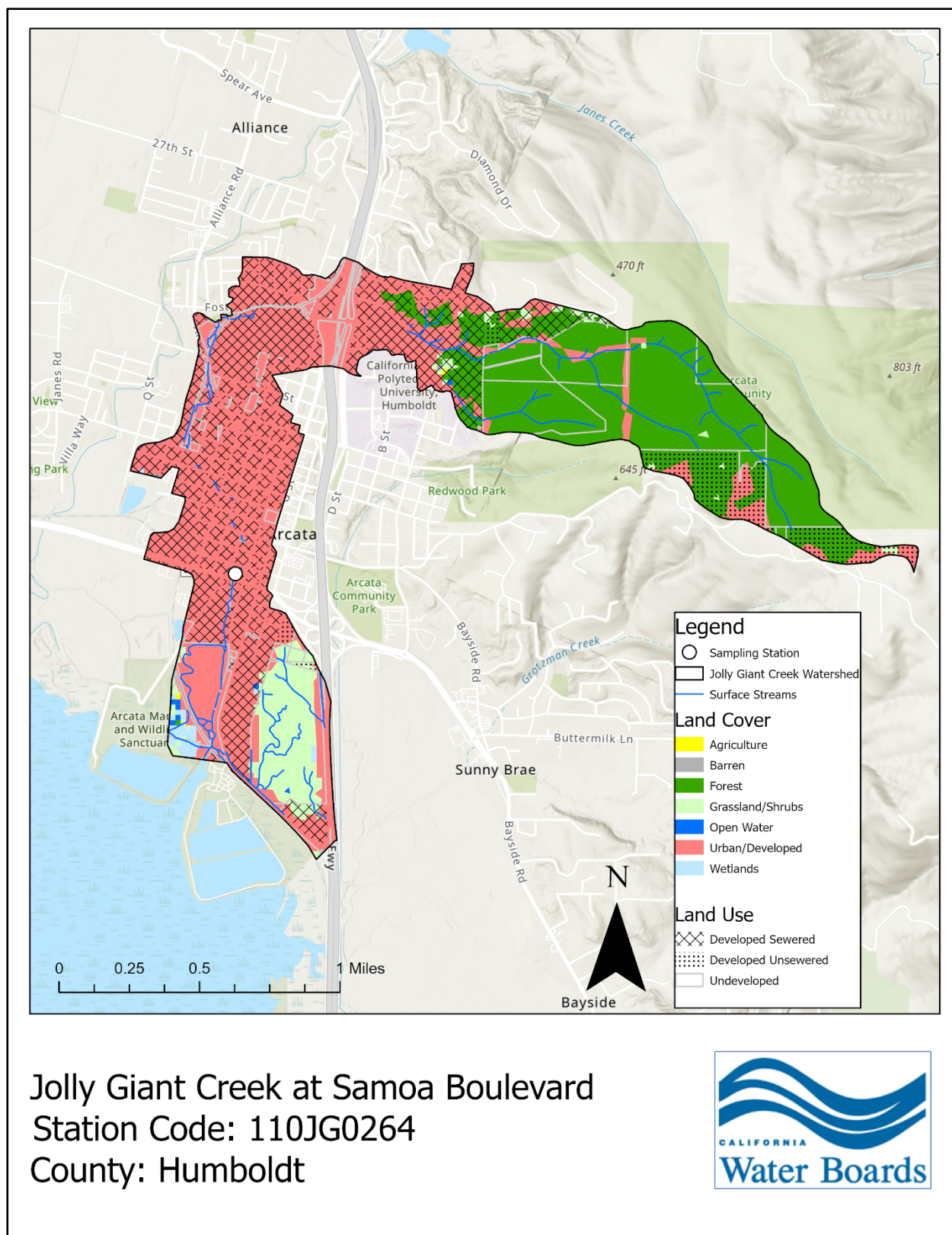
This station was sampled as part of the Impaired Streams Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (9/11),
- Winter (3/5), and
- Summer (6/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-46 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-46 Land Cover and Land Use in the Jolly Giant Creek at Samoa Boulevard watershed**



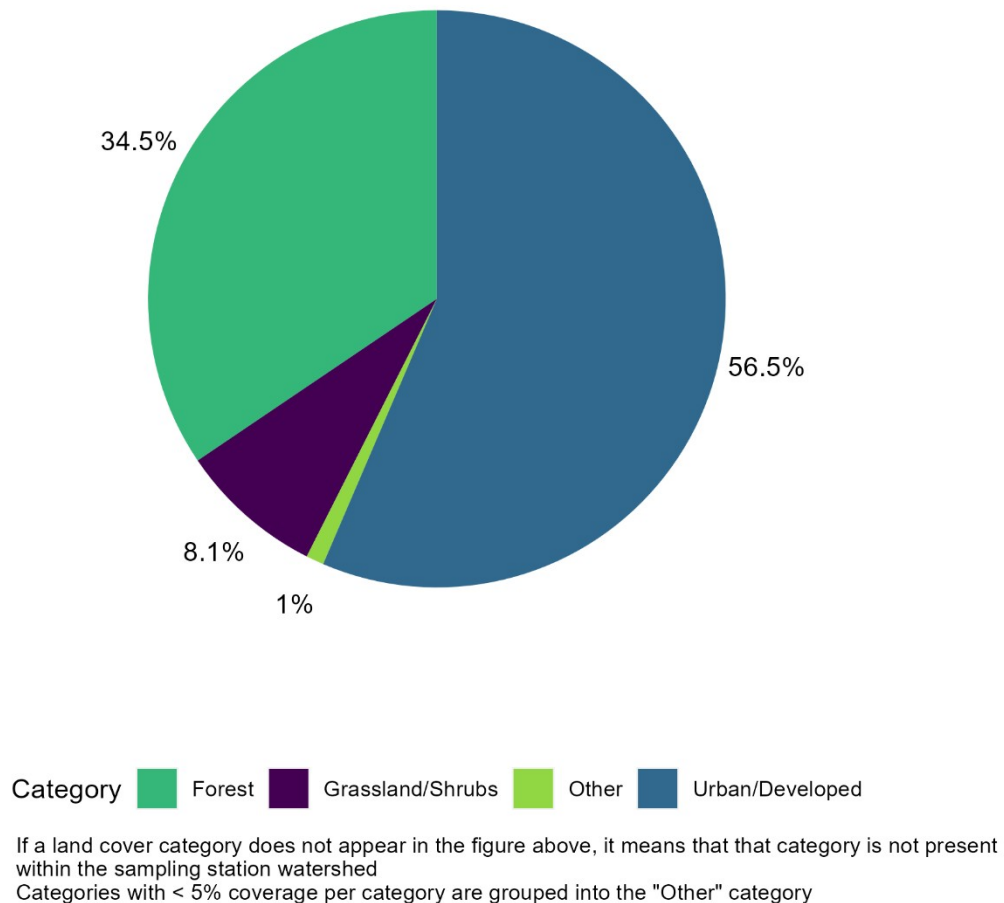
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard

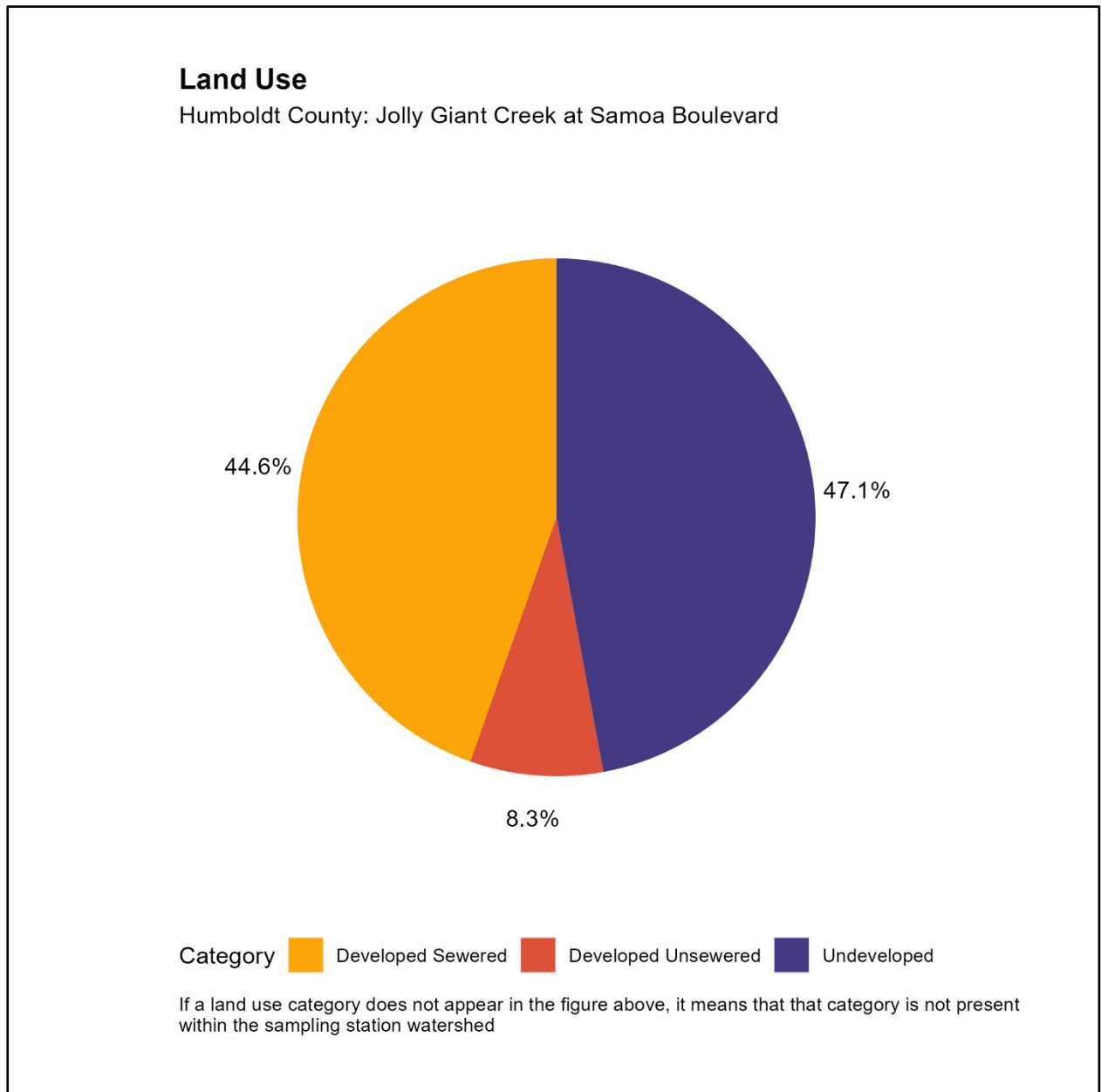


**Figure A-47 Percentage coverage by land cover category in the Jolly Giant Creek at Samoa Boulevard watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])

- Grazing (0 acres [0%])



**Figure A-48 Percentage coverage by land use category in the Jolly Giant Creek at Samoa Boulevard watershed**

Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-49 below.

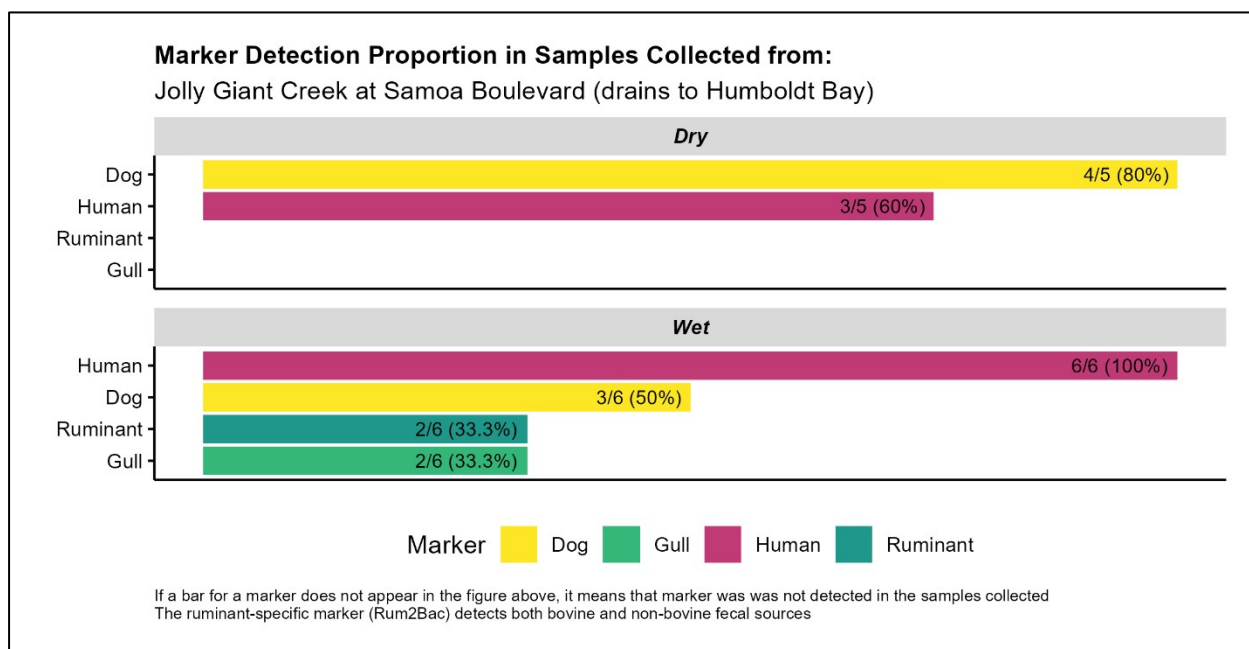
Specifically, the marker detection percentage in the dry sampling period were:

- Dog (4/5 [80%]),
- Human (3/5 [60%]),
- Gull (0/5 [0%]), and
- Ruminant (0/5 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Human (6/6 [100%]),
- Dog (3/6 [50%]),
- Gull (2/6 [33.3%]), and
- Ruminant (2/6 [33.3%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-49 Detection percentage of species-specific markers evaluated in samples collected from the Jolly Giant Creek at Samoa Boulevard station**

### **Liscom Slough at Jackson Road (110UNSJXN):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The enterococcus data collected from this saline sampling station was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (3/4),
- Winter (3/3), and
- Summer (0/1).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. The Liscom Slough at Jackson Road sampling station is located in Arcata Bottoms. The primary upstream land covers are grassland, shrubland, and agriculture. Liscom Slough also flows directly through dairy parcels. This site was selected to assess the impacts of cattle. Dairy cattle grazing is present upstream of this sampling station.

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-50 below.

Specifically, the marker detection percentage in the dry sampling period were:

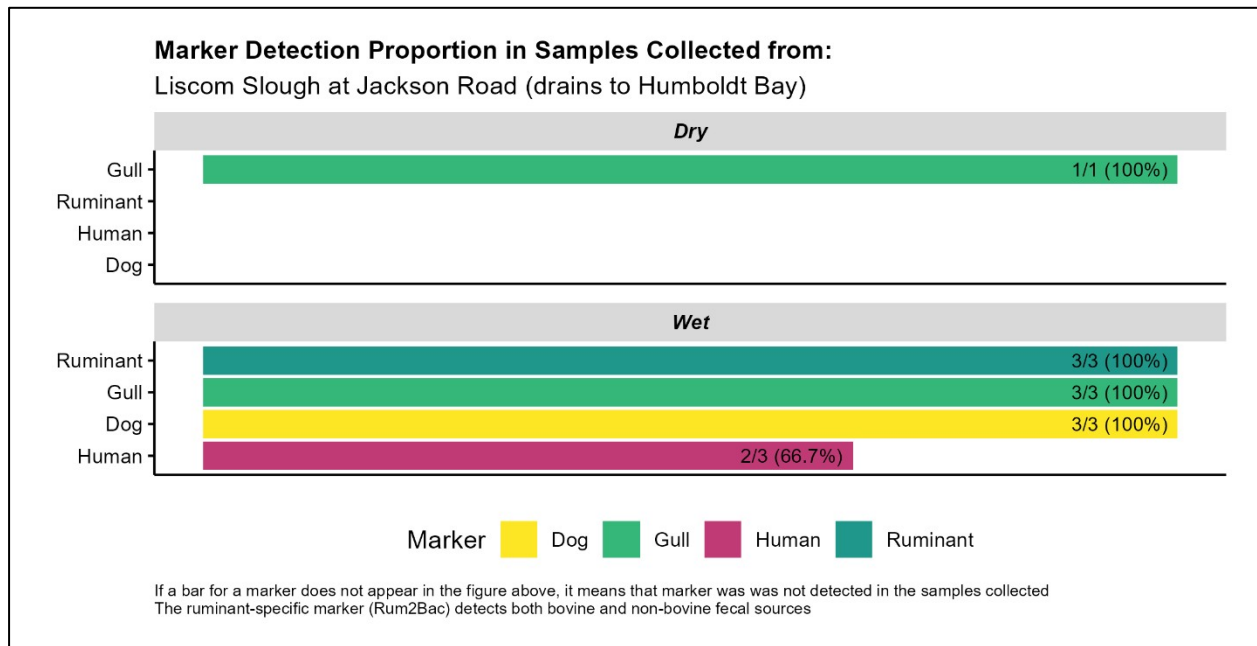
- Gull (1/1 [100%]),
- Dog (0/1 [0%]),
- Human (0/1 [0%]), and

- Ruminant (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/3 [100%]),
- Gull (3/3 [100%]),
- Ruminant (3/3 [100%]), and
- Human (2/3 [66.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-50 Detection percentage of species-specific markers evaluated in samples collected from the Liscom Slough at Jackson Road station**

**Martin Slough at Campton Street & Fern Street (110MS6750):**

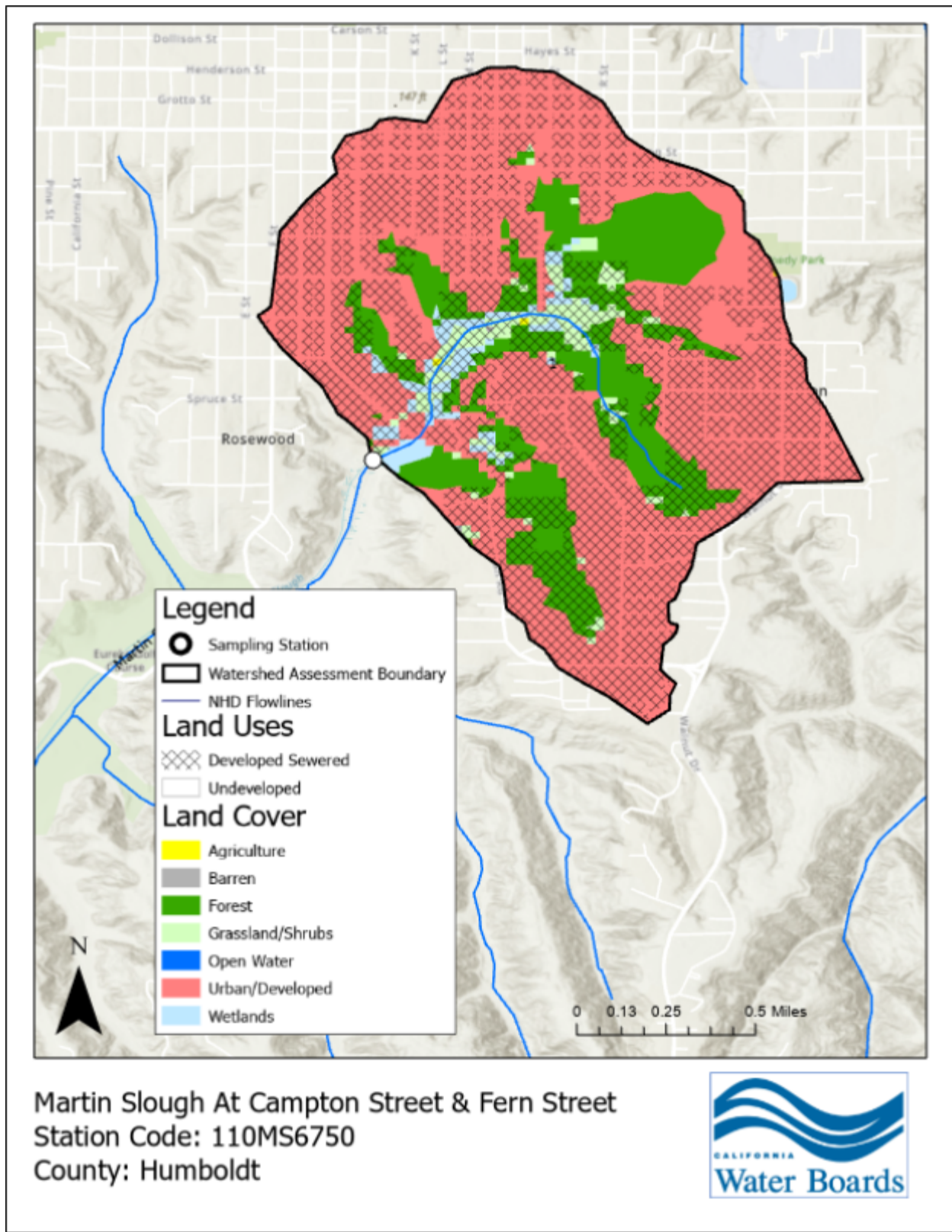
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (1/4),
- Winter (0/2), and
- Summer (1/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-51 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-51 Land cover and land use in the Martin Slough at Campton Street & Fern Street watershed**



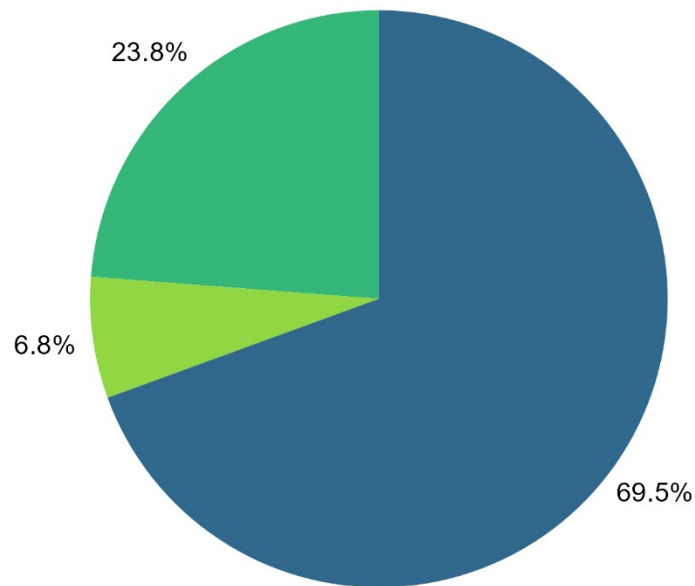
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-52 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (564.01 acres [69.5%]),
- Forest (193.02 acres [23.8%]),
- Grassland/Shrubs (29.6 acres [3.7%]),
- Wetlands (24.01 acres [3%]),
- Agriculture (0.5 acres [0.1%]),
- Barren (0.33 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Martin Slough at Campton Street & Fern Street



Category  Forest  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

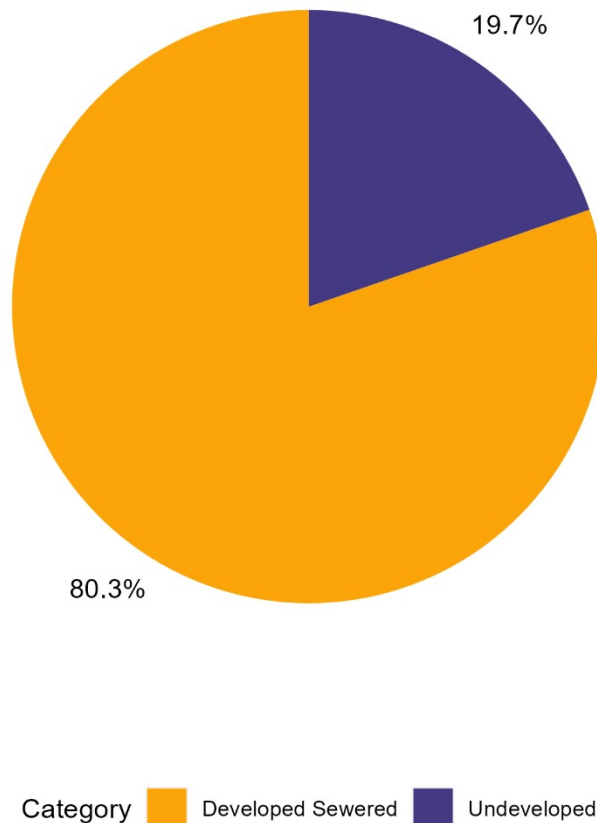
**Figure A-52 Percentage coverage by land cover category in the Martin Slough at Campton Street & Fern Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-53 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (553.67 acres [80.3%]),
- Undeveloped (135.81 acres [19.7%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Martin Slough at Campton Street & Fern Street



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-53 Percentage coverage by land use category in the Martin Slough at Campton Street & Fern Street watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-54 below.

Specifically, the marker detection percentage in the dry sampling period were:

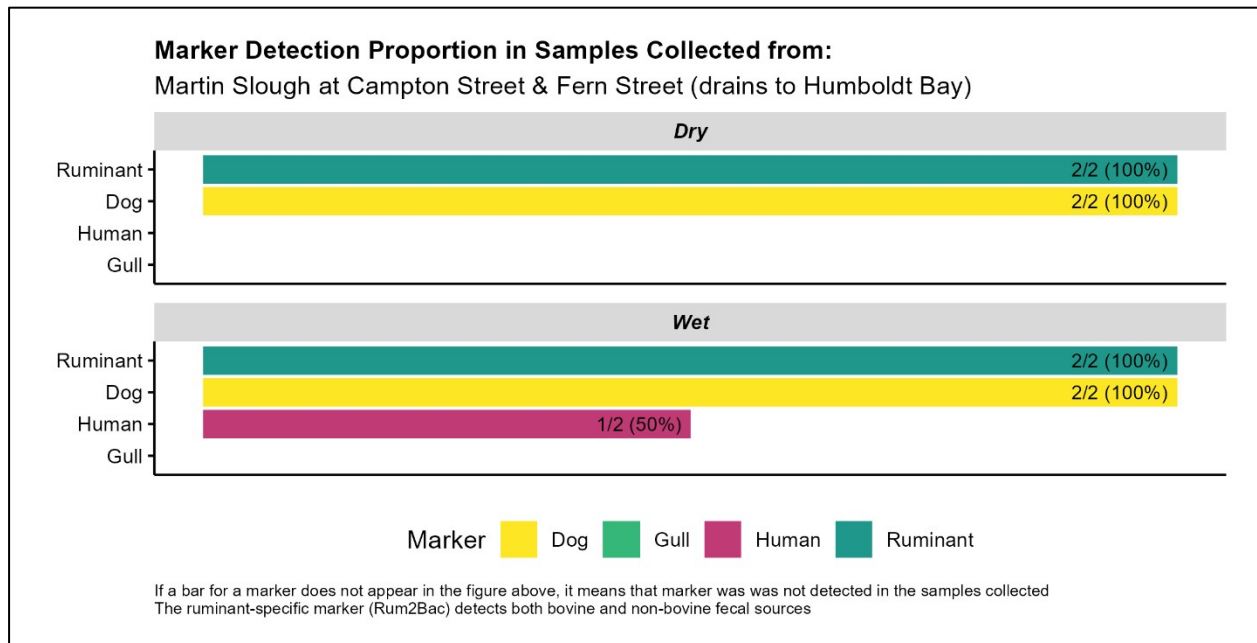
- Dog (2/2 [100%]),
- Ruminant (2/2 [100%]),

- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%]),
- Ruminant (2/2 [100%]),
- Human (1/2 [50%]), and
- Gull (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-54 Detection percentage of species-specific markers evaluated in samples collected from the Martin Slough at Campton Street & Fern Street station**

**Martin Slough at Pine Hill Road (110MS1481):**

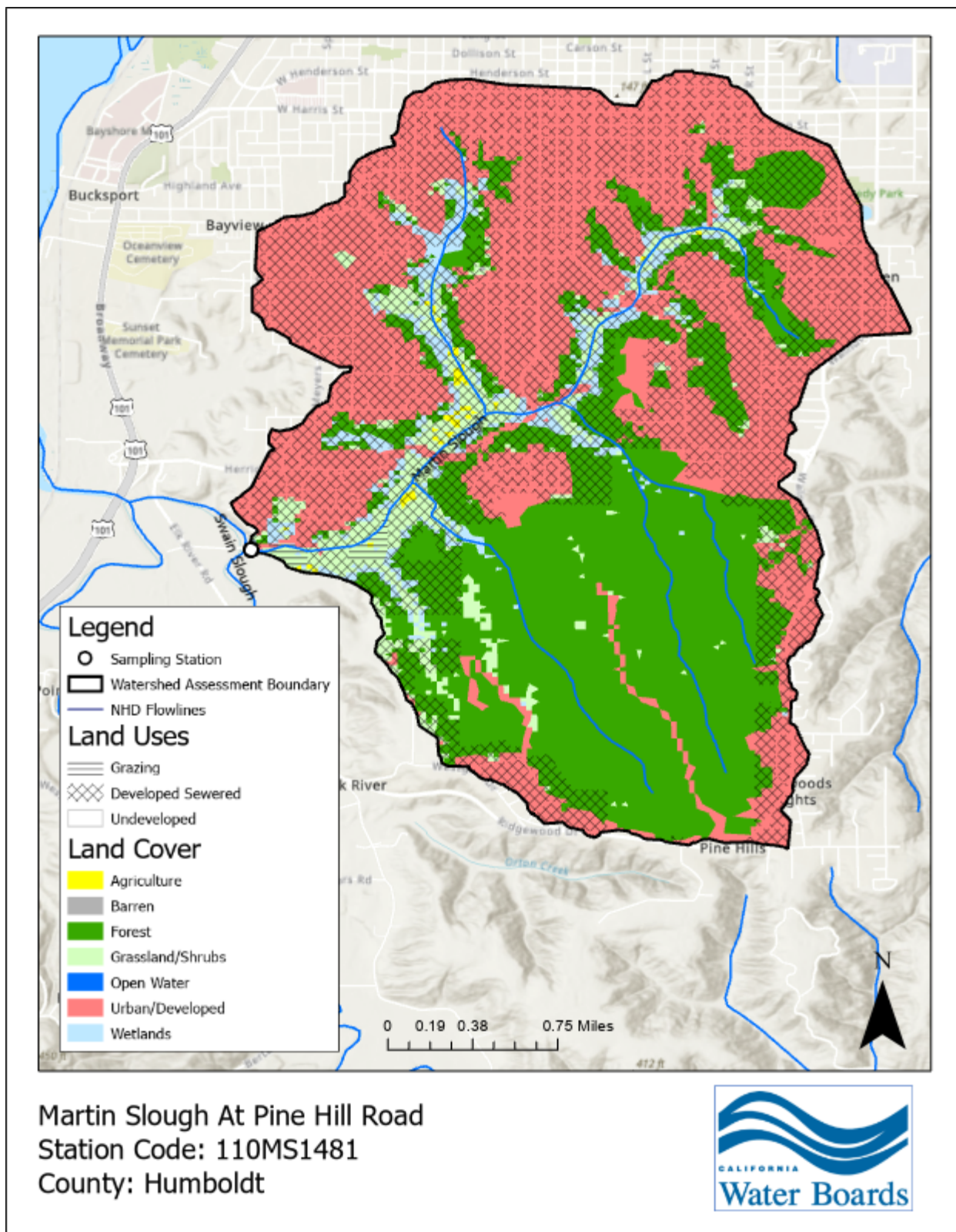
This station was sampled as part of the Impaired Streams Monitoring Study of the Coastal Pathogen Project.

This is a saline sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The enterococcus data collected from this saline sampling station was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (6/11),
- Winter (3/5), and
- Summer (3/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-55 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-55 Land cover and land use in the Martin Slough at Pine Hill Road watershed**

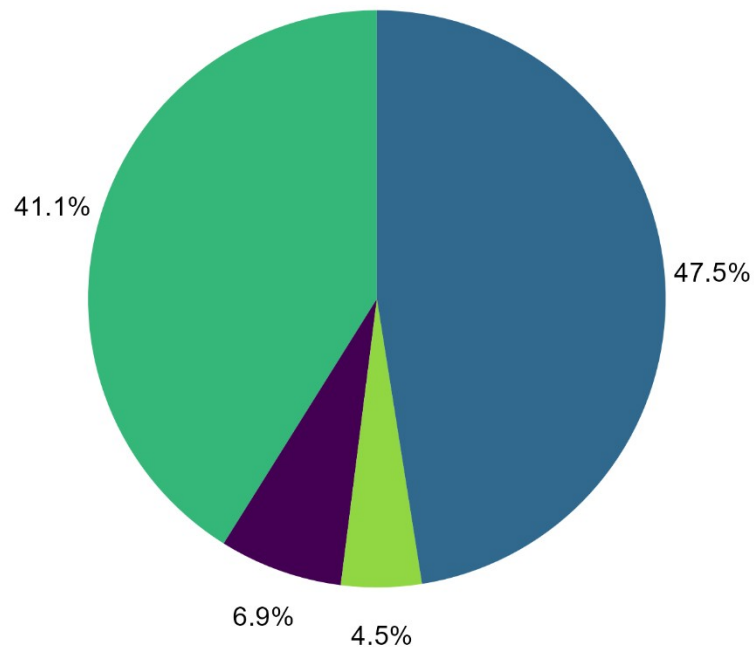
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-56 below. Specifically, the coverage of land cover categories in this watershed are:




- Urban/Developed (1590.01 acres [47.5%]),
- Forest (1376.08 acres [41.1%]),
- Grassland/Shrubs (231.6 acres [6.9%]),
- Wetlands (141.95 acres [4.2%]),
- Agriculture (10.36 acres [0.3%]),
- Barren (0.6 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Martin Slough at Pine Hill Road



Category  Forest  Grassland/Shrubs  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure A-56 Percentage coverage by land cover category in the Martin Slough at Pine Hill Road watershed**

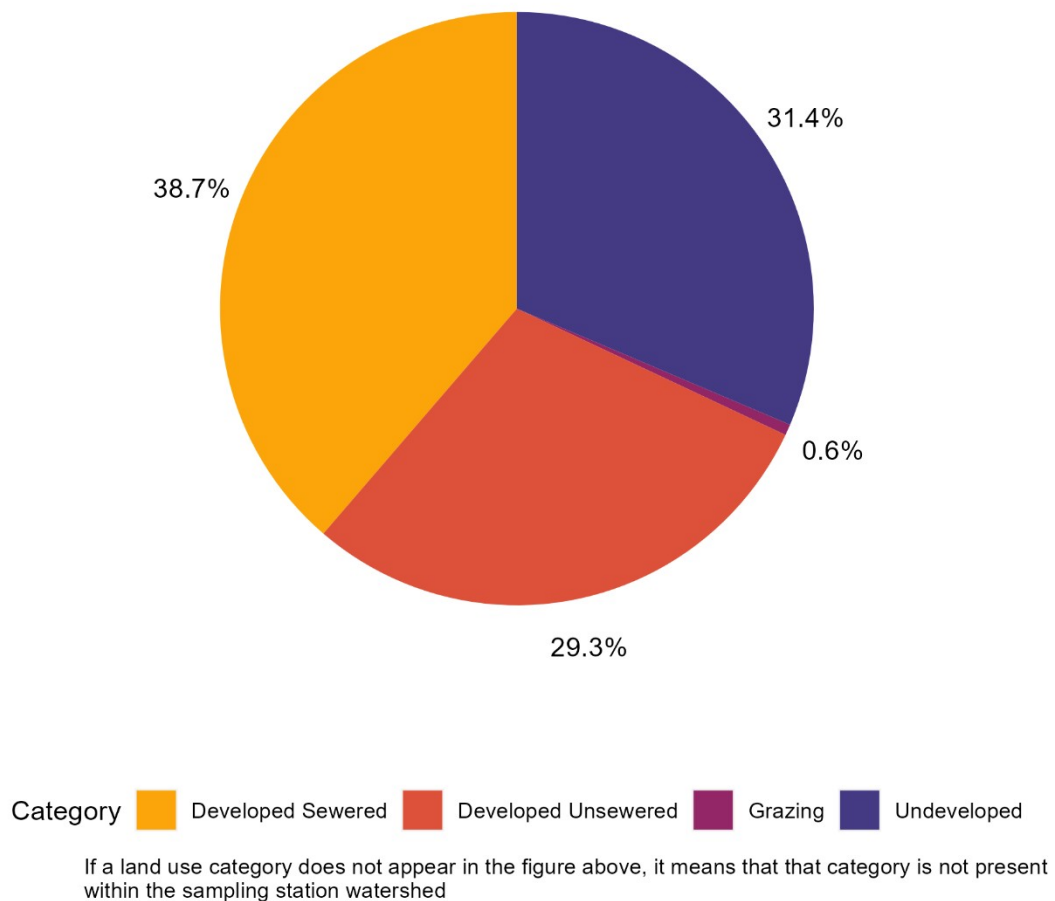
Land use categories observed in the watershed of this sampling station are illustrated in Figure A-57 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1186.37 acres [38.7%]),
- Undeveloped (960.41 acres [31.4%]),
- Developed Unsewered (898.01 acres [29.3%]), and
- Grazing (17.2 acres [0.6%]).



## Land Use

Humboldt County: Martin Slough at Pine Hill Road



**Figure A-57 Percentage coverage by land use category in the Martin Slough at Pine Hill Road watershed**

Eleven samples (six in the dry period, and five in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-58 below.

Specifically, the marker detection percentage in the dry sampling period were:

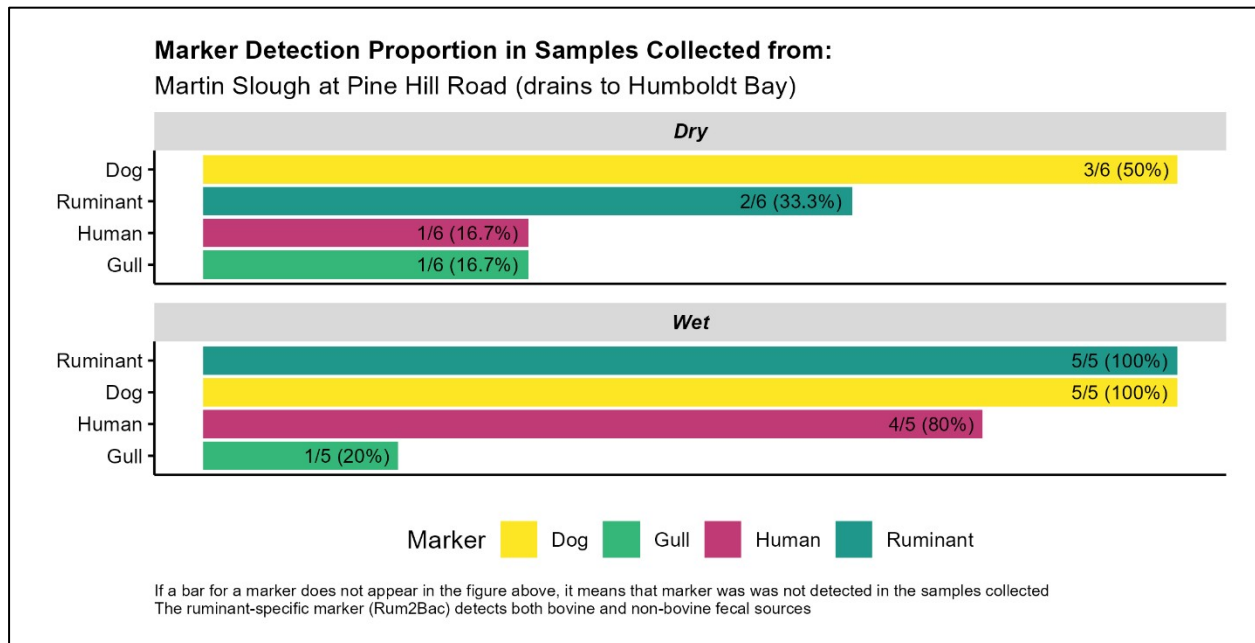
- Dog (3/6 [50%]),
- Ruminant (2/6 [33.3%]),

- Gull (1/6 [16.7%]), and
- Human (1/6 [16.7%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (5/5 [100%]),
- Ruminant (5/5 [100%]),
- Human (4/5 [80%]), and
- Gull (1/5 [20%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-58 Detection percentage of species-specific markers evaluated in samples collected from the Martin Slough at Pine Hill Road station**

**McDaniel Slough at Q Street (110MD3750):**

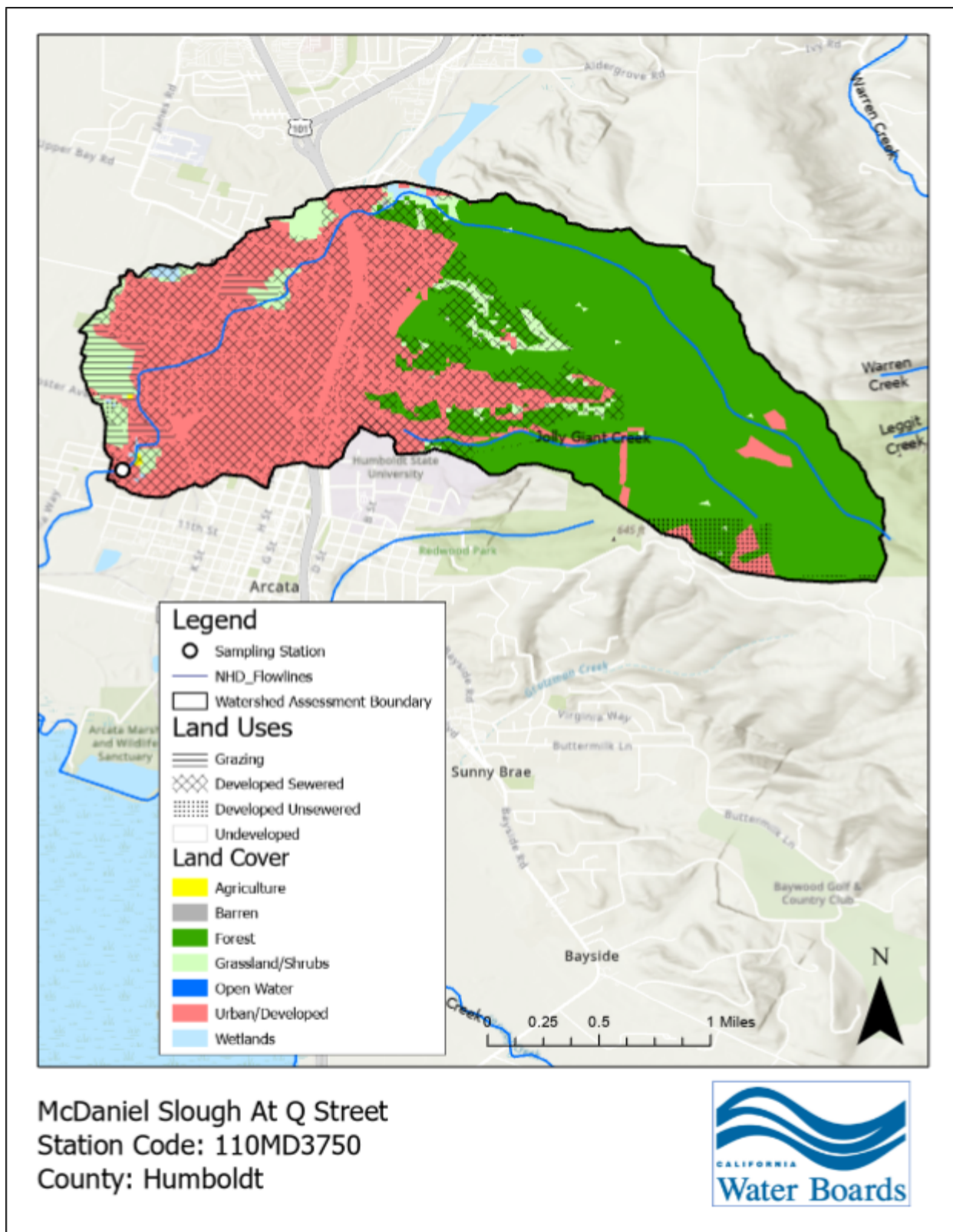
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/3), and
- Summer (1/1).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-59 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-59 Land cover and land use in the McDaniel Slough at Q Street watershed**

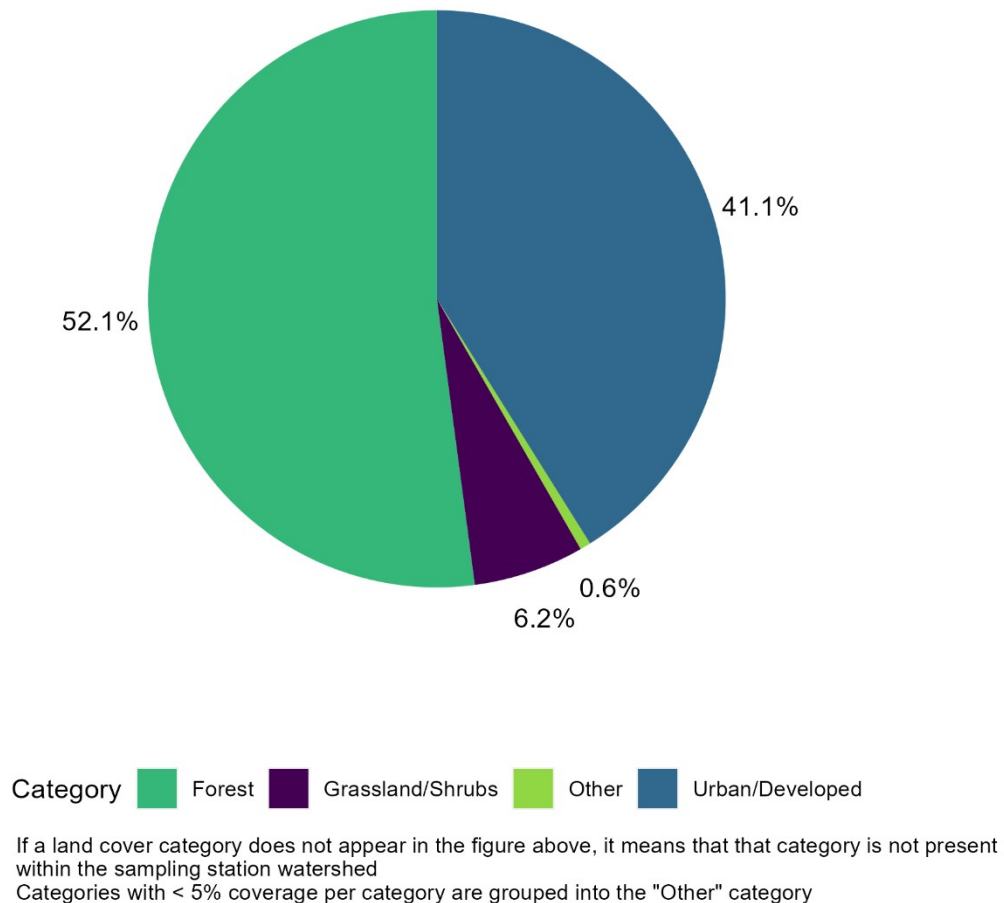
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-60 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (954.25 acres [52.1%]),
- Urban/Developed (752.77 acres [41.1%]),
- Grassland/Shrubs (113.44 acres [6.2%]),
- Wetlands (8.76 acres [0.5%]),
- Agriculture (1.1 acres [0.1%]),
- Barren (0.66 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: McDaniel Slough at Q Street



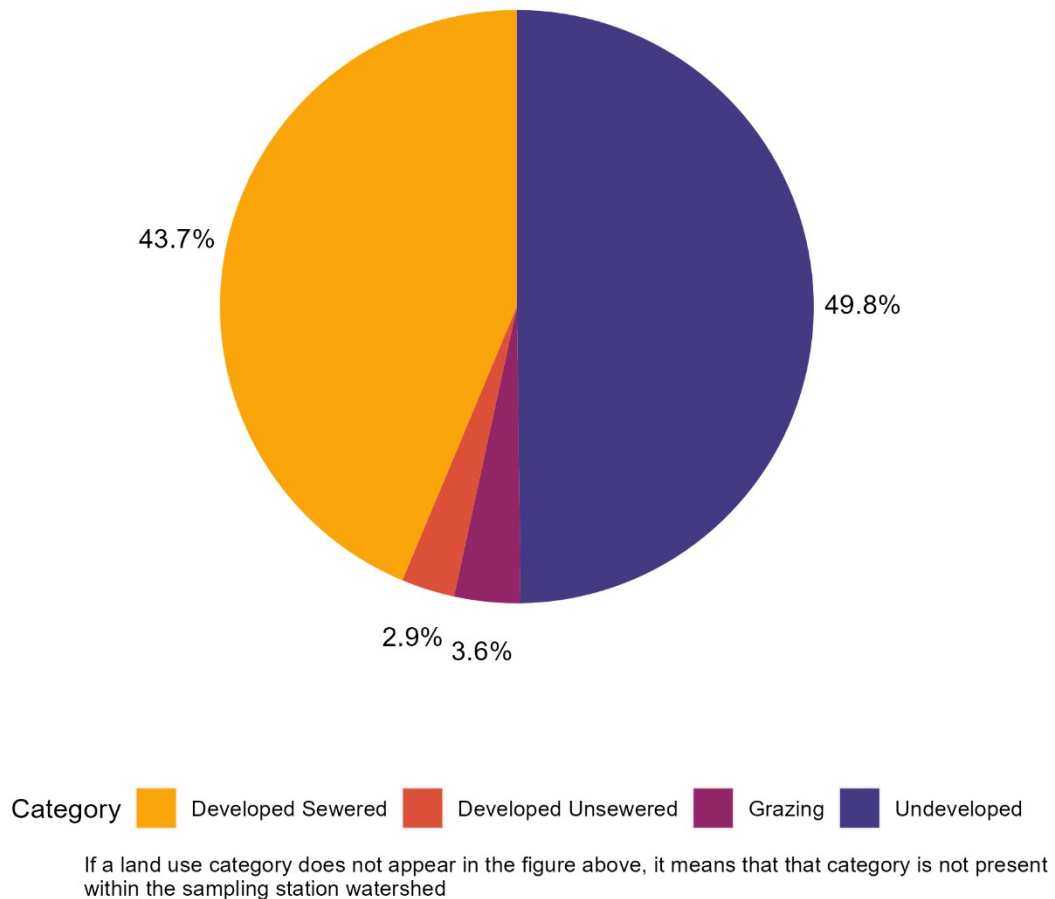
**Figure A-60 Percentage coverage by land cover category in the McDaniel Slough at Q Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-61 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (843.12 acres [49.8%]),
- Developed Sewered (738.96 acres [43.7%]),
- Developed Unsewered (49.87 acres [2.9%]), and
- Grazing (60.34 acres [3.6%]).

## Land Use

Humboldt County: McDaniel Slough at Q Street



**Figure A-61 Percentage coverage by land use category in the McDaniel Slough at Q Street watershed**

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-62 below.

Specifically, the marker detection percentage in the dry sampling period were:

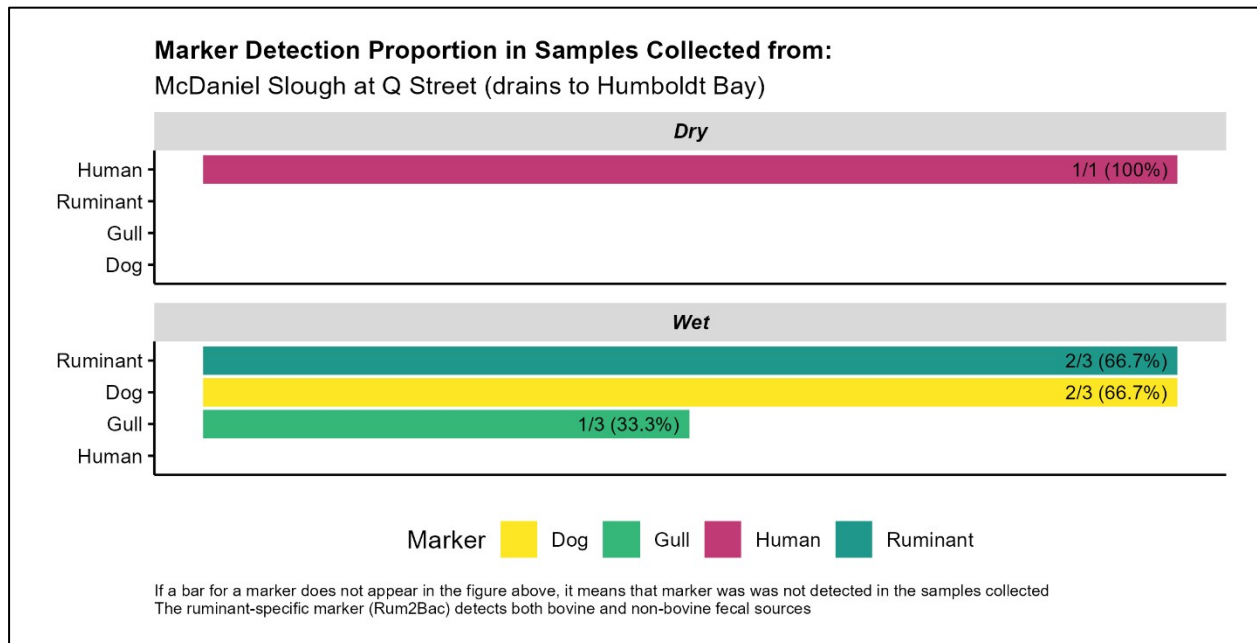
- Human (1/1 [100%]),
- Dog (0/1 [0%]),

- Gull (0/1 [0%]), and
- Ruminant (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/3 [66.7%]),
- Ruminant (2/3 [66.7%]),
- Gull (1/3 [33.3%]), and
- Human (0/3 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-62 Detection percentage of species-specific markers evaluated in samples collected from the McDaniel Slough at Q Street station**



**Roadside Ditch at Foster Road & Seidel Road (110DSEIDL):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. A comparison of FIB data collected from this sampling station to the REC-1 WQO has not been performed since FIB data collected from off-stream structures has not been analyzed for exceedances of water quality objectives, and the Roadside Ditch at Foster Road & Seidel Road sampling station represents land use runoff, and not instream conditions.

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. This sampling station is in a ditch that drains a dairy cattle grazing field.

Three samples (all three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the wet sampling periods from this sampling station are illustrated in Figure A-63 below.

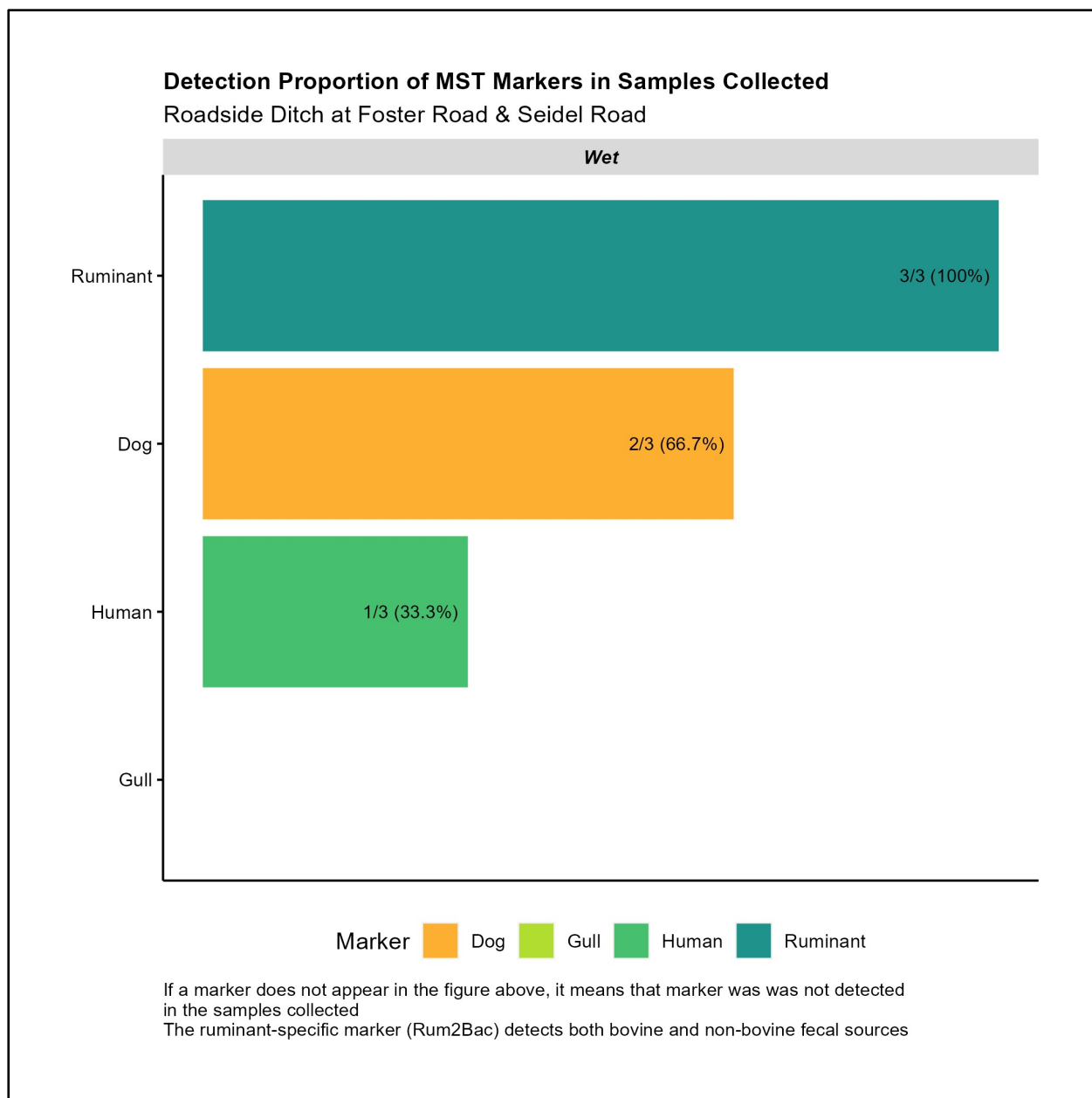
Specifically, the marker detection percentage in the dry sampling period were:

- Dog (0/1 [0%]),
- Gull (0/1 [0%]),
- Human (0/1 [0%]), and
- Ruminant (0/1 [0%]).

Specifically, the marker percentage in the wet sampling period are:

- Ruminant (3/3 [100%]),
- Dog (2/3 [66.7%]),
- Human (1/3 [33.3%]), and
- Gull (0/3 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-63 Detection percentage of species-specific markers evaluated in samples collected from the Roadside Ditch at Foster Road & Seidel Road station**

**Roadside Ditch at Jackson Ranch Road (110DJXNRD):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. A comparison of FIB data collected from this sampling station to the REC-1 WQO has not been performed since FIB data collected from off-stream structures has not been analyzed for exceedances of water quality objectives, and the Roadside Ditch at Jackson Ranch Road sampling station represents land use runoff, and not instream conditions.

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. This sampling station is in a ditch that drains a dairy cattle grazing field.

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-64 below.

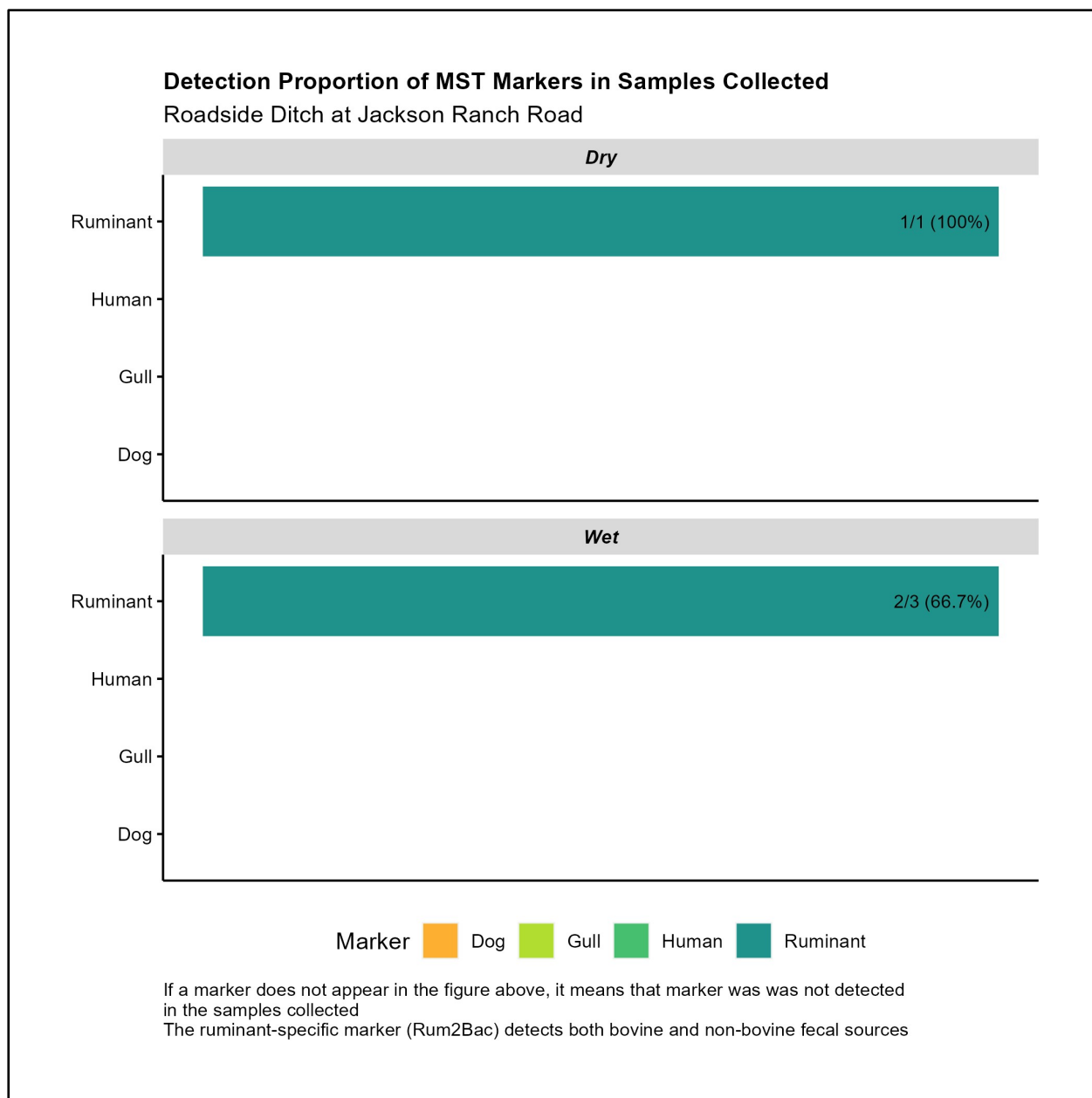
Specifically, the marker detection percentage in the dry sampling period were:

- Ruminant (1/1 [100%]),
- Dog (0/1 [0%]),
- Gull (0/1 [0%]), and
- Human (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/3 [66.7%]),
- Dog (0/3 [0%]),
- Gull (0/3 [0%]), and
- Human (0/3 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-64 Detection percentage of species-specific markers evaluated in samples collected from the Roadside Ditch at Jackson Ranch Road station**

**Salmon Creek at Eel River Drive (110SA1720):**

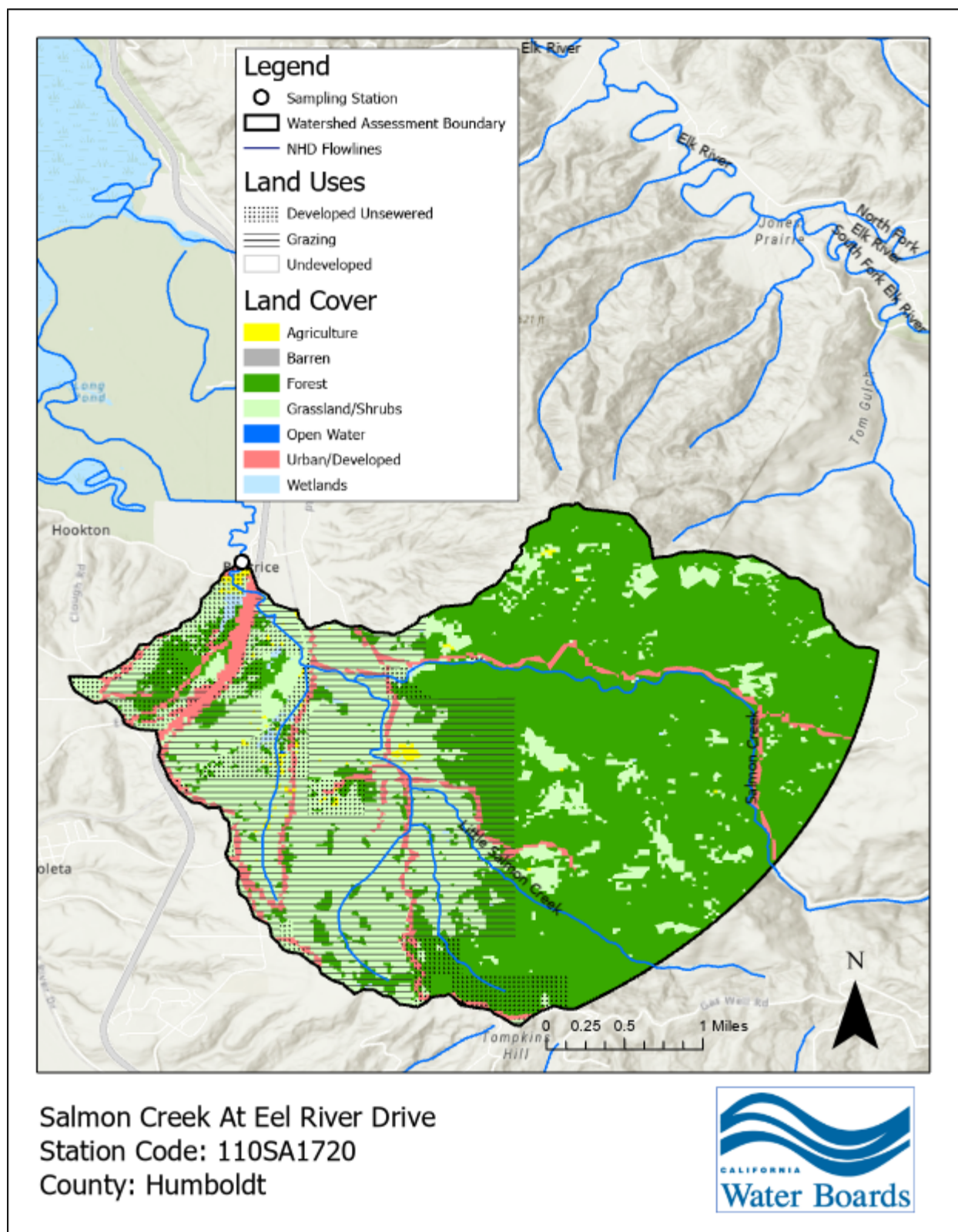
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (1/4),
- Winter (1/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-65 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-65 Land cover and land use in the Salmon Creek at Eel River Drive watershed**

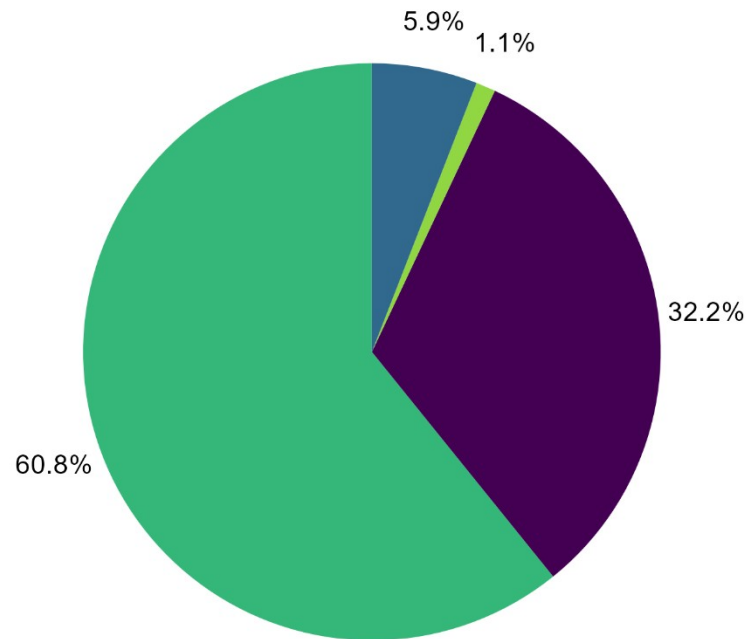
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-66 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (3042.13 acres [60.8%]),
- Grassland/Shrubs (1609.4 acres [32.2%]),
- Urban/Developed (294.95 acres [5.9%]),
- Agriculture (30.75 acres [0.6%]),
- Wetlands (24.62 acres [0.5%]),
- Barren (0.44 acres [0%]), and
- Open Water (0.22 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Salmon Creek at Eel River Drive



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

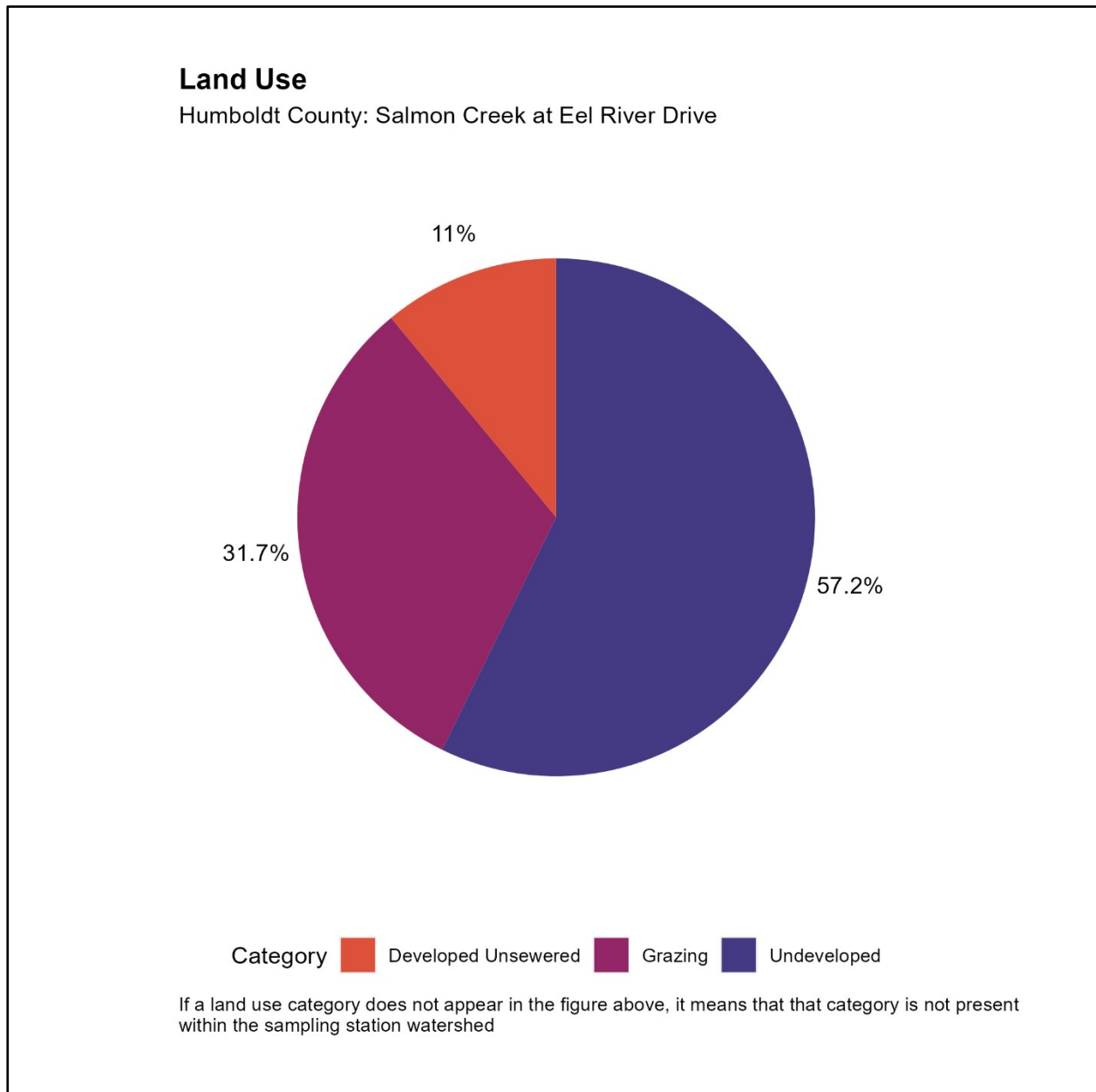
**Figure A-66 Percentage coverage by land cover category in the Salmon Creek at Eel River Drive watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-67 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (2828.94 acres [57.2%]),
- Grazing (1568.69 acres [31.7%]),
- Developed Unsewered (545.74 acres [11%]), and
- Developed Sewered (0 acres [0%]).



- Both dairy and non-dairy cattle grazing are present in this sampling station watershed.



**Figure A-67 Percentage coverage by land use category in the Salmon Creek at Eel River Drive watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-68 below.

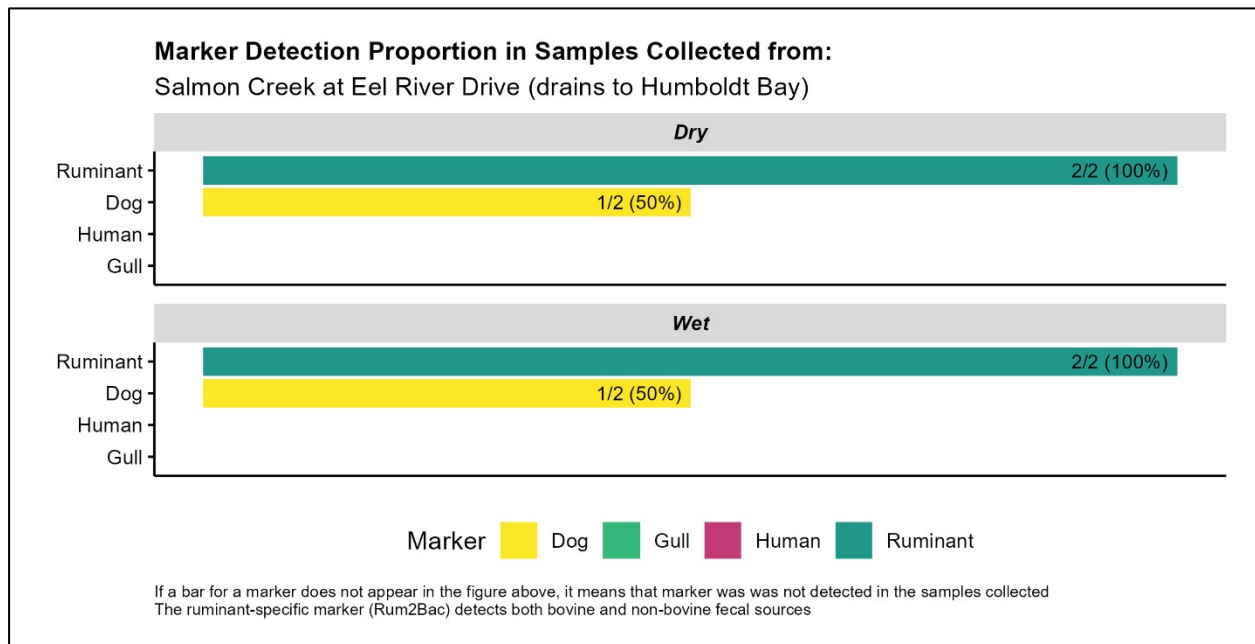
Specifically, the marker detection percentage in the dry sampling period were:

- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-68 Detection percentage of species-specific markers evaluated in samples collected from the Salmon Creek at Eel River Drive station**

**Swain Slough at Elk River Road (110SS9000):**

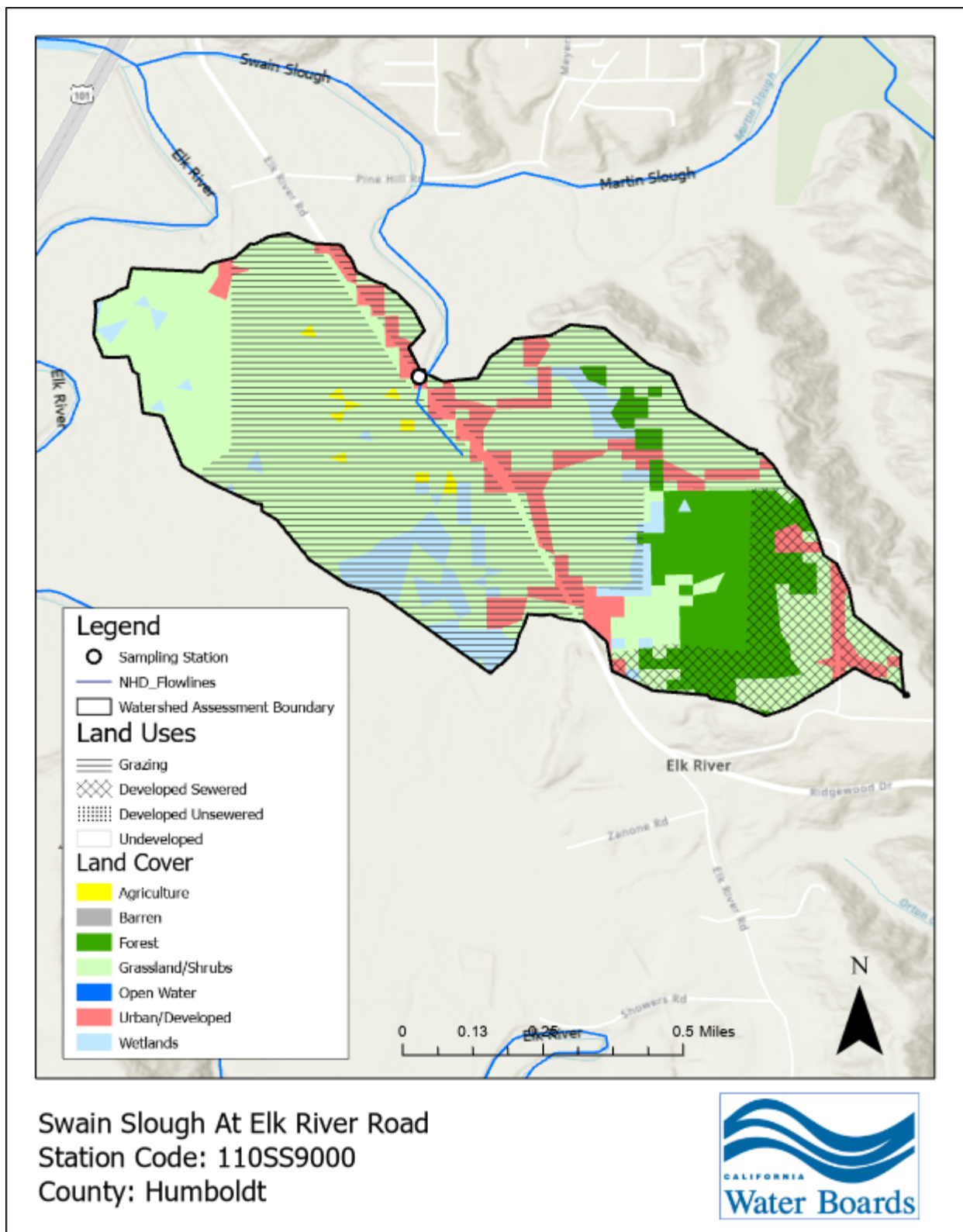
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The enterococcus data collected from this saline sampling station was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/2), and
- Summer (1/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled "Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams" (North Coast Regional Water Quality Control Board, 2023c).

Figure A-69 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-69 Land cover and land use in the Swain Slough at Elk River Road watershed**

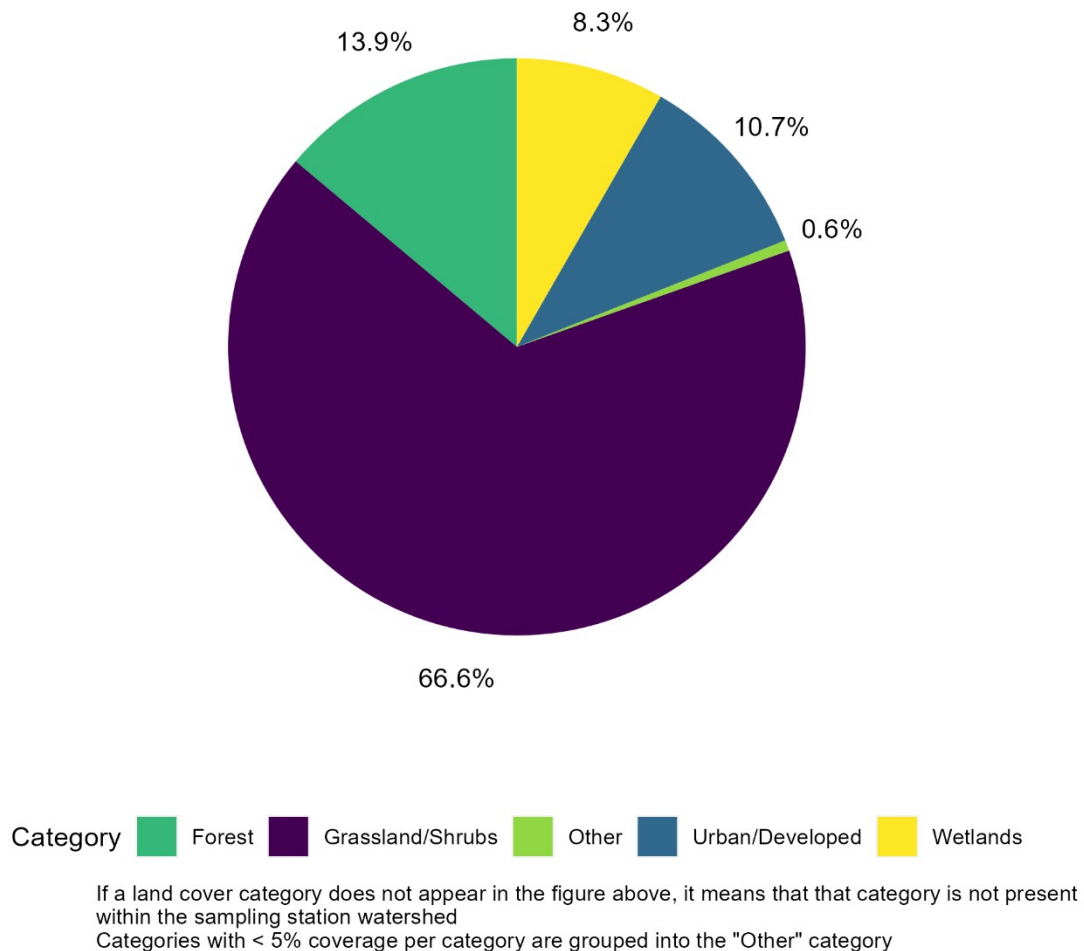
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-70 below. Specifically, the coverage of land cover categories in this watershed are:

- Grassland/Shrubs (199.85 acres [66.6%]),
- Forest (41.87 acres [13.9%]),
- Urban/Developed (31.99 acres [10.7%]),
- Wetlands (24.88 acres [8.3%]),
- Agriculture (1.66 acres [0.6%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Swain Slough at Elk River Road



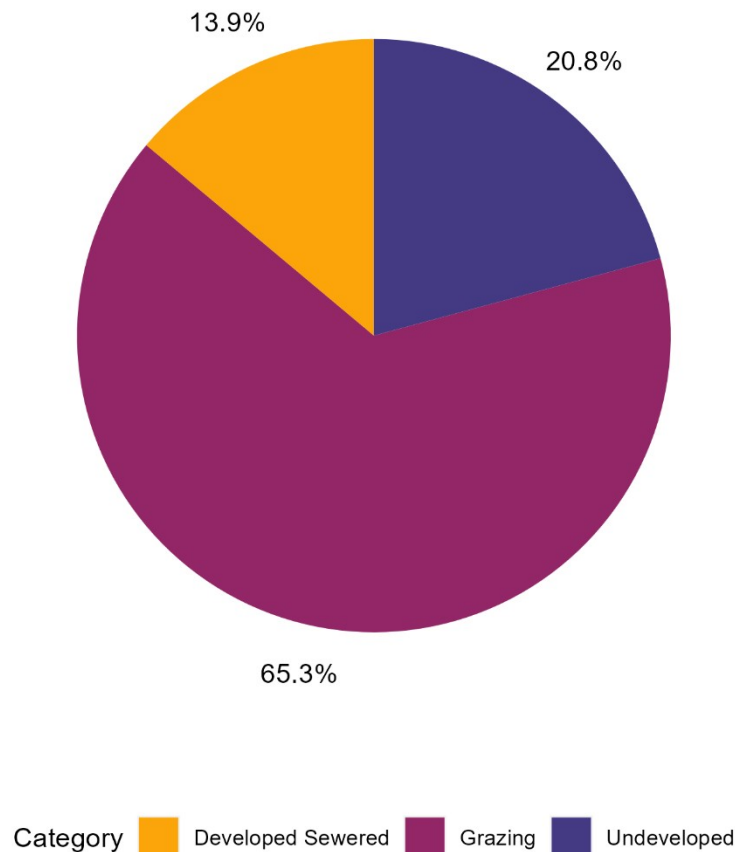
**Figure A-70 Percentage coverage by land cover category in the Swain Slough at Elk River Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-71 below. Specifically, the coverage of land use categories in this watershed are:

- Grazing (191.61 acres [65.3%]),
- Undeveloped (60.99 acres [20.8%]),
- Developed Sewered (40.92 acres [13.9%]), and
- Developed Unsewered (0 acres [0%]).
- Dairy cattle grazing is present in this sampling station watershed.

## Land Use

Humboldt County: Swain Slough at Elk River Road



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-71 Percentage coverage by land use category in the Swain Slough at Elk River Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-72 below.

Specifically, the marker detection percentage in the dry sampling period were:

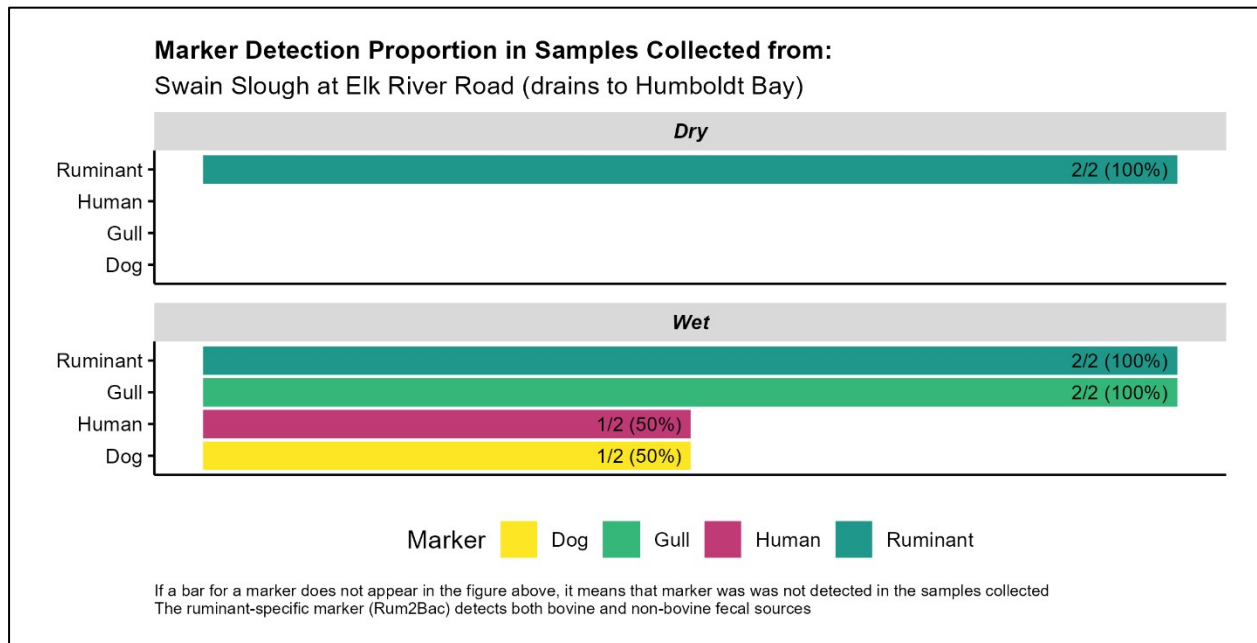
- Ruminant (2/2 [100%]),
- Dog (0/2 [0%]),

- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Gull (2/2 [100%]),
- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]), and
- Human (1/2 [50%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-72 Detection percentage of species-specific markers evaluated in samples collected from the Swain Slough at Elk River Road station**



### **Unnamed Slough at Lanphere Road (110UNSLPHR):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (3/4),
- Winter (2/3), and
- Summer (1/1).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. The Unnamed Slough at Lanphere Road sampling station is located in Arcata Bottoms. The primary upstream land covers are grassland, shrubland, and agriculture. This station is near dairy parcels and was selected to assess the impacts of cattle.

Four samples (one in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-73 below.

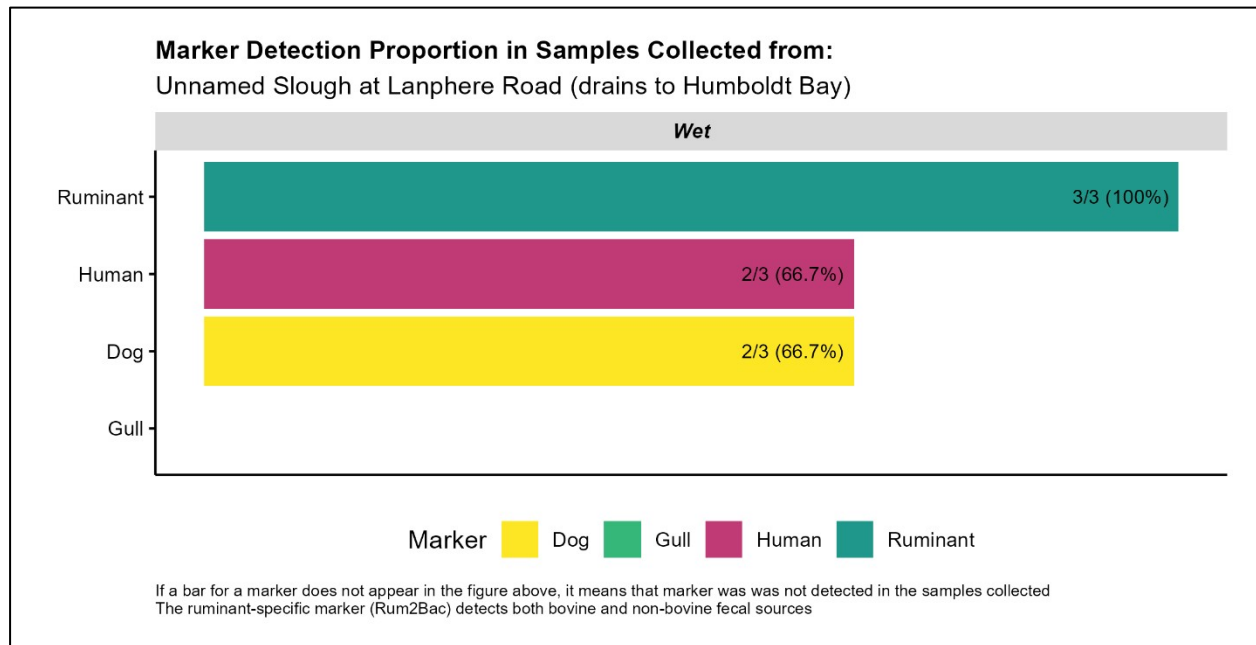
Specifically, the marker detection percentage in the dry sampling period were:

- Dog (0/1 [0%]),
- Gull (0/1 [0%]),
- Human (0/1 [0%]), and
- Ruminant (0/1 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (3/3 [100%]),
- Dog (2/3 [66.7%]),
- Human (2/3 [66.7%]), and
- Gull (0/3 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-73 Detection percentage of species-specific markers evaluated in samples collected from the Unnamed Slough at Lanphere Road station**

### **Unnamed Slough at Ranch Road (110UNSRNCH):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/4),
- Winter (1/2), and
- Summer (1/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

A map of the watershed of this sampling station, and the numeric coverage of land cover and land use categories within that watershed could not be generated for this sampling station because of technical limitations. However, a narrative description of land cover observed within this watershed has been provided. Specifically, the watershed delineation of this sampling station could not be processed because the topography is too level to where a drainage basin cannot be defined with available elevation data. The Unnamed Slough at Ranch Road sampling station is located near the southeast end of the Humboldt Bay National Wildlife Refuge. The primary upstream land covers are a combination of grassland, shrubland, agriculture, and forest. This station was selected for the source assessment to assess the impacts of wildlife. Dairy cattle grazing is present in this sampling station watershed.

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-74 below.

Specifically, the marker detection percentage in the dry sampling period were:

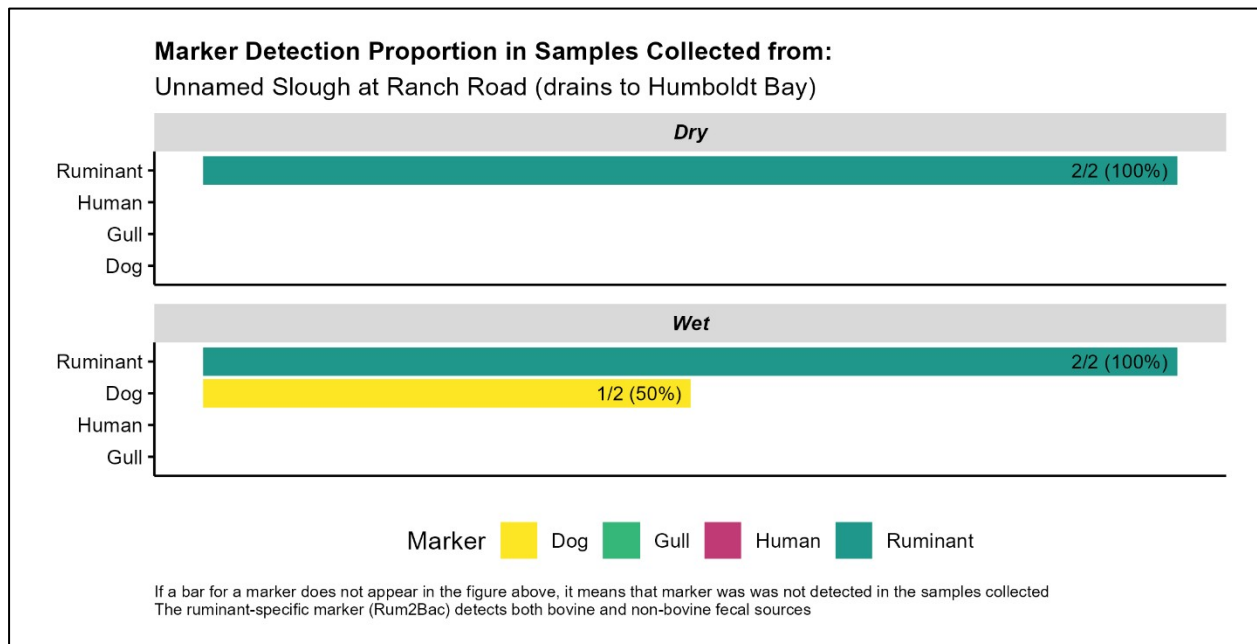
- Ruminant (2/2 [100%]),

- Dog (0/2 [0%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),
- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-74 Detection percentage of species-specific markers evaluated in samples collected from the Unnamed Slough at Ranch Road station**

### **Jolly Giant Creek at 14th Street near M Street (110JG0516)**

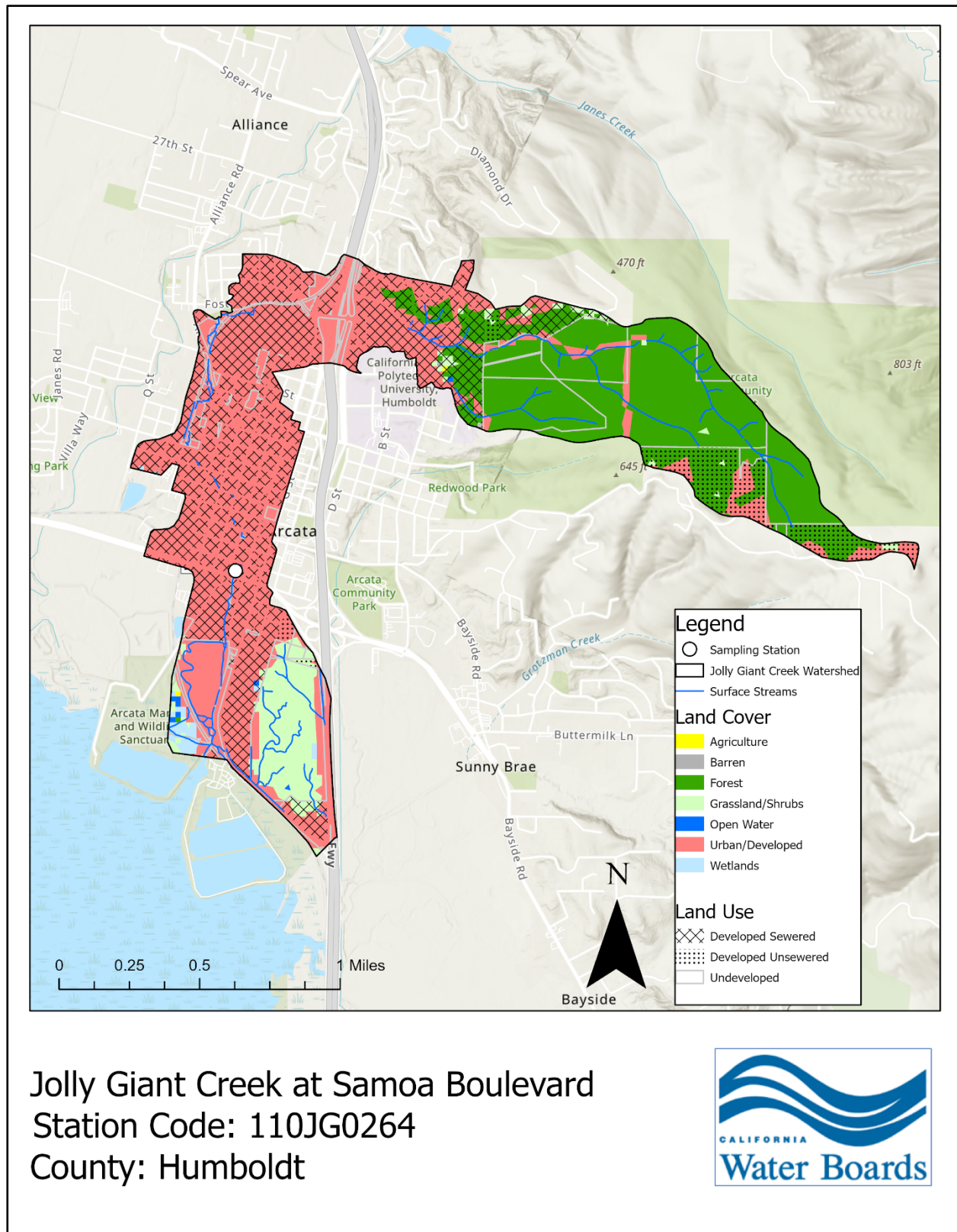
This station was sampled as part of the Jolly Giant Creek Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (3/6),
- Winter (1/3), and
- Summer (2/3).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria and Microbial Source Tracking Data from Jolly Giant Creek (North Coast Regional Water Quality Control Board, 2023a)”.

The figure below illustrates the land cover and land use in the watershed of this sampling station. This sampling station is in watershed of the Jolly Giant Creek at Samoa Boulevard (110JG0264) sampling station sampled under the Impaired Streams Monitoring Study of the Coastal Pathogen Project, therefore the figure representing this sampling station watershed is included below.



This sampling station belongs in the same watershed as the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Streams Monitoring Study (110JG0264) of the Coastal Pathogen Project, the percentage of land cover and land use in the sampling station watershed of this sampling station is the same as that of the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Monitoring Streams Study of the Coastal Pathogen Project. Therefore, the land cover and land use percentages of both stations are identical and are listed below.

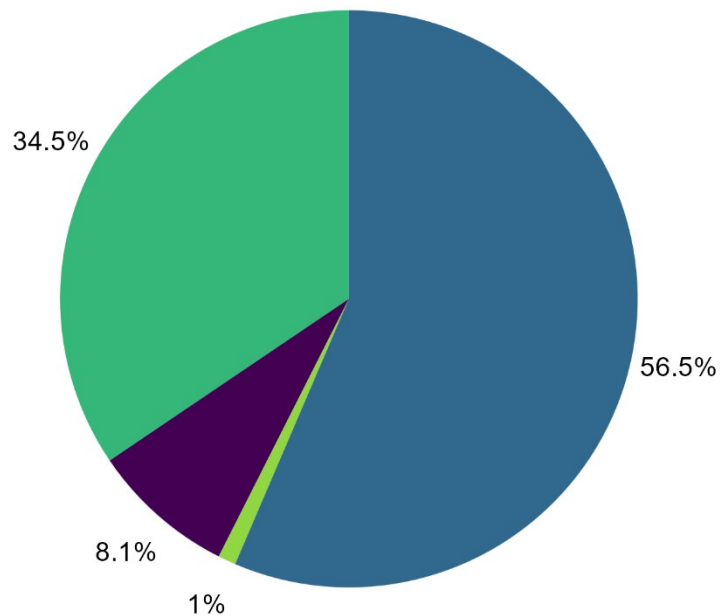
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard



Category  Forest  Grassland/Shrubs  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

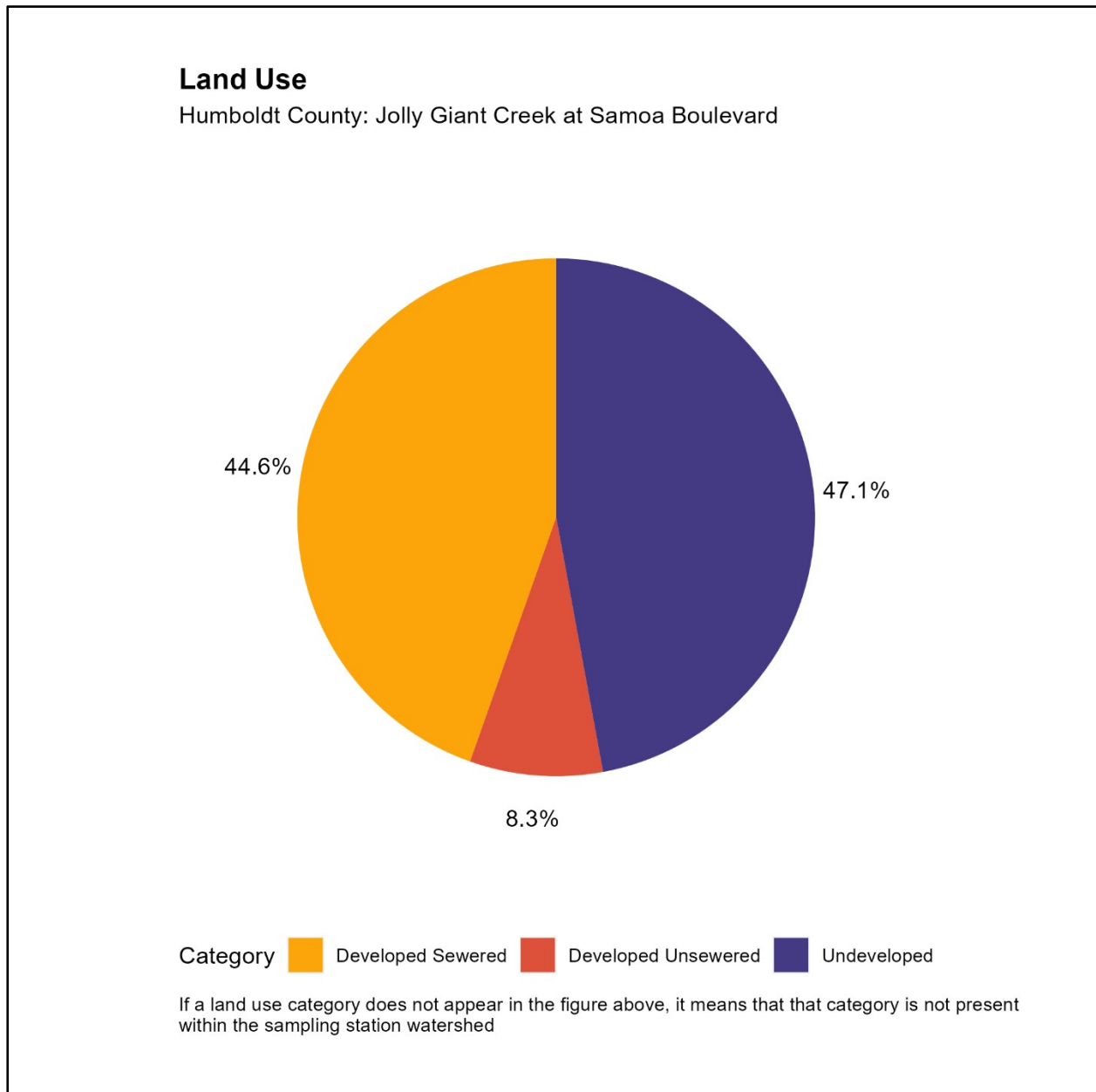
**Figure A-76 Percentage coverage by land cover category in the 14th Street near M Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])



- Grazing (0 acres [0%])



**Figure A-77 Percentage coverage by land use category in the 14th Street near M Street watershed**

Six samples (three in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in the figure below.

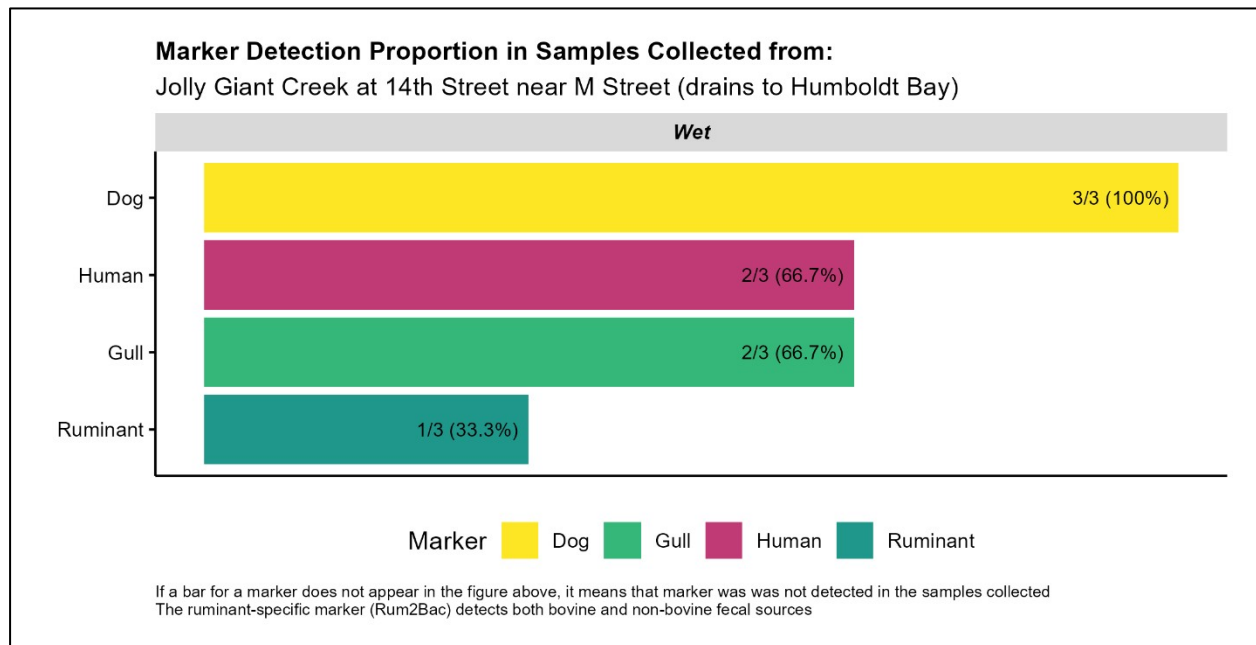
Specifically, the marker detection percentage in the dry sampling period were:

- Dog (0/3 [0%]),
- Human (0/3 [0%]),
- Gull (0/3 [0%]), and
- Ruminant (0/3 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/3 [100%]),
- Human (2/3 [66.7%]),
- Gull (2/3 [66.7%]), and
- Ruminant (1/3 [33.3%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-78 Detection percentage of species-specific markers evaluated in samples collected from the 14th Street near M Street station**

### **Jolly Giant Creek at 7th Street and J Street (110JG0331)**

This station was sampled as part of the Jolly Giant Creek Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (5/6),
- Winter (3/3), and
- Summer (2/3).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria and Microbial Source Tracking Data from Jolly Giant Creek (North Coast Regional Water Quality Control Board, 2023a)”..

The figure below illustrates the land cover and land use in the watershed of this sampling station. This sampling station is in watershed of the Jolly Giant Creek at Samoa Boulevard (110JG0264) sampling station sampled under the Impaired Streams Monitoring Study of the Coastal Pathogen Project, therefore the figure representing this sampling station watershed is included below.

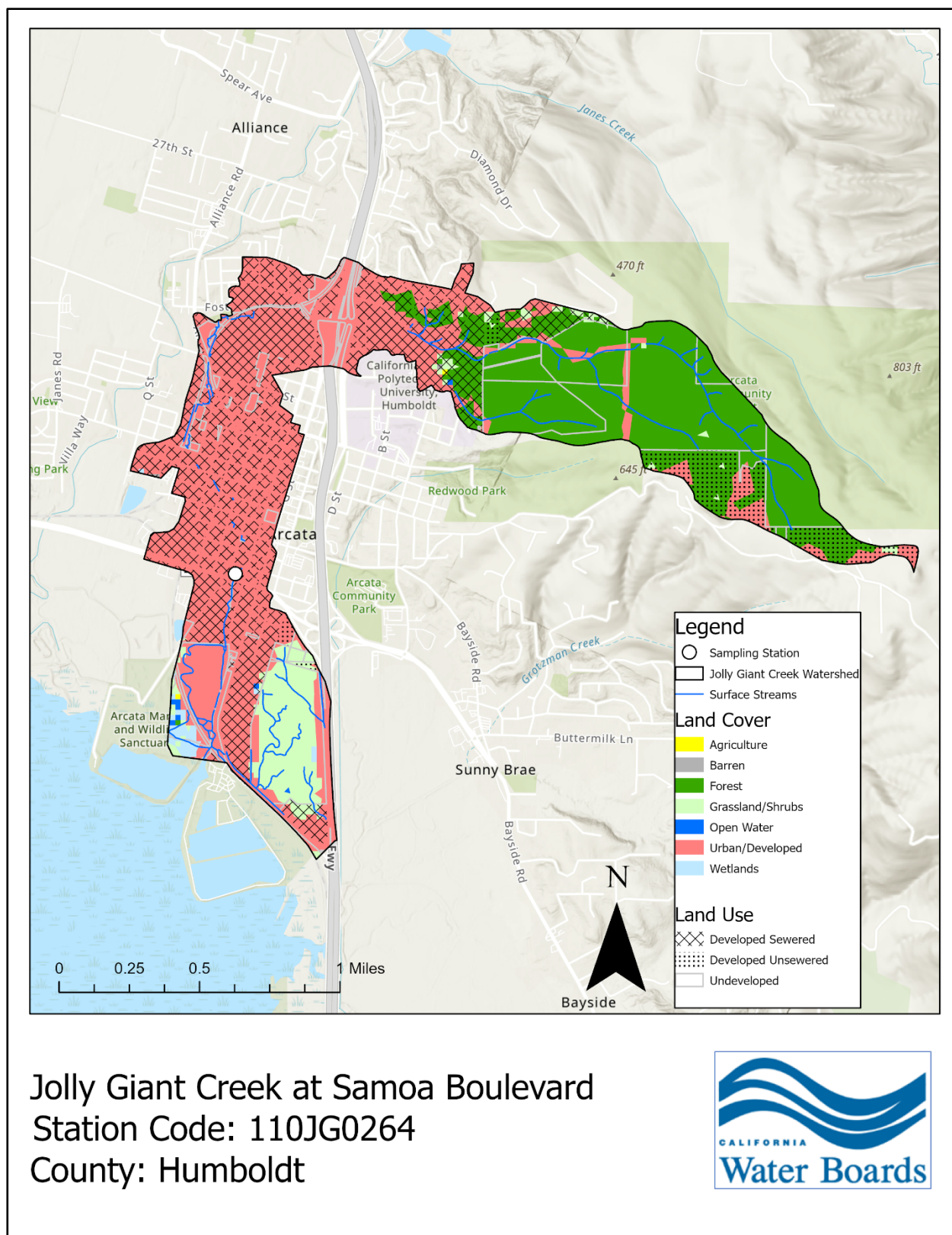


Figure A-79 Land Cover and Land Use in the 7th Street and J Street watershed

This sampling station belongs in the same watershed as the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Streams Monitoring Study (110JG0264) of the Coastal Pathogen Project, the percentage of land cover and land use in the sampling station watershed of this sampling station is the same as that of the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Monitoring Streams Study of the Coastal Pathogen Project. Therefore, the land cover and land use percentages of both stations are identical and are listed below.

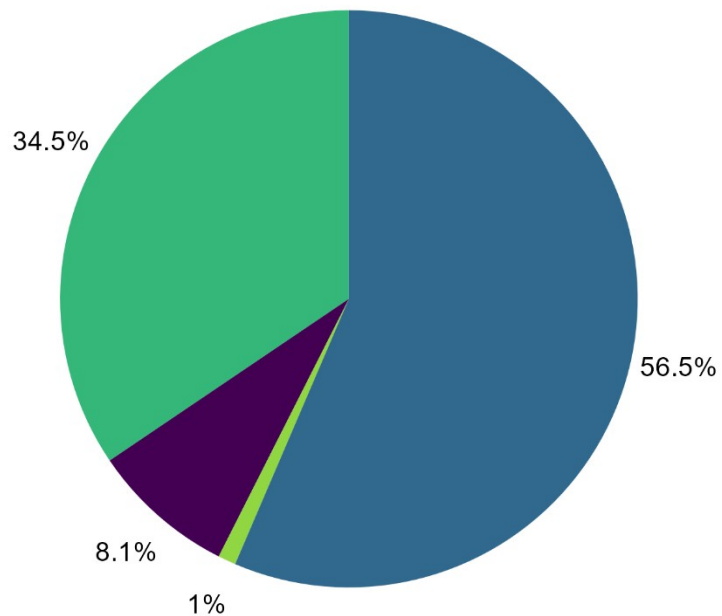
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard



Category  Forest  Grassland/Shrubs  Other  Urban/Developed

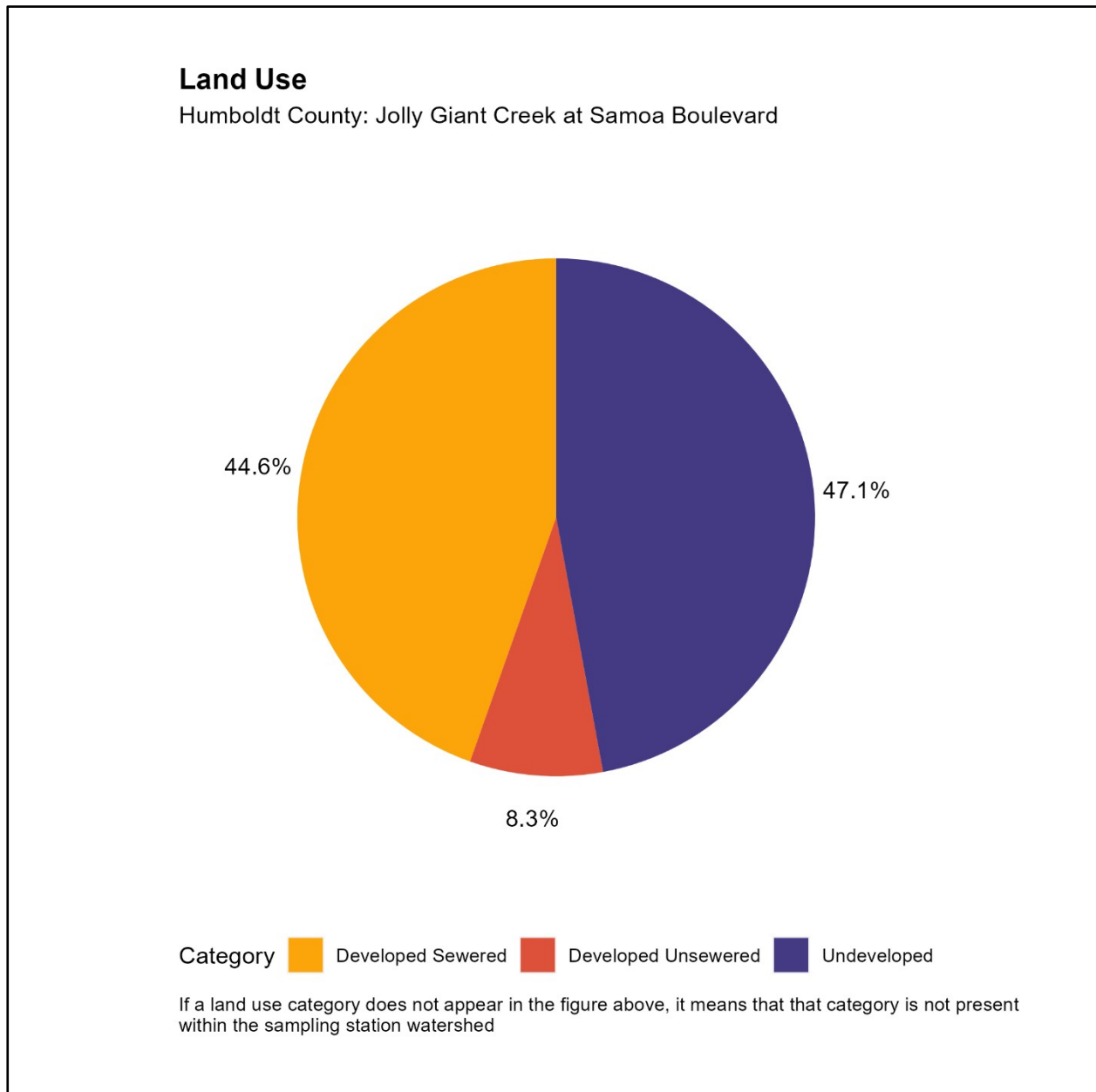
If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure A-80 Percentage coverage by land cover category in the 7th Street and J Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])

- Grazing (0 acres [0%])



**Figure A-81 Percentage coverage by land use category in the 7th Street and J Street watershed**

Six samples (three in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in the figure below.

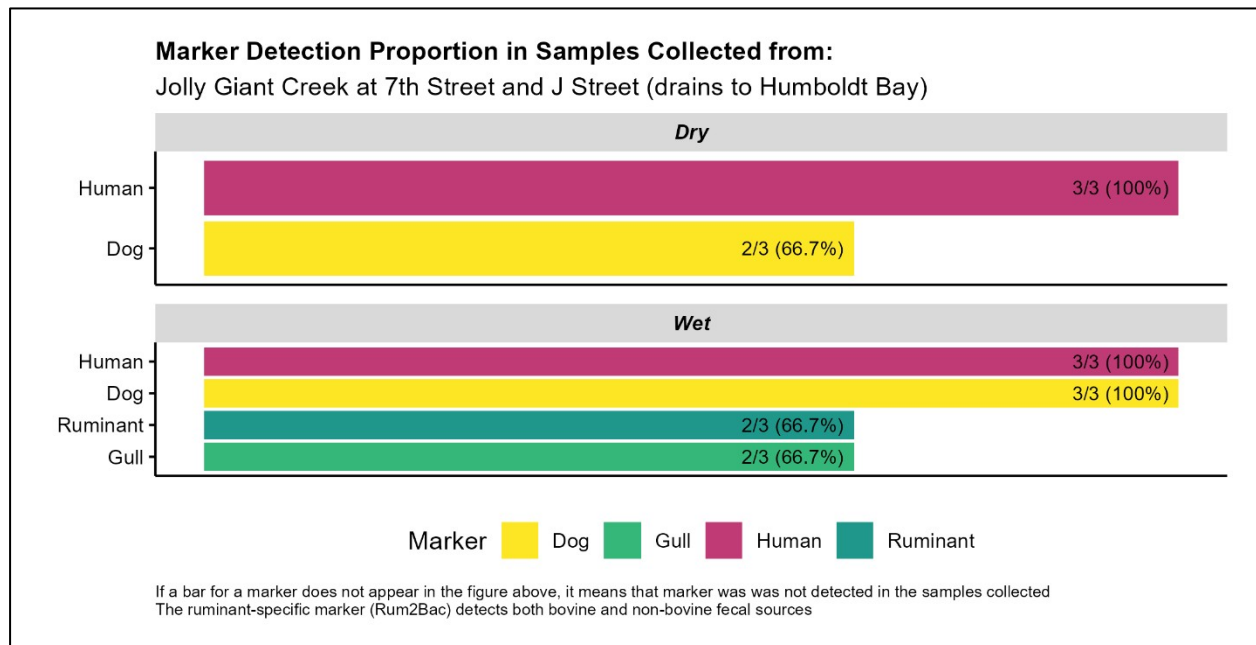
Specifically, the marker detection percentage in the dry sampling period were:

- Human (3/3 [100%]),
- Dog (2/3 [66.7%]),
- Gull (0/3 [0%]), and
- Ruminant (0/3 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Human (3/3 [100%]),
- Dog (3/3 [100%]),
- Gull (2/3 [66.7%]), and
- Ruminant (2/3 [66.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-82 Detection percentage of species-specific markers evaluated in samples collected from the 7th Street and J Street station**



### **Jolly Giant Creek at 9th Street and J Street (110JG0378)**

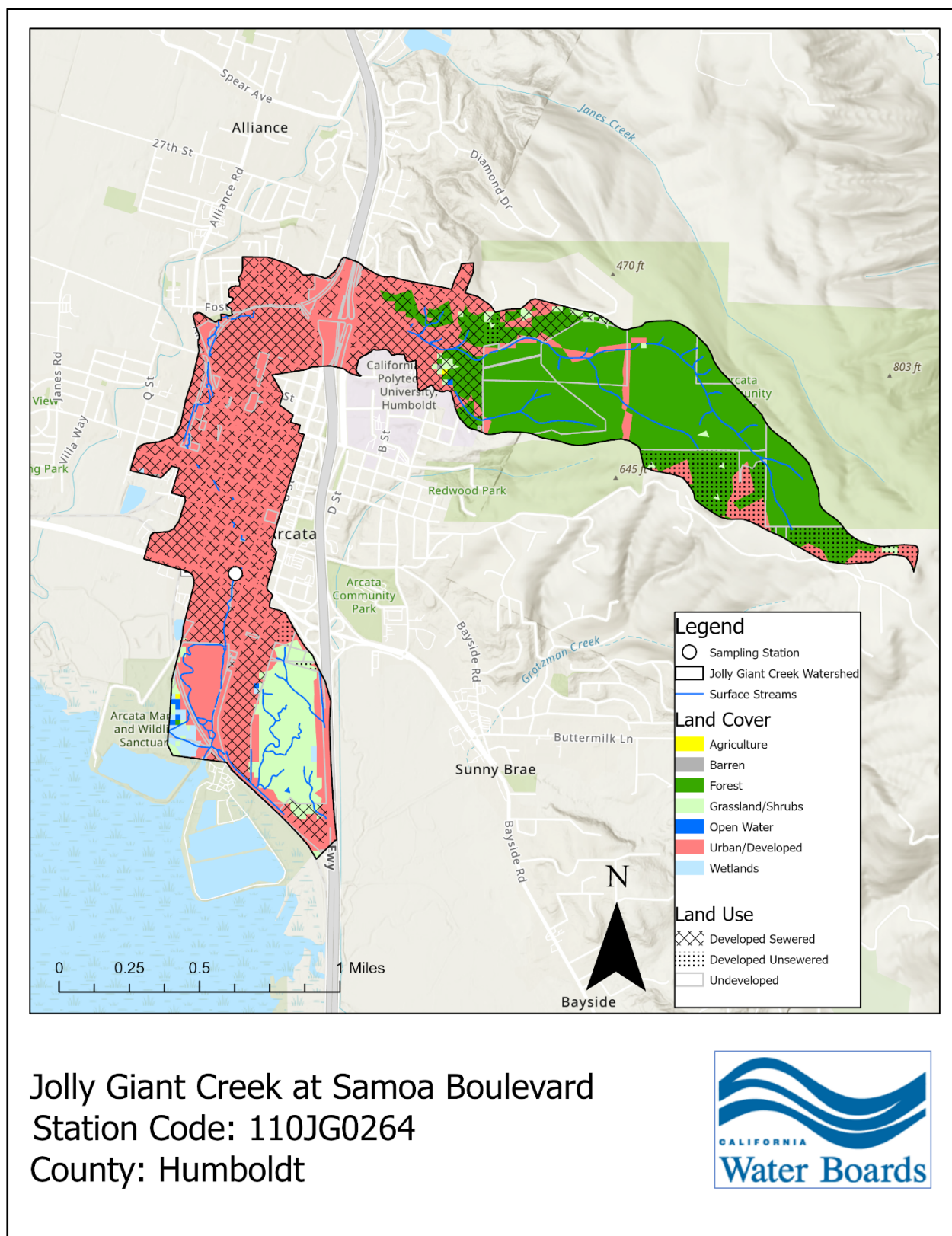
This station was sampled as part of the Jolly Giant Creek Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (3/6),
- Winter (1/3), and
- Summer (2/3).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria and Microbial Source Tracking Data from Jolly Giant Creek (North Coast Regional Water Quality Control Board, 2023a)”..

The figure below illustrates the land cover and land use in the watershed of this sampling station. This sampling station is in watershed of the Jolly Giant Creek at Samoa Boulevard (110JG0264) sampling station sampled under the Impaired Streams Monitoring Study of the Coastal Pathogen Project, therefore the figure representing this sampling station watershed is included below.



**Figure A-83 Land Cover and Land Use in the 9th Street and J Street watershed**

This sampling station belongs in the same watershed as the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Streams Monitoring Study (110JG0264) of the Coastal Pathogen Project, the percentage of land cover and land use in the sampling station watershed of this sampling station is the same as that of the Jolly Giant Creek at Samoa Boulevard sampling station sampled under the Impaired Monitoring Streams Study of the Coastal Pathogen Project. Therefore, the land cover and land use percentages of both stations are identical and are listed below.

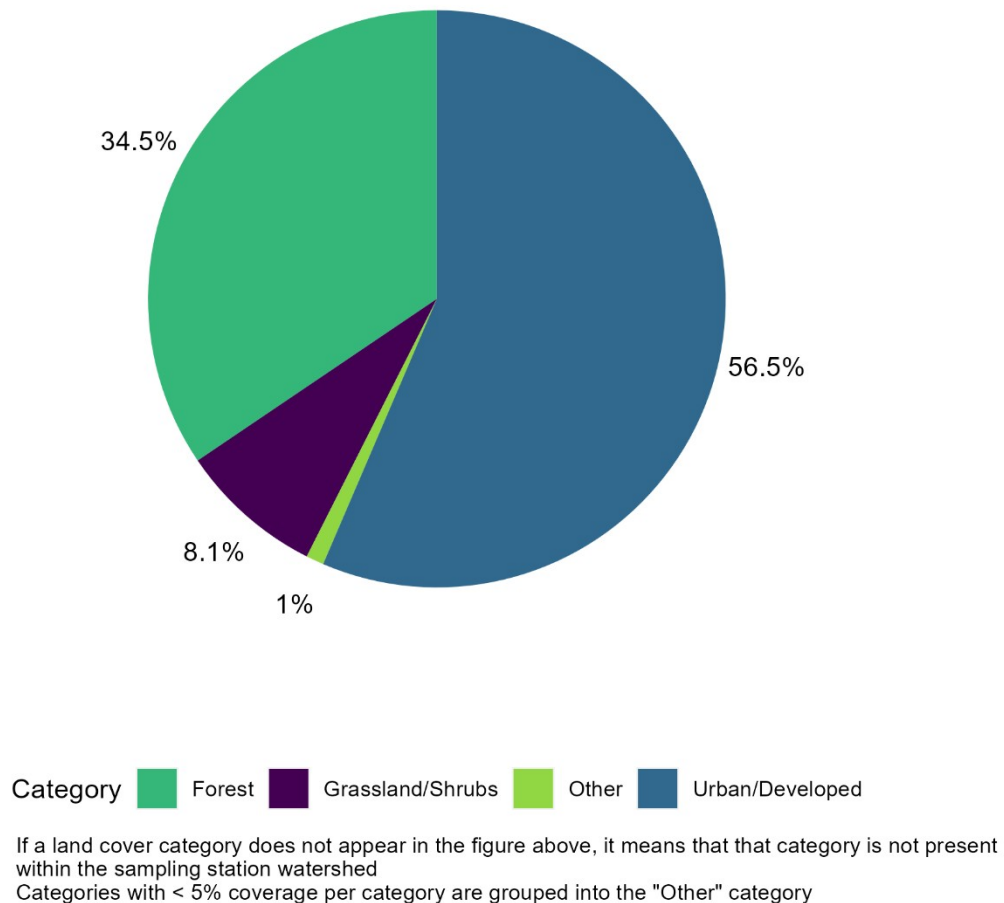
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard



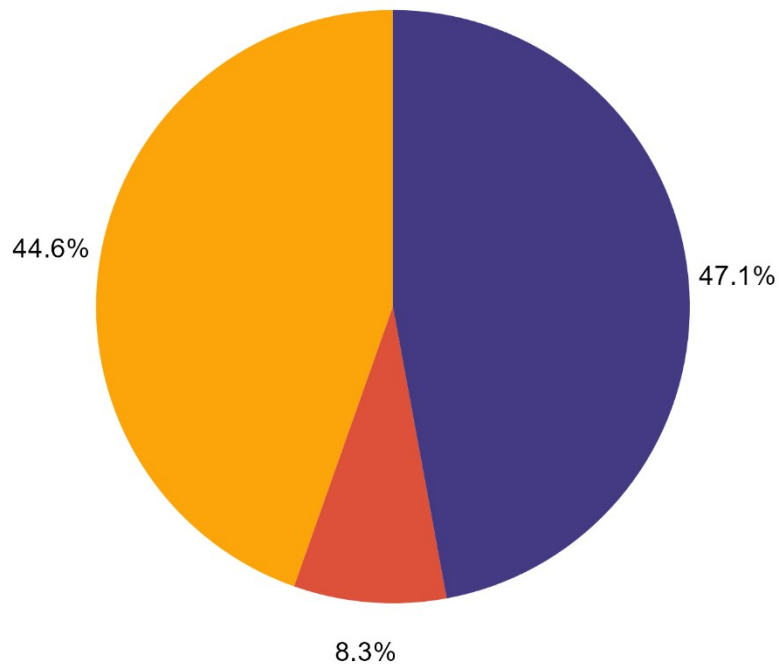
**Figure A-84 Percentage coverage by land cover category in the 9th Street and J Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])
- Grazing (0 acres [0%])

## Land Use

Humboldt County: Jolly Giant Creek at Samoa Boulevard



Category ■ Developed Sewered ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

### Figure A-85 Percentage coverage by land use category in the 9th Street and J Street watershed

Six samples (three in the dry period, and three in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in the figure below.

Specifically, the marker detection percentage in the dry sampling period were:

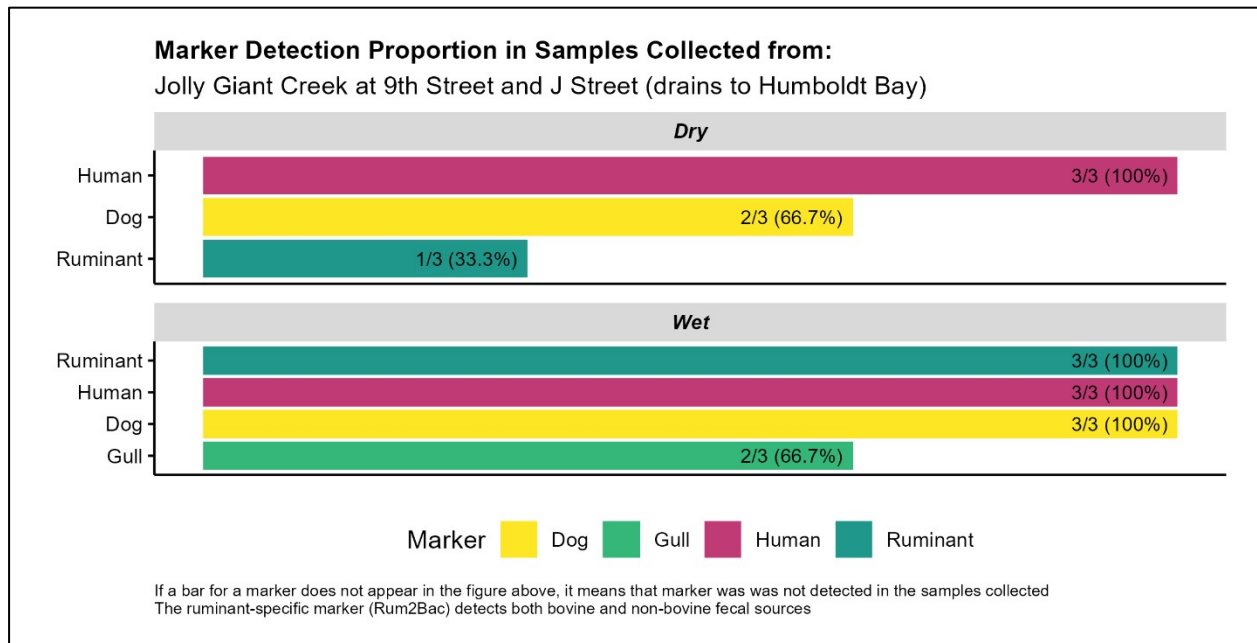
- Human (3/3 [100%]),
- Dog (2/3 [66.7%]),

- Ruminant (1/3 [33.3%]), and
- Gull (0/3 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Human (3/3 [100%]),
- Dog (3/3 [100%]),
- Ruminant (3/3 [100%]), and
- Gull (2/3 [66.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-86 Detection percentage of species-specific markers evaluated in samples collected from the 9th Street and J Street station**

### **Jolly Giant Creek at Alliance Road near 17th Street (110JG0580)**

This station was sampled as part of the Jolly Giant Creek Monitoring Study of the Coastal Pathogen Project.

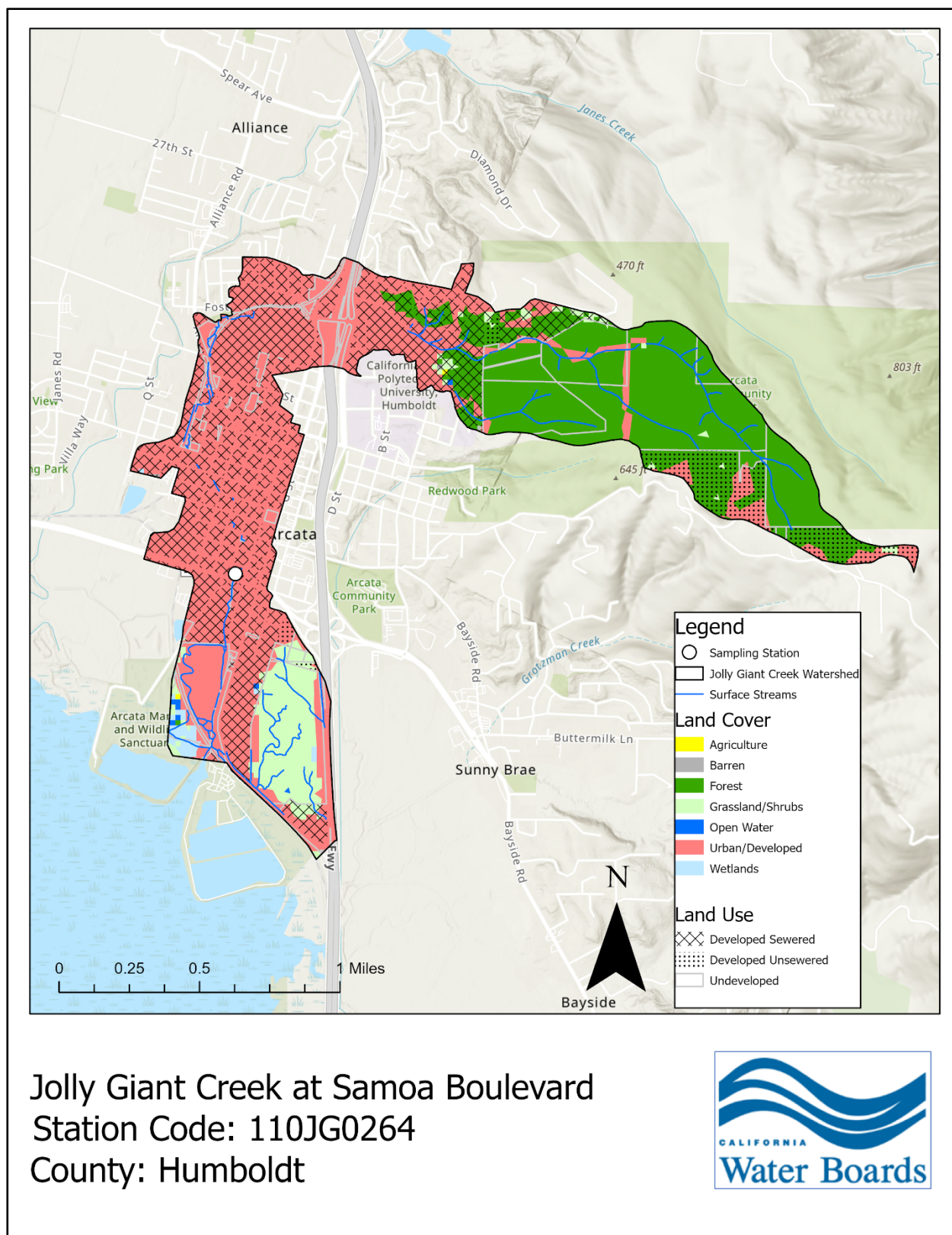
This is a freshwater sampling station. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (2/6),
- Winter (1/3), and
- Summer (1/3).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria and Microbial Source Tracking Data from Jolly Giant Creek (North Coast Regional Water Quality Control Board, 2023a)”..

The figure below illustrates the land cover and land use in the watershed of this sampling station. This sampling station is in watershed of the Jolly Giant Creek at Samoa Boulevard (110JG0264) sampling station sampled under the Impaired Streams Monitoring Study of the Coastal Pathogen Project, therefore the figure representing this sampling station watershed is included below.





**Figure A-87 Land Cover and Land Use in the at Alliance Road near 17th Street watershed**



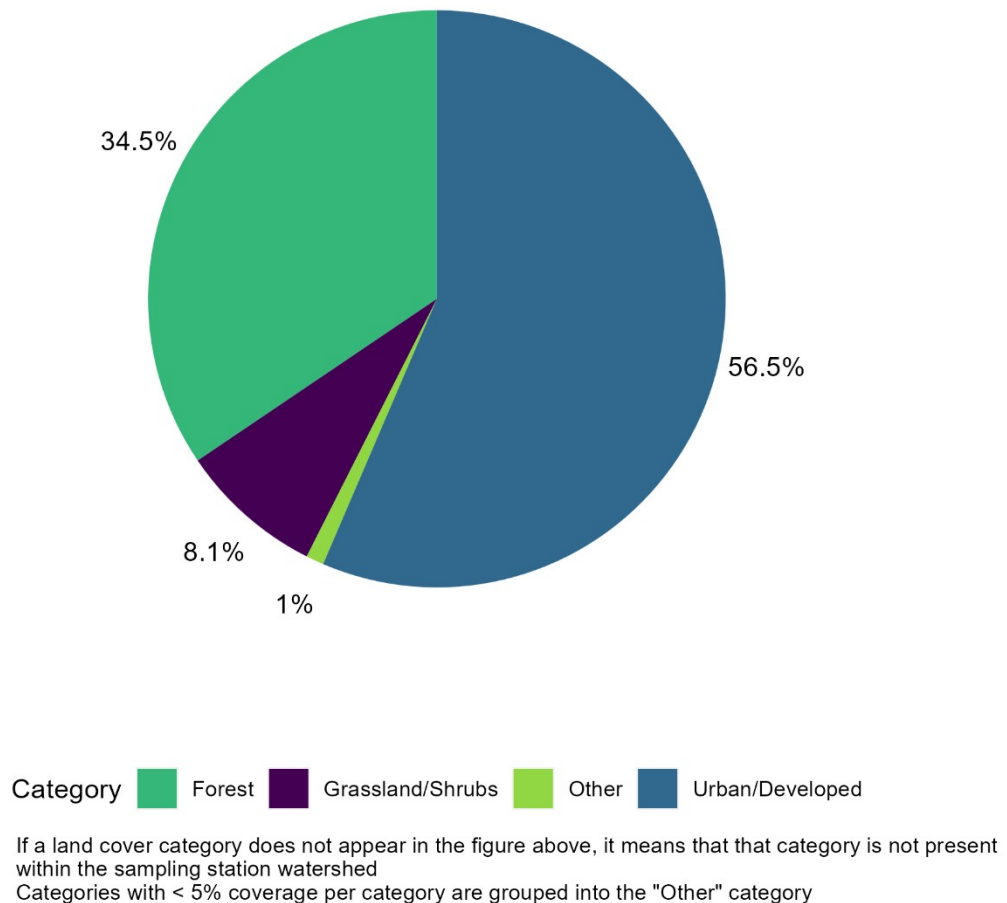
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard



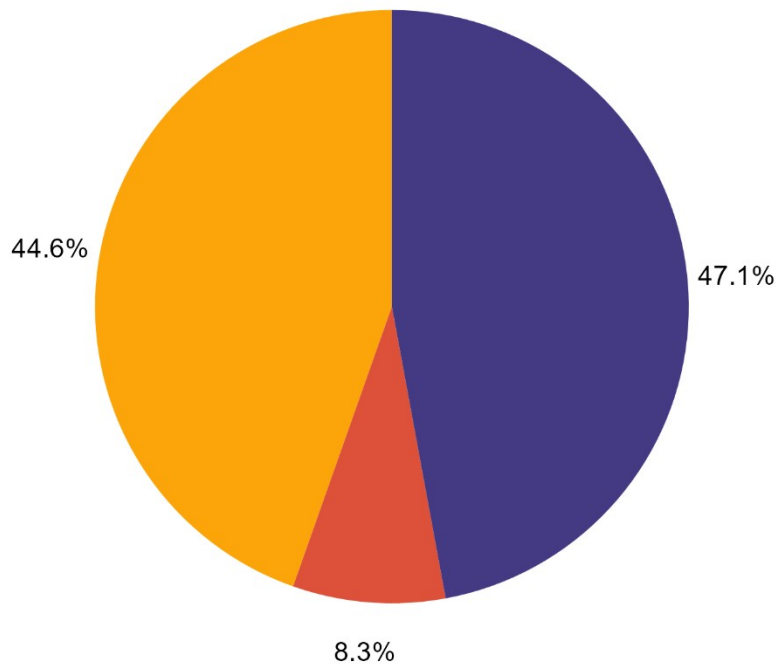
**Figure A-88 Percentage coverage by land cover category in the at Alliance Road near 17th Street watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])
- Grazing (0 acres [0%])

## Land Use

Humboldt County: Jolly Giant Creek at Samoa Boulevard



Category ■ Developed Sewered ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

### Figure A-89 Percentage coverage by land use category in the at Alliance Road near 17th Street watershed

Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-49 below.

Specifically, the marker detection percentage in the dry sampling period were:

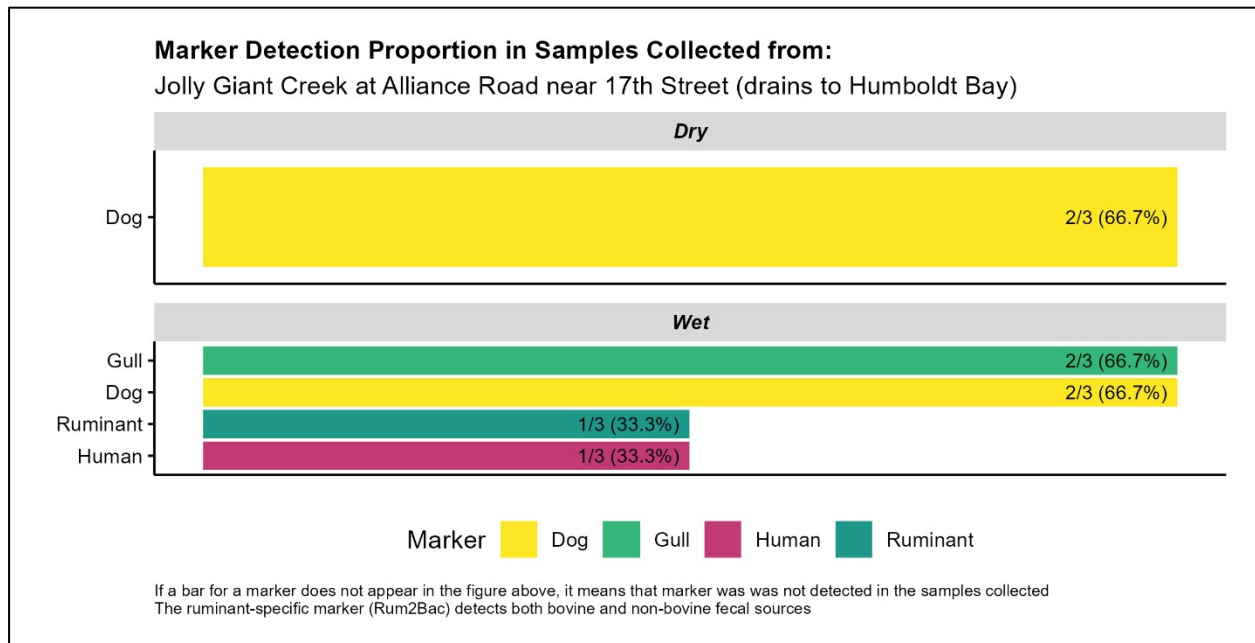
- Dog (2/3 [66.7%]),
- Human (0/3 [%]),

- Gull (0/3 [0%]), and
- Ruminant (0/3 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/3 [66.7%]),
- Gull (2/3 [66.7%]),
- Human (1/3 [33.3%]), and
- Ruminant (1/3 [33.3%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-90 Detection percentage of species-specific markers evaluated in samples collected from the at Alliance Road near 17th Street station**

### **Jolly Giant Creek at Samoa Boulevard (110JG0264) (Jolly Giant Creek Monitoring Study)**

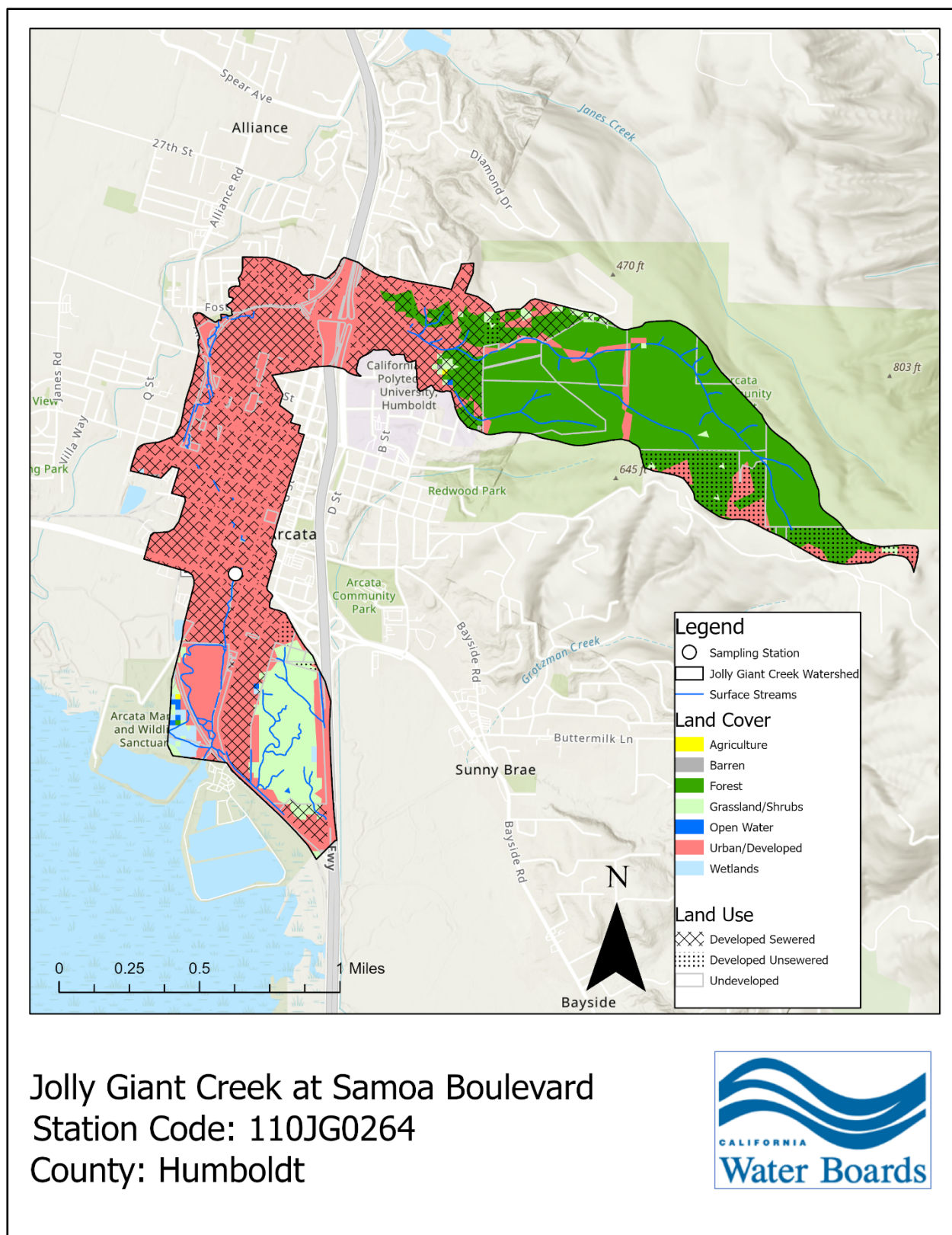
This station was sampled as part of the Jolly Giant Creek Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The *E. coli* data collected from this freshwater sampling station was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (/6),
- Winter (/3), and
- Summer (/3).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure A-46 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure A-91 Land Cover and Land Use in the Jolly Giant Creek at Samoa Boulevard watershed**

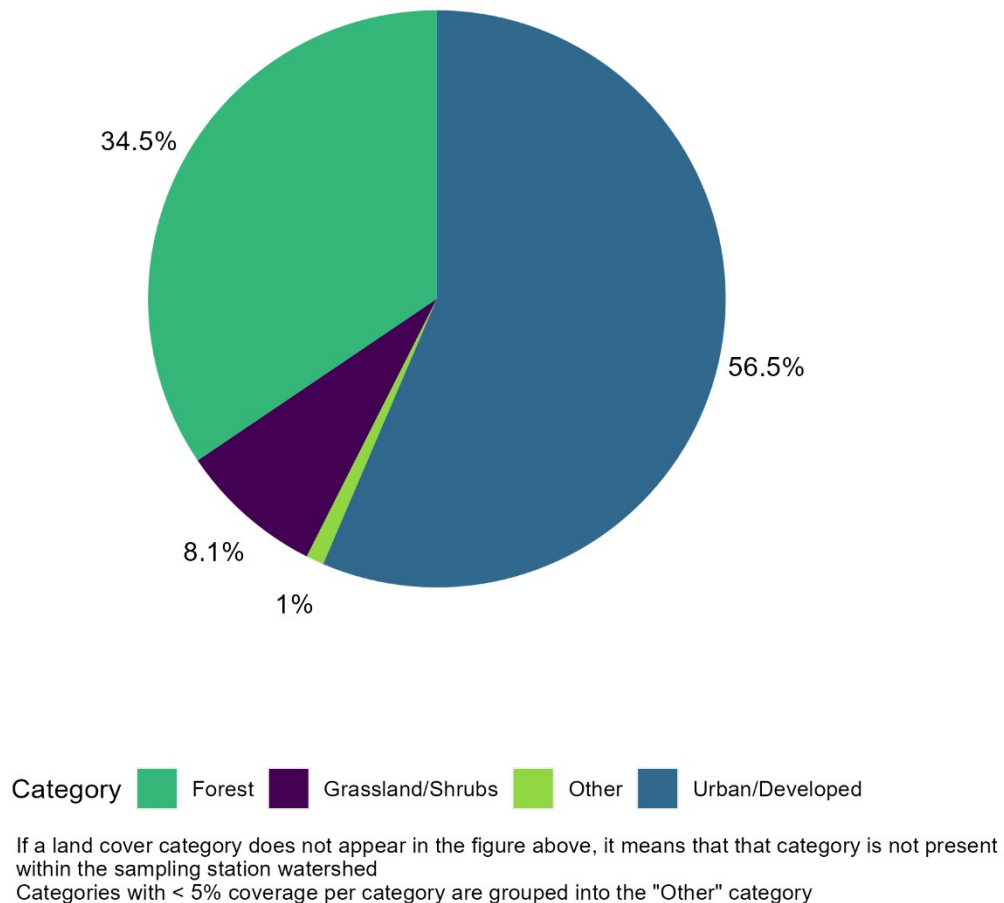
Land cover categories observed in the watershed of this sampling station are illustrated in Figure A-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (580.79 acres (56.5%))
- Forest (354.52 acres [34.5%])
- Grassland/Shrubs (82.83 acres [8.1%])
- Wetlands (8.10 acres [0.8%])
- Open Water (1.74 acres [0.2%])
- Agriculture (0.44 acres [0%])
- Barren (0.43 acres [0%])

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Jolly Giant Creek at Samoa Boulevard



**Figure A-92 Percentage coverage by land cover category in the Jolly Giant Creek at Samoa Boulevard watershed**

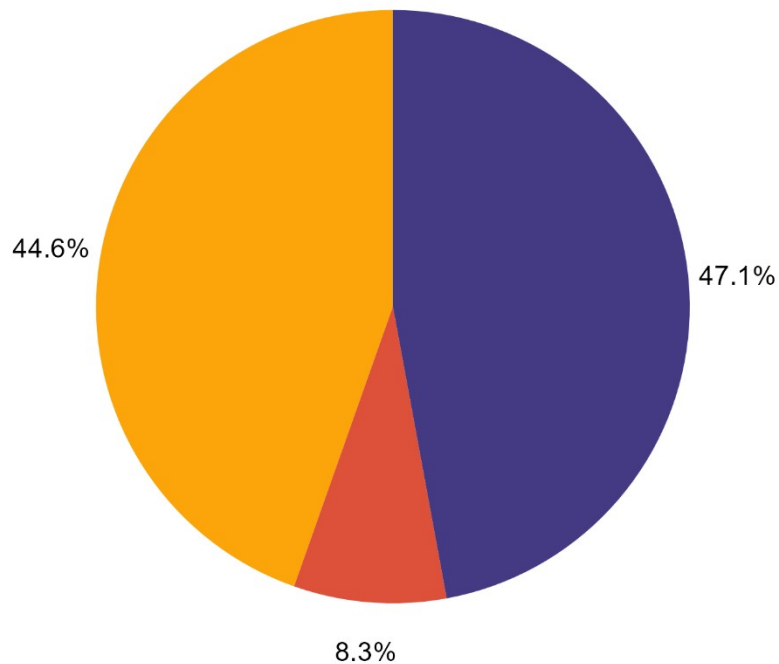
Land use categories observed in the watershed of this sampling station are illustrated in Figure A-48 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (484.55 acres [47.1%])
- Developed Sewered (458.6 acres [44.6%])
- Developed Unsewered (85.7 acres [8.3%])
- Grazing (0 acres [0%])



## Land Use

Humboldt County: Jolly Giant Creek at Samoa Boulevard



Category ■ Developed Sewered ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure A-93 Percentage coverage by land use category in the Jolly Giant Creek at Samoa Boulevard watershed**

Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure A-49 below.

Specifically, the marker detection percentage in the dry sampling period were:

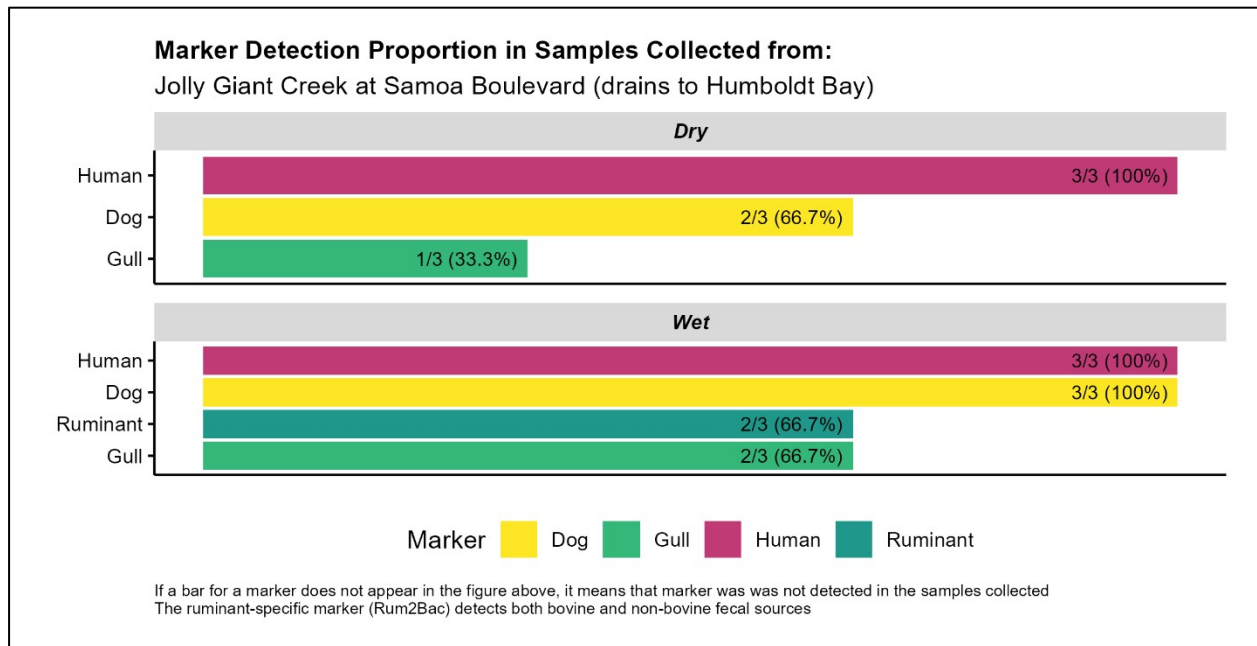
- Human (3/3 [100%]),
- Dog (2/3 [66.7%]),

- Gull (1/3 [33.3%]), and
- Ruminant (0/3 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Human (3/3 [100%]),
- Dog (3/3 [100%]),
- Gull (2/3 [66.7%]), and
- Ruminant (2/3 [66.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure A-94 Detection percentage of species-specific markers evaluated in samples collected from the Jolly Giant Creek at Samoa Boulevard station**

## **Appendix B – Land Cover and Land Use Coverage, and Species-Specific Marker Detection in Coastal Streams Draining into the Pacific Ocean**

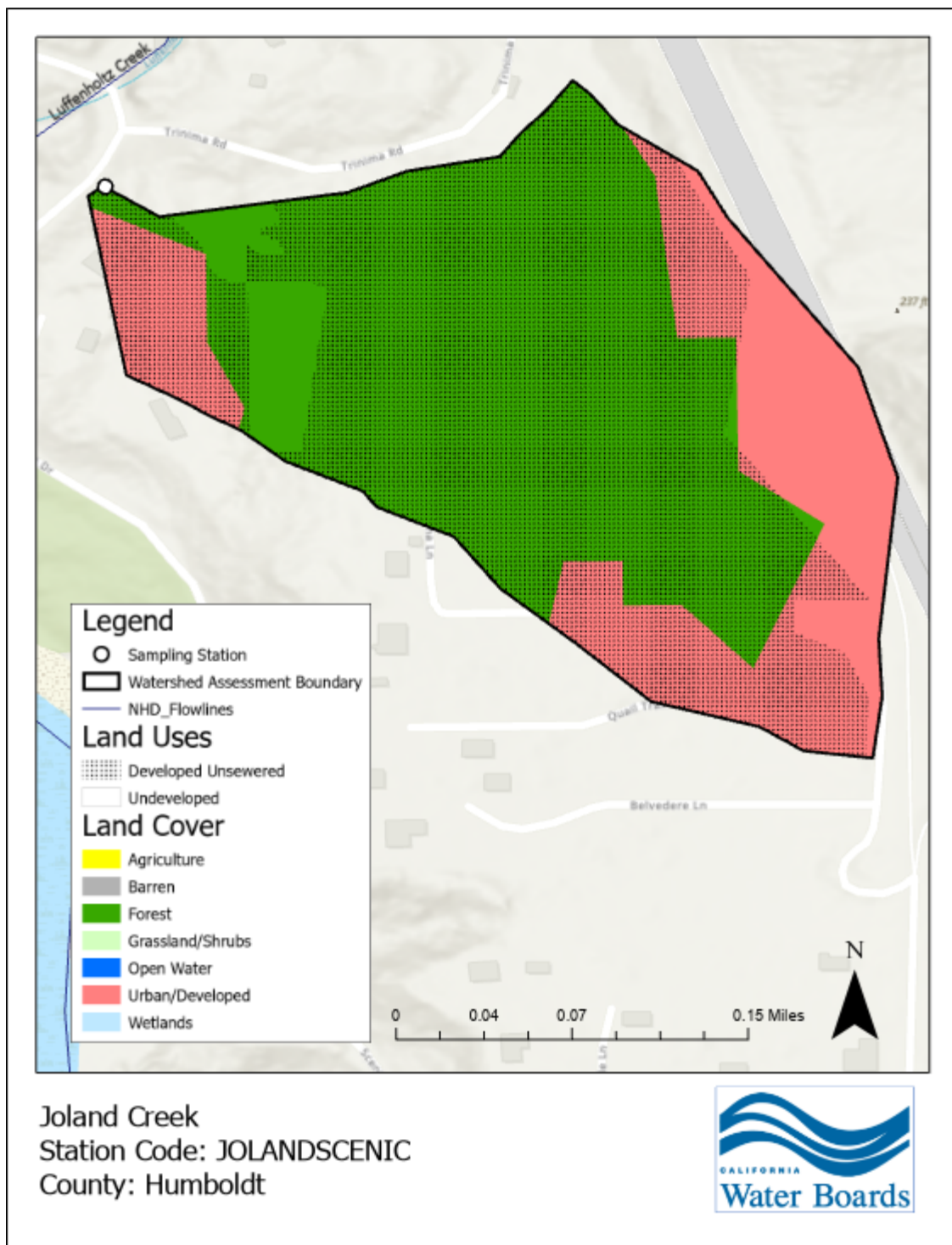
Results of the assessment of land cover, land use, and MST data collected from each sampling station sampled in 10 Humboldt County coastal streams draining into Humboldt Bay are detailed below. In addition, any exceedances of the REC-1 Objective at these sampling stations (if evaluated) are also included.

### **Joland Creek (JOLANDSCENIC):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-1 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-1 Land cover and land use in the Joland Creek watershed**

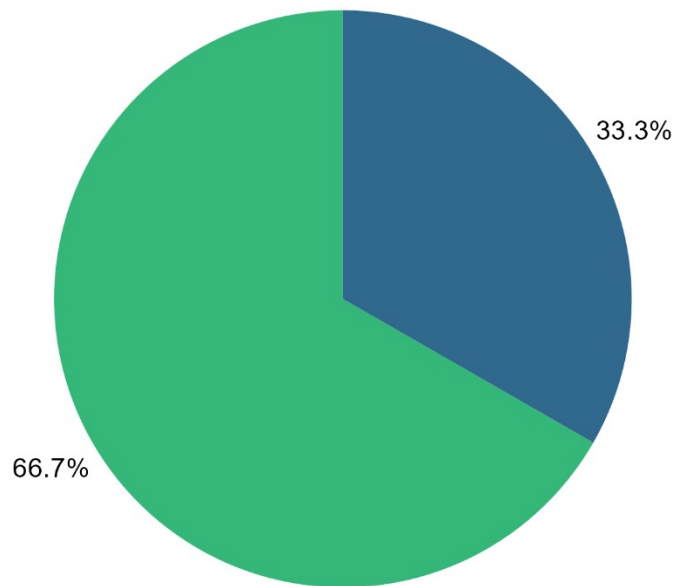
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-2 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (16.88 acres [66.7%]),
- Urban/Developed (8.41 acres [33.3%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Grassland/Shrubs (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Joland Creek



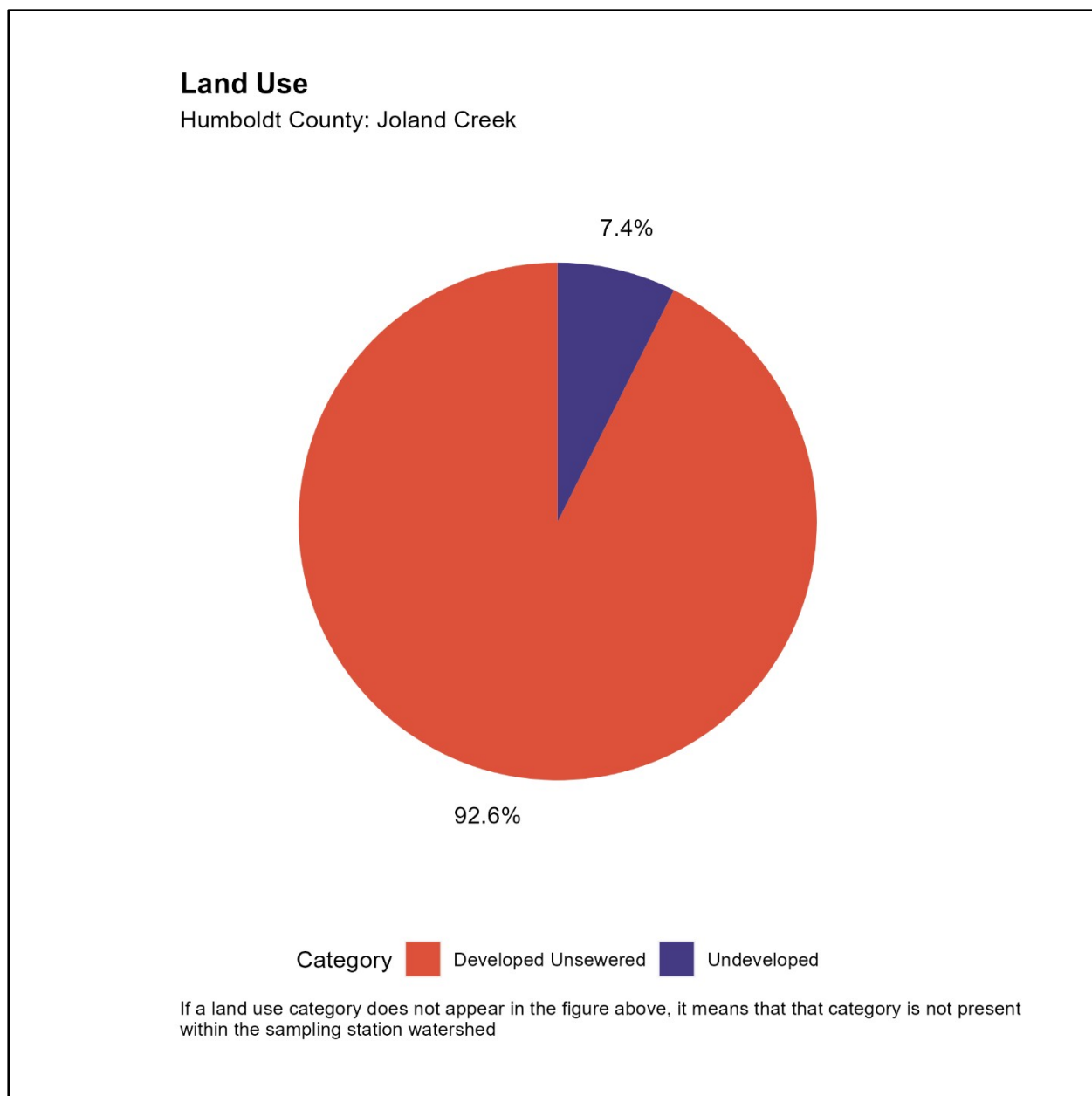
Category ■ Forest ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure B-2 Percentage coverage by land cover category in the Joland Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-3 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Unsewered (25.76 acres [92.6%]),
- Undeveloped (2.07 acres [7.4%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).



**Figure B-3 Percentage coverage by land use category in the Joland Creek watershed**

Five samples were collected from this sampling station. All five samples were collected in the wet sampling period.

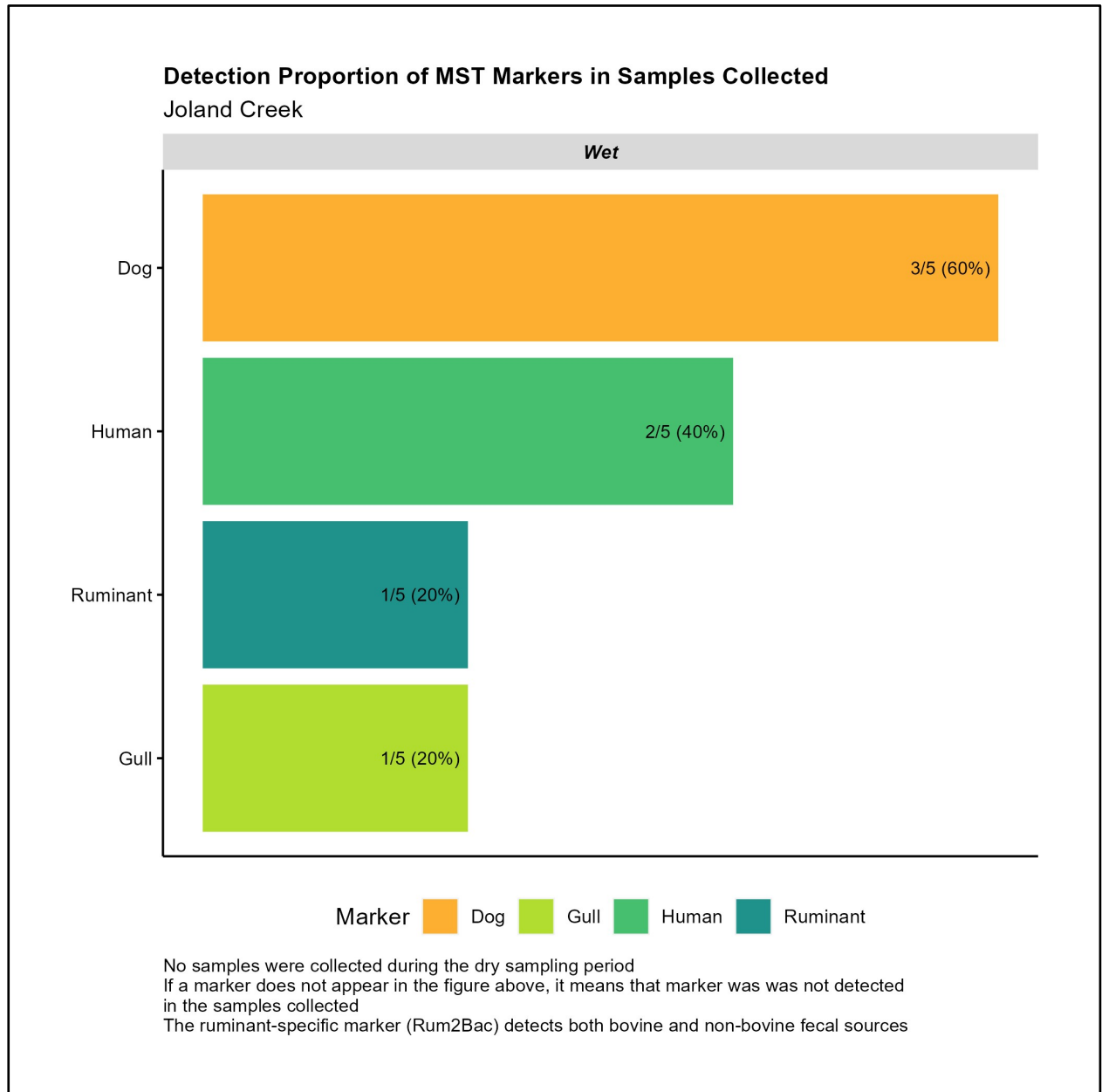
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-4 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/5 [60%]),
- Human (2/5 [40%]),

- Gull (1/5 [20%]), and
- Ruminant (1/5 [20%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-4 Detection percentage of species-specific markers evaluated in samples collected from the Joland Creek station**



**Little River at Highway 101 (108LR0663) & Little River (LITTLERIVER101):**

“Little River at Highway 101 (108LR0663)” was sampled under the Impaired Streams Monitoring Study, and “Little River (LITTLERIVER101)” was sampled under the Humboldt County APMP Study. These two sampling stations are 46 feet apart. Therefore, the watershed for both these sampling stations is the same.

The Little River at Highway 101 (108LR0663) sampling station is a saline sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The enterococcus data collected from this saline sampling station under the Coastal Pathogen Project was compared to the enterococcus-based saline threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/11),
- Winter (0/5), and
- Summer (0/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

FIB data collected from the Little River (LITTLERIVER) sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-5 below illustrates the land cover and land use in the watershed of these sampling stations.

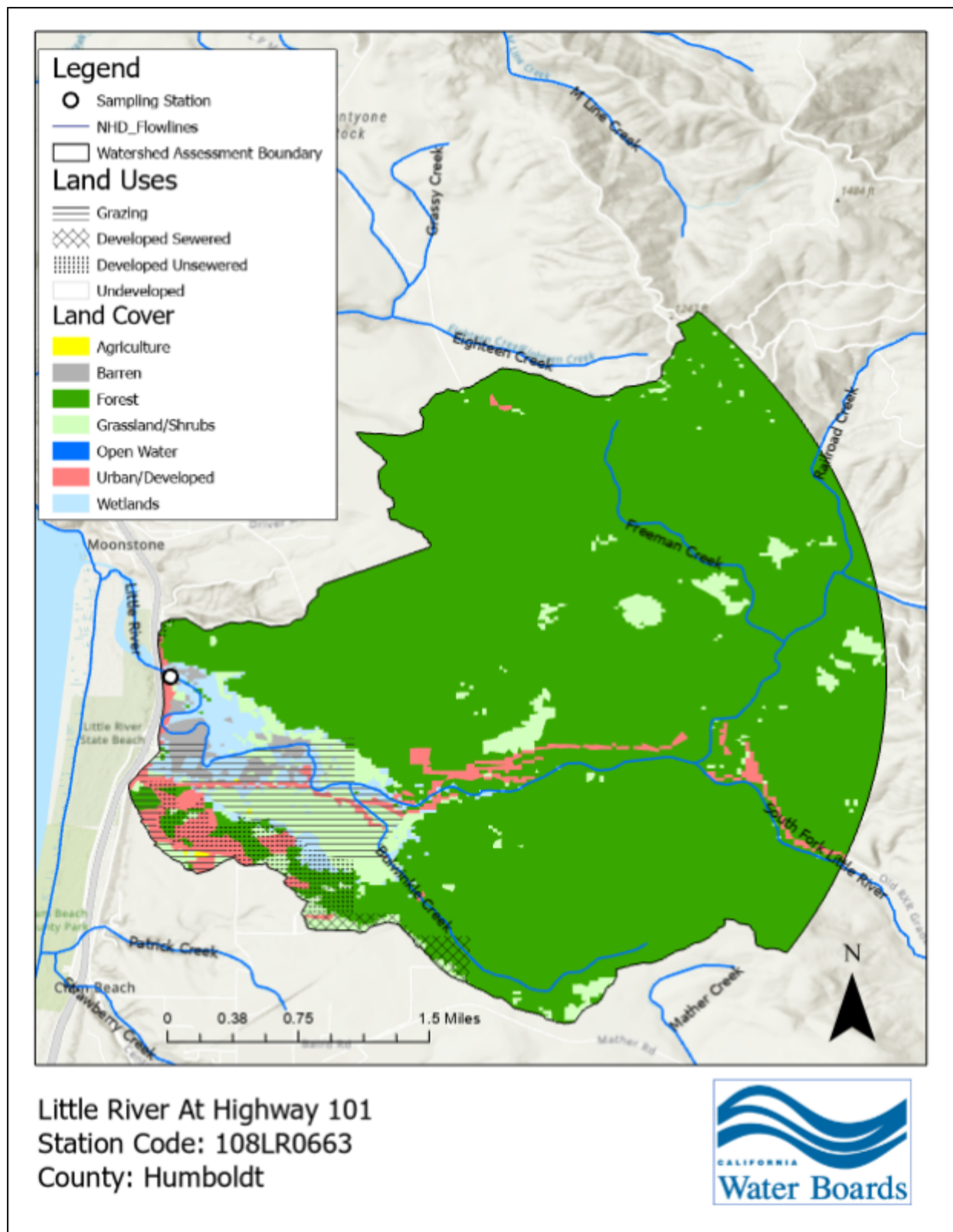


Figure B-5 Land cover and land use in the Little River at Highway 101 watershed

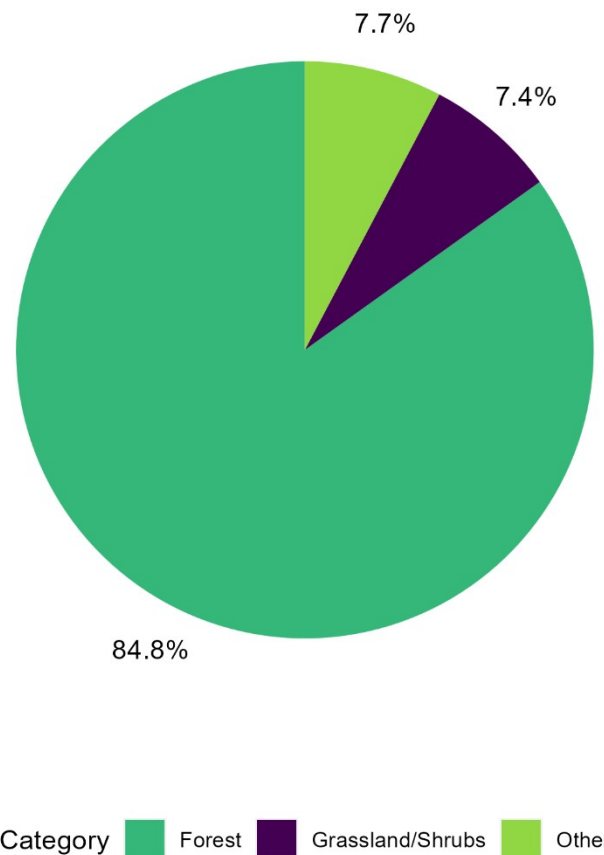
Land cover categories observed in the watershed of these sampling stations are illustrated in Figure B-6 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (4573.34 acres [84.8%]),
- Grassland/Shrubs (399.98 acres [7.4%]),
- Urban/Developed (179.92 acres [3.3%]),
- Wetlands (166.71 acres [3.1%]),
- Barren (68.04 acres [1.3%]),
- Open Water (0.22 acres [0%]), and
- Agriculture (2.06 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Little River at Highway 101



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

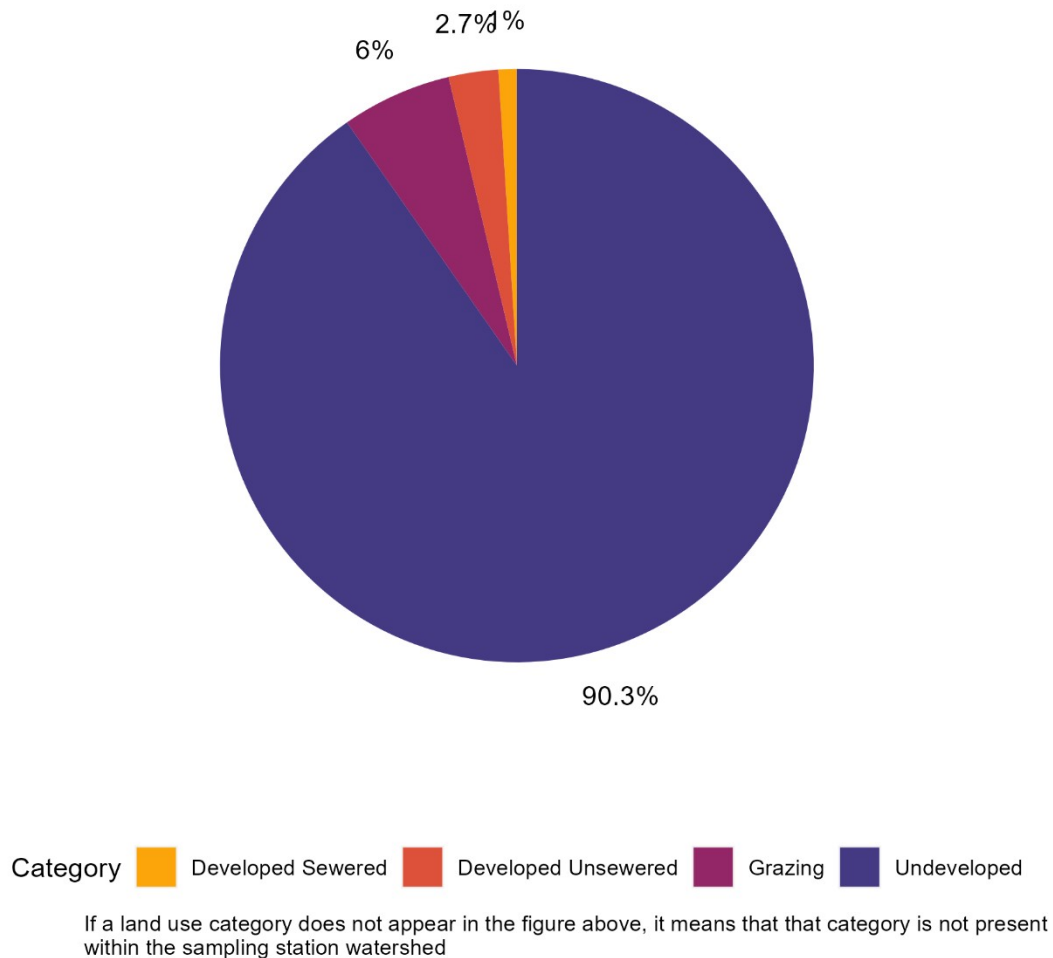
**Figure B-6 Percentage coverage by land cover category in the Little River at Highway 101 watershed**

Land use categories observed in the watershed of these sampling stations are illustrated in Figure B-7 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (4871.46 acres [90.3%]),
- Grazing (324.8 acres [6%]),
- Developed Unsewered (148.22 acres [2.7%]), and
- Developed Sewered (51.79 acres [1%]).
- Non-dairy cattle grazing is present in this sampling station watershed.

## Land Use

Humboldt County: Little River at Highway 101



**Figure B-7 Percentage coverage by land use category in the Little River at Highway 101 watershed**

MST data from each of these two sampling stations has been assessed separately. This is because, except in the case of this coastal stream, the Coastal Pathogen Project, and Humboldt County APMP Study did not collect samples from overlapping sampling stations. Furthermore, the Impaired Streams Monitoring Study of the Coastal Pathogen Project (under which the “Little River at Highway 101 station was sampled) was conducted from February 2016 to January 2018, whereas the Humboldt County APMP Study (under which the “Little River” station was sampled) was conducted from April 2019 to November 2022. In addition, whereas samples were collected from both the dry

as well as wet sampling periods under the Impaired Streams Monitoring Study and Source Assessment Study, samples were collected only in the wet sampling period under the Humboldt County APMP Study. Therefore, combining MST data from these overlapping sampling stations will lead to incorrect conclusions about the MST marker percentages detected from these stations. The MST data assessment from each of these overlapping sampling stations is presented below:

*Little River at Highway 101 (108LR0663)*: Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure B-8 below.

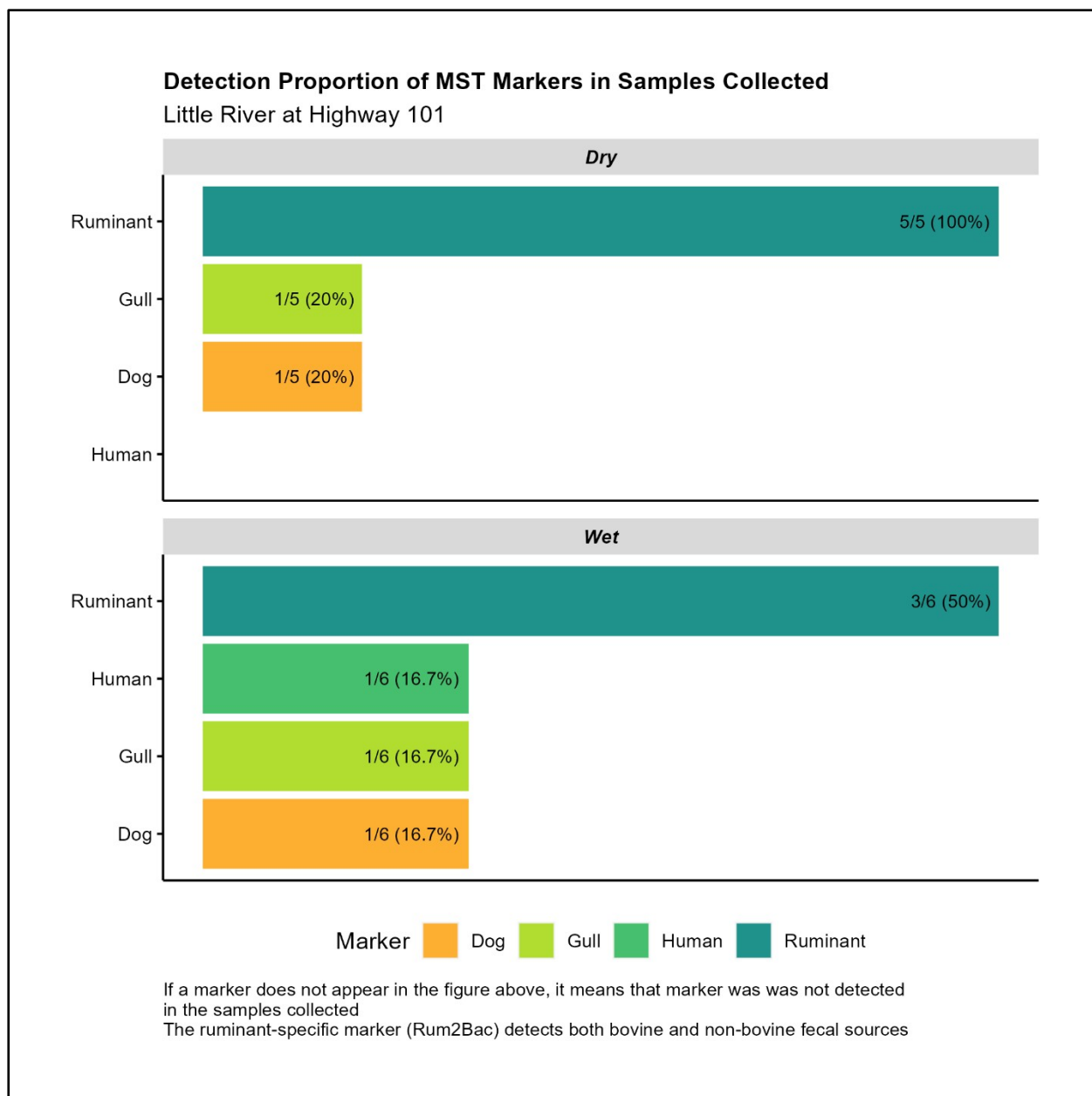
Specifically, the marker detection percentage in the dry sampling period were:

- Ruminant (5/5 [100%]),
- Dog (1/5 [20%]),
- Gull (1/5 [20%]), and
- Human (0/5 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (3/6 [50%]),
- Dog (1/6 [16.7%]),
- Gull (1/6 [16.7%]), and
- Human (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-8 Detection percentage of species-specific markers evaluated in samples collected from the Little River at Highway 101 station**

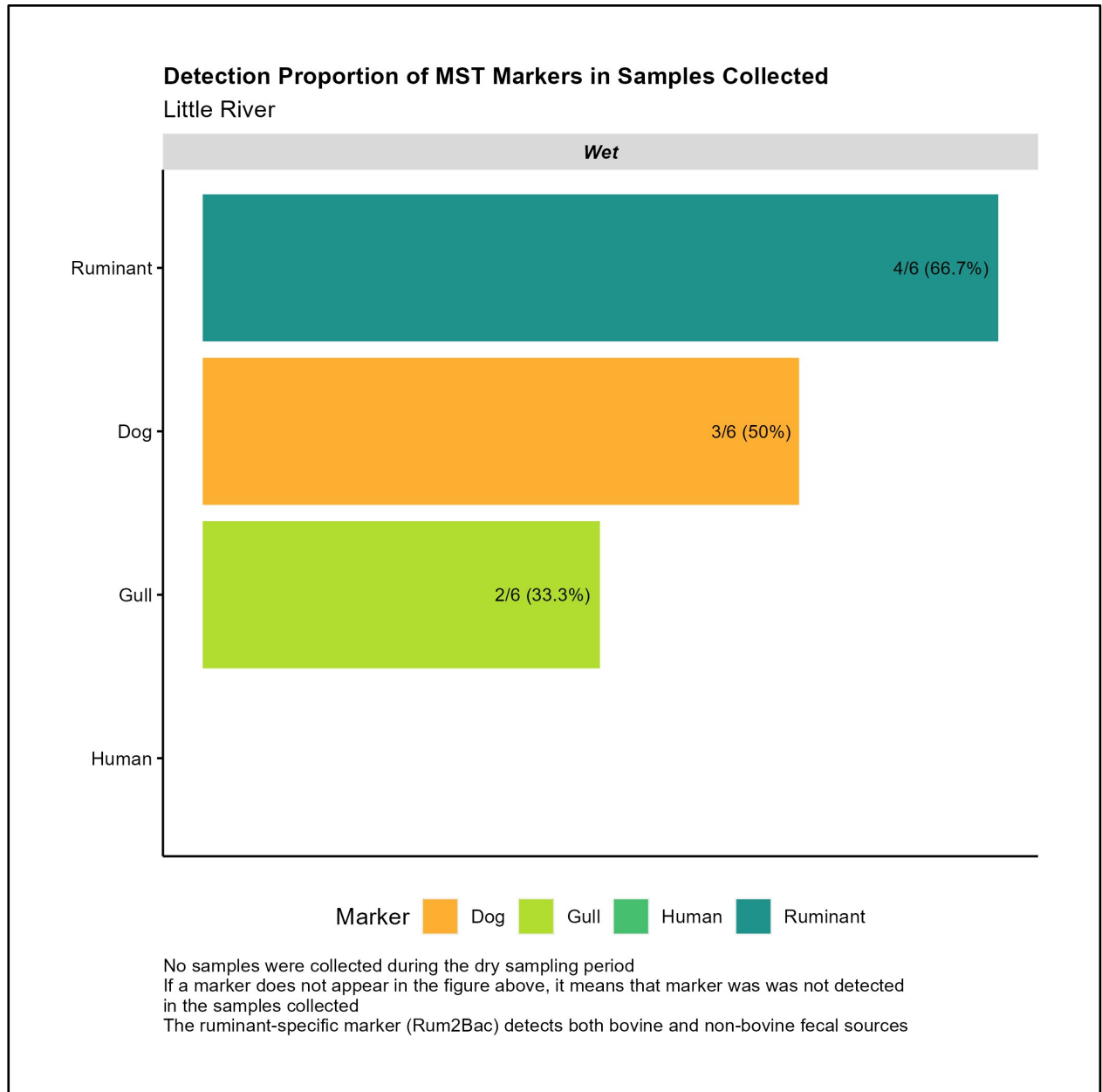
*Little River (LITTLERIVER101)*: Six samples were collected from this sampling station. All six samples were collected in the wet sampling period. The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-9 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (4/6 [66.7%]),

- Dog (3/6 [50%]),
- Gull (2/6 [33.3%]), and
- Human (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-9 Detection percentage of species-specific markers evaluated in samples collected from the Little River station**

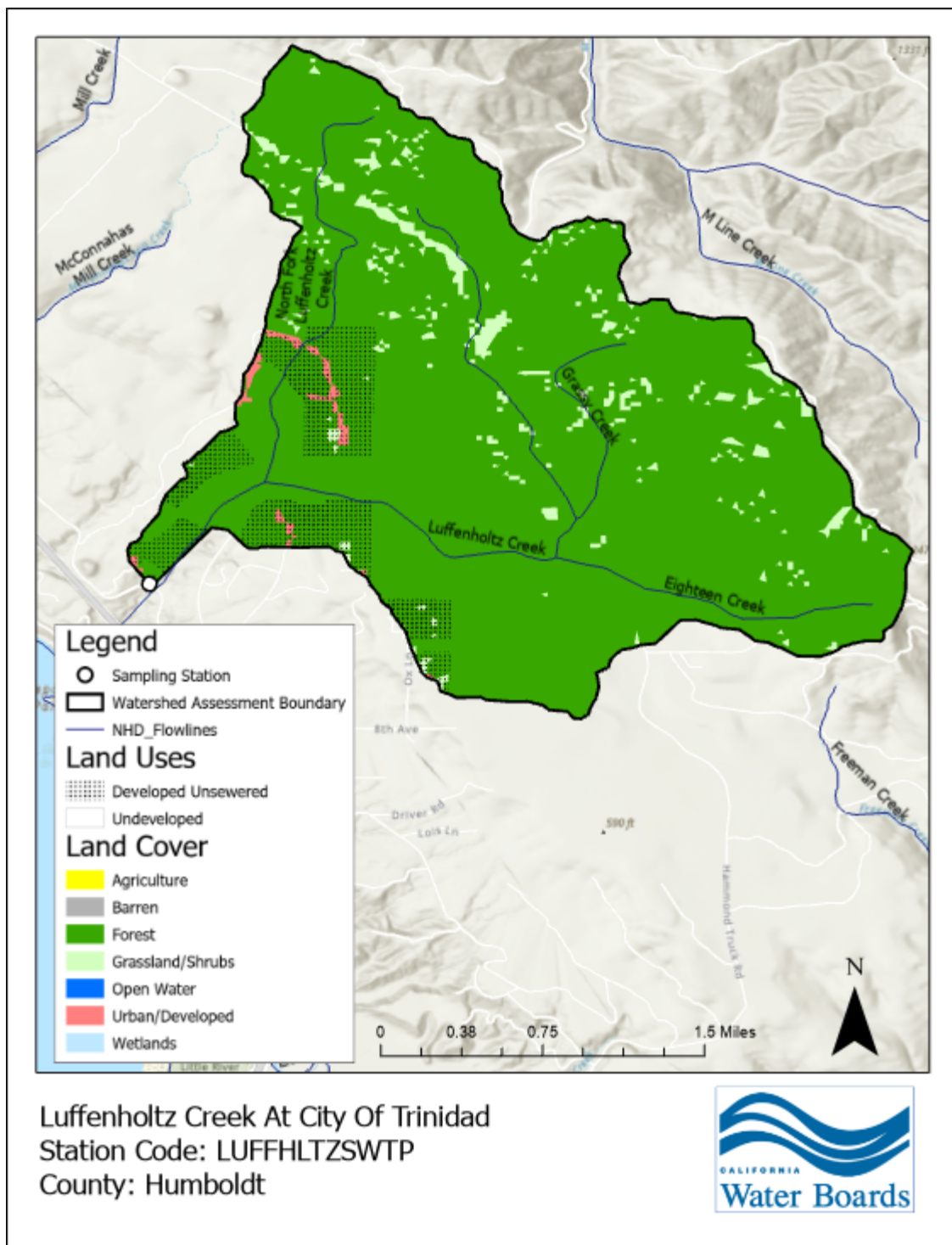


**Luffenholtz Creek at City of Trinidad (LUFFHLTZSWTP):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-10 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-10 Land cover and land use in the Luffenholtz Creek at City of Trinidad watershed**

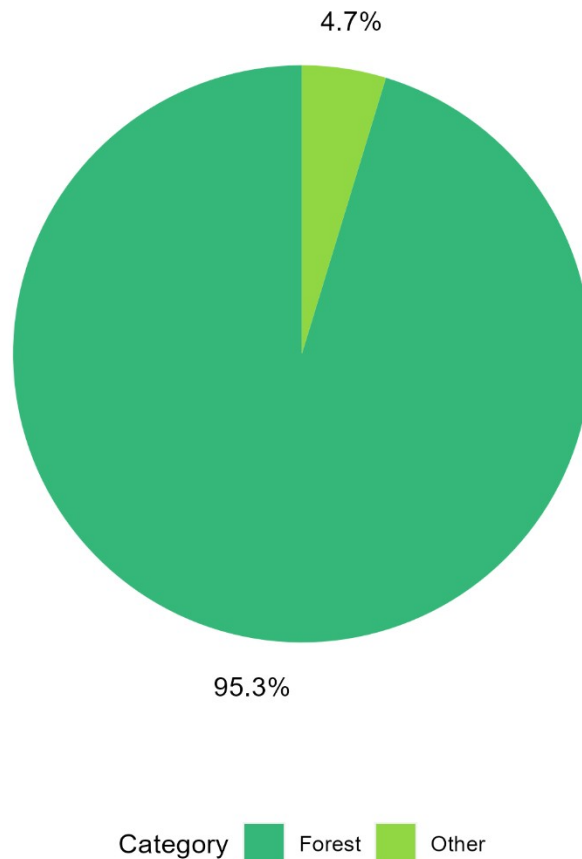
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-11 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (2611.81 acres [95.3%]),
- Grassland/Shrubs (110.34 acres [4%]),
- Urban/Developed (18.94 acres [0.7%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Luffenholtz Creek at City Of Trinidad



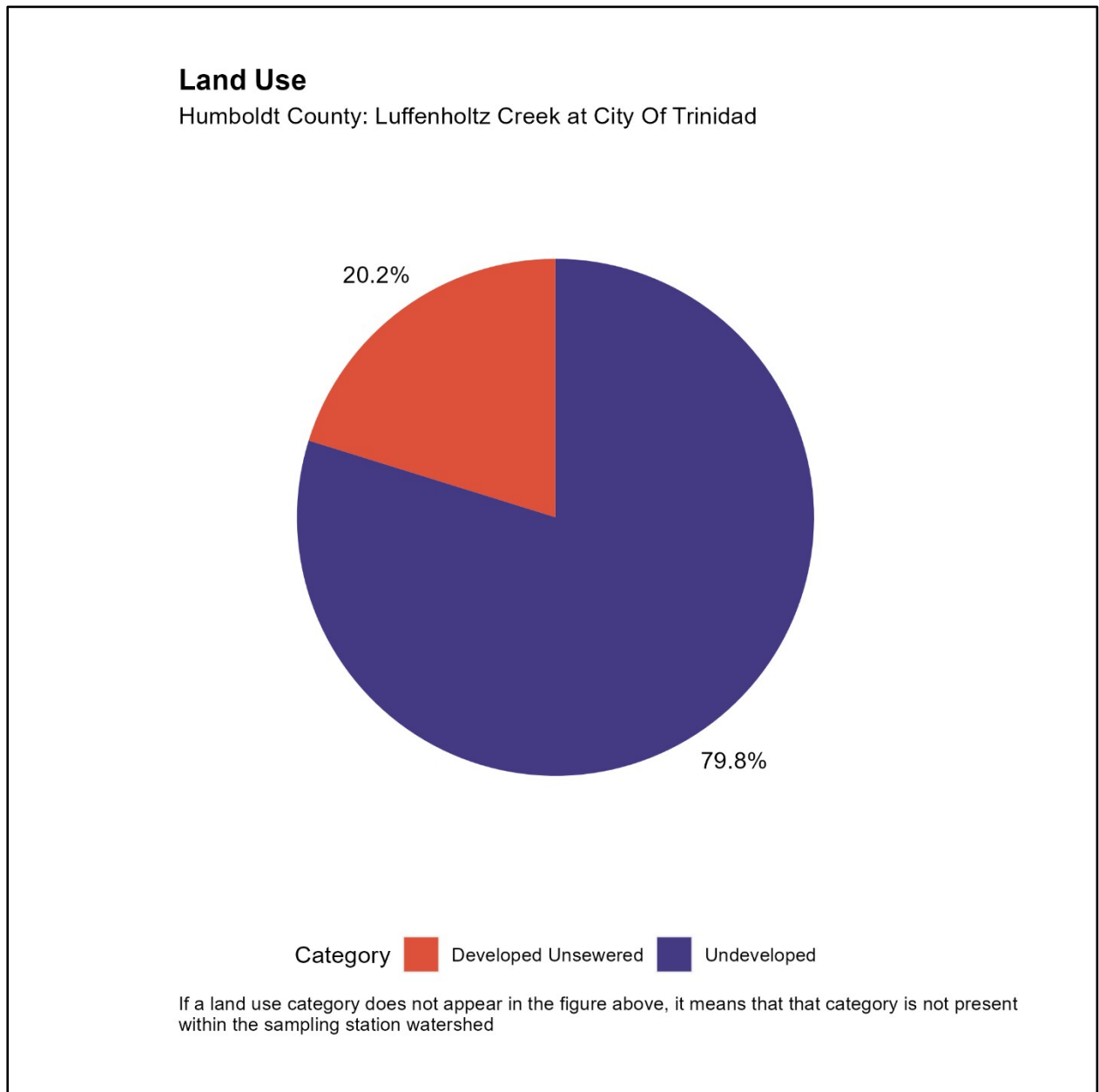
If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure B-11 Percentage coverage by land cover category in the Luffenholtz Creek at City of Trinidad watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-12 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (2530.43 acres [79.8%]),
- Developed Unsewered (639.8 acres [20.2%]),
- Developed Sewered (0 acres [0%]), and

- Grazing (0 acres [0%]).



**Figure B-12 Percentage coverage by land use category in the Luffenholtz Creek at City of Trinidad watershed**

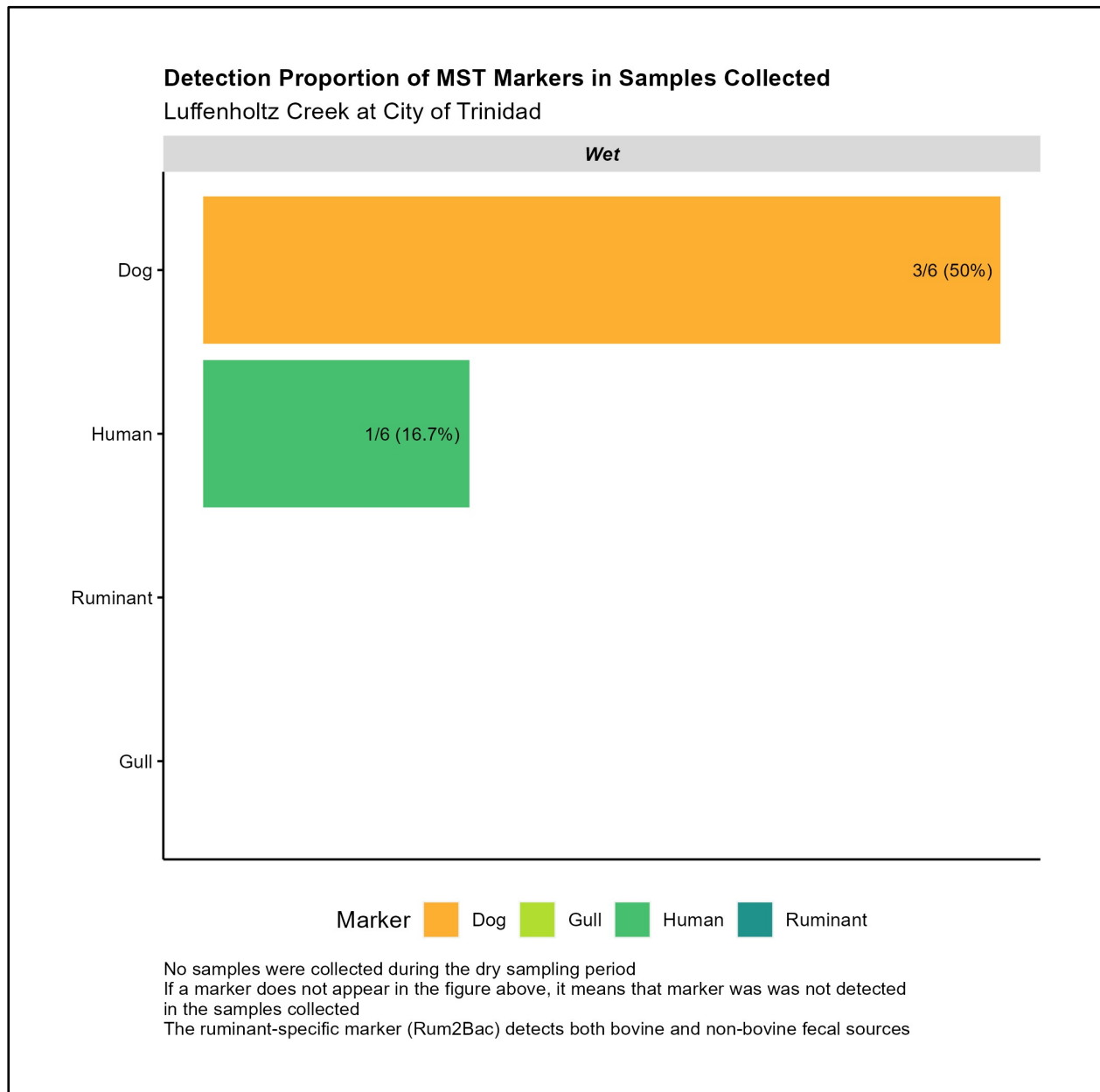
Six samples were collected from this sampling station. All six samples were collected in the wet sampling period.

The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-13 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/6 [50%]),
- Human (1/6 [16.7%]),
- Gull (0/6 [0%]), and
- Ruminant (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



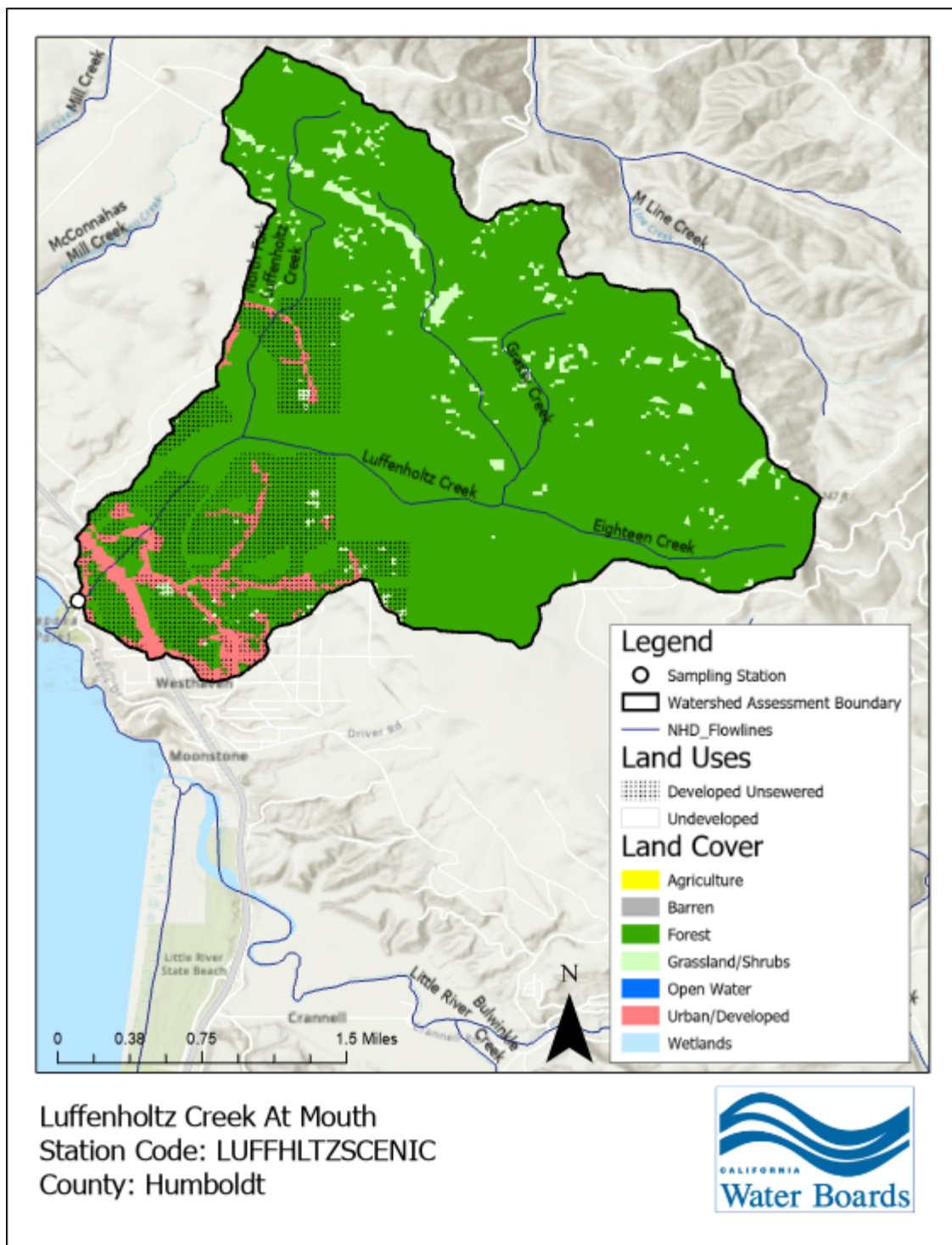
**Figure B-13 Detection percentage of species-specific markers evaluated in samples collected from the Luffenholtz Creek at City of Trinidad station**

**Luffenholtz Creek at Mouth (LUFFHLTZSCENIC):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-14 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-14 Land cover and land use in the Luffenholtz Creek at Mouth watershed**

Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-15 below. Specifically, the coverage of land cover categories in this watershed are:

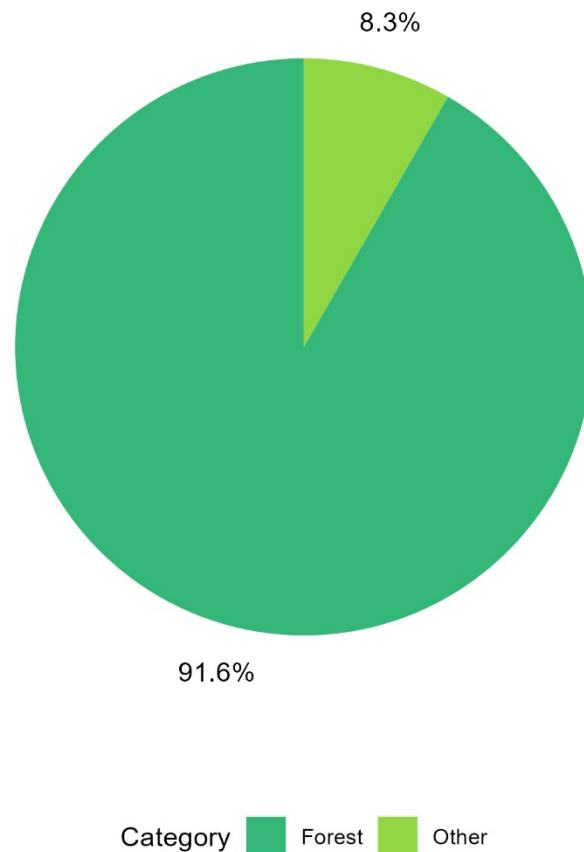


- Forest (2966.74 acres [91.6%]),
- Urban/Developed (152.92 acres [4.7%]),
- Grassland/Shrubs (117.85 acres [3.6%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Luffenholtz Creek at Mouth



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

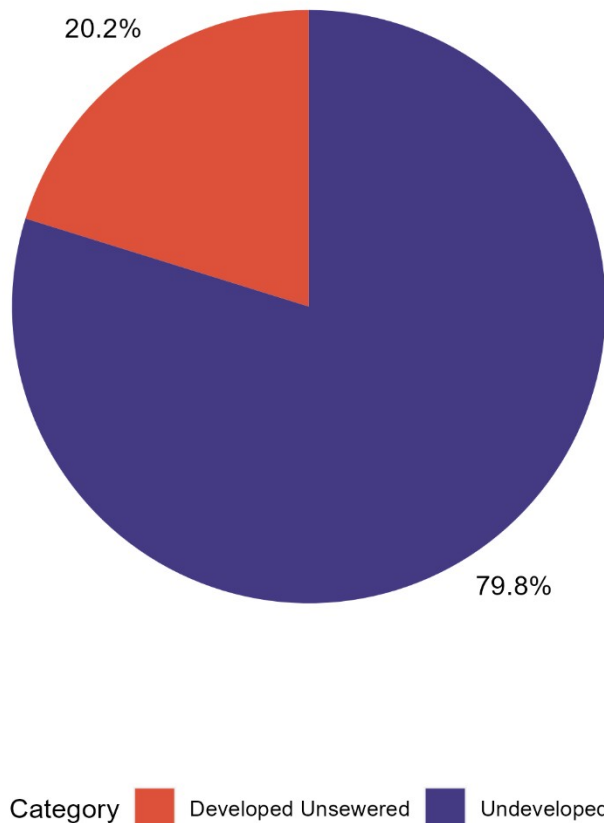
**Figure B-15 Percentage coverage by land cover category in the Luffenholtz Creek at Mouth watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-16 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (2530.43 acres [79.8%]),
- Developed Unsewered (639.8 acres [20.2%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Luffenholtz Creek at Mouth



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-16 Percentage coverage by land use category in the Luffenholtz Creek at Mouth watershed**

Six samples were collected from this sampling station. All six samples were collected in the wet sampling period.

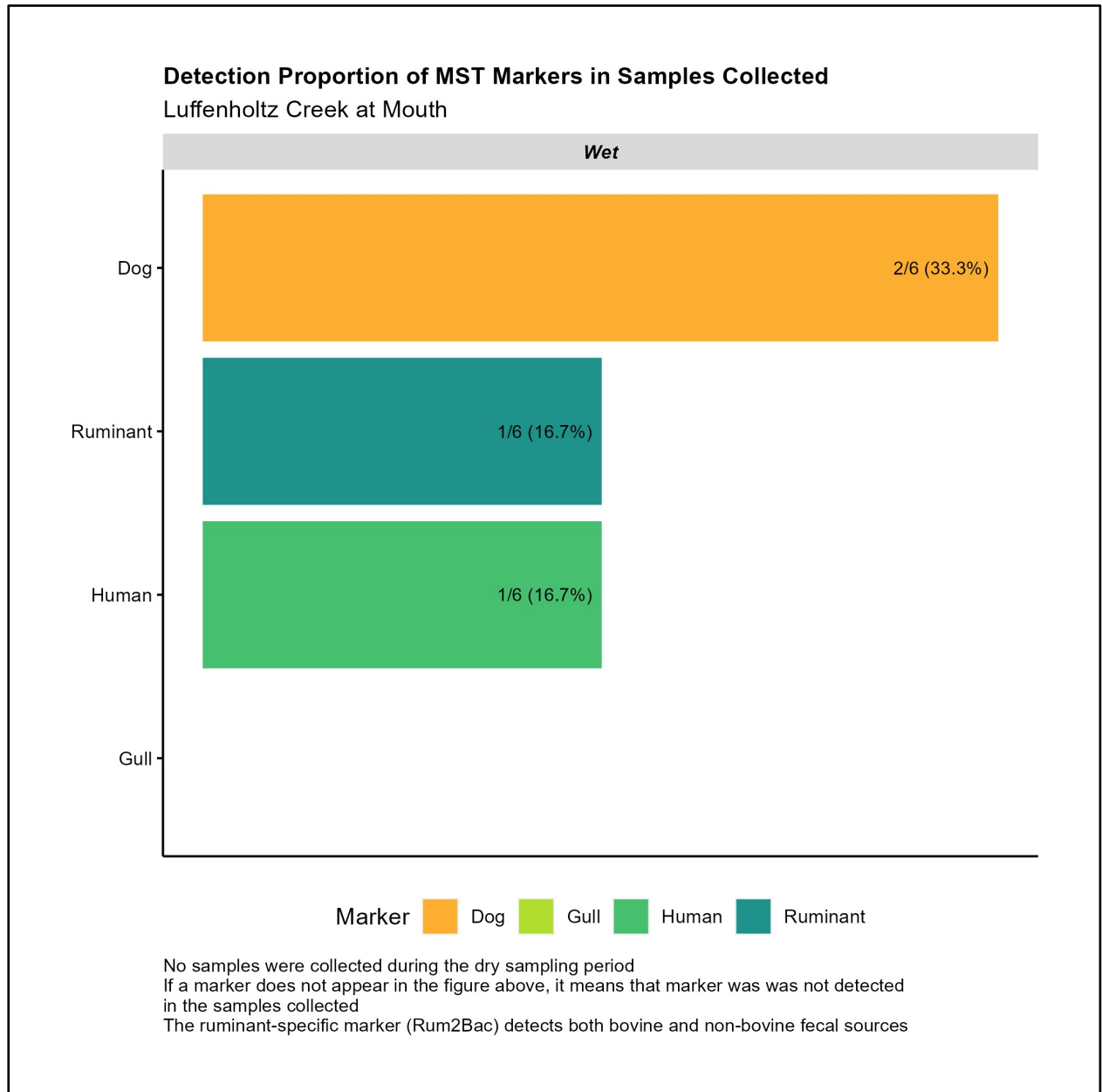
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-17 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/6 [33.3%]),
- Human (1/6 [16.7%]),

- Ruminant (1/6 [16.7%]), and
- Gull (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-17 Detection percentage of species-specific markers evaluated in samples collected from the Luffenholtz Creek at Mouth station**

**Mill Creek at Mouth (MILLCRWOODBRIDGE):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-18 below illustrates the land cover and land use in the watershed of this sampling station.

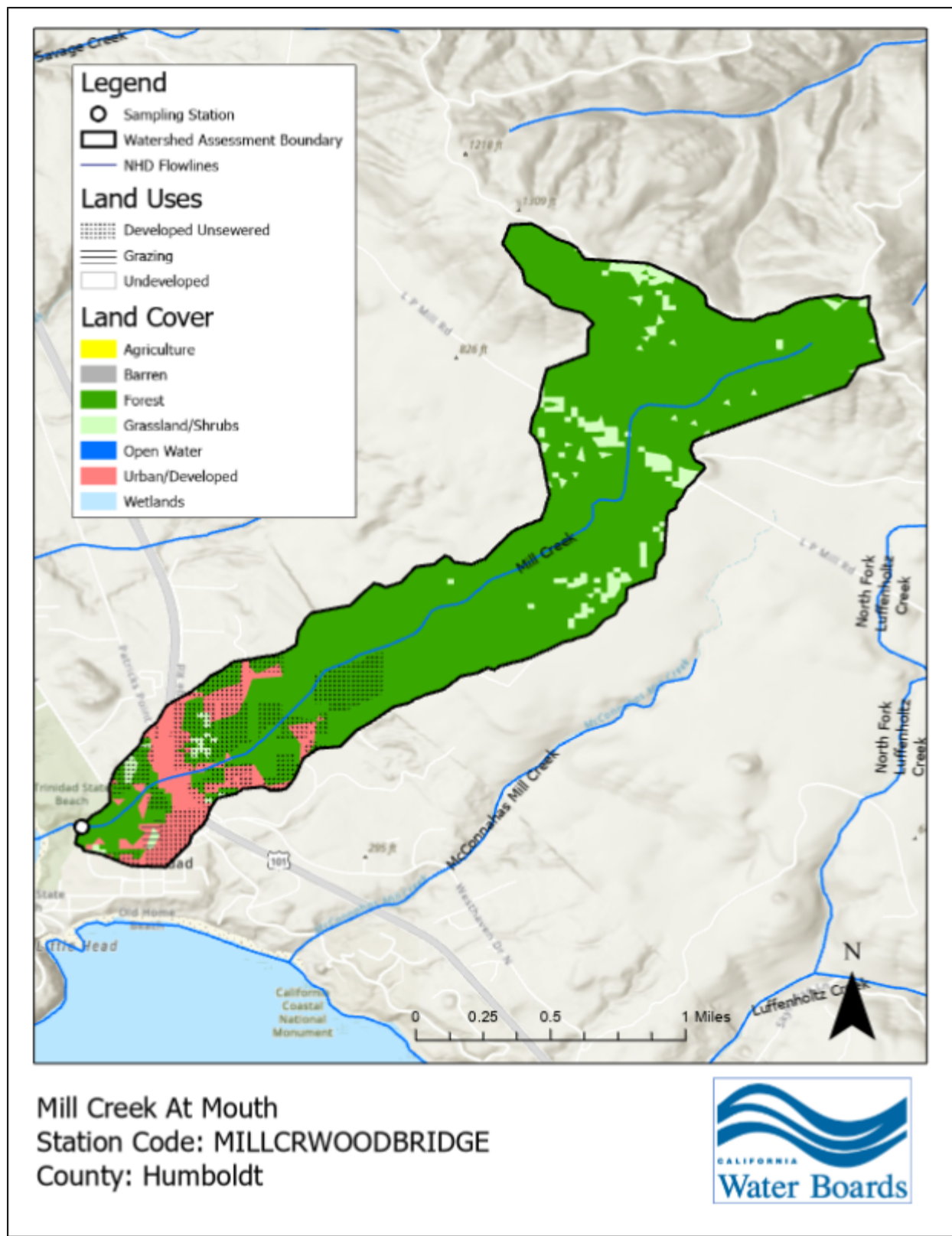


Figure B-18 Land cover and land use in the Mill Creek at Mouth watershed

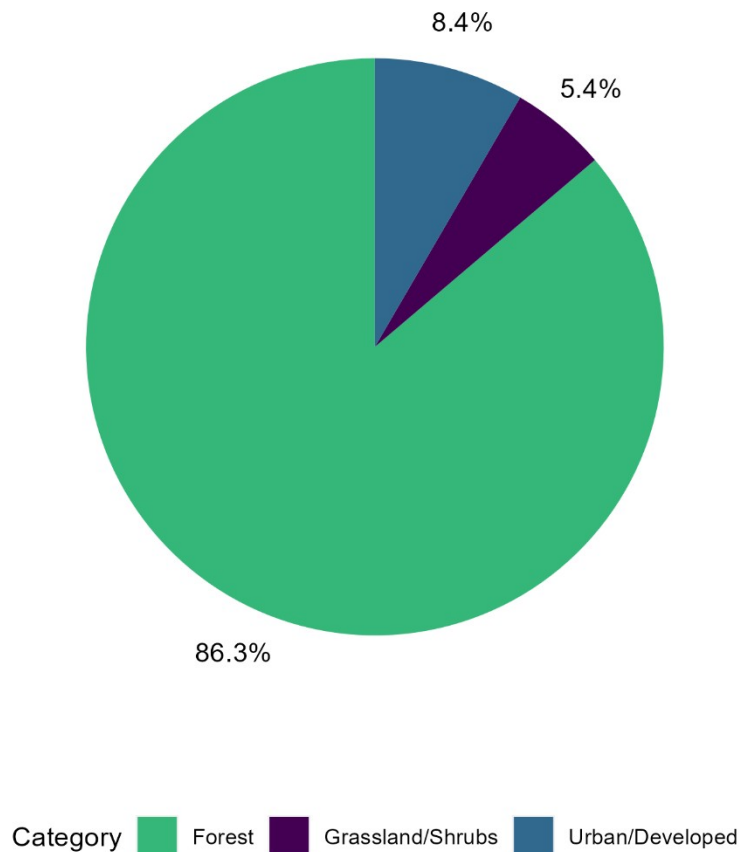
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-19 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (719.97 acres [86.3%]),
- Urban/Developed (70.13 acres [8.4%]),
- Grassland/Shrubs (44.64 acres [5.4%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Mill Creek at Mouth



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure B-19 Percentage coverage by land cover category in the Mill Creek at Mouth watershed**

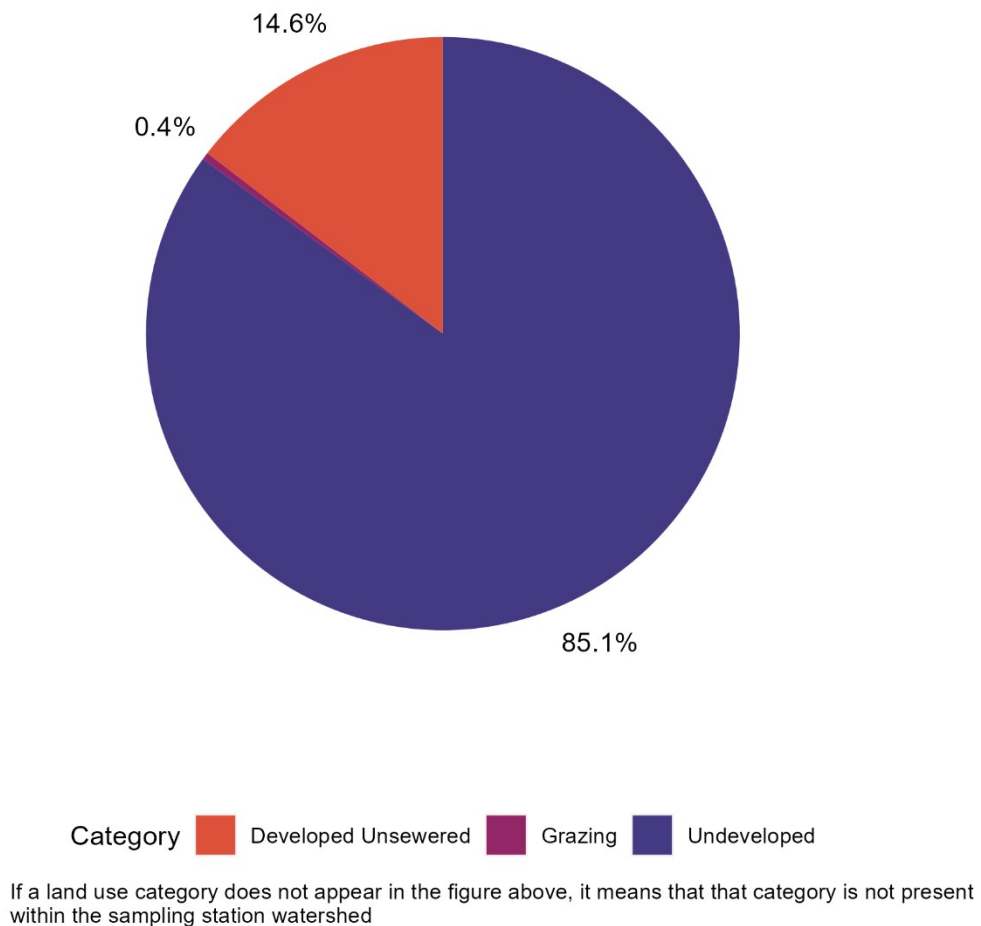
Land use categories observed in the watershed of this sampling station are illustrated in Figure B-20 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (691.78 acres [85.1%]),
- Developed Unsewered (118.44 acres [14.6%]),
- Grazing (2.92 acres [0.4%]), and
- Developed Sewered (0 acres [0%]).



## Land Use

Humboldt County: Mill Creek at Mouth



**Figure B-20 Percentage coverage by land use category in the Mill Creek at Mouth watershed**

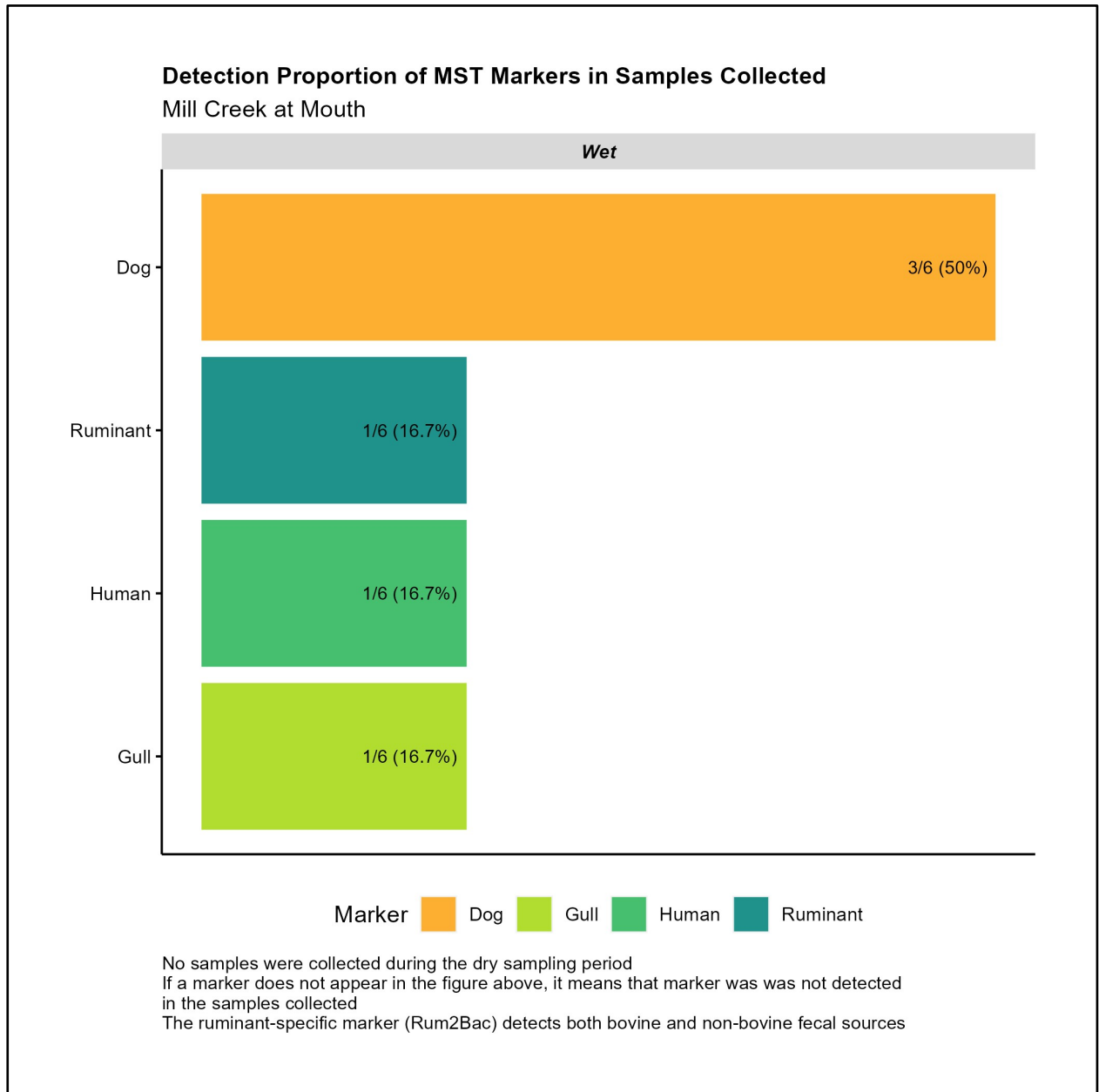
Six samples were collected from this sampling station. All six samples were collected in the wet sampling period.

The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-21 below. Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/6 [50%]),
- Gull (1/6 [16.7%]),

- Human (1/6 [16.7%]), and
- Ruminant (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-21 Detection percentage of species-specific markers evaluated in samples collected from the Mill Creek at Mouth station**

**Mill Creek at Stagecoach Road (108MC1250):**

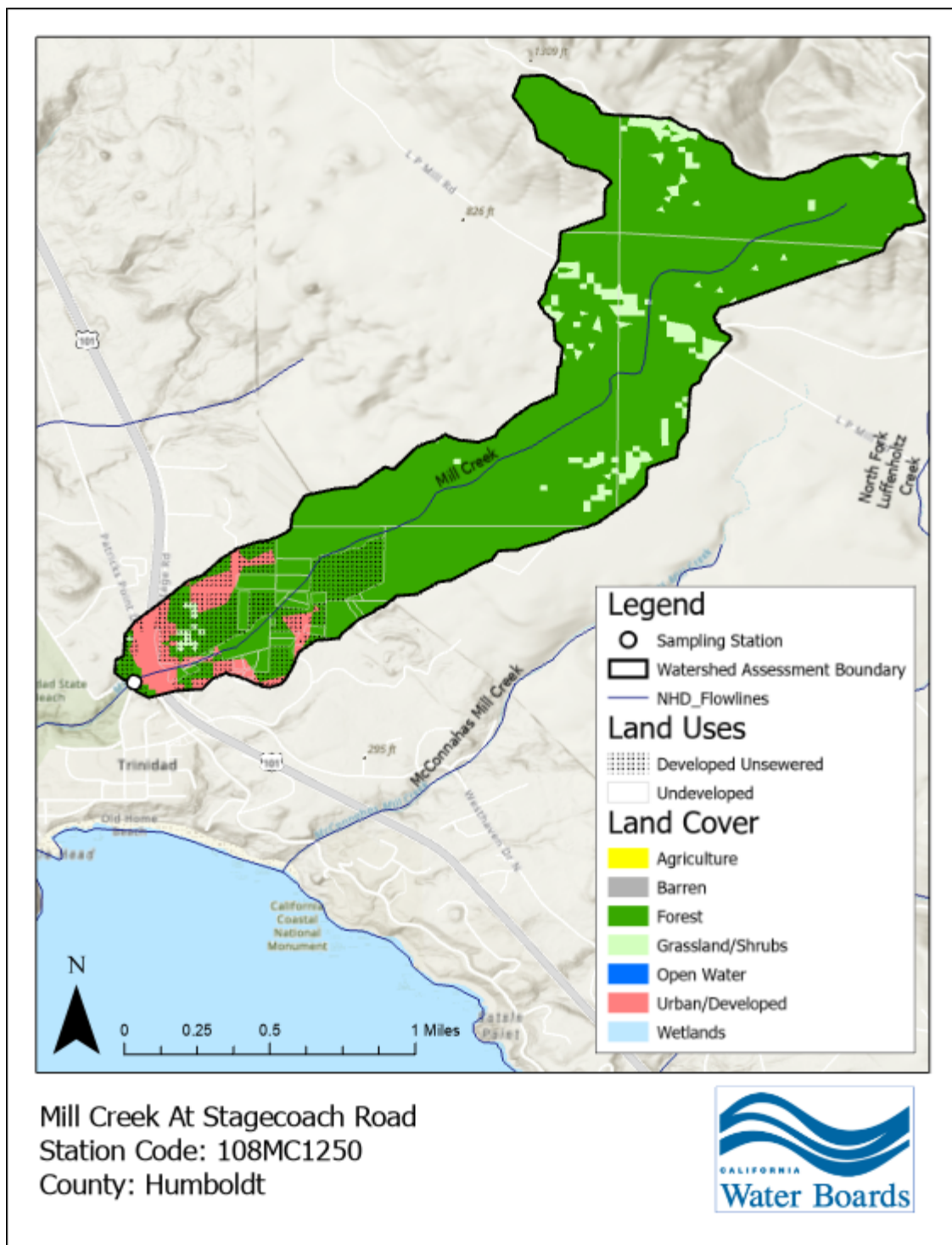
This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

The *E. coli* data collected from this freshwater sampling station under the Coastal Pathogen Project was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure B-22 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-22 Land cover and land use in the Mill Creek at Stagecoach Road watershed**

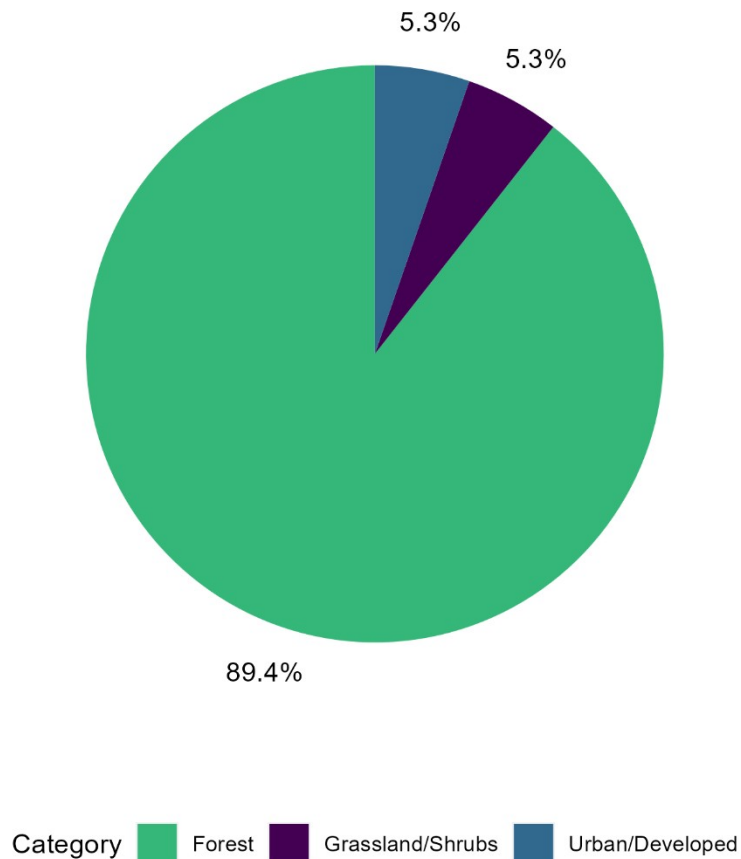
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-23 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (688.45 acres [89.4%]),
- Urban/Developed (40.92 acres [5.3%]),
- Grassland/Shrubs (40.51 acres [5.3%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Mill Creek at Stagecoach Road



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

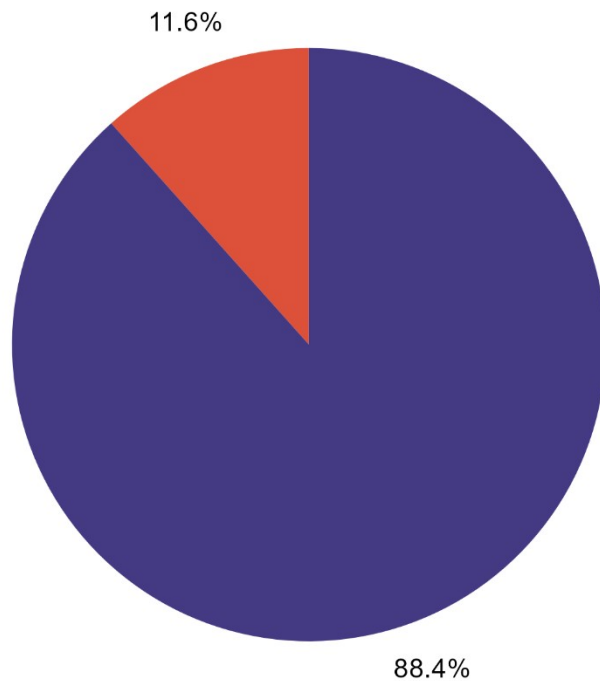
**Figure B-23 Percentage coverage by land cover category in the Mill Creek at Stagecoach Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-24 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (666.21 acres [88.4%]),
- Developed Unsewered (87.57 acres [11.6%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Mill Creek at Stagecoach Road



Category ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-24 Percentage coverage by land use category in the Mill Creek at Stagecoach Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure B-25 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%]),
- Gull (0/2 [0%]),

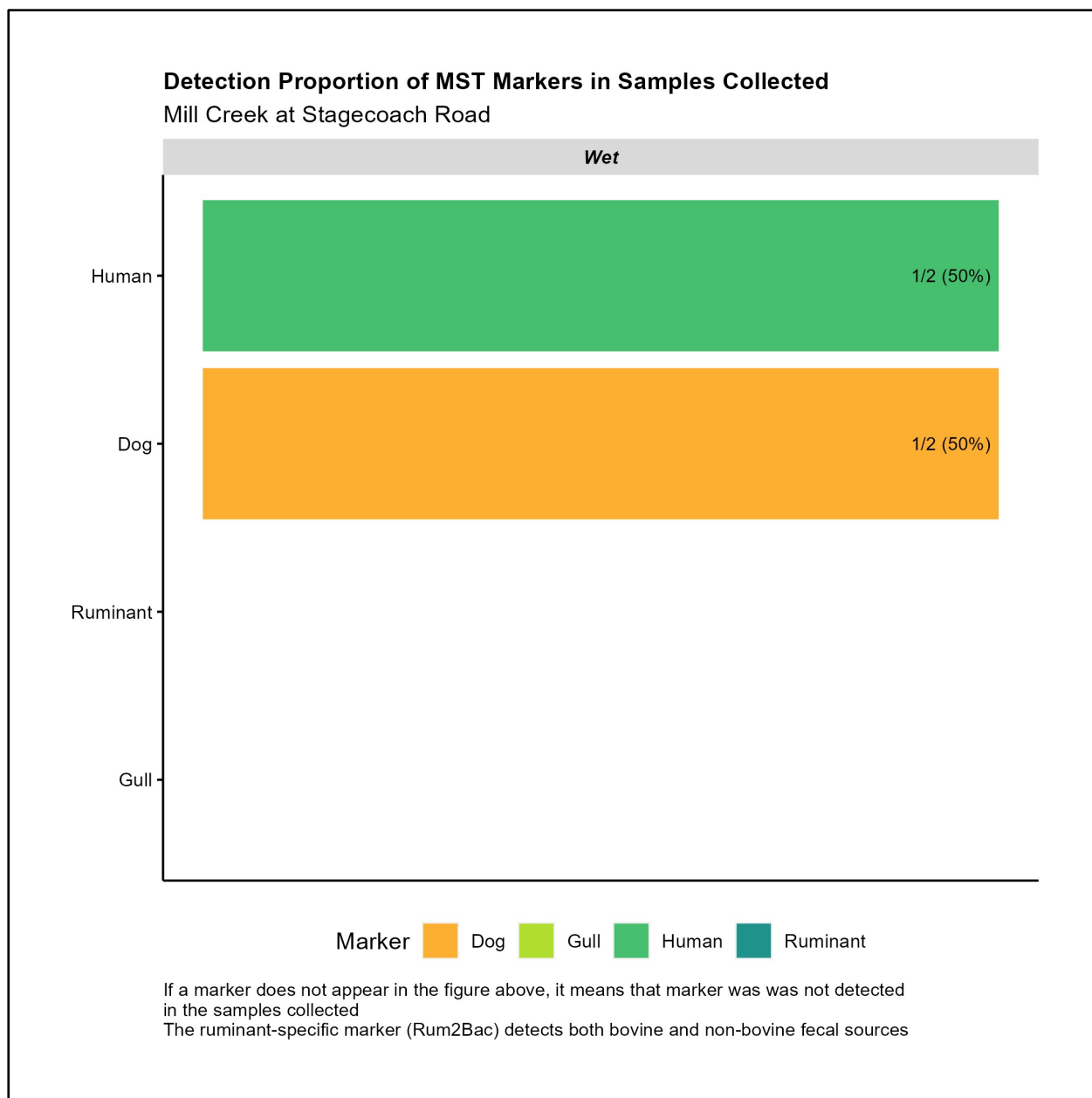
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Human (1/2 [50%]),
- Gull (0/2 [0%]), and
- Ruminant (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.





**Figure B-25 Detection percentage of species-specific markers evaluated in samples collected from the Mill Creek at Stagecoach Road station**

**Norton Creek at Highway 101 (109NR1488):**

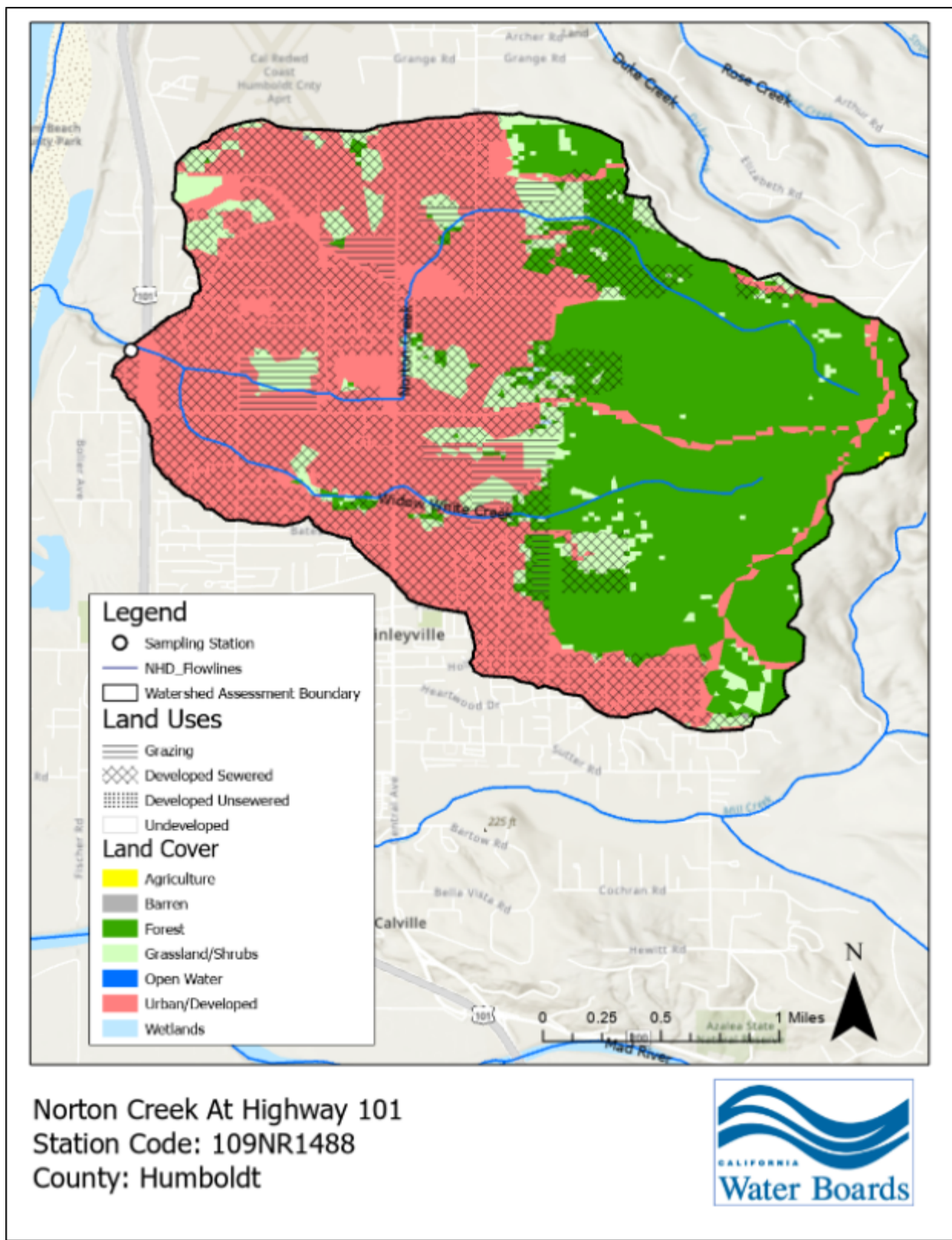
This station was sampled as part of the Impaired Streams Monitoring Study of the Coastal Pathogen Project.

This is a freshwater sampling station that is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use. The *E. coli* data collected from this freshwater sampling station under the Coastal Pathogen Project was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (4/11),
- Winter (1/5), and
- Summer (3/6).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure B-26 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-26 Land cover and land use in the Norton Creek at Highway 101 watershed**

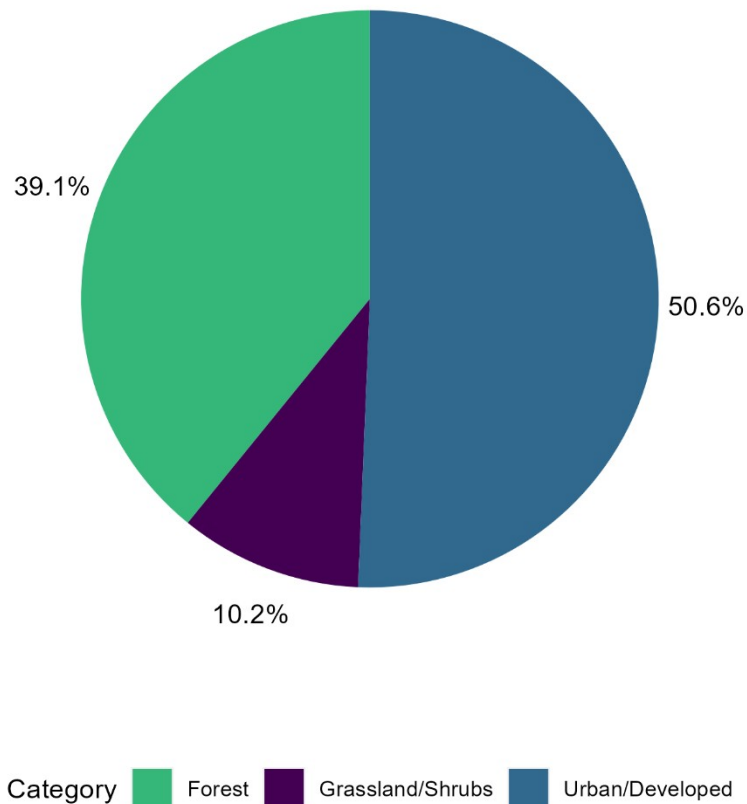
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-27 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (1388.7 acres [50.6%]),
- Forest (1074 acres [39.1%]),
- Grassland/Shrubs (281.22 acres [10.2%]),
- Wetlands (1.17 acres [0%]),
- Agriculture (0.44 acres [0%]),
- Barren (0.44 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Norton Creek at Highway 101



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

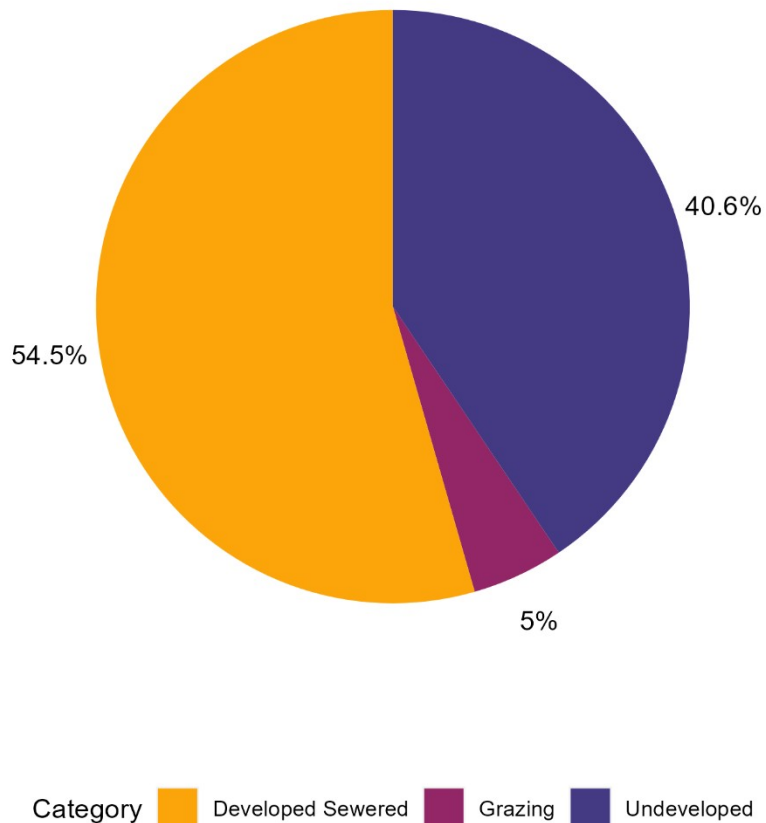
**Figure B-27 Percentage coverage by land cover category in the Norton Creek at Highway 101 watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-28 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1408.91 acres [54.5%]),
- Undeveloped (1049.23 acres [40.6%]),
- Grazing (128.46 acres [5%]), and
- Developed Unsewered (0 acres [0%]).

## Land Use

Humboldt County: Norton Creek at Highway 101



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-28 Percentage coverage by land use category in the Norton Creek at Highway 101 watershed**

Eleven samples (five in the dry period, and six in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure B-29 below.

Specifically, the marker detection percentage in the dry sampling period were:

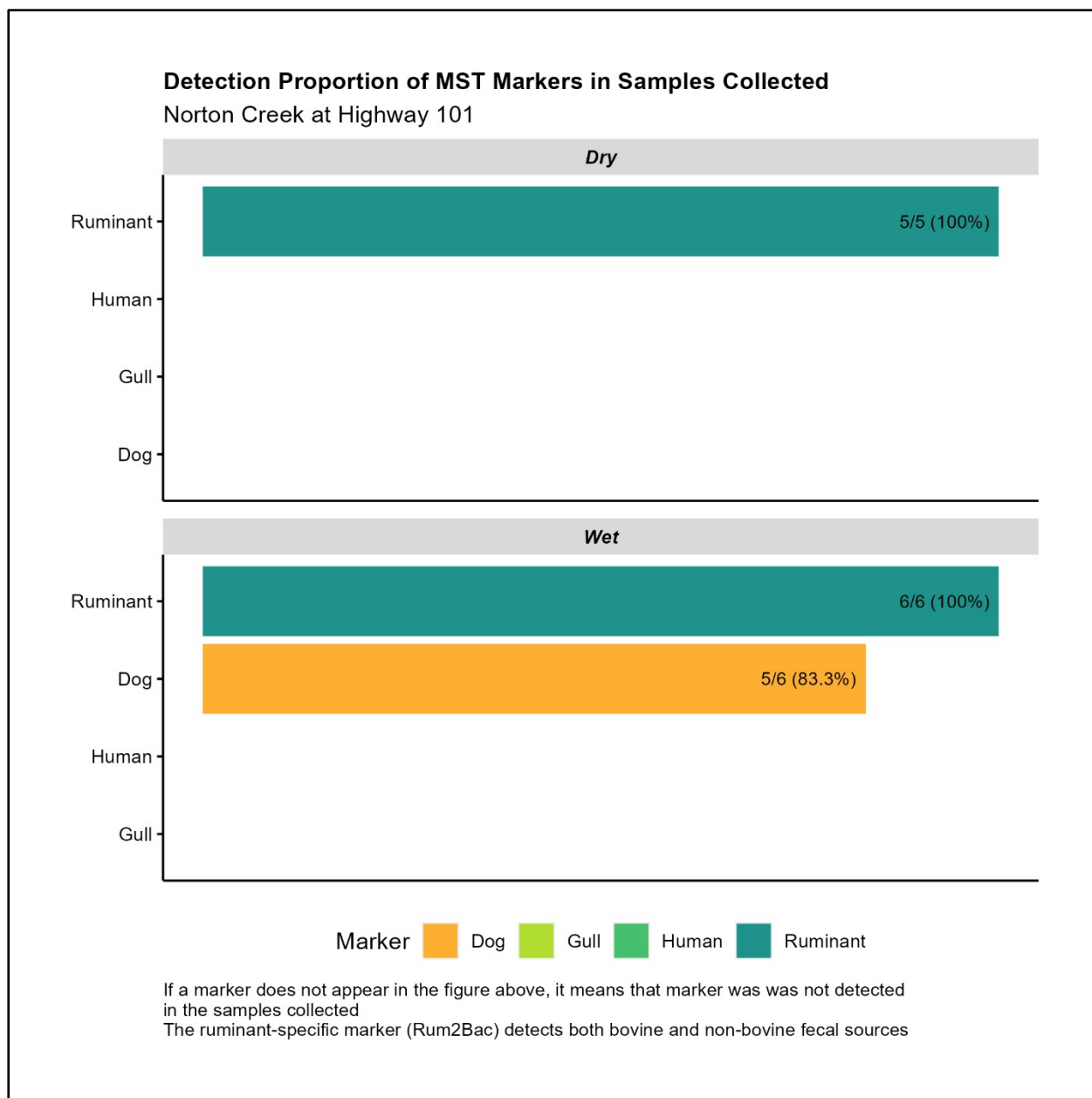
- Ruminant (5/5 [100%]),
- Dog (0/5 [0%]),

- Gull (0/5 [0%]), and
- Human (0/5 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (6/6 [100%]),
- Dog (5/6 [83.3%]),
- Gull (0/6 [0%]), and
- Human (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-29 Detection percentage of species-specific markers evaluated in samples collected from the Norton Creek at Highway 101 station**

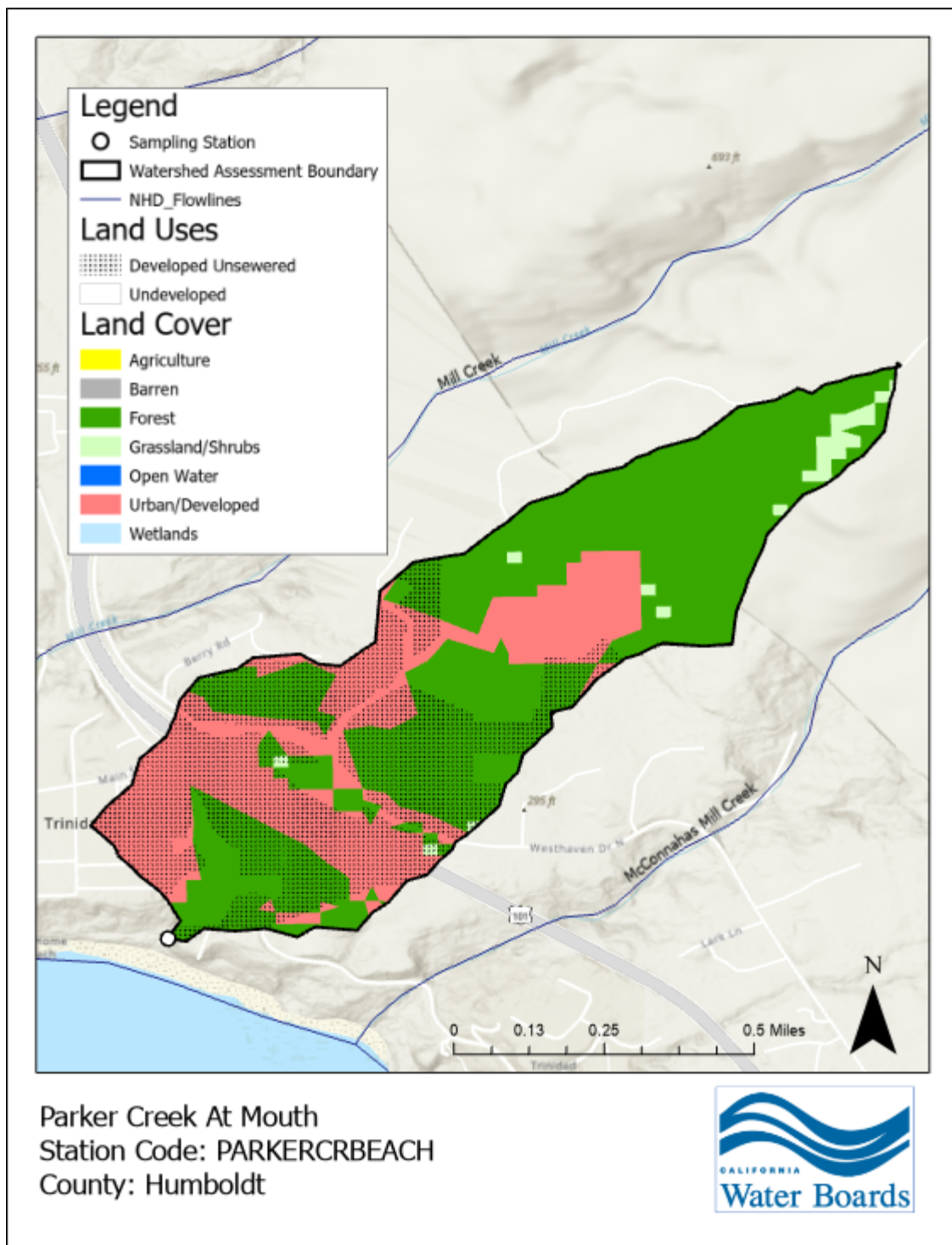


**Parker Creek at Mouth (PARKERCRBEACH):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-30 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-30 Land cover and land use in the Parker Creek at Mouth watershed**

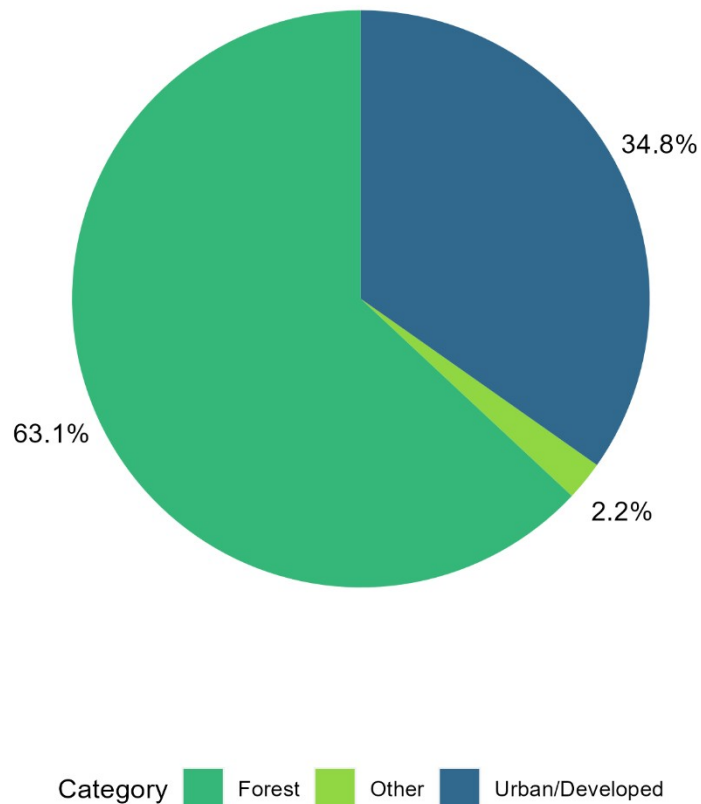
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-31 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (140.63 acres [63.1%]),
- Urban/Developed (77.45 acres [34.8%]),
- Grassland/Shrubs (4.8 acres [2.2%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Parker Creek at Mouth



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

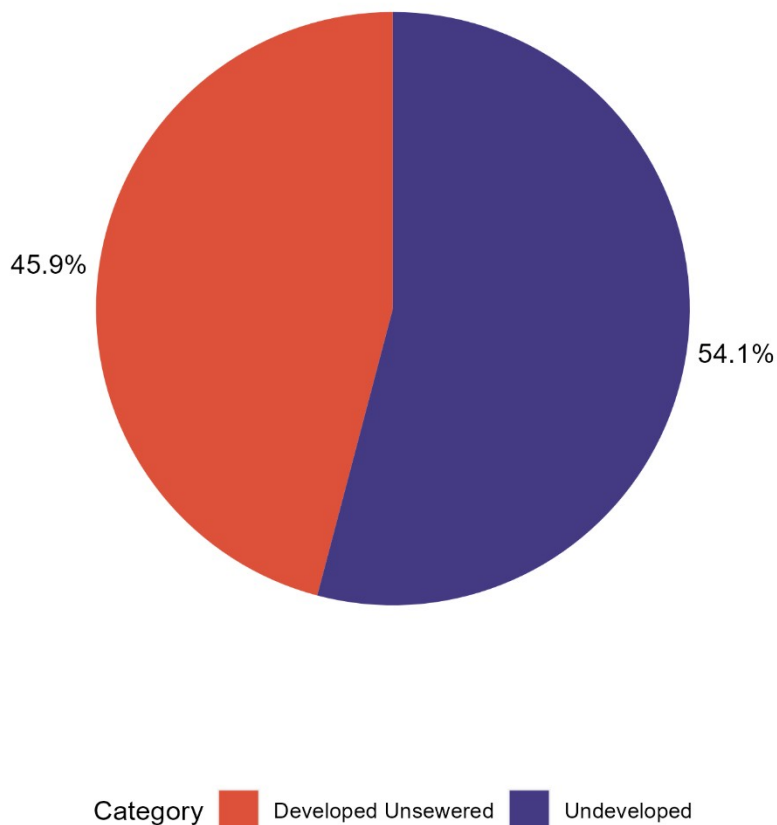
**Figure B-31 Percentage coverage by land cover category in the Parker Creek at Mouth watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-32 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (116.51 acres [54.1%]),
- Developed Unsewered (99.02 acres [45.9%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Parker Creek at Mouth



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

### Figure B-32 Percentage coverage by land use category in the Parker Creek at Mouth watershed

Six samples were collected from this sampling station. All six samples were collected in the wet sampling period.

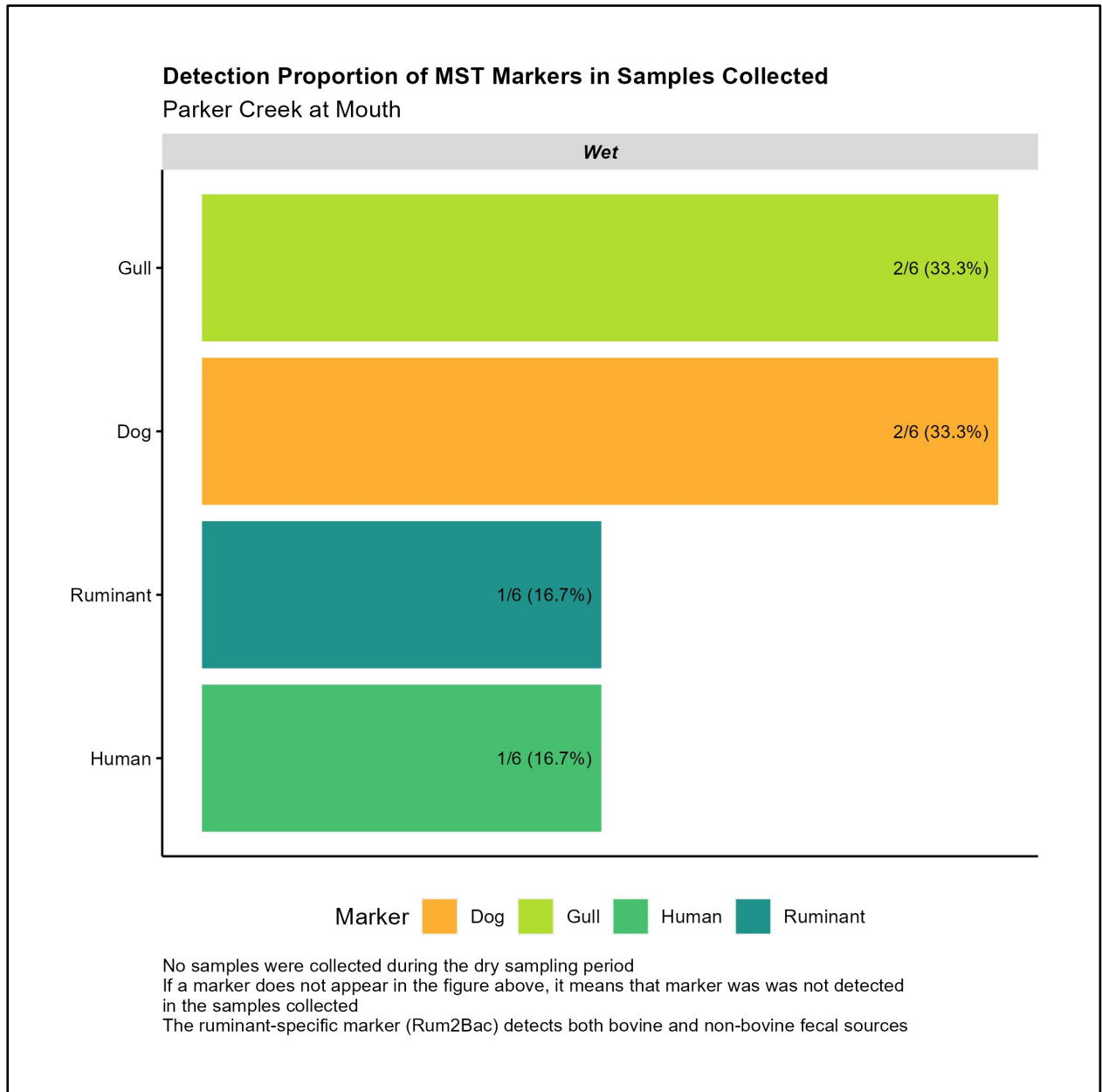
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-33 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/6 [33.3%]),
- Gull (2/6 [33.3%]),

- Human (1/6 [16.7%]), and
- Ruminant (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



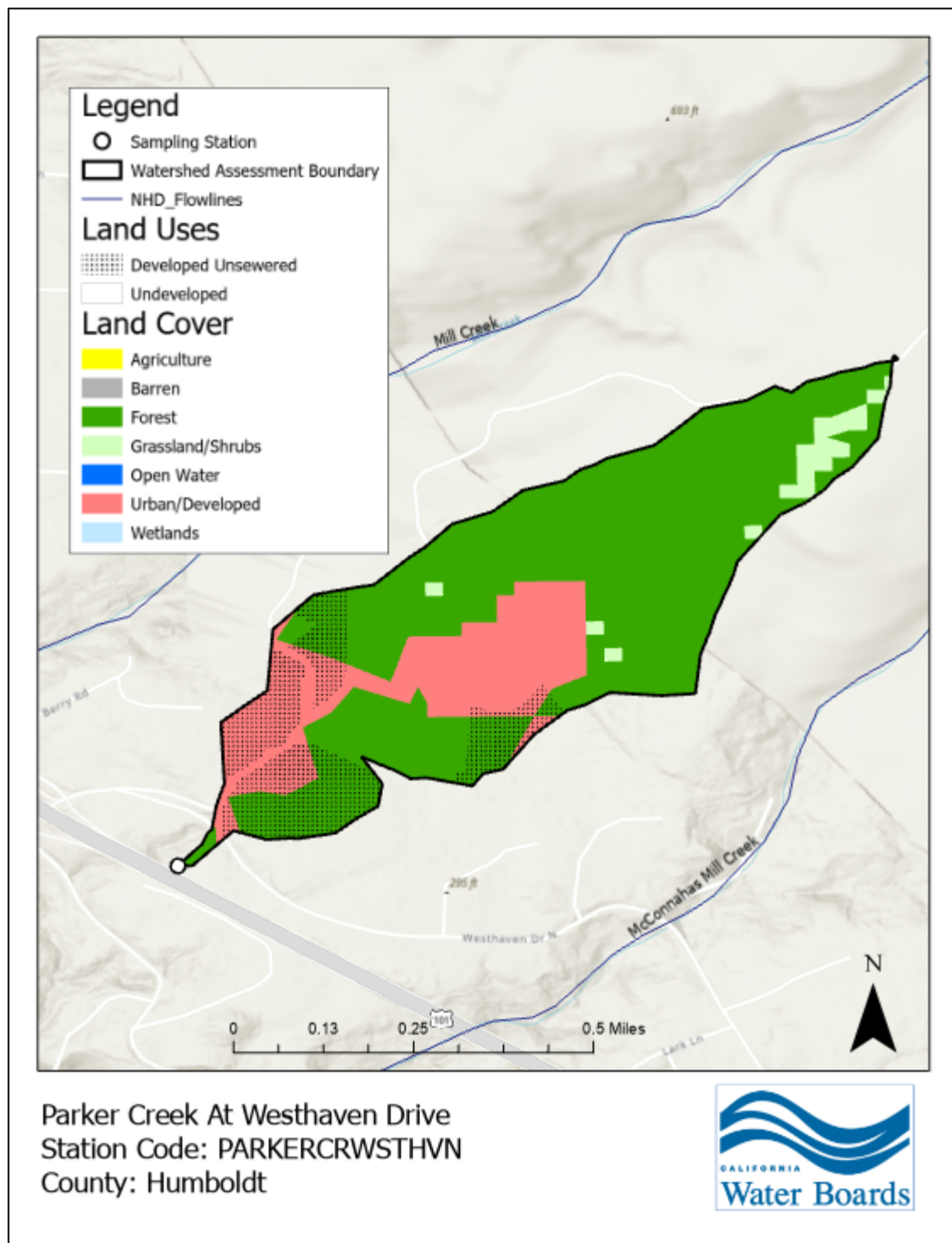
**Figure B-33 Detection percentage of species-specific markers evaluated in samples collected from the Parker Creek at Mouth station**

**Parker Creek at Westhaven Drive (PARKERCRWSTHVN):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-34 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-34 Land cover and land use in the Parker Creek at Westhaven Drive watershed**

Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-35 below. Specifically, the coverage of land cover categories in this watershed are:

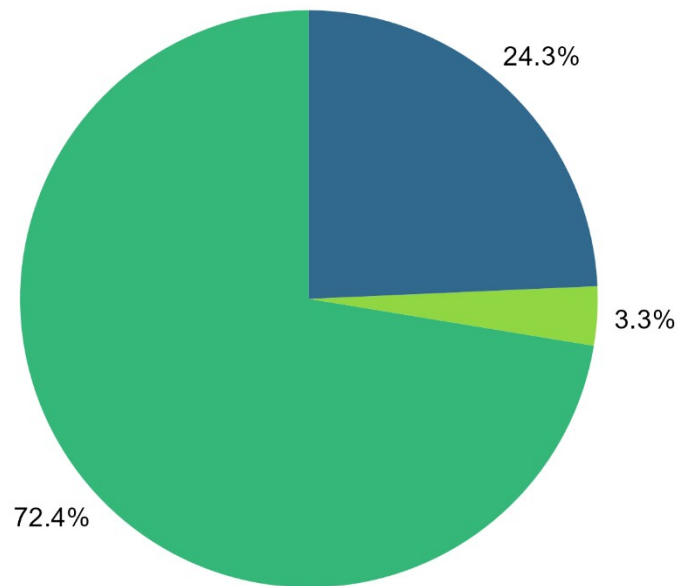


- Forest (90.99 acres [72.4%]),
- Urban/Developed (30.46 acres [24.3%]),
- Grassland/Shrubs (4.17 acres [3.3%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Parker Creek at Westhaven Drive



Category  Forest  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

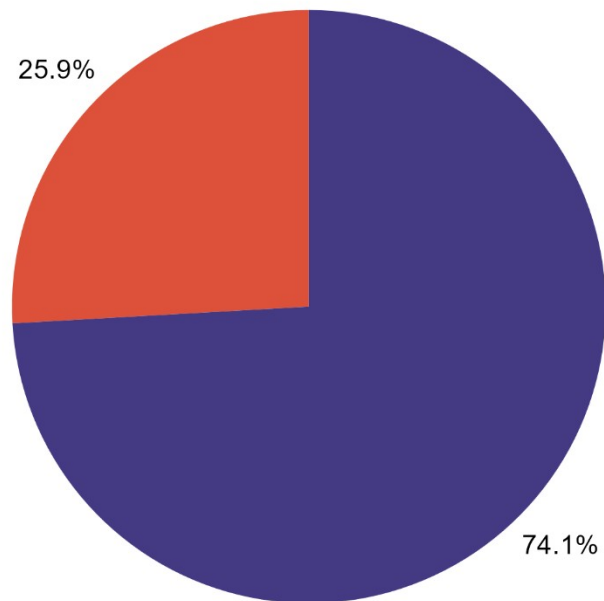
**Figure B-35 Percentage coverage by land cover category in the Parker Creek at Westhaven Drive watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-36 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (102.67 acres [74.1%]),
- Developed Unsewered (35.93 acres [25.9%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Parker Creek at Westhaven Drive



Category ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-36 Percentage coverage by land use category in the Parker Creek at Westhaven Drive watershed**

Six samples were collected from this sampling station. All six samples were collected in the wet sampling period.

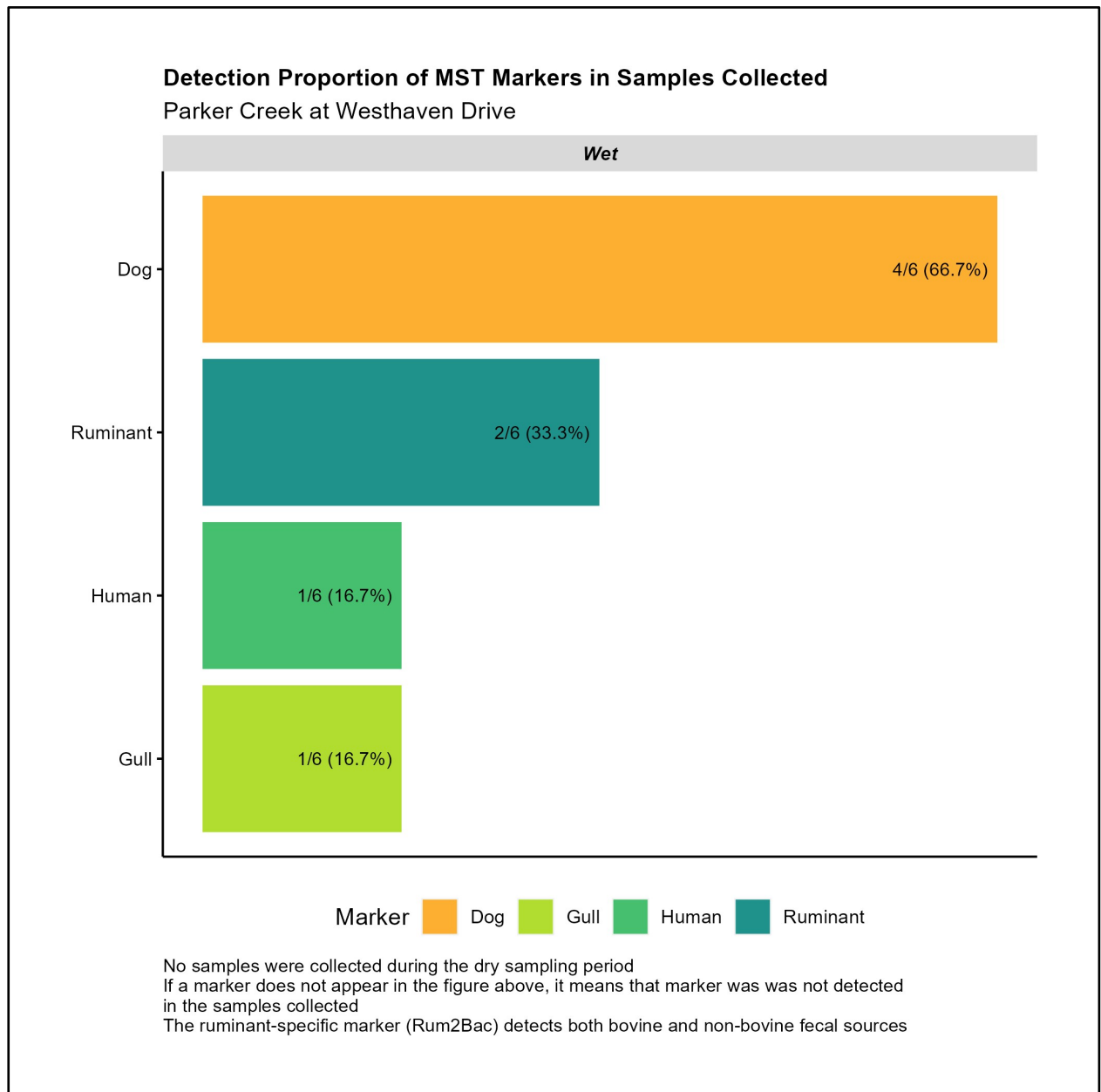
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-37 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (4/6 [66.7%]),
- Ruminant (2/6 [33.3%]),

- Gull (1/6 [16.7%]), and
- Human (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-37 Detection percentage of species-specific markers evaluated in samples collected from the Parker Creek at Westhaven Drive station**

**Patrick Creek (PATRICKCLAM):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-38 below illustrates the land cover and land use in the watershed of this sampling station.

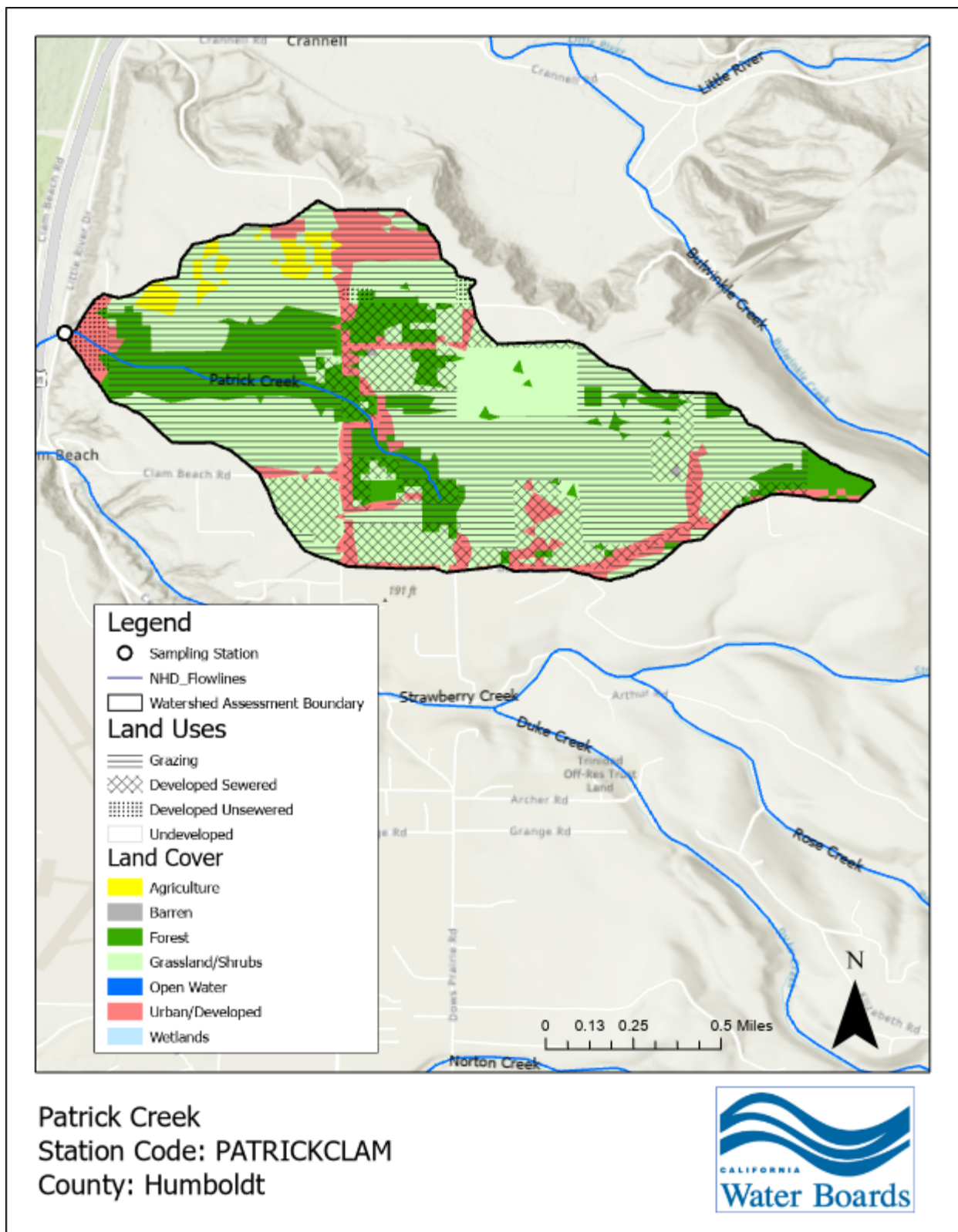


Figure B-38 Land cover and land use in the Patrick Creek watershed

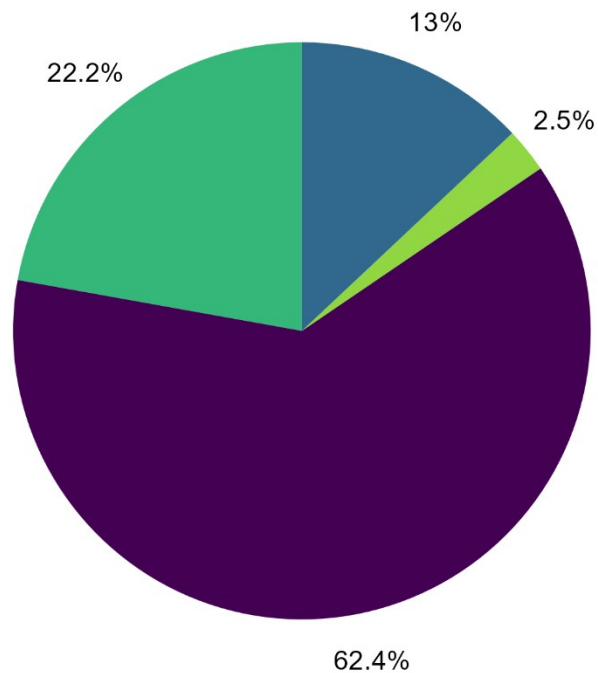
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-39 below. Specifically, the coverage of land cover categories in this watershed are:

- Grassland/Shrubs (388.22 acres [62.4%]),
- Forest (138.04 acres [22.2%]),
- Urban/Developed (80.54 acres [13%]),
- Agriculture (14.63 acres [2.4%]),
- Barren (0.53 acres [0.1%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Patrick Creek



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

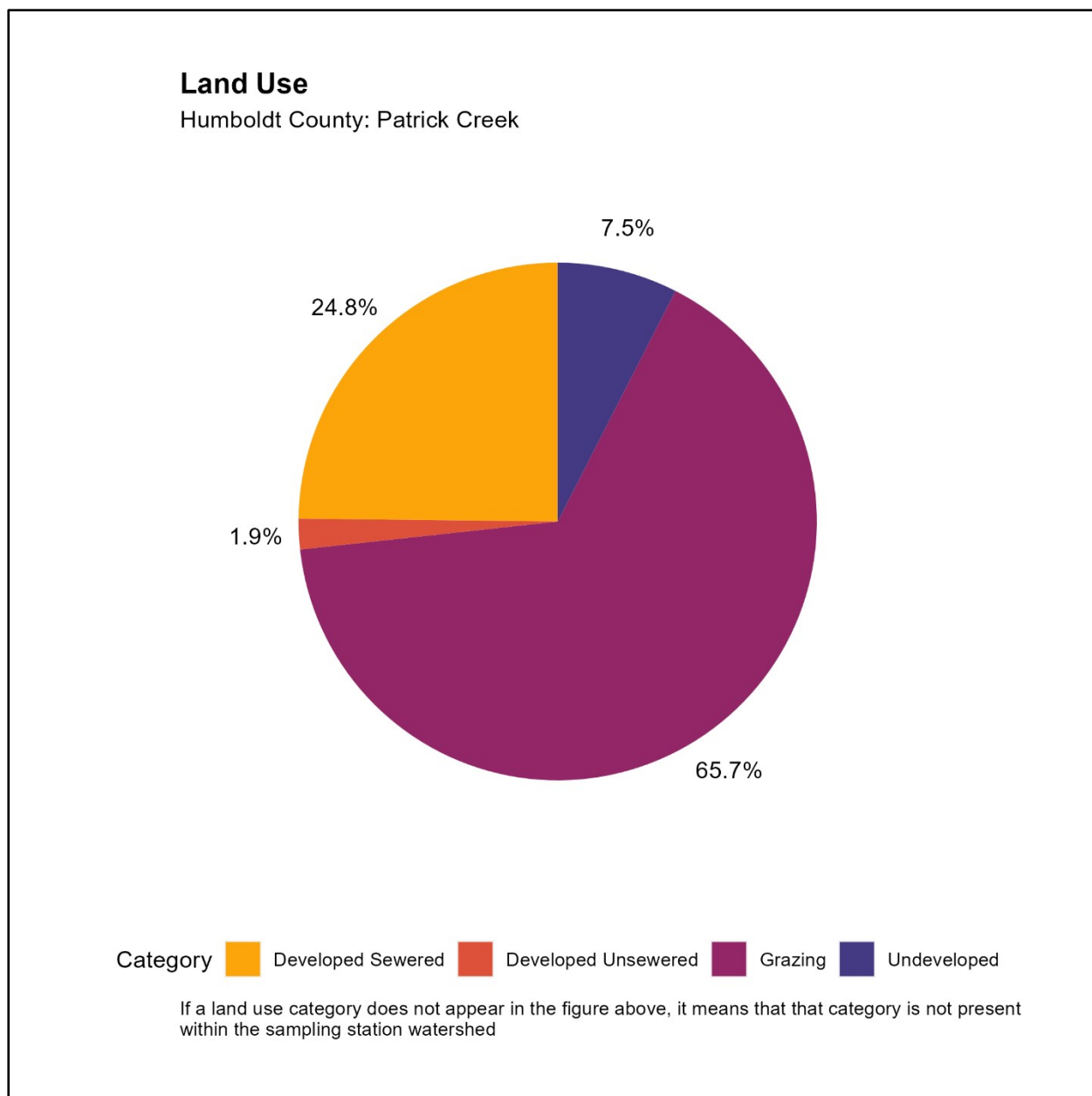
If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure B-39 Percentage coverage by land cover category in the Patrick Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-40 below. Specifically, the coverage of land use categories in this watershed are:

- Grazing (402.95 acres [65.7%]),
- Developed Sewered (152.19 acres [24.8%]),
- Undeveloped (46.14 acres [7.5%]), and
- Developed Unsewered (11.7 acres [1.9%]).
- Non-dairy cattle grazing is present in this sampling station watershed.





**Figure B-40 Percentage coverage by land use category in the Patrick Creek watershed**

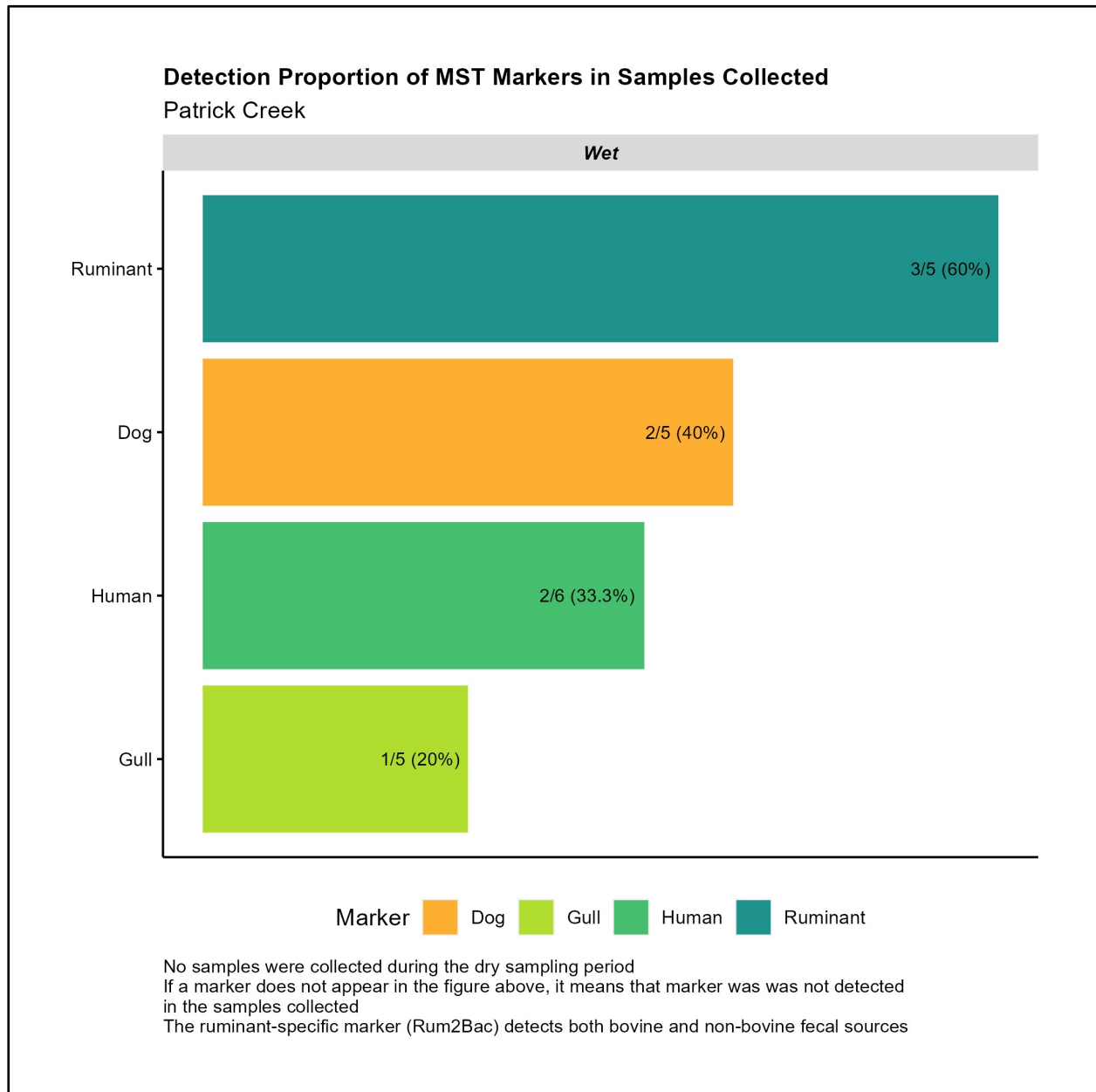
Six samples were collected from this sampling station. All six samples were collected in the wet sampling period. Although six samples were collected from this sampling station, the sample collected on one of the six collection dates was only evaluated for the presence of the human-specific marker, and not the dog-, gull-, or ruminant-specific markers.

The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-41 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (3/5 [60%]),
- Dog (2/5 [40%]),
- Human (2/6 [33.3%]), and
- Gull (1/5 [20%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



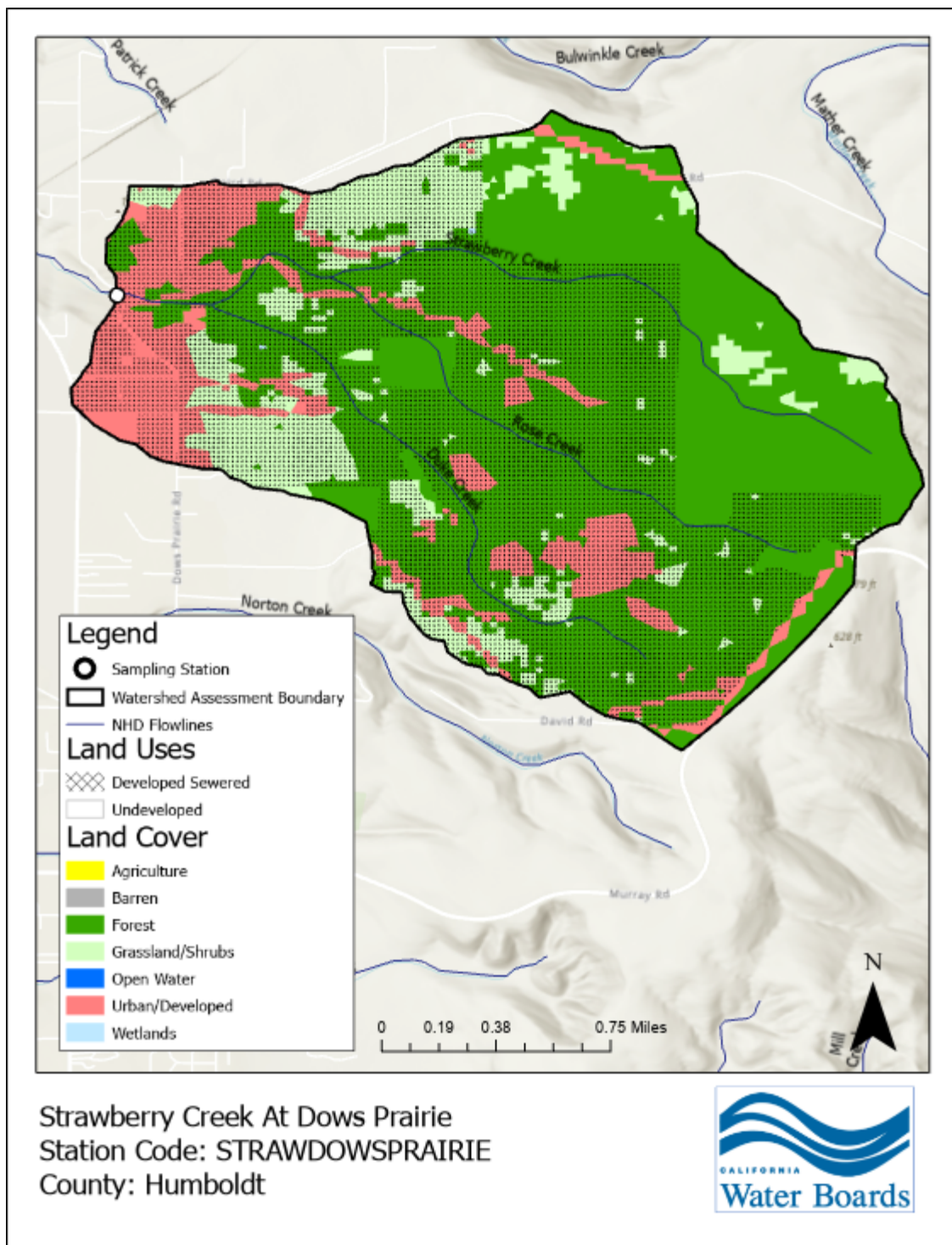
**Figure B-41 Detection percentage of species-specific markers evaluated in samples collected from the Patrick Creek station**

**Strawberry Creek at Dows Prairie (STRAWDOWSPRAIRIE):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-42 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-42 Land cover and land use in the Strawberry Creek at Dows Prairie watershed**

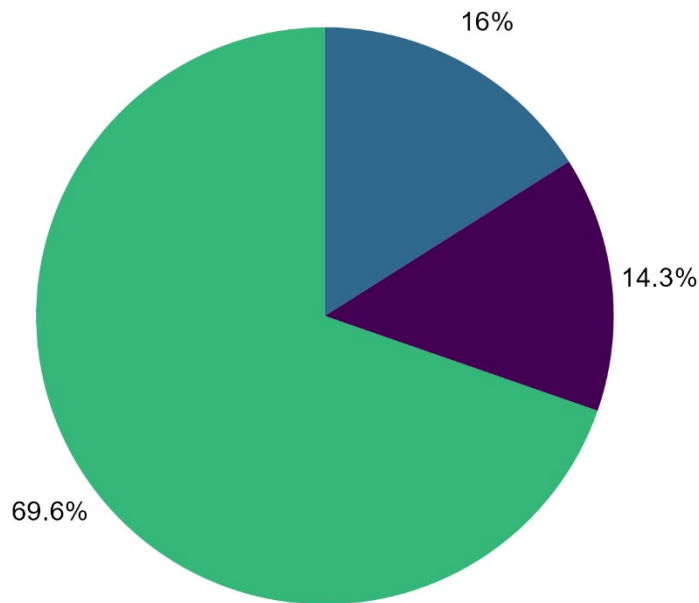
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-43 below. Specifically, the coverage of land cover categories in this watershed are:




- Forest (1151.97 acres [69.6%]),
- Urban/Developed (265.28 acres [16%]),
- Grassland/Shrubs (236.84 acres [14.3%]),
- Wetlands (0.36 acres [0%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Strawberry Creek at Dows Prairie



Category  Forest  Grassland/Shrubs  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

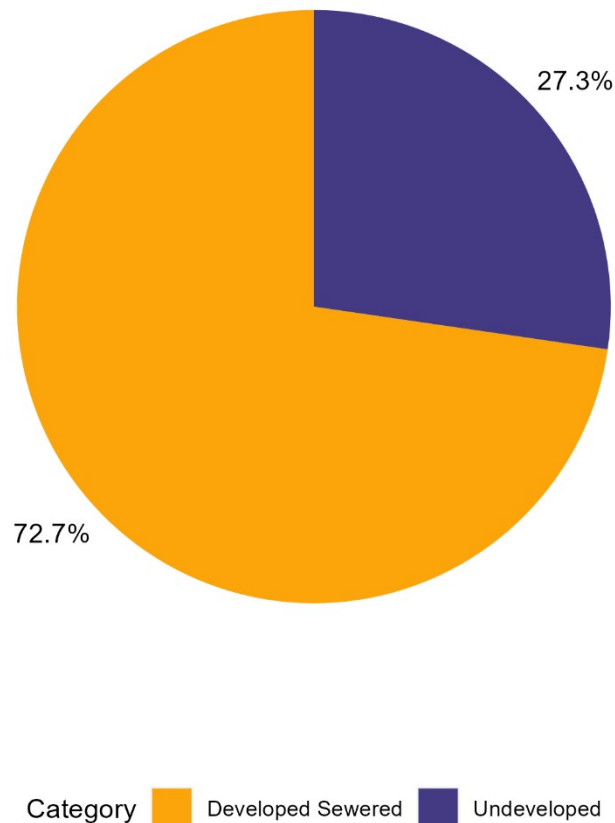
**Figure B-43 Percentage coverage by land cover category in the Strawberry Creek at Dows Prairie watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-44 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1189.59 acres [72.7%]),
- Undeveloped (446.29 acres [27.3%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Strawberry Creek at Dows Prairie



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-44 Percentage coverage by land use category in the Strawberry Creek at Dows Prairie watershed**

Five samples were collected from this sampling station. All five samples were collected in the wet sampling period.

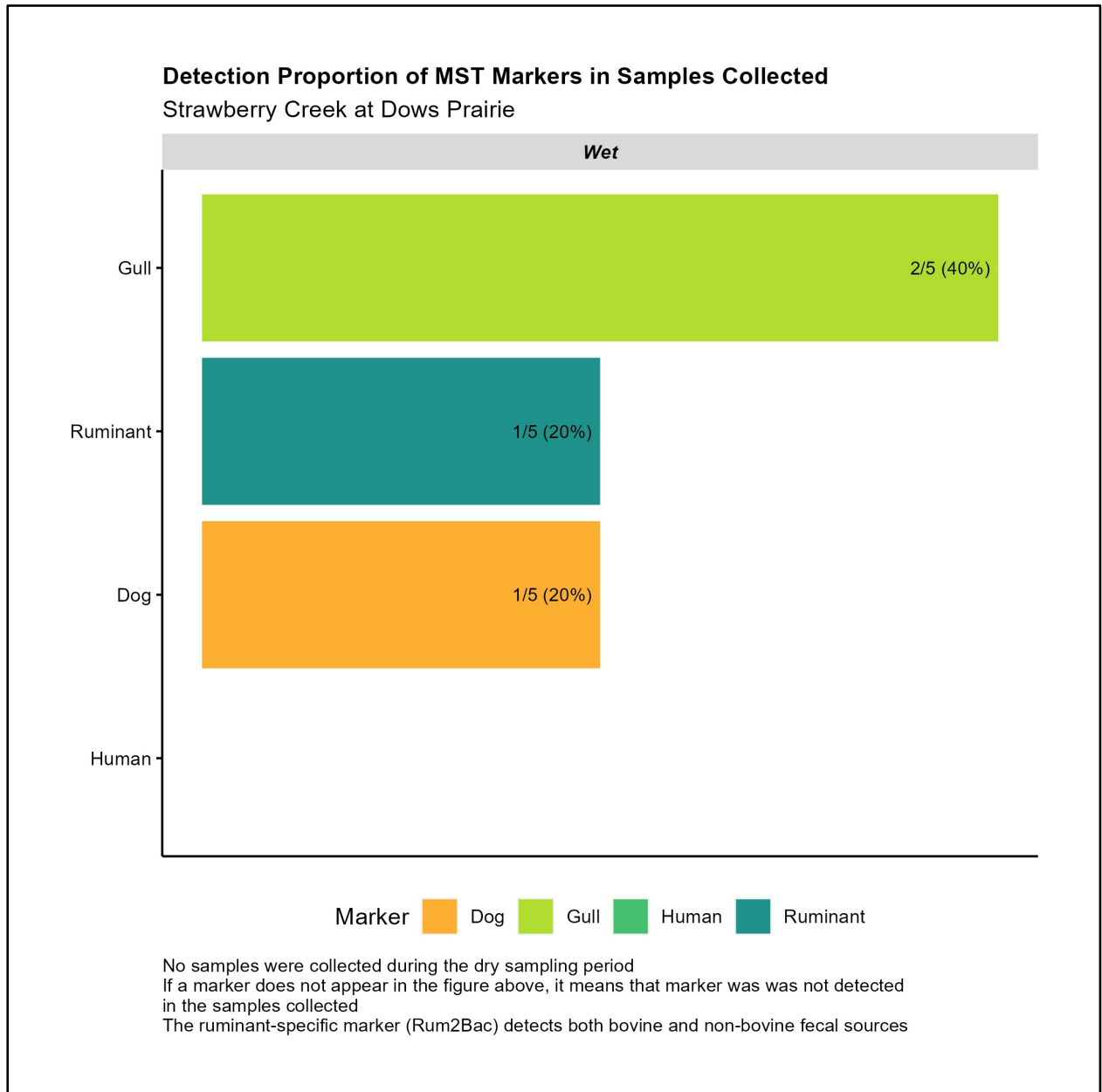
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-45 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Gull (2/5 [40%]),
- Dog (1/5 [20%]),

- Ruminant (1/5 [20%]), and
- Human (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-45 Detection percentage of species-specific markers evaluated in samples collected from the Strawberry Creek at Dows Prairie station**

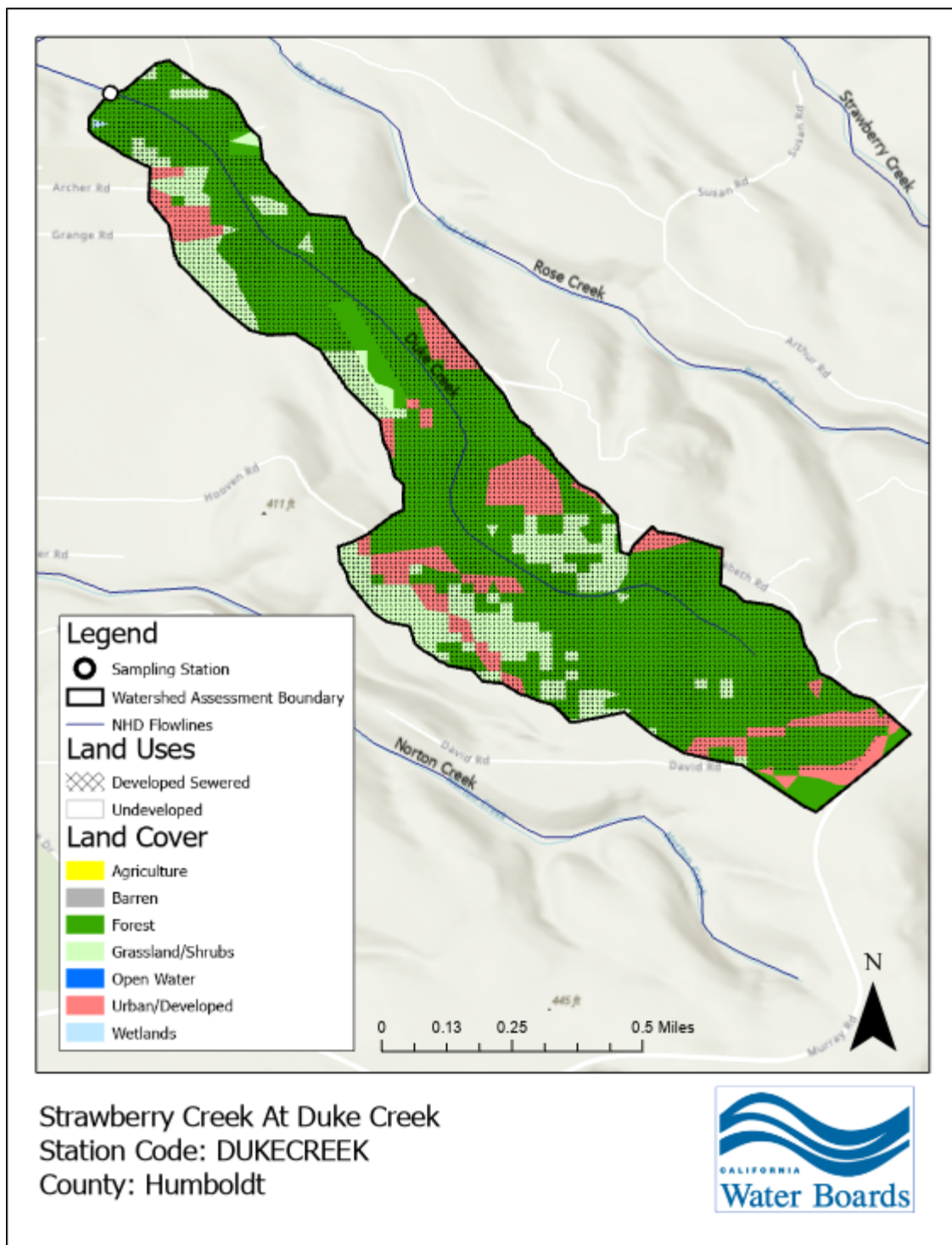


**Strawberry Creek at Duke Creek (DUKECREEK):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-46 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-46 Land cover and land use in the Strawberry Creek at Duke Creek watershed**

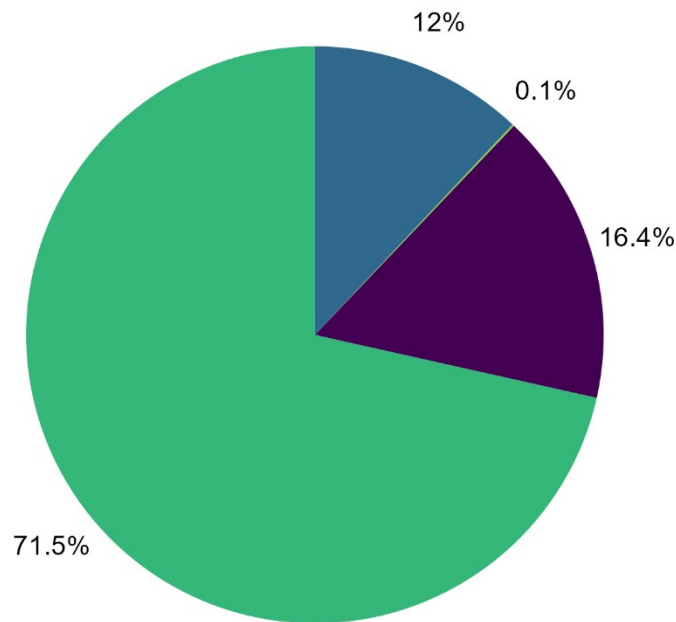
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-47 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (199.68 acres [71.5%]),
- Grassland/Shrubs (45.81 acres [16.4%]),
- Urban/Developed (33.61 acres [12%]),
- Wetlands (0.14 acres [0.1%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Strawberry Creek at Duke Creek



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

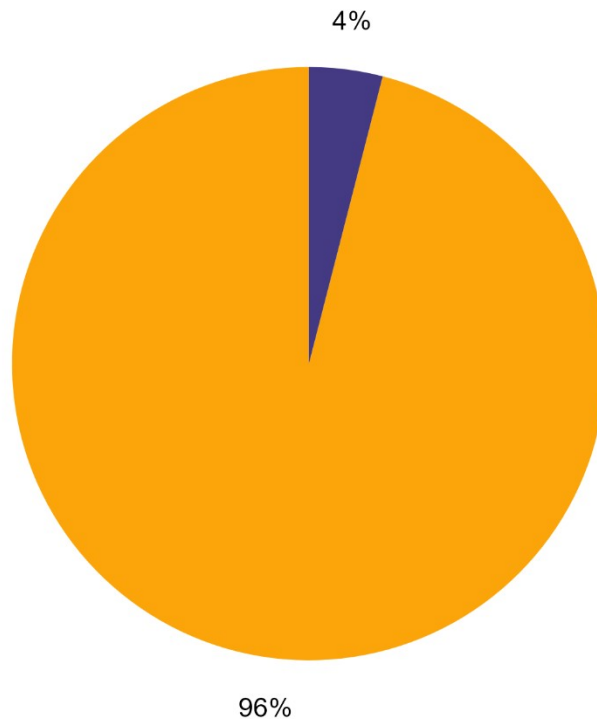
**Figure B-47 Percentage coverage by land cover category in the Strawberry Creek at Duke Creek watershed**


Land use categories observed in the watershed of this sampling station are illustrated in Figure B-48 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (266.79 acres [96%]),
- Undeveloped (11.05 acres [4%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Strawberry Creek at Duke Creek



Category  Developed Sewered  Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-48 Percentage coverage by land use category in the Strawberry Creek at Duke Creek watershed**

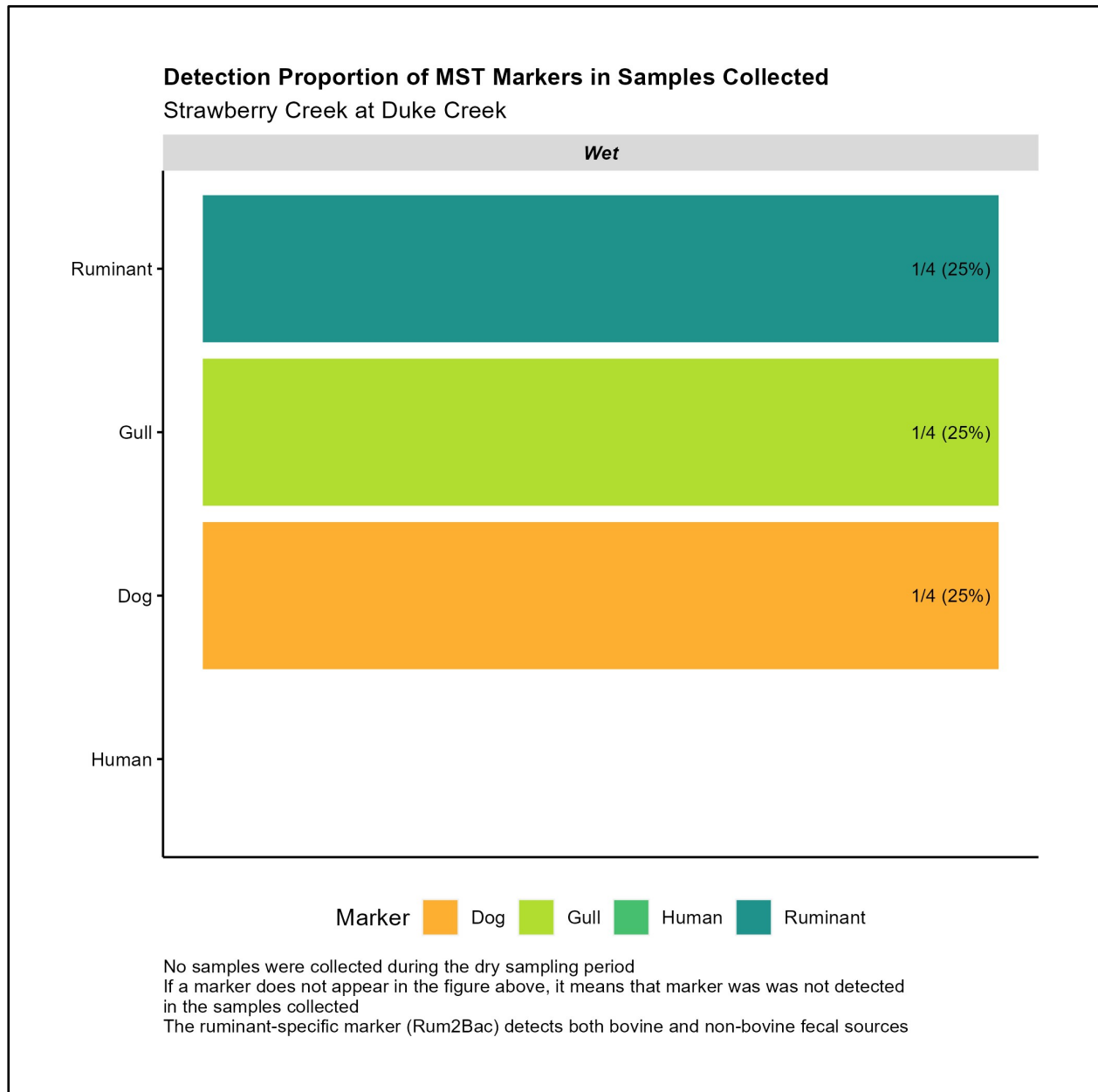
Five samples were collected from this sampling station. All five samples were collected in the wet sampling period. Although five samples were collected from this sampling station, the sample collected on one of the six collection dates was only evaluated for the presence of the human-specific marker, and not the dog-, gull-, or ruminant-specific markers.

The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-49 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/4 [25%]),
- Gull (1/4 [25%]),
- Ruminant (1/4 [25%]), and
- Human (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



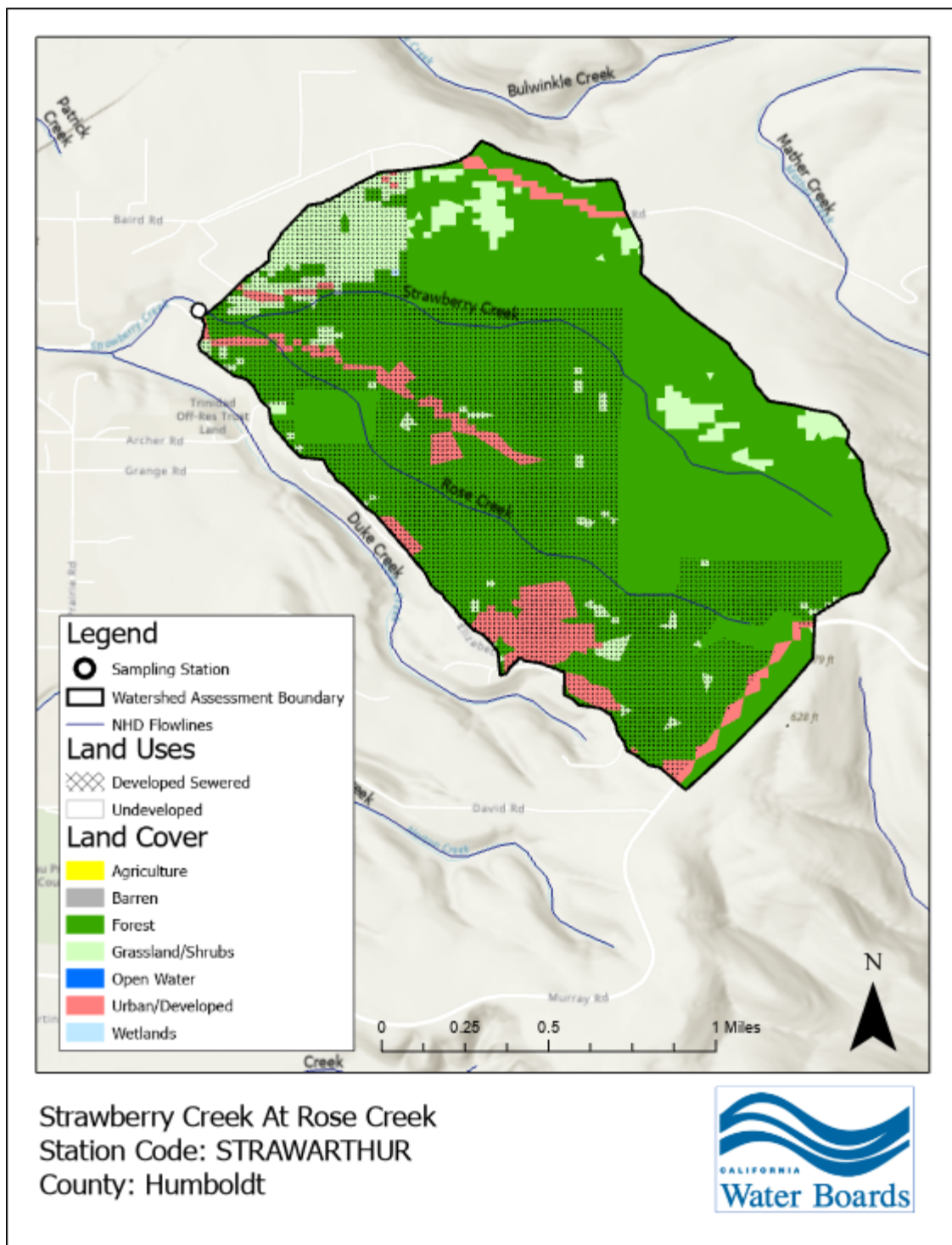
**Figure B-49 Detection percentage of species-specific markers evaluated in samples collected from the Strawberry Creek at Duke Creek station**

**Strawberry Creek at Rose Creek (STRAWARTHUR):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-50 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-50 Land cover and land use in the Strawberry Creek at Rose Creek watershed**

Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-51 below. Specifically, the coverage of land cover categories in this watershed are:

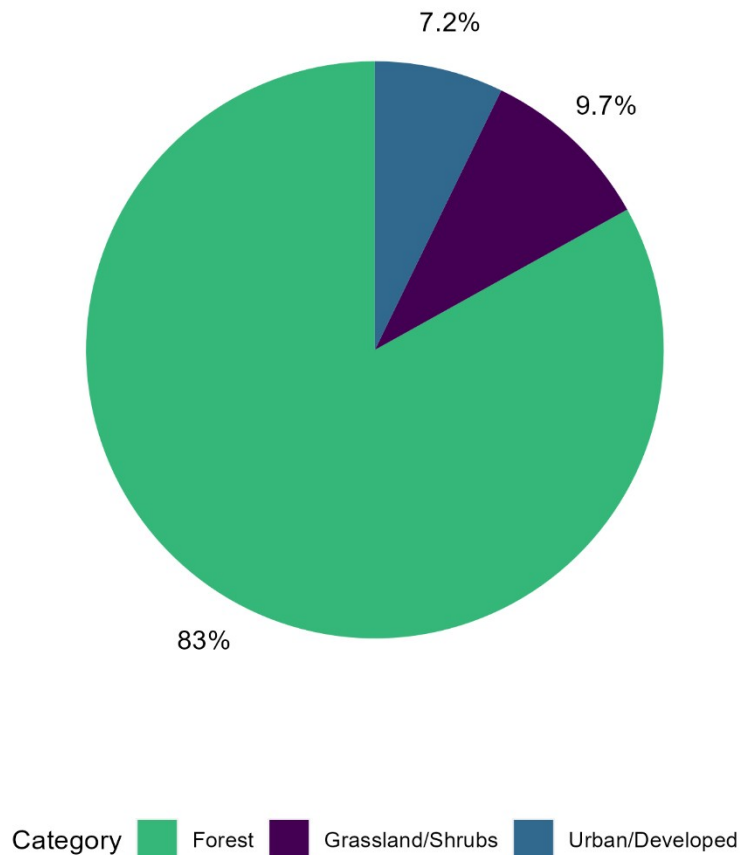


- Forest (852.41 acres [83%]),
- Grassland/Shrubs (99.54 acres [9.7%]),
- Urban/Developed (74.27 acres [7.2%]),
- Wetlands (0.22 acres [0%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Strawberry Creek at Rose Creek



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

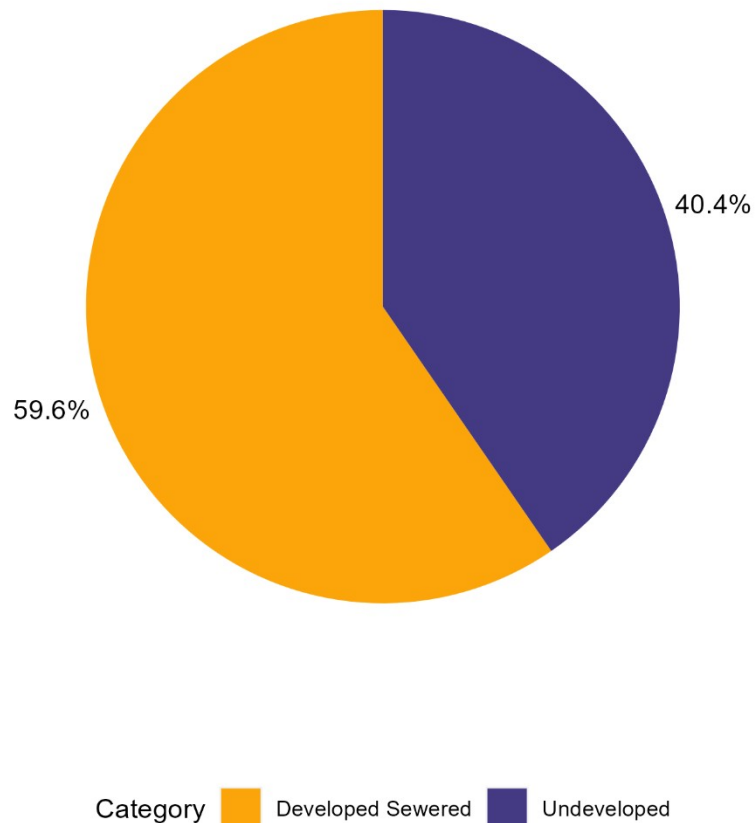
**Figure B-51 Percentage coverage by land cover category in the Strawberry Creek at Rose Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-52 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (607.85 acres [59.6%]),
- Undeveloped (412.66 acres [40.4%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Strawberry Creek at Rose Creek



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

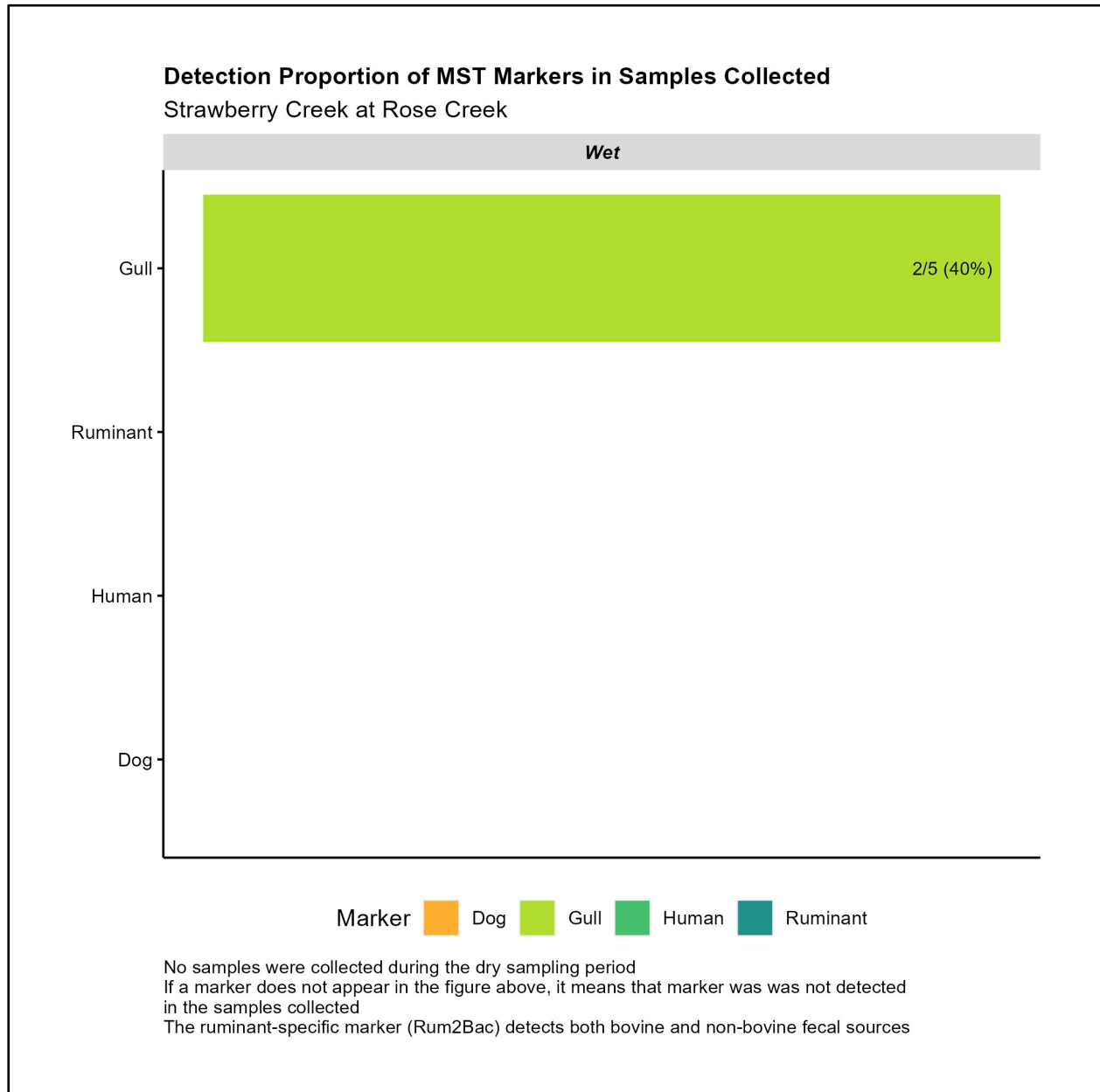
**Figure B-52 Percentage coverage by land use category in the Strawberry Creek at Rose Creek watershed**

Six samples were collected from this sampling station. All six samples were collected in the wet sampling period. Although six samples were collected from this sampling station, the sample collected on one of the six collection dates was only evaluated for the presence of the human-specific marker, and not the dog-, gull-, or ruminant-specific markers. The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-53 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Gull (2/5 [40%]),
- Dog (0/5 [0%]),
- Human (0/6 [0%]), and
- Ruminant (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-53 Detection percentage of species-specific markers evaluated in samples collected from the Strawberry Creek at Rose Creek station**

**Strawberry Creek at Highway 101 (108SC0550):**

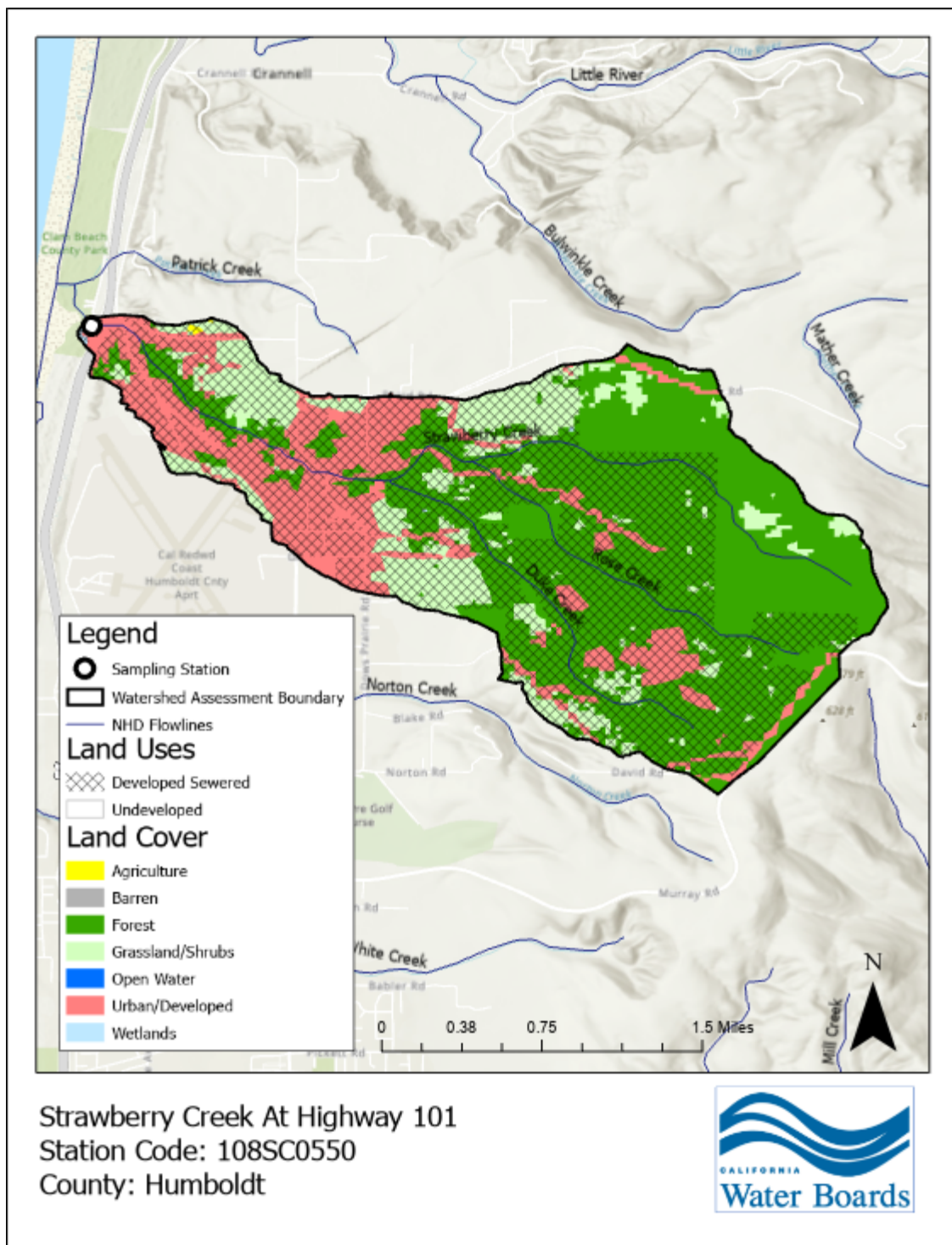
This station was sampled under the Source Assessment Study.

This sampling station has not been assessed for impairment of REC-1 beneficial use. Strawberry Creek at Highway 101 (108SC0550) is a freshwater sampling station. The *E. coli* data collected from this freshwater sampling station collected under the Coastal Pathogen Project was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure B-54 below illustrates the land cover and land use in the watershed of these sampling stations.



**Figure B-54 Land cover and land use in the Strawberry Creek at Highway 101 watershed**

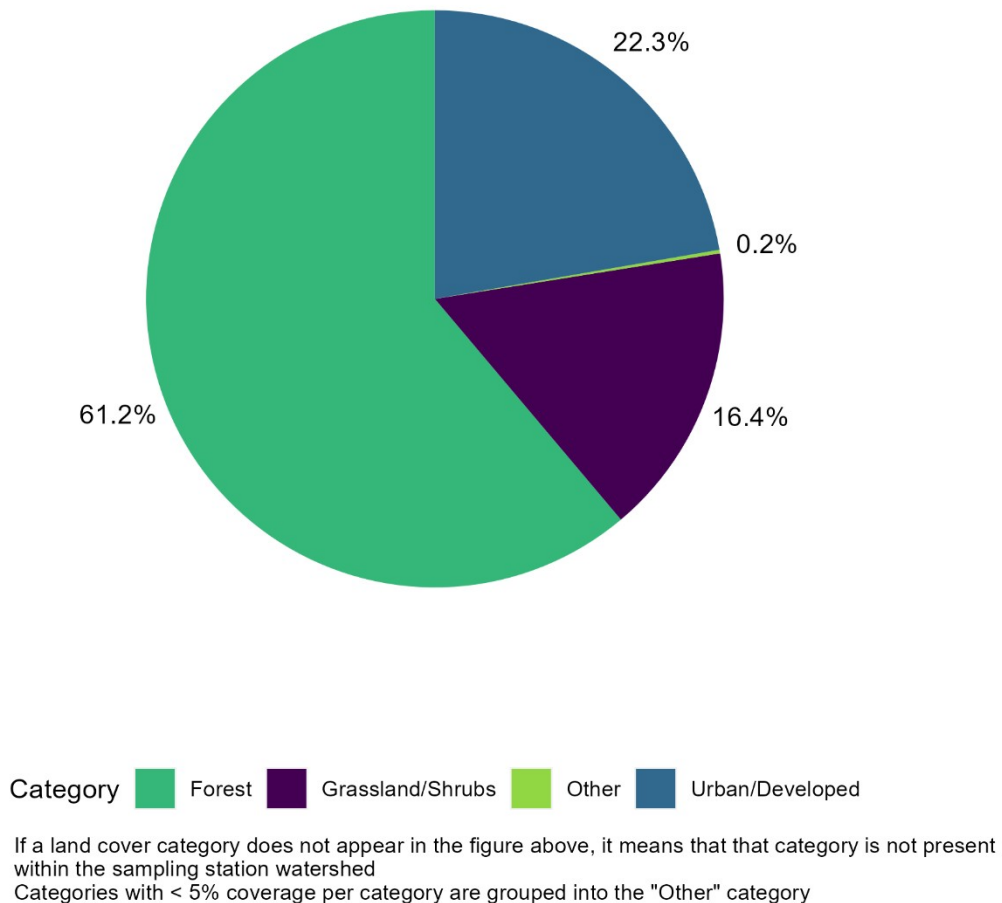
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-55 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1212.82 acres [61.2%]),
- Urban/Developed (442 acres [22.3%]),
- Grassland/Shrubs (324.4 acres [16.4%]),
- Wetlands (1.91 acres [0.1%]),
- Agriculture (1.11 acres [0.1%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Strawberry Creek at Highway 101



**Figure B-55 Percentage coverage by land cover category in the Strawberry Creek at Highway 101 watershed**

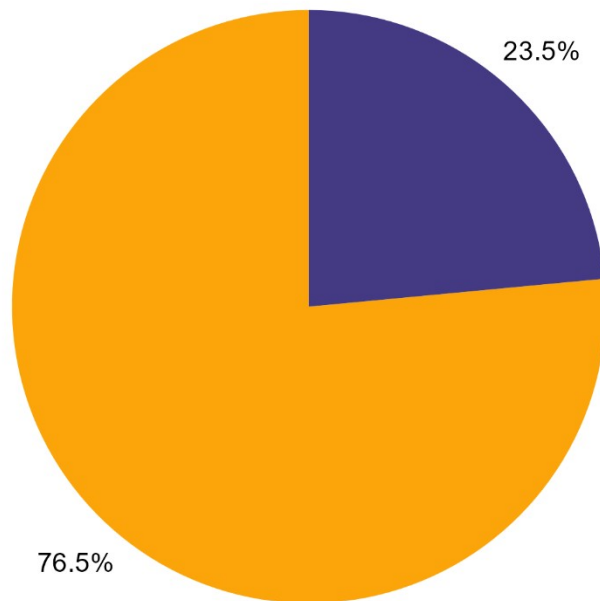
Land use categories observed in the watershed of this sampling station are illustrated in Figure B-56 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1483.83 acres [76.5%]),
- Undeveloped (456.19 acres [23.5%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).



## Land Use

Humboldt County: Strawberry Creek at Highway 101



Category ■ Developed Sewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-56 Percentage coverage by land use category in the Strawberry Creek at Highway 101 watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure B-57 below.

Specifically, the marker detection percentage in the dry sampling period were:

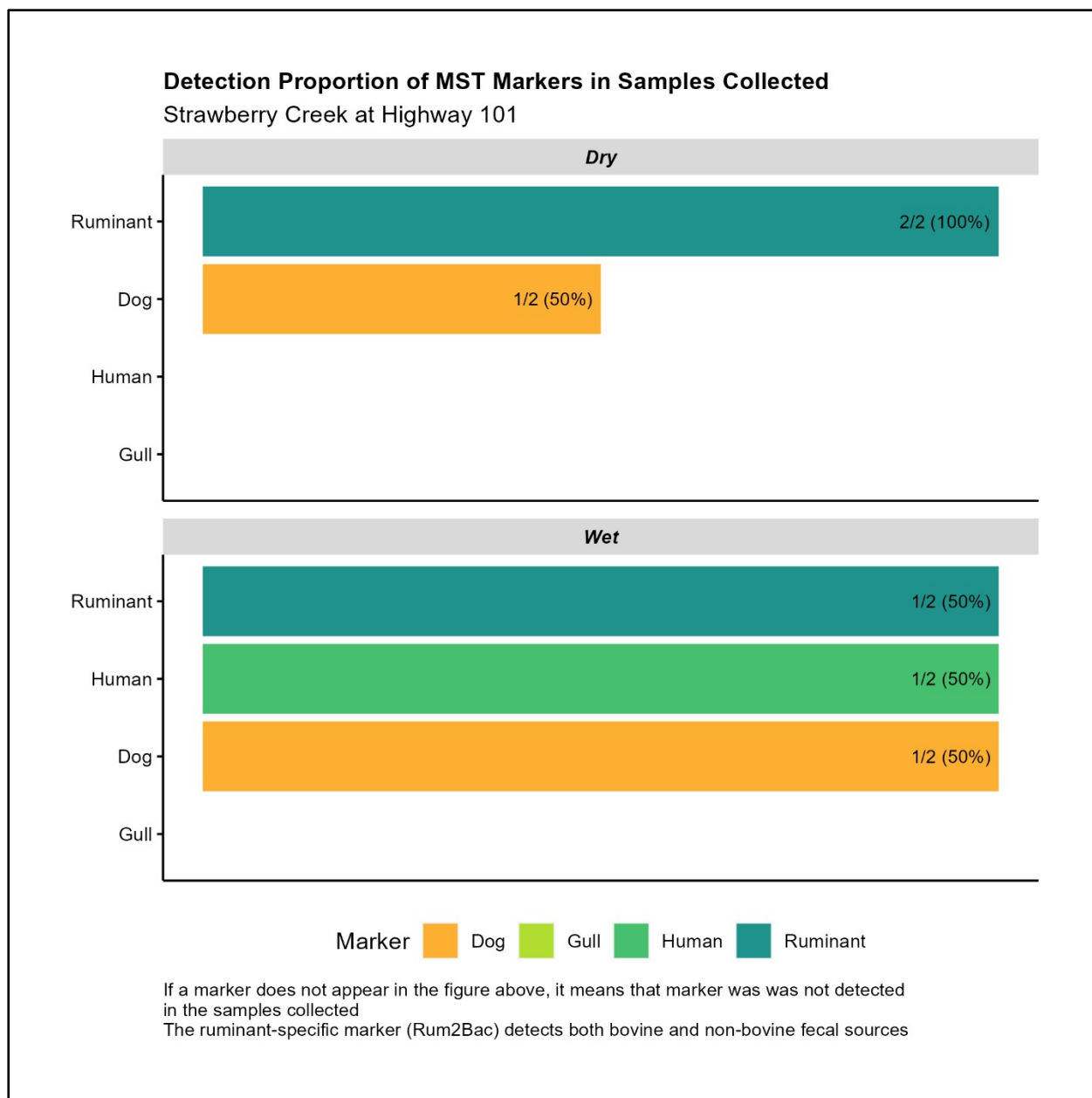
- Ruminant (2/2 [100%]),
- Dog (1/2 [50%]),

- Gull (0/2 [0%]), and
- Human (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Human (1/2 [50%]),
- Ruminant (1/2 [50%]), and
- Gull (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



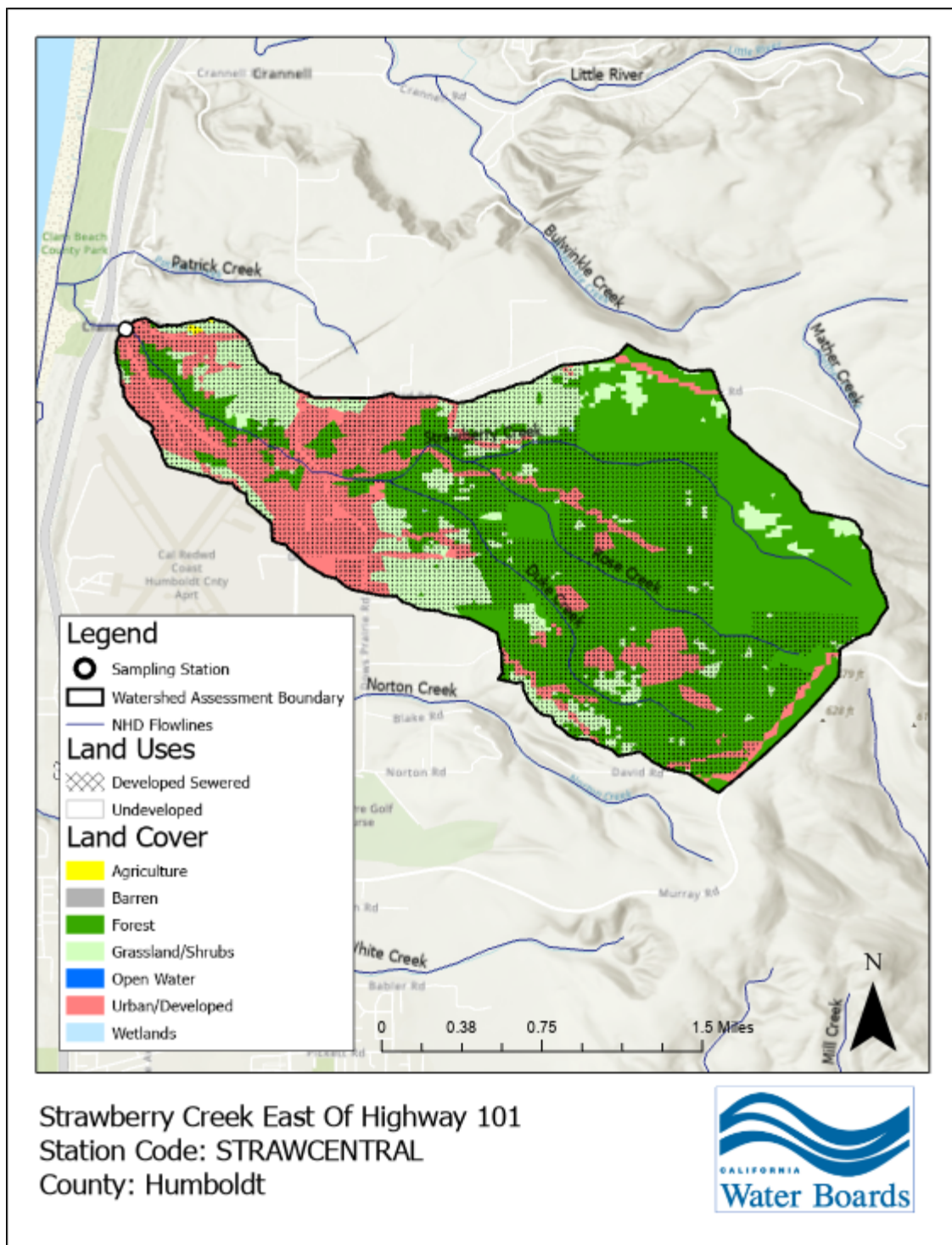
**Figure B-57 Detection percentage of species-specific markers evaluated in samples collected from the Strawberry Creek at Highway 101 station**

**Strawberry Creek East of Highway 101 (STRAWCENTRAL):**

This station was sampled under the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-58 below illustrates the land cover and land use in the watershed of these sampling stations.



**Figure B-58 Land cover and land use in the Strawberry Creek East of Highway 101 watershed**

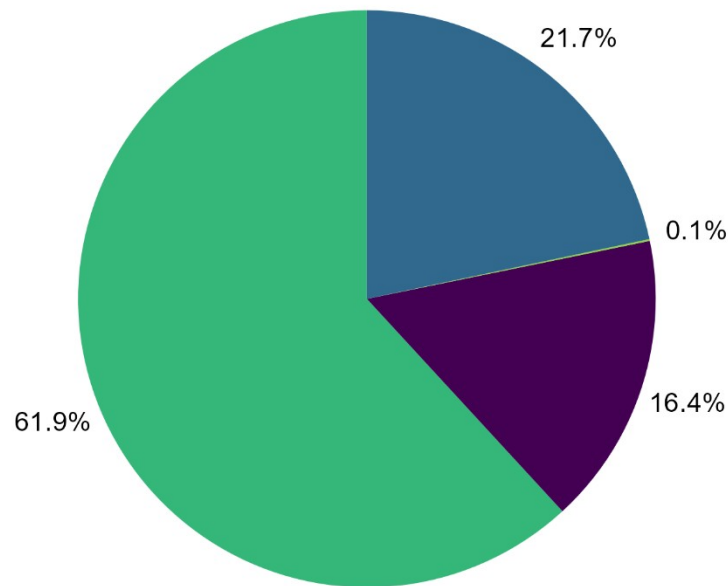
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-59 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1204.88 acres [61.9%]),
- Urban/Developed (422.4 acres [21.7%]),
- Grassland/Shrubs (318.71 acres [16.4%]),
- Agriculture (1.11 acres [0.1%]),
- Wetlands (0.36 acres [0%]),
- Barren (0 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Strawberry Creek East Of Highway 101



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

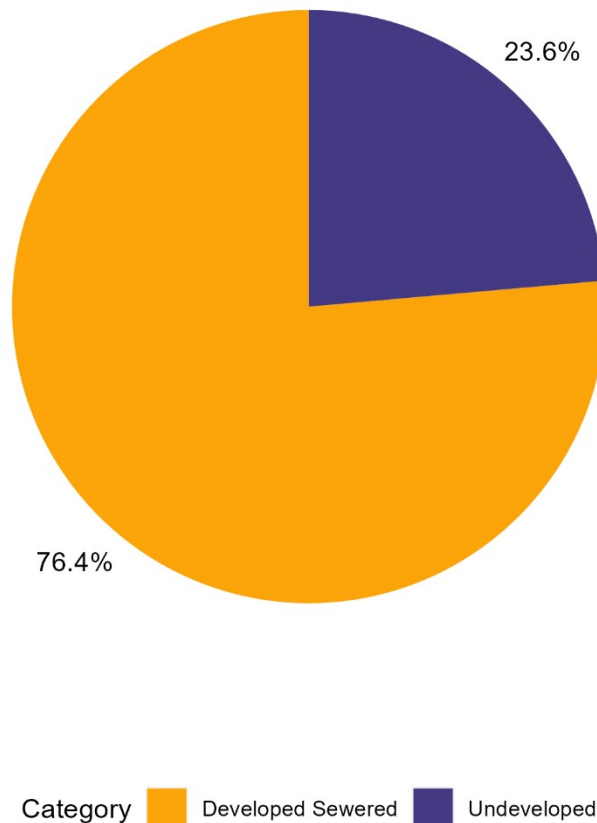
**Figure B-59 Percentage coverage by land cover category in the Strawberry Creek East of Highway 101 watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-60 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1461.48 acres [76.4%]),
- Undeveloped (451 acres [23.6%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Strawberry Creek East Of Highway 101



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-60 Percentage coverage by land use category in the Strawberry Creek East of Highway 101 watershed**

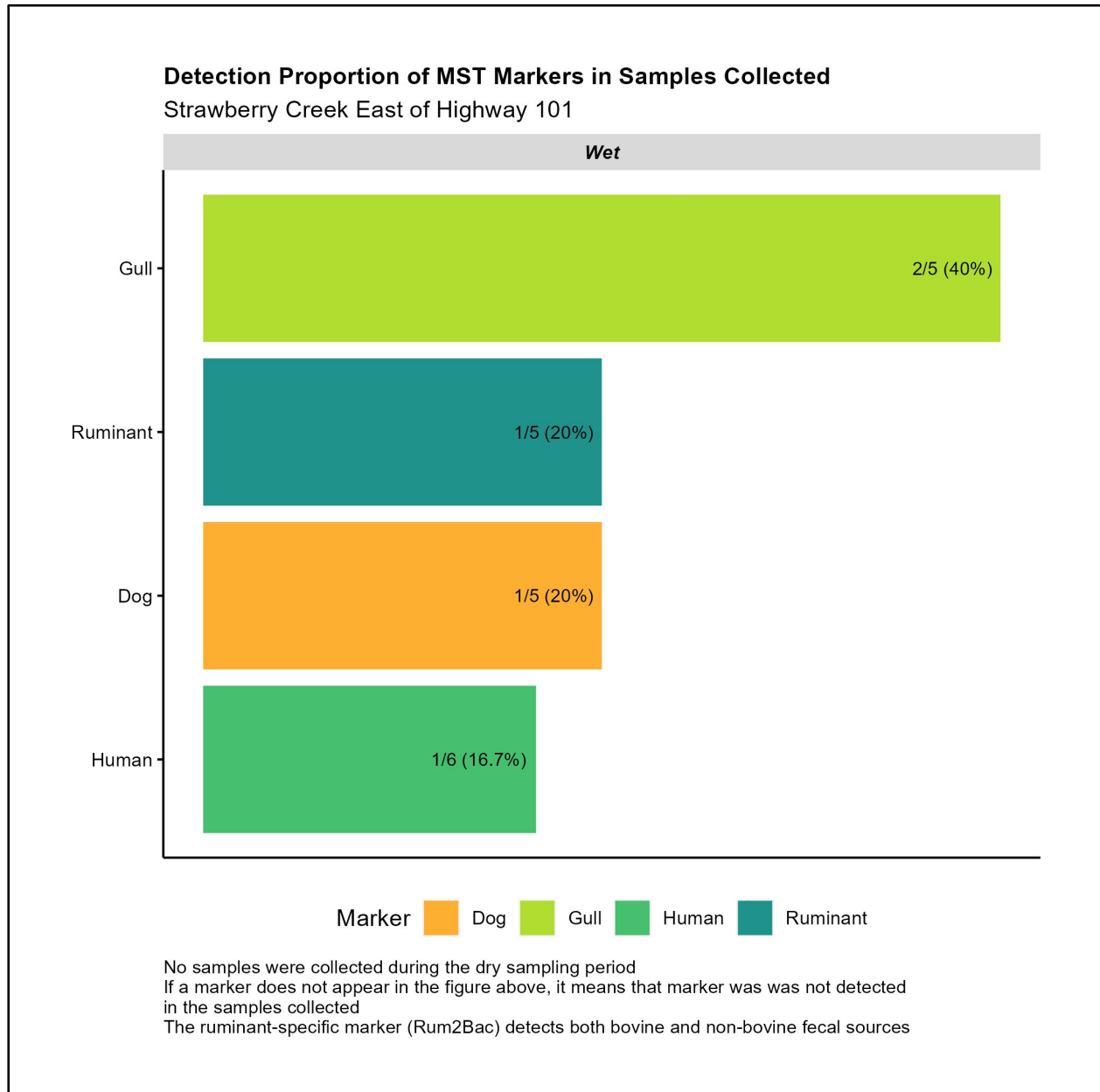
Six samples were collected from this sampling station. All six samples were collected in the wet sampling period. Although six samples were collected from this sampling station, the sample collected on one of the six collection dates was only evaluated for the presence of the human-specific marker, and not the dog-, gull-, or ruminant-specific markers. The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-61 below.

Specifically, the marker detection percentage in the wet sampling period were:



- Gull (2/5 [40%]),
- Dog (1/5 [20%]),
- Ruminant (1/5 [20%]), and
- Human (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



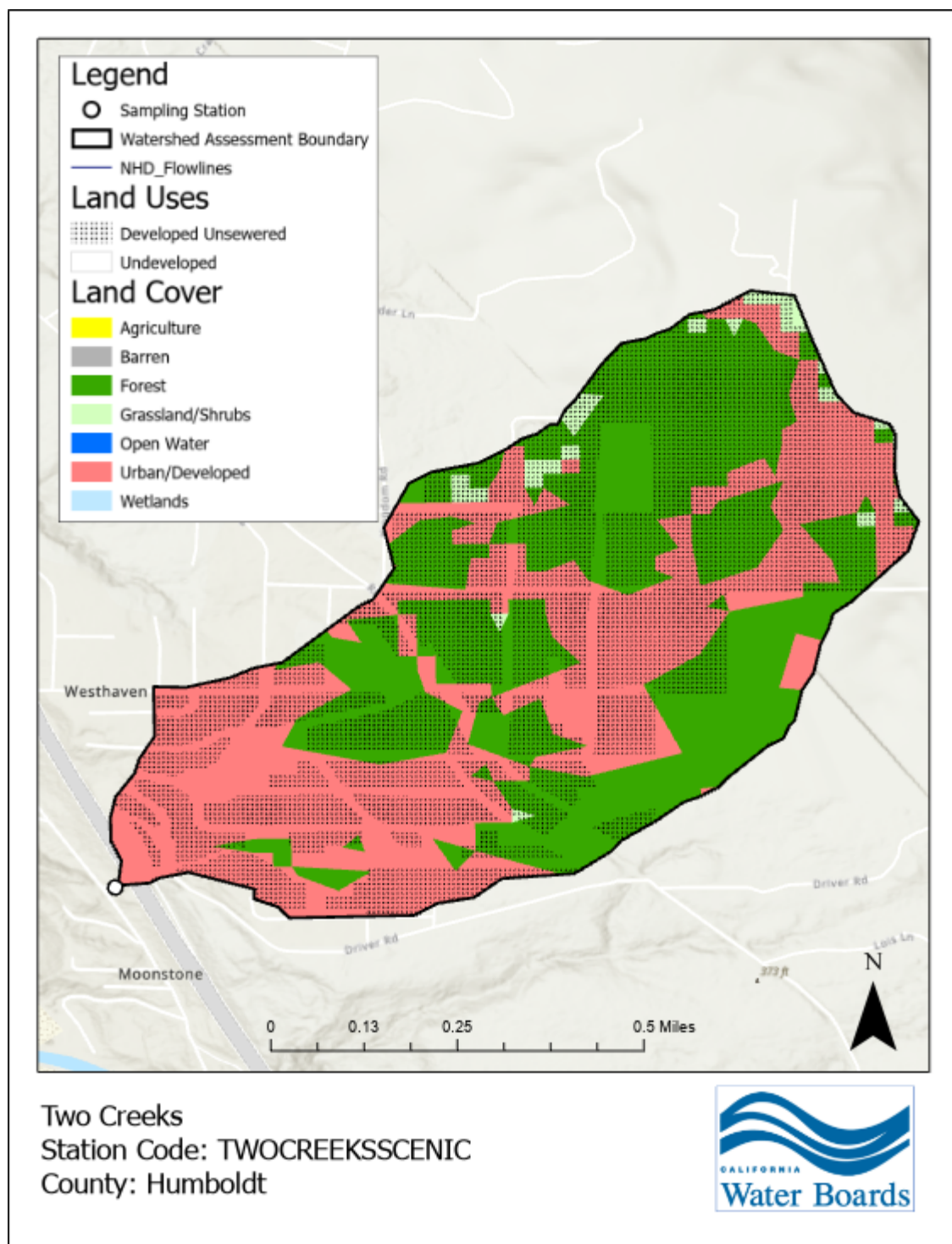
**Figure B-61 Detection percentage of species-specific markers evaluated in samples collected from the Strawberry Creek East of Highway 101 station**

**Two Creeks (TWOCREEKSSCENIC):**

This station was sampled as part of the Humboldt County APMP Study.

This station has not been assessed for impairment of beneficial use. FIB data collected from this sampling station under the Humboldt County APMP Study have not been compared to the REC-1 WQO for exceedance determination, due to the unavailability of a QAPP for the Humboldt County APMP Study at the time of assessment. Since exceedances of water quality objectives can potentially lead to waterbodies being placed on the Section 303(d) List a QAPP is necessary when assessing exceedances.

Figure B-62 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure B-62 Land cover and land use in the Two Creeks watershed**

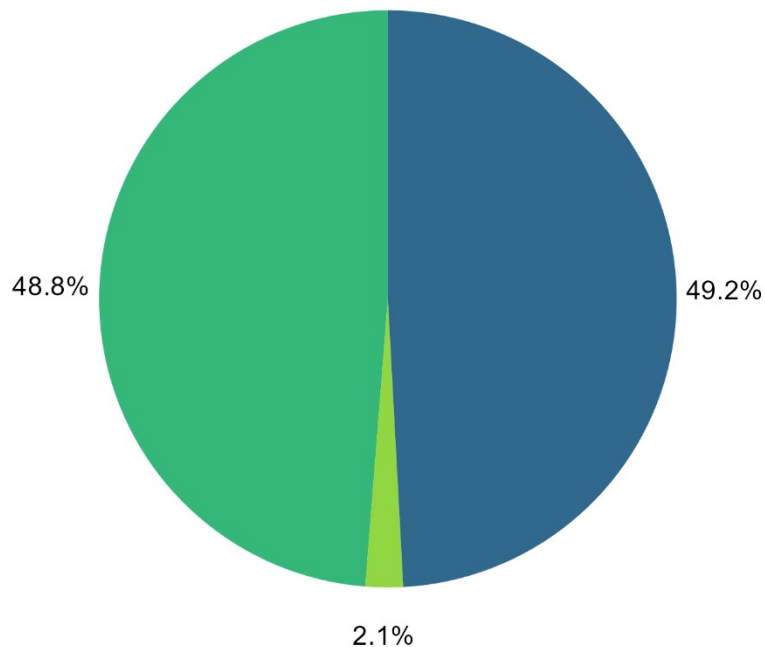
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-63 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (116.02 acres [49.2%]),
- Forest (115.11 acres [48.8%]),
- Grassland/Shrubs (4.86 acres [2.1%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Two Creeks



Category ■ Forest ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

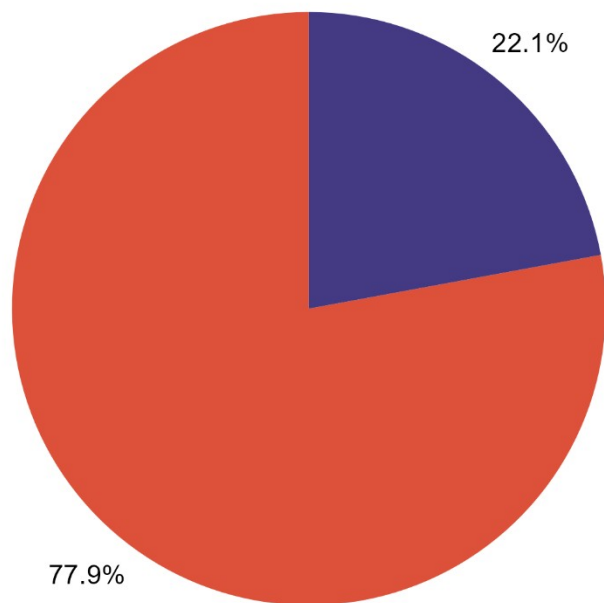
**Figure B-63 Percentage coverage by land cover category in the Two Creeks watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-64 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Unsewered (160.29 acres [77.9%]),
- Undeveloped (45.52 acres [22.1%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

## Land Use

Humboldt County: Two Creeks



Category ■ Developed Unsewered ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

### Figure B-64 Percentage coverage by land use category in the Two Creeks watershed

Five samples were collected from this sampling station. All five samples were collected in the wet sampling period.

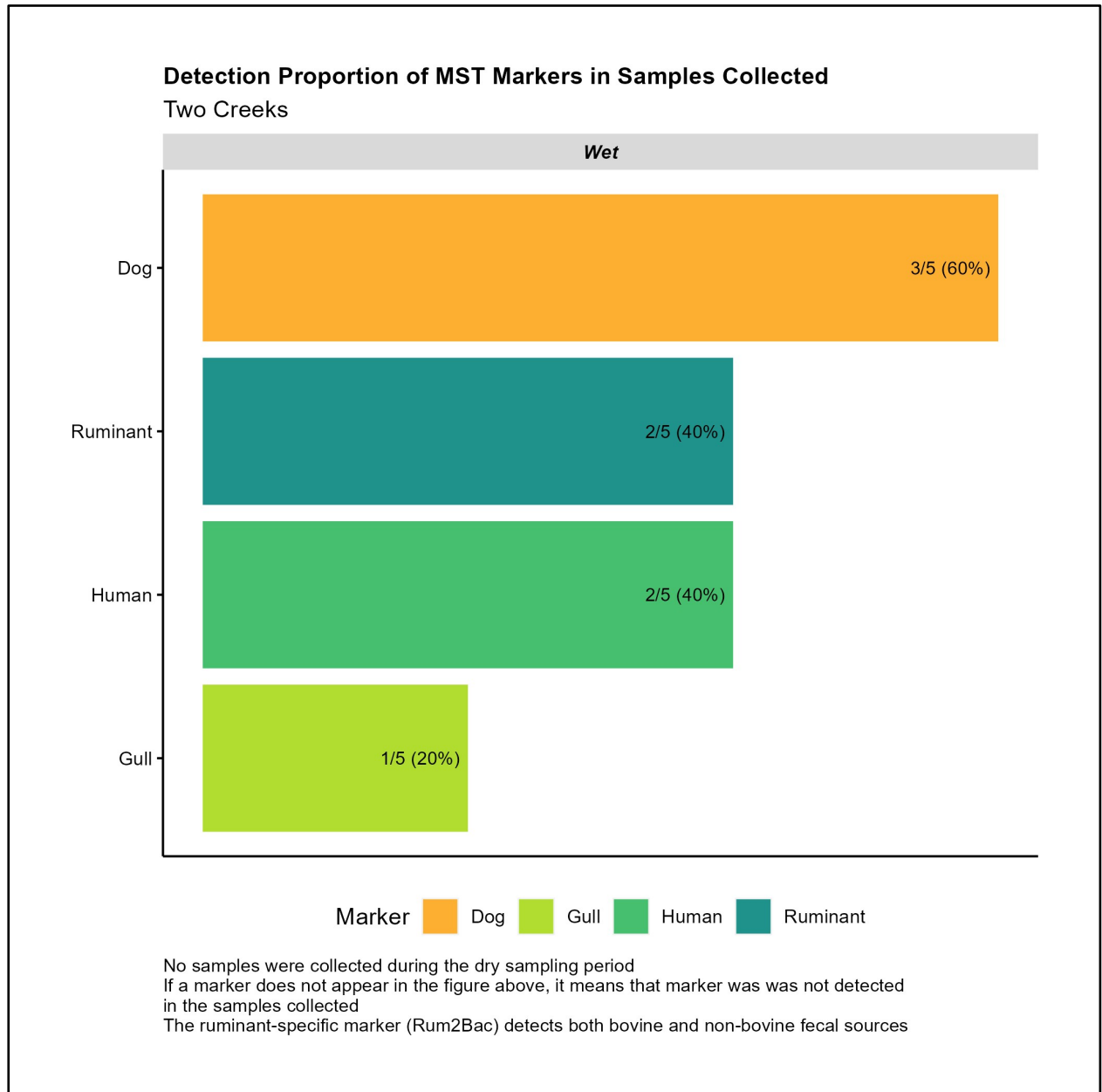
The detection percentage of MST markers in samples collected from wet sampling periods from this sampling station are illustrated in Figure B-65 below.

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (3/5 [60%]),
- Human (2/5 [40%]),

- Ruminant (2/5 [40%]), and
- Gull (1/5 [20%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-65 Detection percentage of species-specific markers evaluated in samples collected from the Two Creeks station**

**Unnamed Creek at Anker Road (109UNTANKR):**

This station was sampled as part of the Source Assessment Study of the Coastal Pathogen Project.

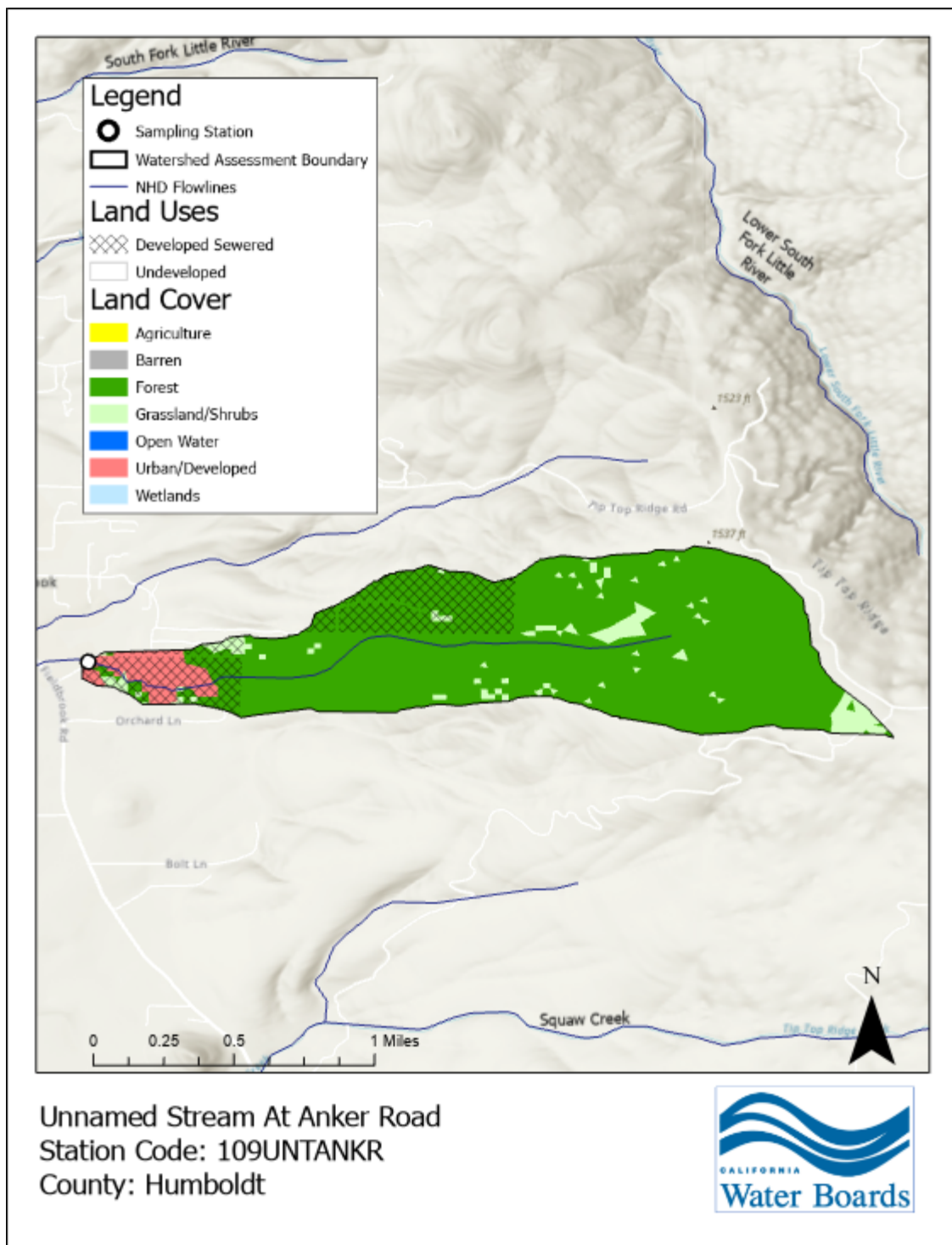
This station has not been assessed for impairment of beneficial use. The *E. coli* data collected from this freshwater sampling station under the Coastal Pathogen Project was compared to the *E. coli*-based freshwater threshold of the REC-1 WQO (STV objective) (Water Quality Objectives for Inland Surface Waters, Enclosed Bays, and Estuaries) (North Coast Regional Water Quality Control Board, 2018). The following number of exceedances/number of calculations were detected for the three assessment periods evaluated:

- Year-Round (0/4),
- Winter (0/2), and
- Summer (0/2).

An assessment of the exceedance of the GM threshold could not be conducted due to insufficient sample collection from this station. An exceedance of the SHELL WQO was not conducted since this is a fecal-coliform based Objective, and fecal coliform data were not collected from this, or any other sampling station sampled under the Coastal Pathogen Project, or Humboldt Bay APMP Study. Further details about the REC-1 WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 24 Humboldt County Coastal Surface Streams” (North Coast Regional Water Quality Control Board, 2023c).

Figure B-66 below illustrates the land cover and land use in the watershed of this sampling station.





**Figure B-66 Land cover and land use in the Unnamed Stream at Anker Road watershed**

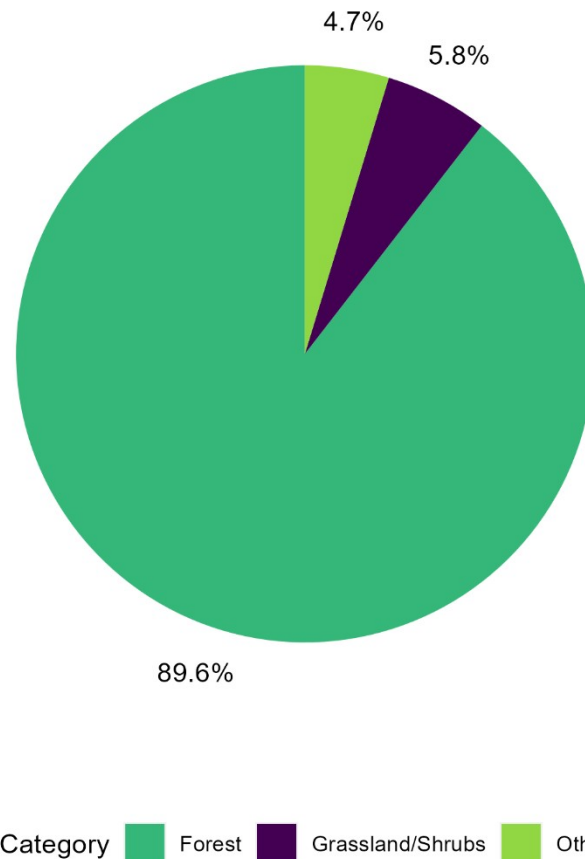
Land cover categories observed in the watershed of this sampling station are illustrated in Figure B-67 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (489.67 acres [89.6%]),
- Grassland/Shrubs (31.58 acres [5.8%]),
- Urban/Developed (25.55 acres [4.7%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Unnamed Stream at Anker Road



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

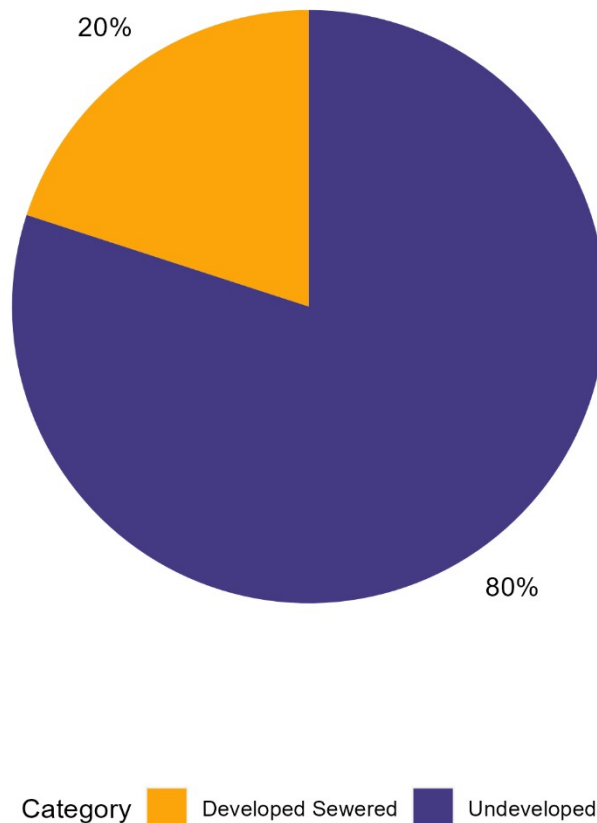
**Figure B-67 Percentage coverage by land cover category in the Unnamed Street at Anker Road watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure B-68 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (434.17 acres [80%]),
- Developed Sewered (108.61 acres [20%]),
- Developed Unsewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Unnamed Stream at Anker Road



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure B-68 Percentage coverage by land use category in the Unnamed Street at Anker Road watershed**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are illustrated in Figure B-69 below.

Specifically, the marker detection percentage in the dry sampling period were:

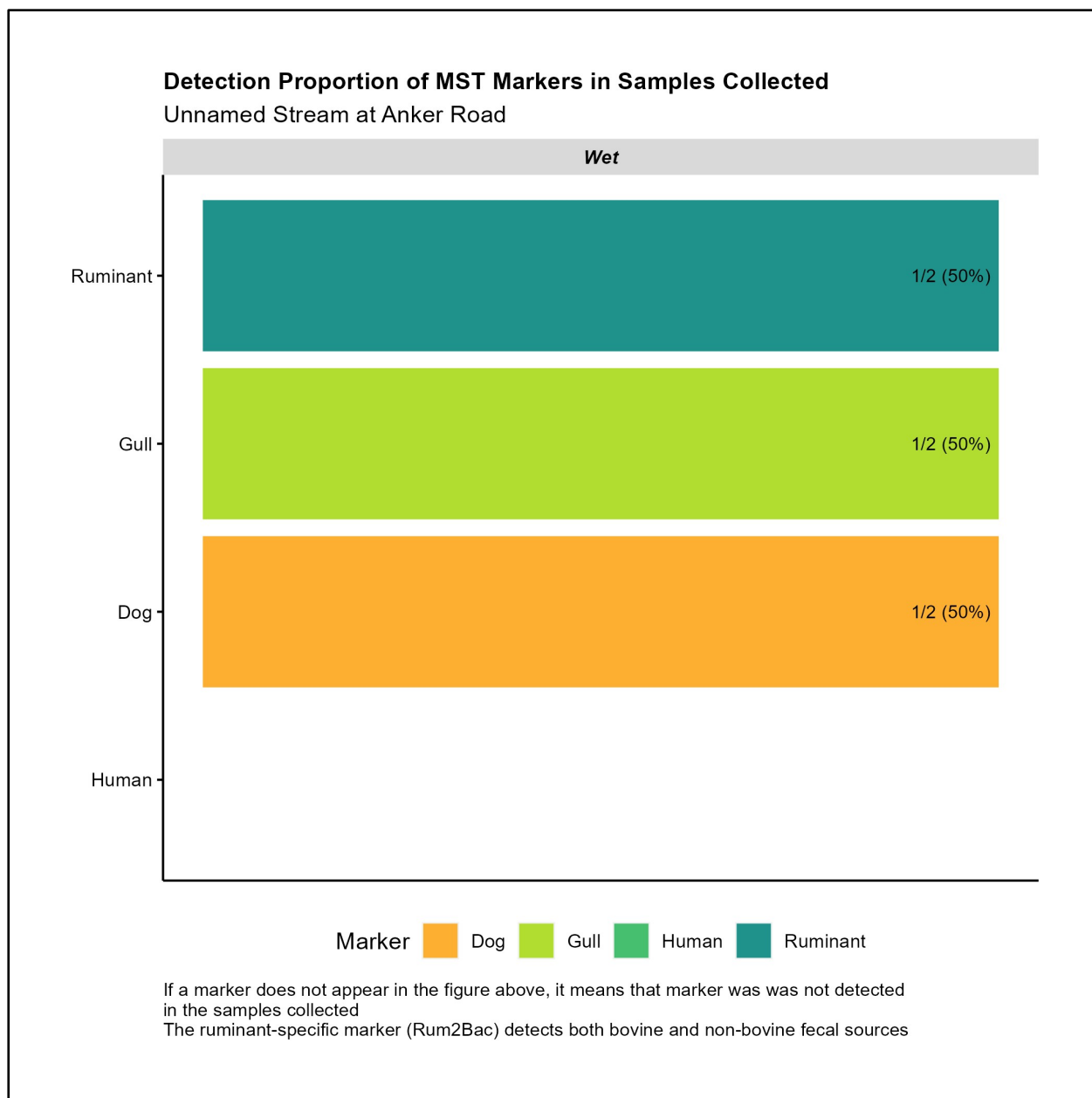
- Dog (0/2 [0%]),
- Gull (0/2 [0%]),

- Human (0/2 [0%]), and
- Ruminant (0/2 [0%]).

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (1/2 [50%]),
- Gull (1/2 [50%]),
- Ruminant (1/2 [50%]), and
- Human (0/2 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure B-69 Detection percentage of species-specific markers evaluated in samples collected from the Unnamed Stream at Anker Road station**

## **Appendix C – Land Cover and Land Use Coverage, and Species-Specific Marker Detection in Humboldt County Ocean Beaches**

Results of the assessment of land cover, land use, and MST data collected from each sampling station sampled at six Humboldt County ocean beaches are detailed below. In addition, any exceedances of the REC-1 and SHELL Objectives at these sampling stations are also included.

### **Clam Beach at Mad River (109MA0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (6/158), and
- STV threshold (3/44).

A comparison of total coliform data collected from this sampling station to the total coliform-based SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (730/7170), and
- 10% threshold (1109/7170).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-1 below illustrates the land cover and land use in the watershed of this sampling station.

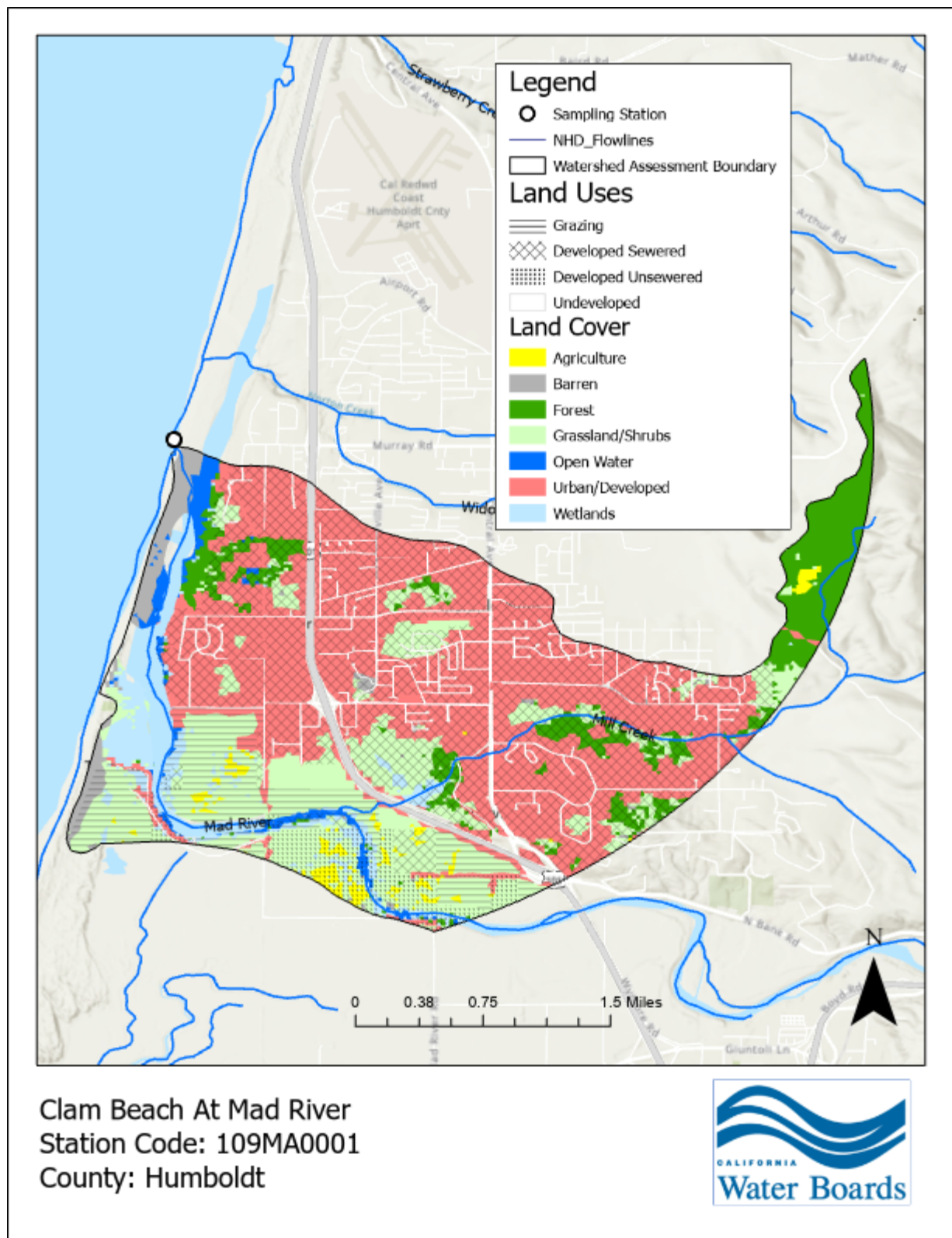


Figure C-1 Land cover and land use in the Clam Beach at Mad River watershed



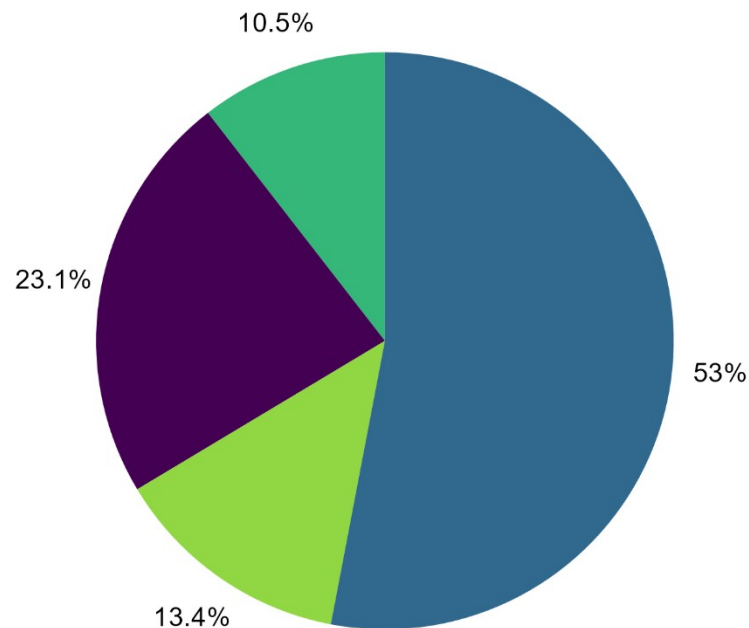
Land cover categories observed in the watershed of this sampling station are illustrated in Figure C-2 below. Specifically, the coverage of land cover categories in this watershed are:




- Urban/Developed (1847.14 acres [53%]),
- Grassland/Shrubs (805.48 acres [23.1%]),
- Forest (364.5 acres [10.5%]),
- Wetlands (161.19 acres [4.6%]),
- Open Water (142.03 acres [4.1%]),
- Barren (106.53 acres [3.1%]), and
- Agriculture (55.9 acres [1.6%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Humboldt County: Clam Beach at Mad River



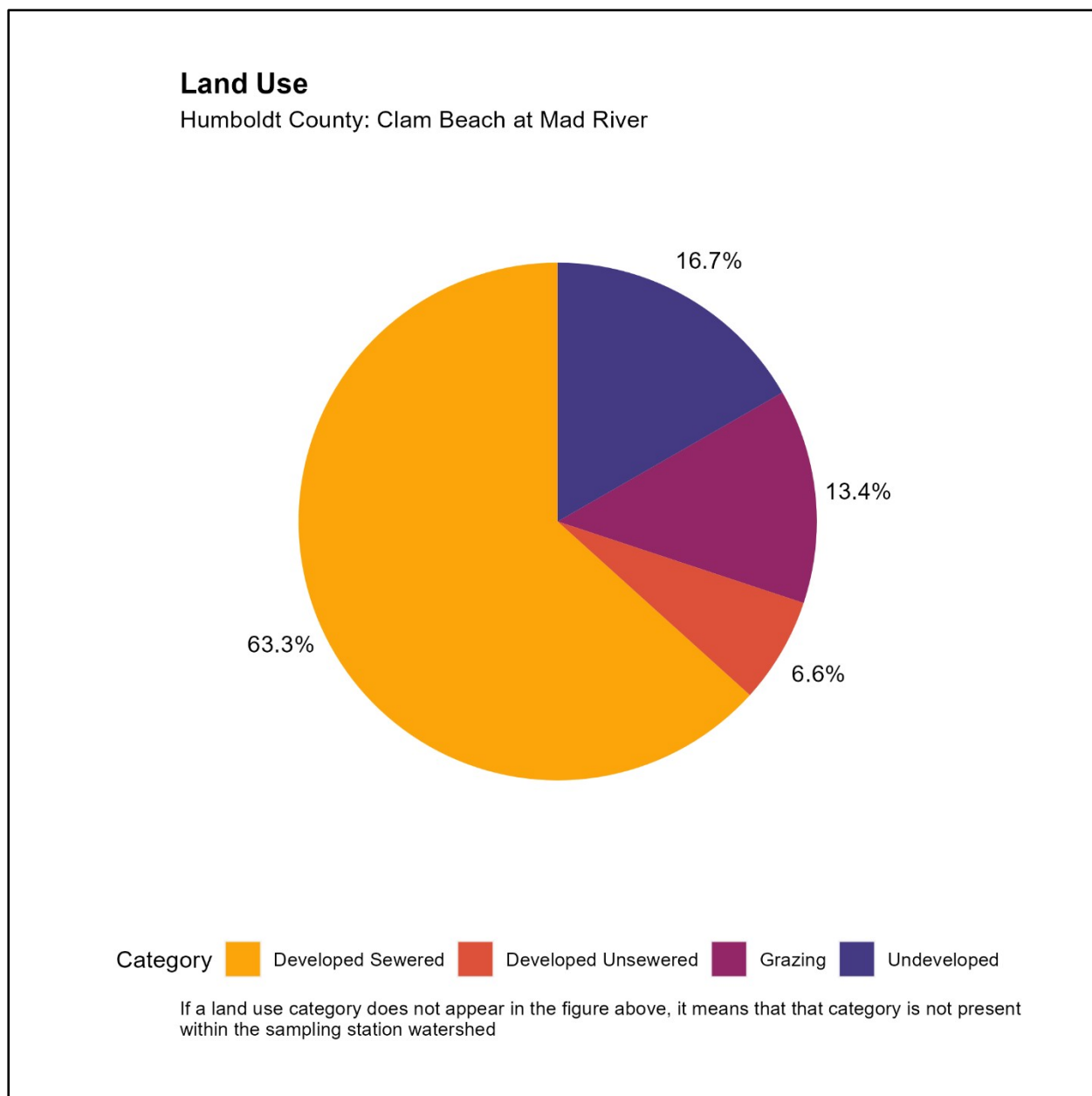
Category  Forest  Grassland/Shrubs  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure C-2 Percentage coverage by land cover category in the Clam Beach at Mad River watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure C-3 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1951.78 acres [63.3%]),
- Undeveloped (515.8 acres [16.7%]),
- Grazing (412.96 acres [13.4%]), and
- Developed Unsewered (202.2 acres [6.6%]).



**Figure C-3 Percentage coverage by land use category in the Clam Beach at Mad River watershed**

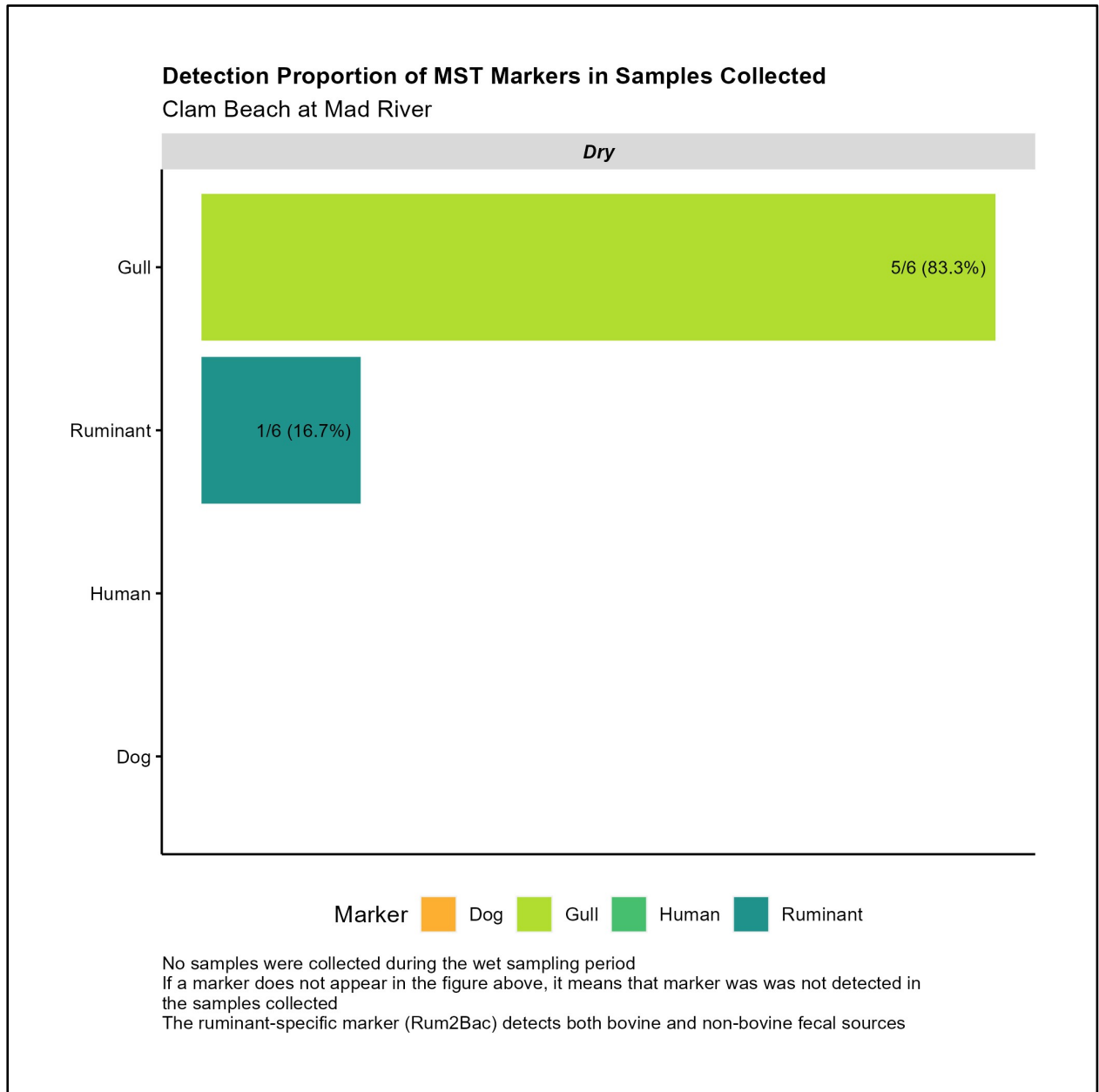
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-4 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/6 [83.3%]),
- Ruminant (1/6 [16.7%]),

- Dog (0/6 [0%]), and
- Human (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-4 Detection percentage of species-specific markers evaluated in samples collected from the Clam Beach at Mad River station**

**Clam Beach at Strawberry Creek (109SW0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use as well as SHELL beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

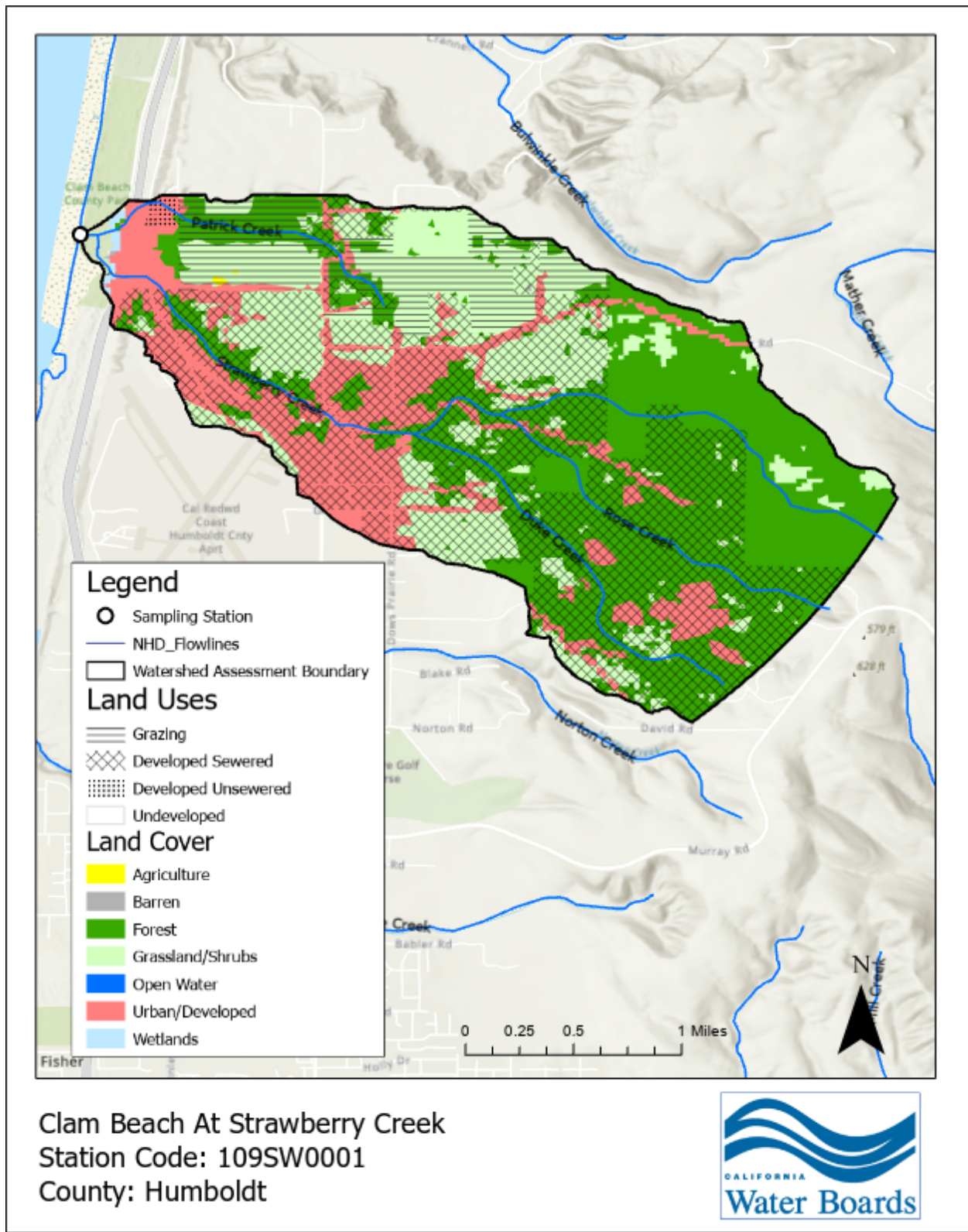
- GM threshold (129/159), and
- STV threshold (21/44).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (1697/8520), and
- 10% threshold (1649/8520).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-5 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure C-5 Land cover and land use in the Clam Beach at Strawberry Creek watershed**

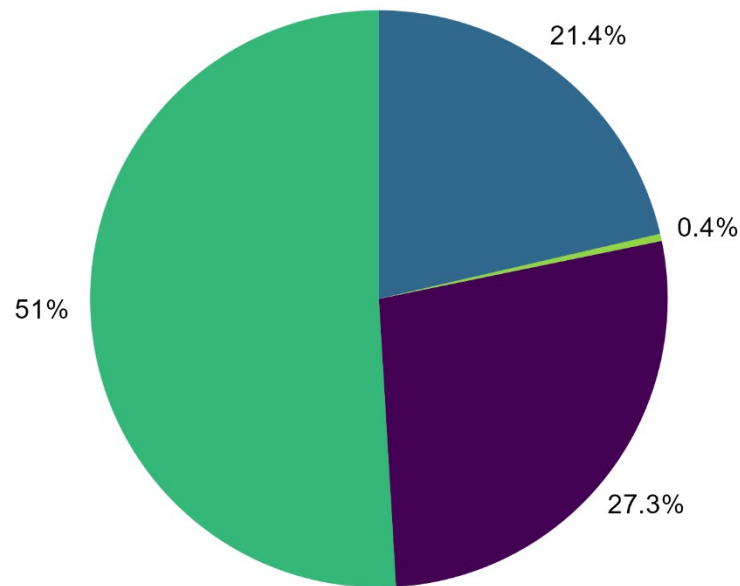
Land cover categories observed in the watershed of this sampling station are illustrated in Figure C-6 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1216.98 acres [51%]),
- Grassland/Shrubs (649.91 acres [27.3%]),
- Urban/Developed (510.37 acres [21.4%]),
- Wetlands (6.03 acres [0.3%]),
- Agriculture (1.11 acres [0.1%]),
- Barren (0.91 acres [0%]), and
- Open Water (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Clam Beach at Strawberry Creek



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure C-6 Percentage coverage by land cover category in the Clam Beach at Strawberry Creek watershed**

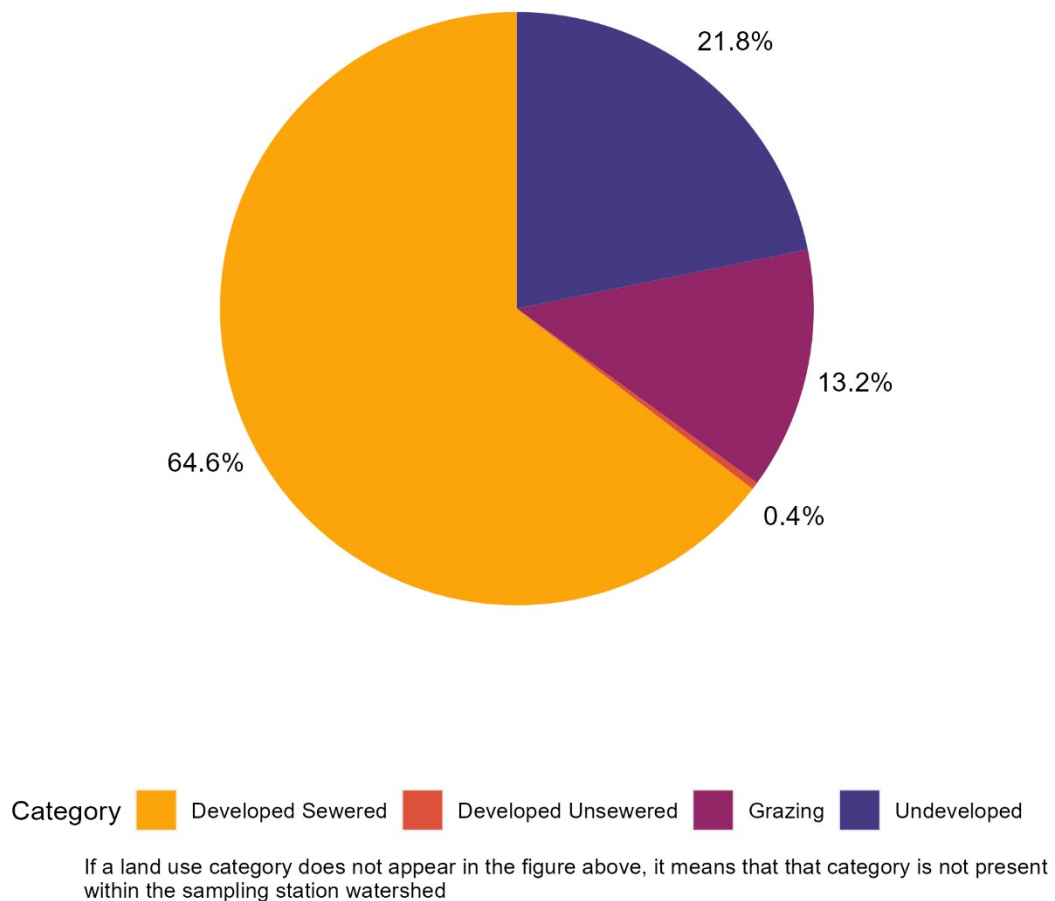
Land use categories observed in the watershed of this sampling station are illustrated in Figure C-7 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Sewered (1514.91 acres [64.6%]),
- Undeveloped (510.11 acres [21.8%]),
- Grazing (308.31 acres [13.2%]), and
- Developed Unsewered (9.98 acres [0.4%]).



## Land Use

Humboldt County: Clam Beach at Strawberry Creek



**Figure C-7 Percentage coverage by land use category in the Clam Beach at Strawberry Creek watershed**

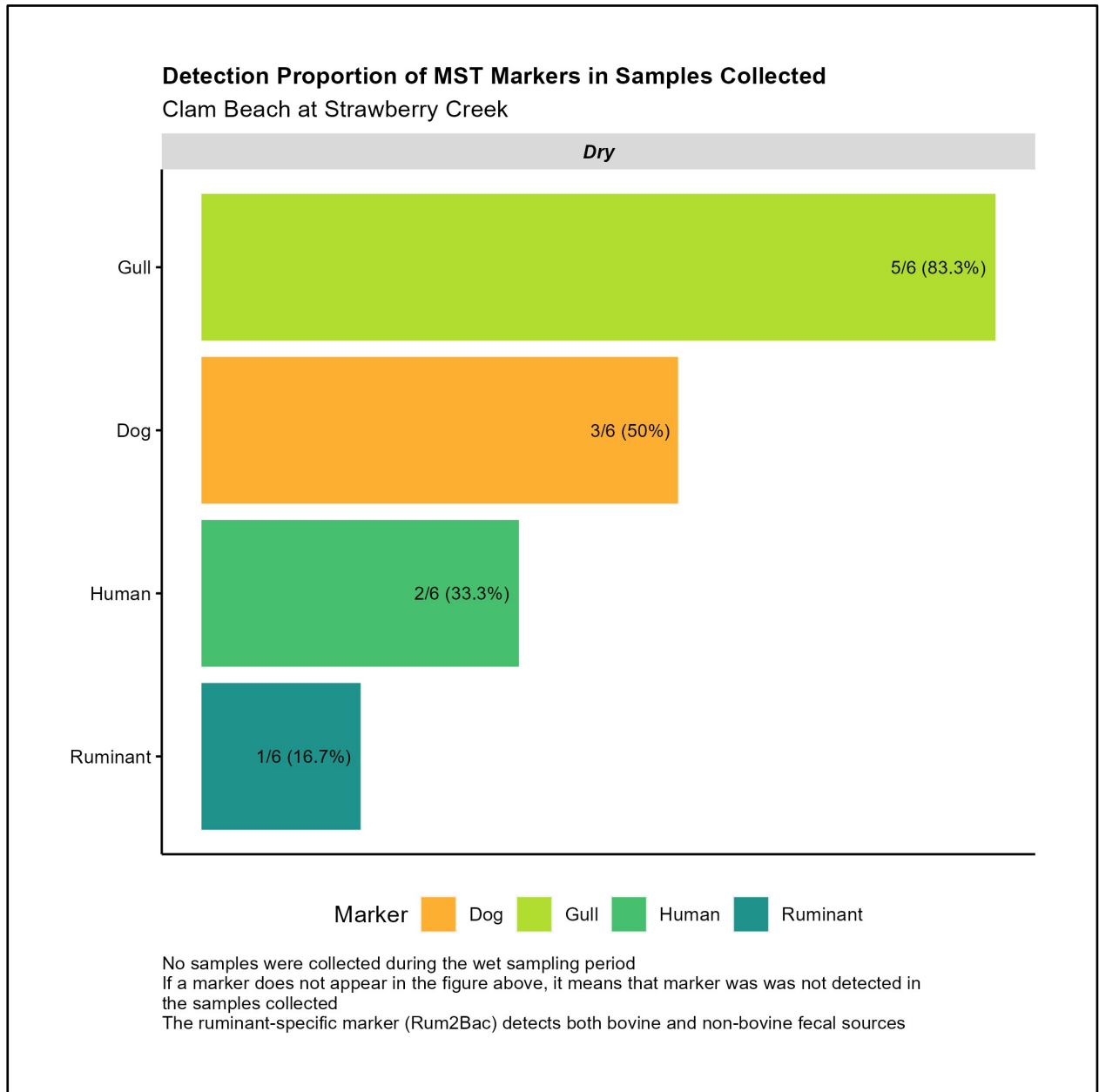
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-8 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/6 [83.3%]),
- Dog (3/6 [50%]),

- Human (2/6 [33.3%]), and
- Ruminant (1/6 [16.7%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-8 Detection percentage of species-specific markers evaluated in samples collected from the Clam Beach at Strawberry Creek station**

**Luffenholtz Beach at Luffenholtz Creek (108LF0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use as well as SHELL beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (103/160), and
- STV threshold (19/44).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (1696/8370), and
- 10% threshold (1689/8370).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-9 below illustrates the land cover and land use in the watershed of this sampling station.

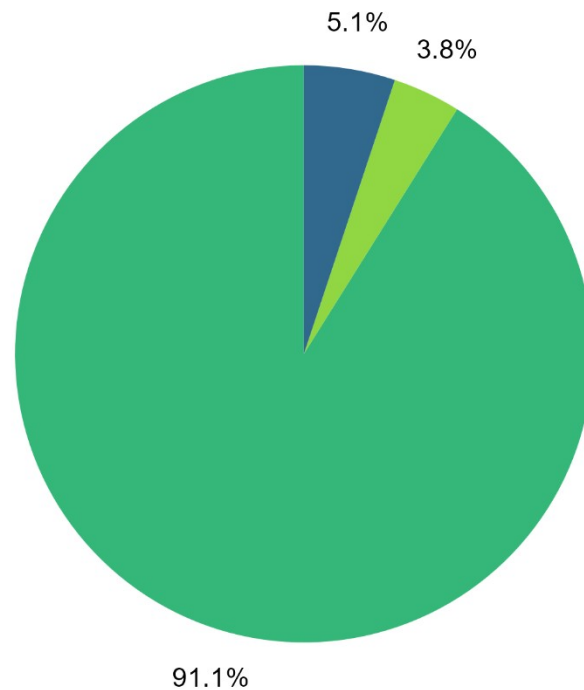


- Forest (3150.35 acres [91.1%]),
- Urban/Developed (175.21 acres [5.1%]),
- Grassland/Shrubs (130.97 acres [3.8%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Luffenholtz Beach at Luffenholtz Creek



Category ■ Forest ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

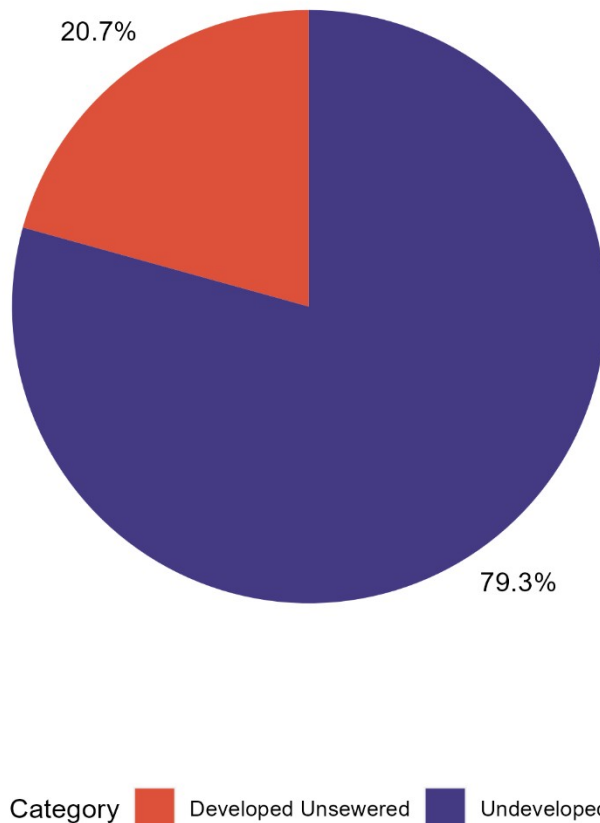
**Figure C-10 Percentage coverage by land cover category in the Luffenholtz Beach at Luffenholtz Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure C-11 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (2687.4 acres [79.3%]),
- Developed Unsewered (700.03 acres [20.7%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Luffenholtz Beach at Luffenholtz Creek



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure C-11 Percentage coverage by land use category in the Luffenholtz Beach at Luffenholtz Creek watershed**

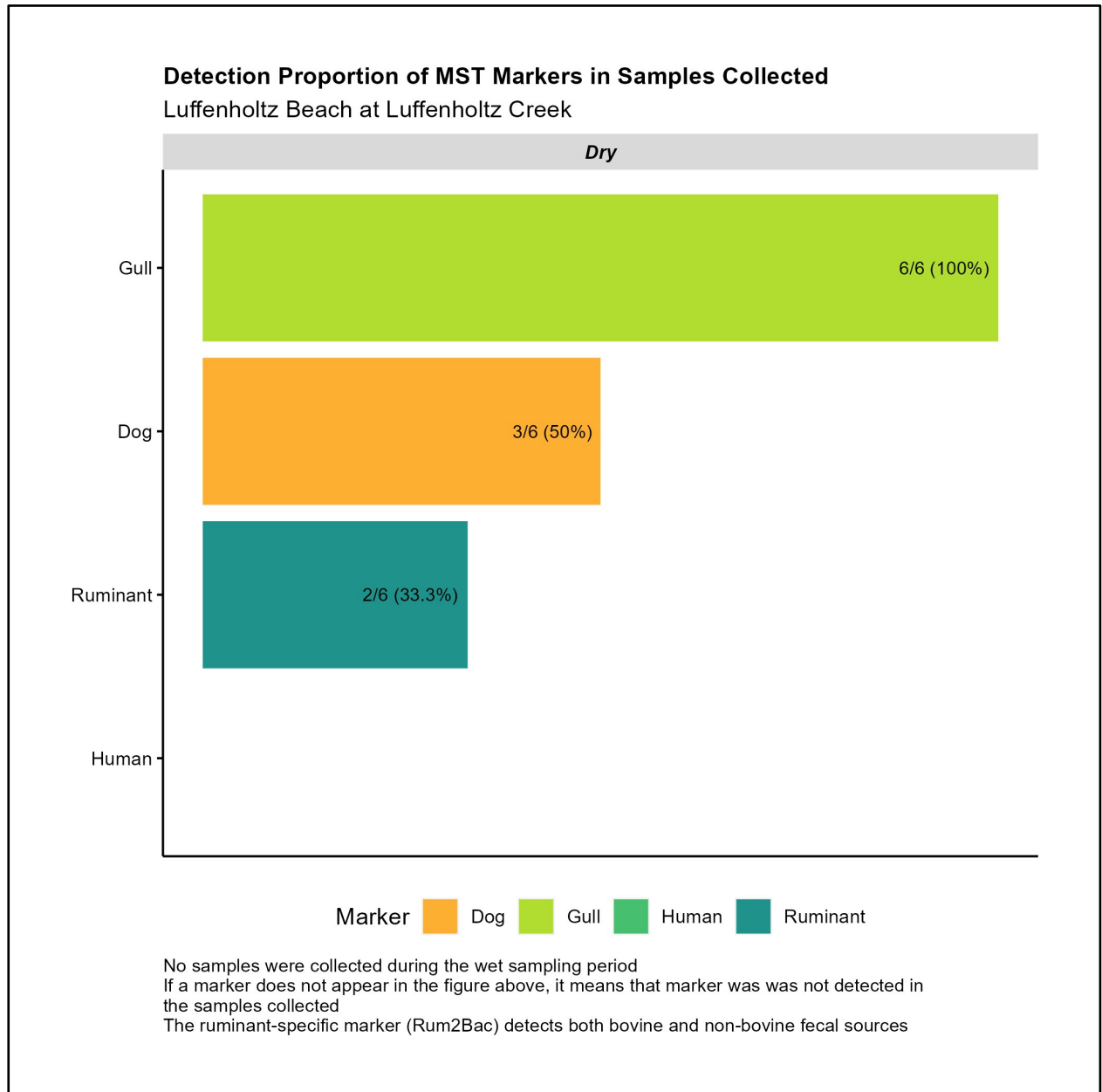
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-12 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (6/6 [100%]),
- Dog (3/6 [50%]),

- Ruminant (2/6 [33.3%]), and
- Human (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-12 Detection percentage of species-specific markers evaluated in samples collected from the Luffenholtz Beach at Luffenholtz Creek station**



**Moonstone Beach at Little River (108LR0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (32/161), and
- STV threshold (11/44).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (1537/8100), and
- 10% threshold (1638/8100).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-13 below illustrates the land cover and land use in the watershed of this sampling station.



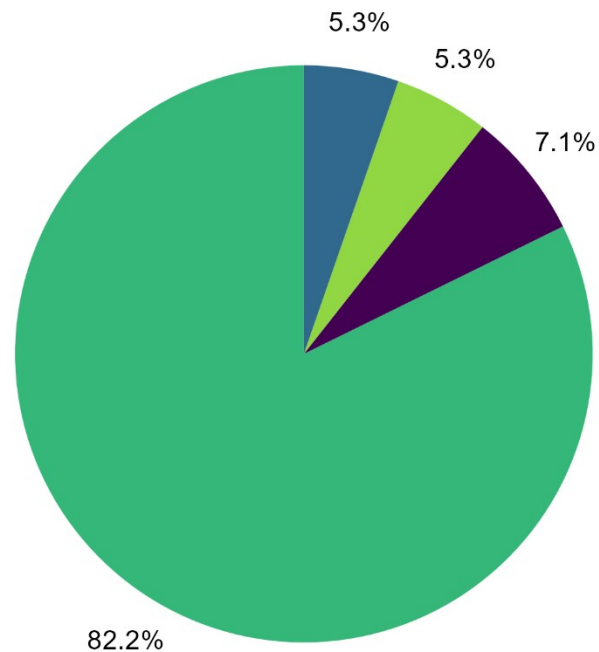
Land cover categories observed in the watershed of this sampling station are illustrated in Figure C-14 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (4236.81 acres [82.2%]),
- Grassland/Shrubs (364.09 acres [7.1%]),
- Urban/Developed (274.17 acres [5.3%]),
- Wetlands (171.19 acres [3.3%]),
- Barren (84.57 acres [1.6%]),
- Open Water (21.84 acres [0.4%]), and
- Agriculture (0.75 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Moonstone Beach at Little River



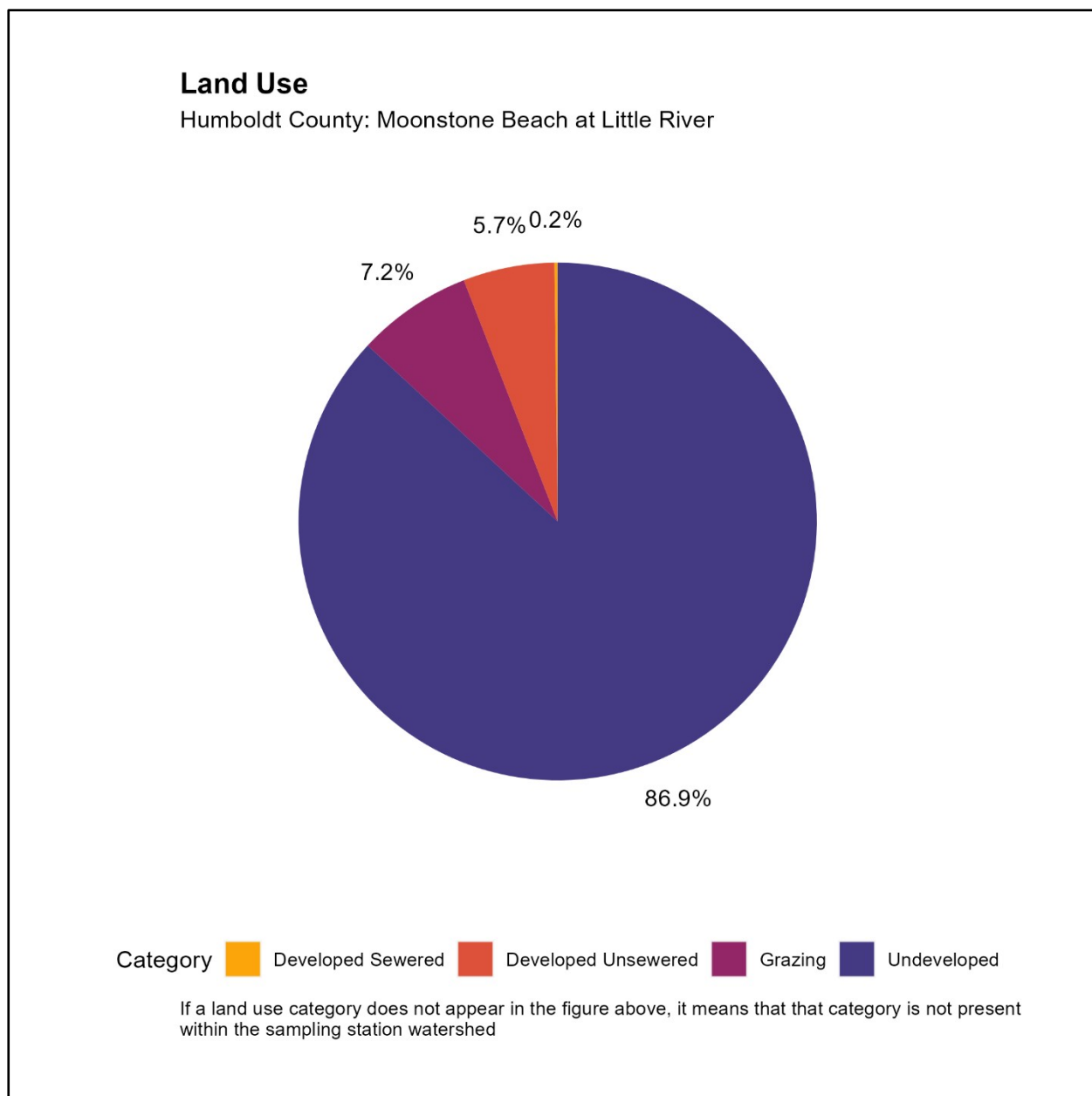
Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure C-14 Percentage coverage by land cover category in the Moonstone Beach at Little River watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure C-15 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (4434.72 acres [86.9%]),
- Grazing (365.53 acres [7.2%]),
- Developed Unsewered (292.15 acres [5.7%]), and
- Developed Sewered (12.23 acres [0.2%]).
- Non-dairy cattle grazing is present in this sampling station watershed.



**Figure C-15 Percentage coverage by land use category in the Moonstone Beach at Little River watershed**

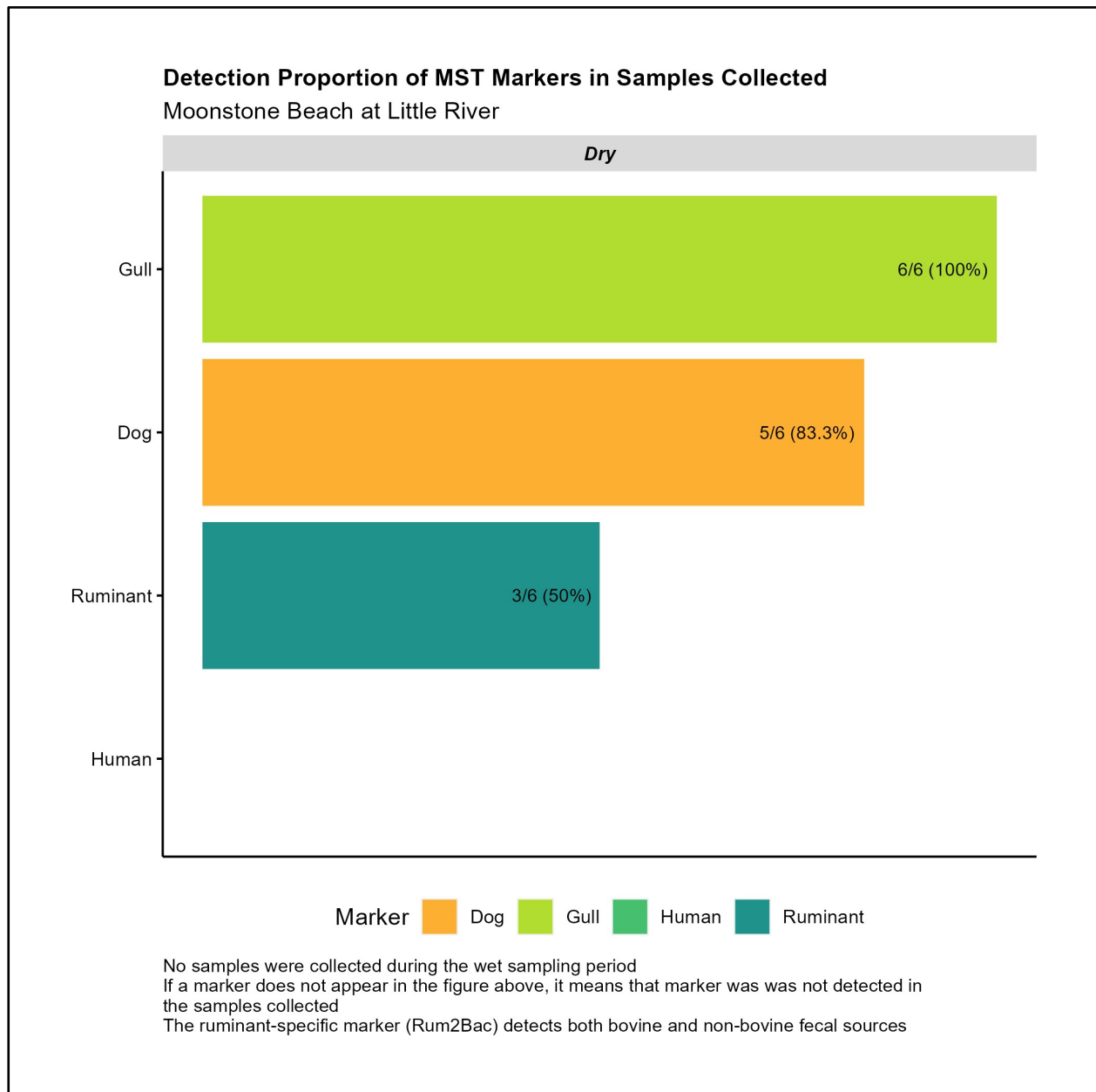
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-16 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Dog (5/6 [83.3%]),
- Gull (6/6 [100%]),

- Human (0/6 [0%]), and
- Ruminant (3/6 [50%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-16 Detection percentage of species-specific markers evaluated in samples collected from the Moonstone Beach at Little River station**

**Old Home Beach at Scenic Drive (108HBOHB1):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

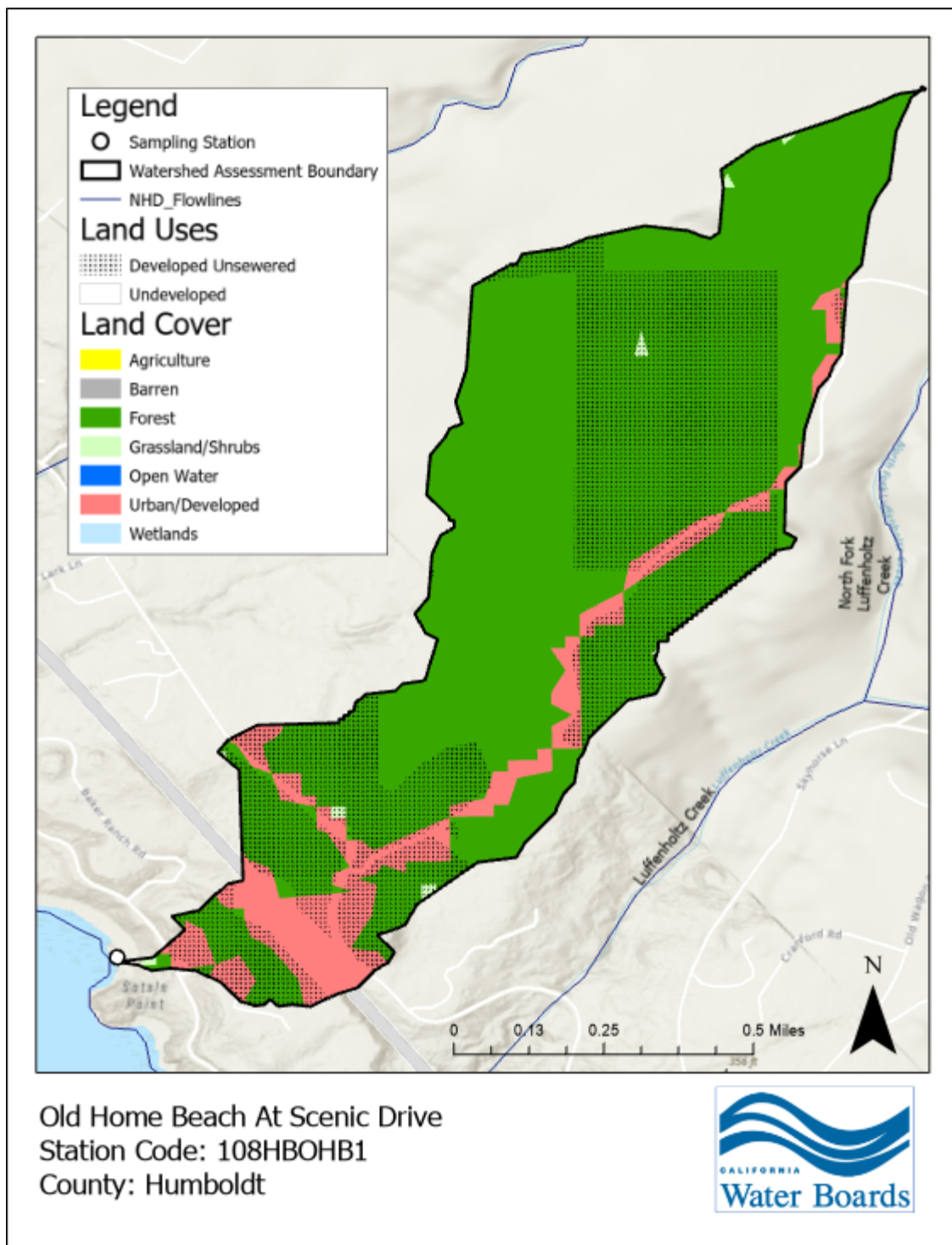
- GM threshold (4/14), and
- STV threshold (2/4).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (149/480), and
- 10% threshold (129/480).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31 which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-17 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure C-17 Land cover and land use in the Old Home Beach at Scenic Drive watershed**

Land cover categories observed in the watershed of this sampling station are illustrated in Figure C-18 below. Specifically, the coverage of land cover categories in this watershed are:

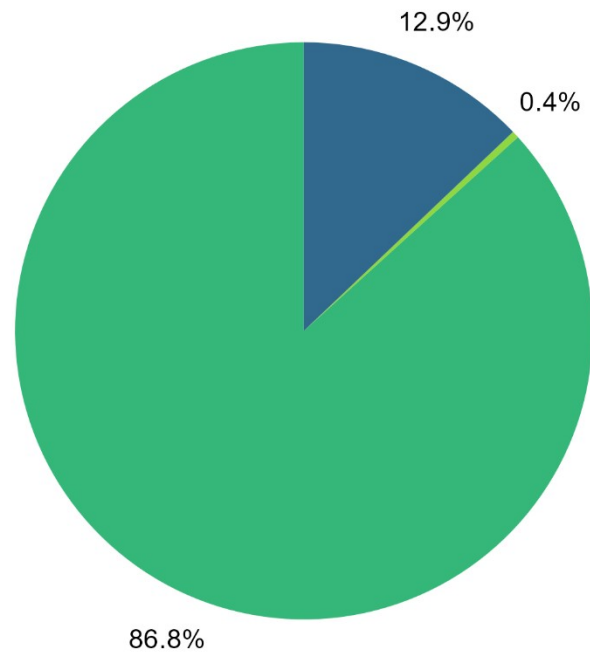


- Forest (292.21 acres [86.8%]),
- Urban/Developed (43.32 acres [12.9%]),
- Grassland/Shrubs (1.17 acres [0.4%]),
- Agriculture (0 acres [0%]),
- Barren (0 acres [0%]),
- Open Water (0 acres [0%]), and
- Wetlands (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Old Home Beach at Scenic Drive



Category ■ Forest ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

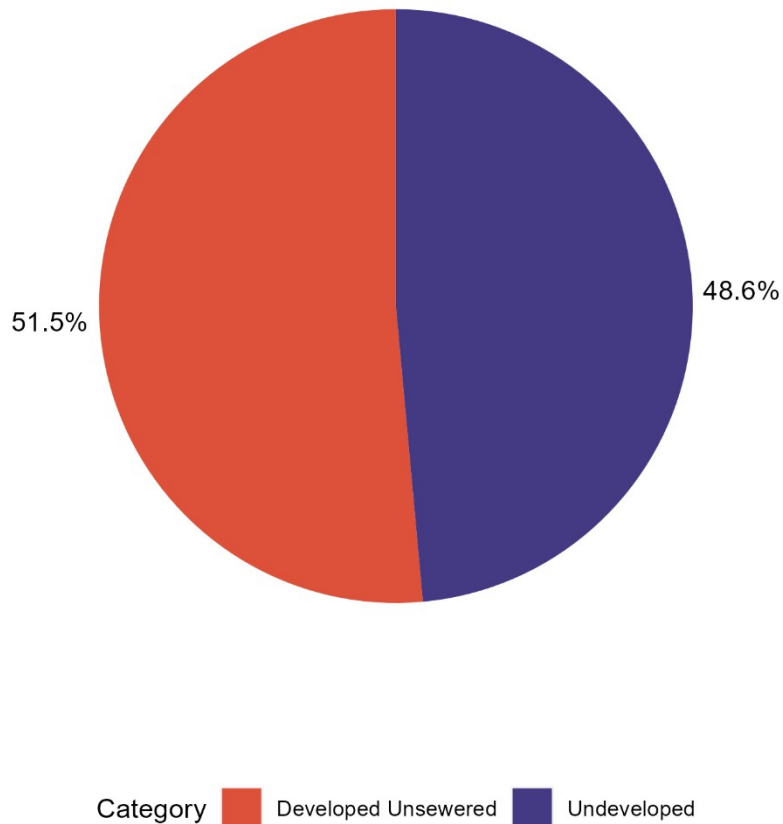
**Figure C-18 Percentage coverage by land cover category in the Old Home Beach at Scenic Drive watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure C-19 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Unsewered (164.61 acres [51.5%]),
- Undeveloped (155.35 acres [48.6%]),
- Developed Sewered (0 acres [0%]), and
- Grazing (0 acres [0%]).

### Land Use

Humboldt County: Old Home Beach at Scenic Drive



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

### Figure C-19 Percentage coverage by land use category in the Old Home Beach at Scenic Drive watershed

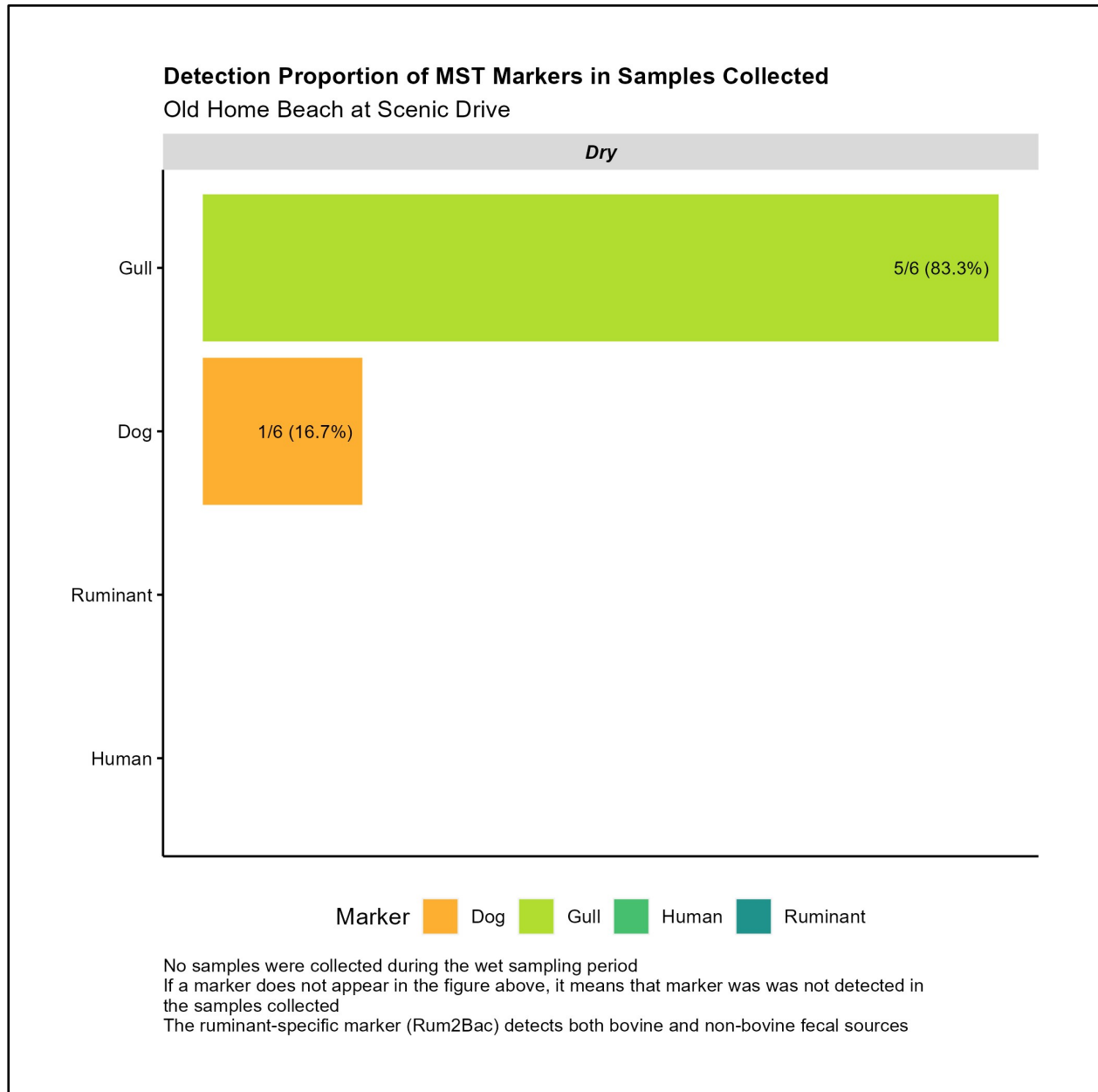
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-20 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/6 [83.3%]),

- Dog (1/6 [16.7%]),
- Human (0/6 [0%]), and
- Ruminant (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-20 Detection percentage of species-specific markers evaluated in samples collected from the Old Home Beach at Scenic Drive station**

**Trinidad State Beach at Mill Creek (108ML0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use as well as SHELL beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

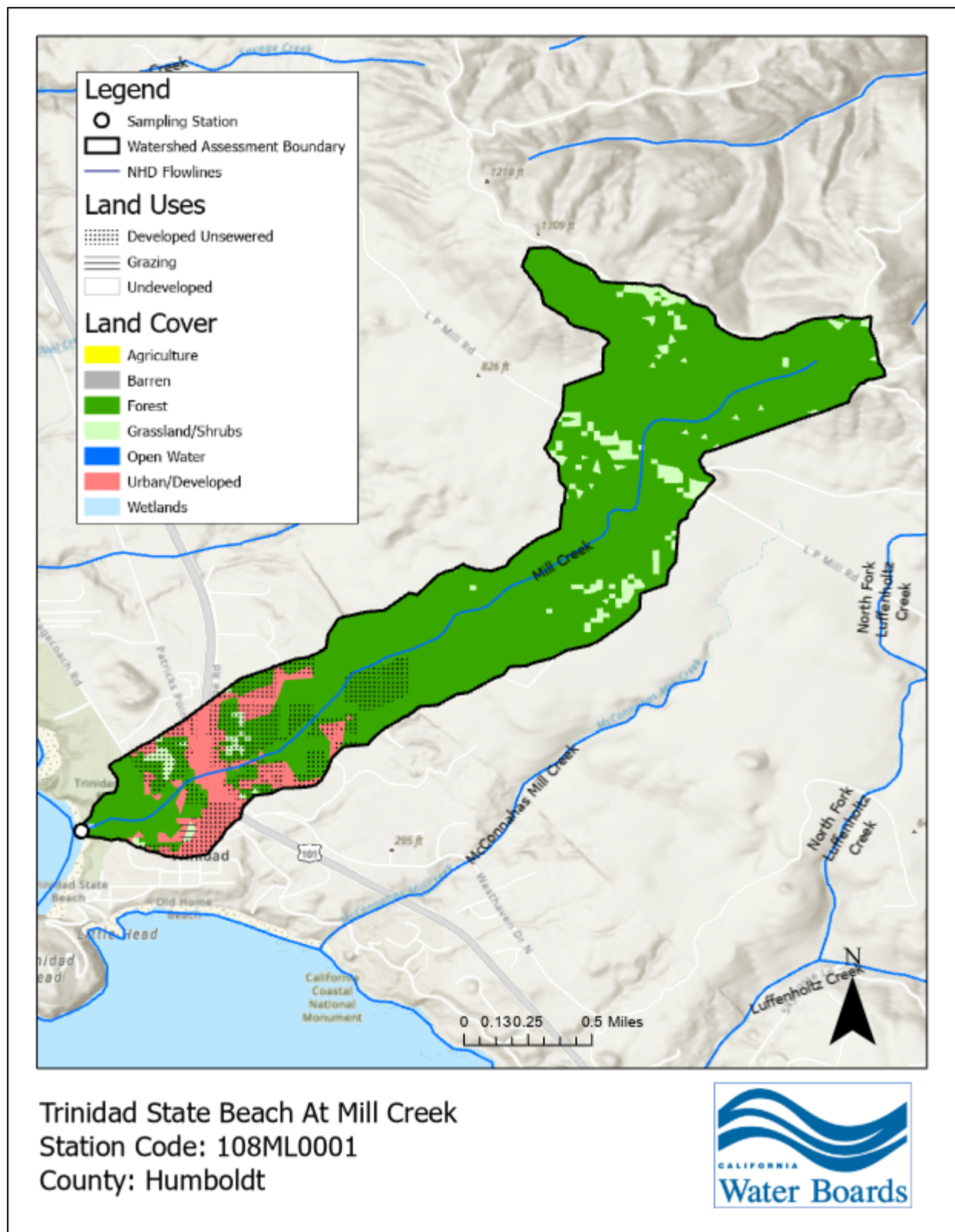
- GM threshold (50/159), and
- STV threshold (19/44).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (1515/8100), and
- 10% threshold (1464/8100).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure C-21 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure C-21 Land cover and land use in the Trinidad State Beach at Mill Creek watershed**

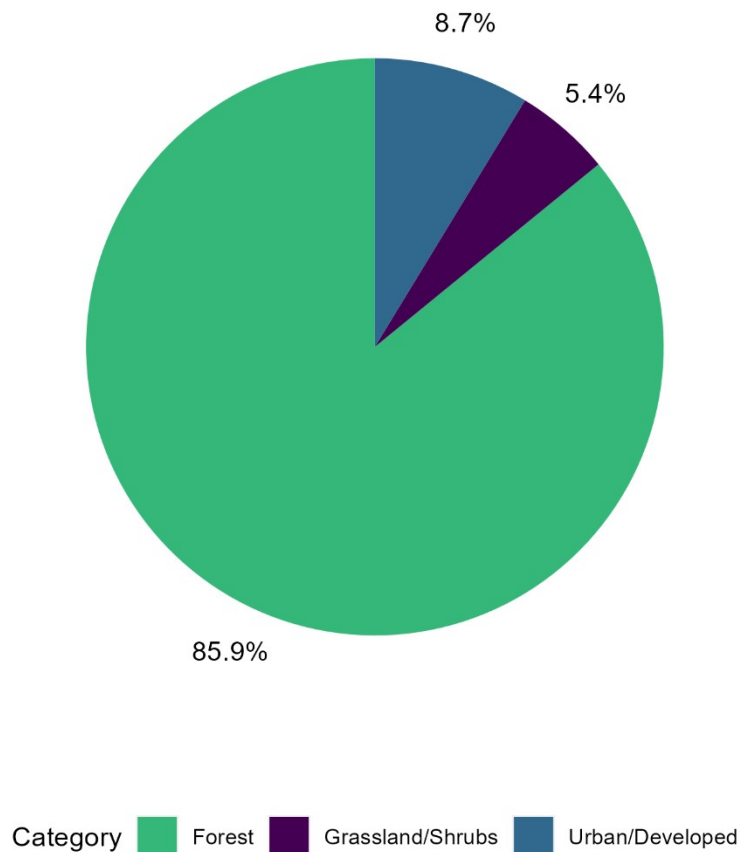
Land cover categories observed in the watershed of this sampling station are illustrated in Figure C-22 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (742.9 acres [85.9%]),
- Urban/Developed (75.12 acres [8.7%]),
- Grassland/Shrubs (46.48 acres [5.4%]),
- Wetlands (0.22 acres [0%]),
- Open Water (0.09 acres [0%]),
- Agriculture (0 acres [0%]), and
- Barren (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Humboldt County: Trinidad State Beach at Mill Creek



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure C-22 Percentage coverage by land cover category in the Trinidad State Beach at Mill Creek watershed**

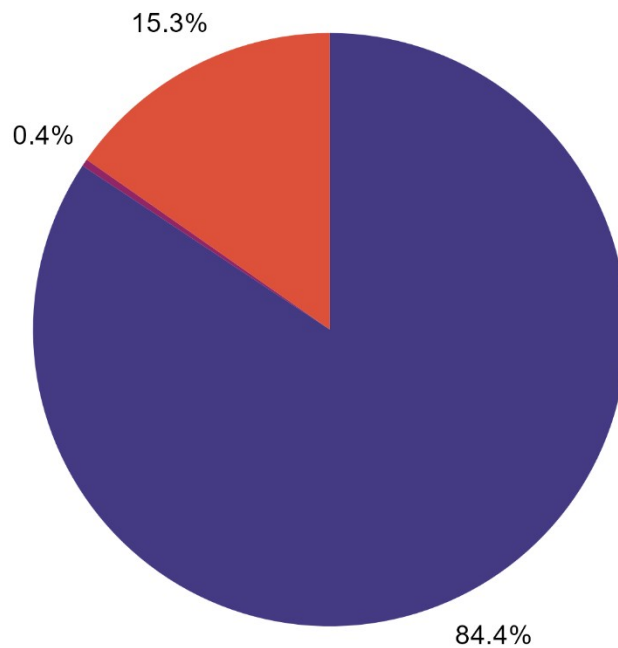
Land use categories observed in the watershed of this sampling station are illustrated in Figure C-23 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (709.59 acres [84.4%]),
- Developed Unsewered (128.72 acres [15.3%]),
- Grazing (2.92 acres [0.4%]), and
- Developed Sewered (0 acres [0%]).



### Land Use

Humboldt County: Trinidad State Beach at Mill Creek



Category ■ Developed Unsewered ■ Grazing ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure C-23 Percentage coverage by land use category in the Trinidad State Beach at Mill Creek watershed**

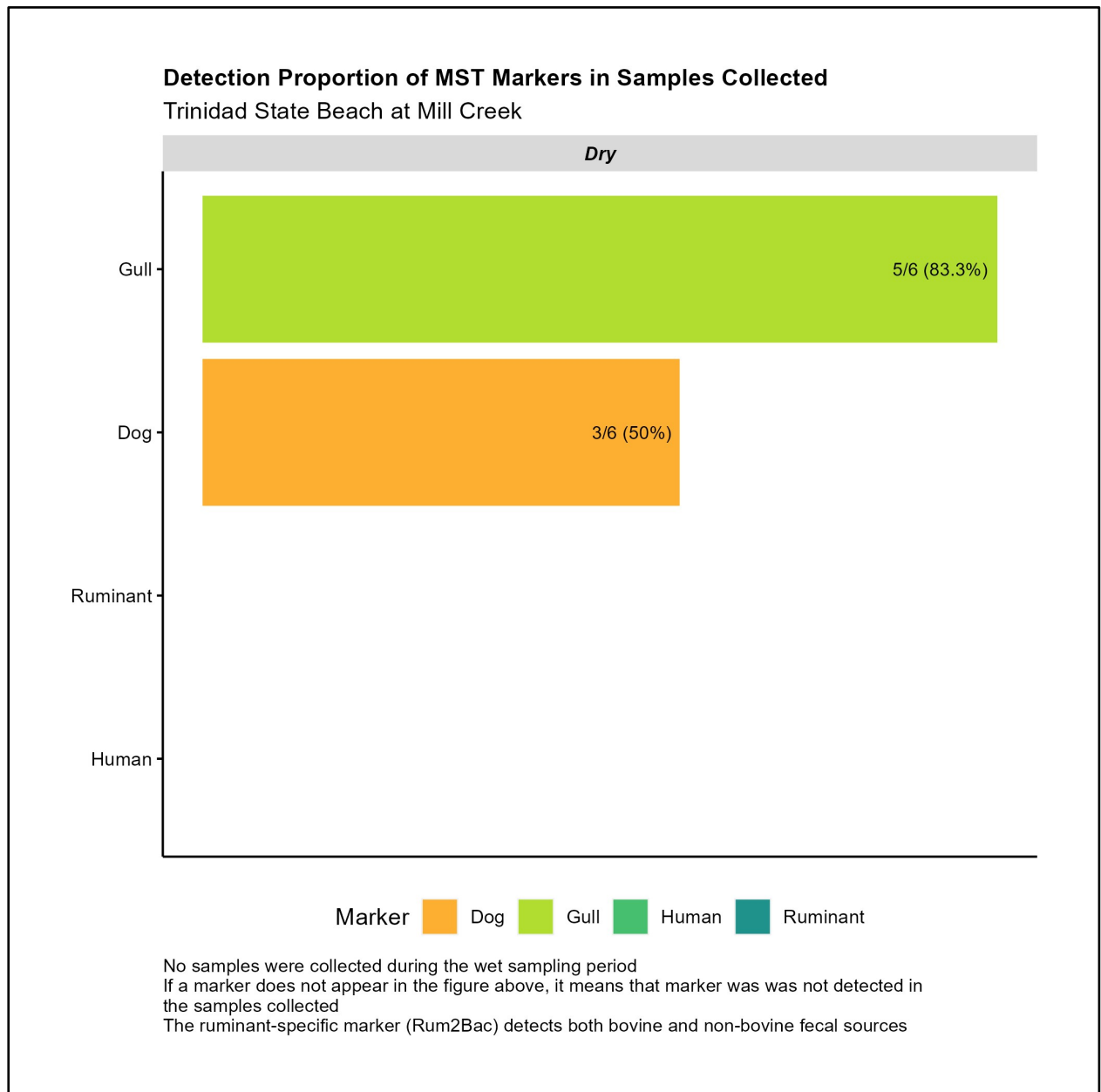
Six samples were collected from this sampling station. All six samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure C-24 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/6 [83.3%]),
- Dog (3/6 [50%]),

- Human (0/6 [0%]), and
- Ruminant (0/6 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure C-24 Detection percentage of species-specific markers evaluated in samples collected from the Trinidad State Beach at Mill Creek station**

## **Appendix D – Land Cover and Land Use Coverage, and Species-Specific Marker Detection in Mendocino County Ocean Beaches**

Results of the assessment of land cover, land use, and MST data collected from each sampling station sampled at five Mendocino County ocean beaches are detailed below. In addition, any exceedances of the REC-1 and SHELL Objectives at these sampling stations are also included.

### **Caspar Beach at Caspar Creek (113CA0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

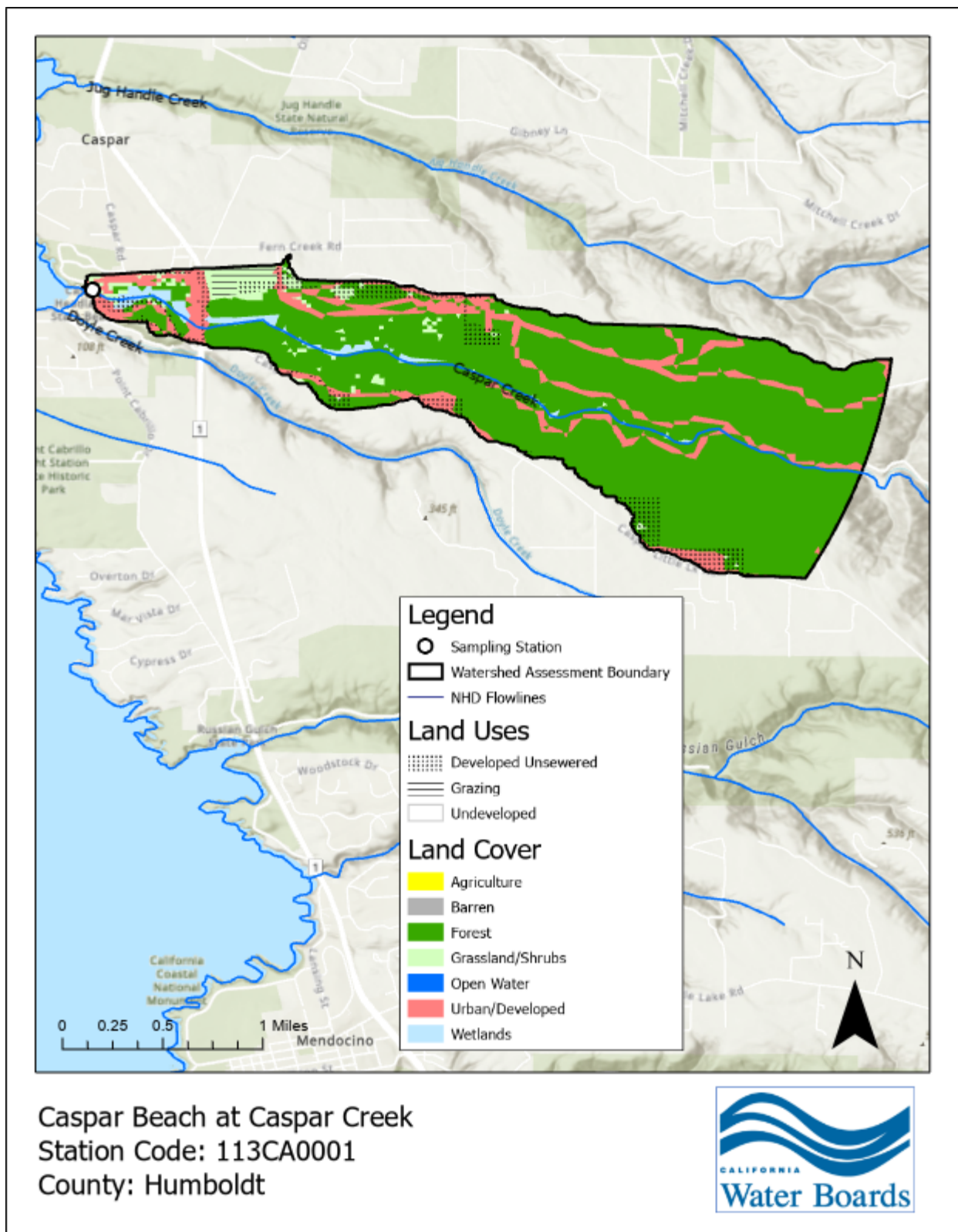
- GM threshold (0/181), and
- STV threshold (1/50).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (830/6810), and
- 10% threshold (782/6810).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure D-1 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure D-1 Land cover and land use in the Caspar Beach at Caspar Creek watershed**

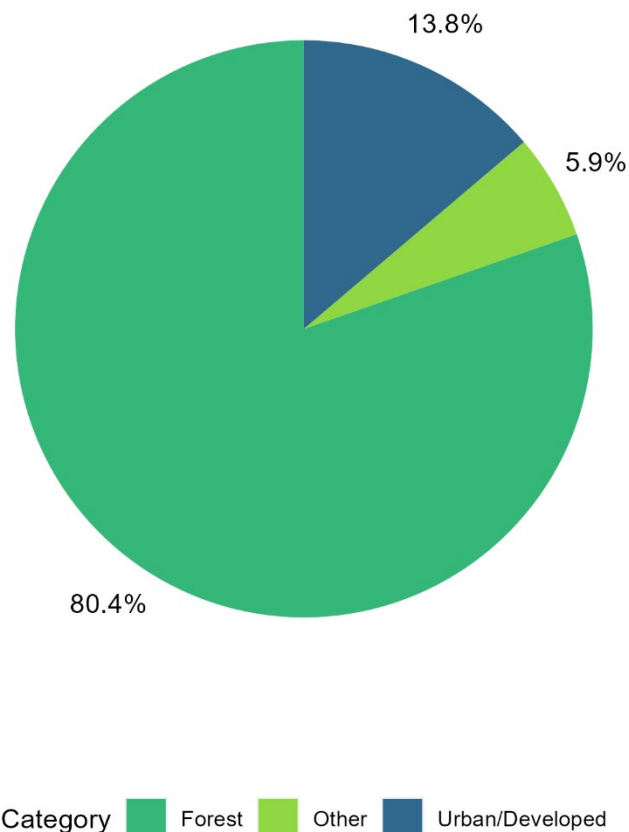
Land cover categories observed in the watershed of this sampling station are illustrated in Figure D-2 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1103.59 acres [80.4%]),
- Urban/Developed (188.9 acres [13.8%]),
- Grassland/Shrubs (53.18 acres [3.9%]),
- Wetlands (27 acres [2%]),
- Open Water (0.03 acres [0%]),
- Agriculture (0 acres [0%]), and
- Barren (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Mendocino County: Caspar Beach at Caspar Creek



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

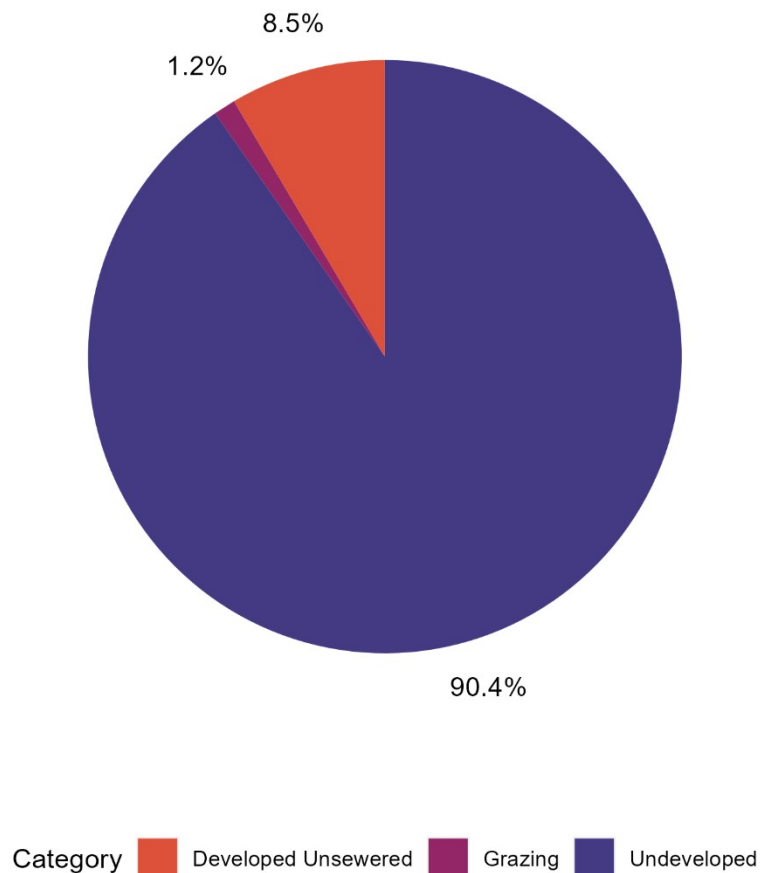
**Figure D-2 Percentage coverage by land cover category in the Caspar Beach at Caspar Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure D-3 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (1241.32 acres [90.4%]),
- Developed Unsewered (116.27 acres [8.5%]),
- Grazing (16.01 acres [1.2%]), and
- Developed Sewered (0 acres [0%]).

## Land Use

Mendocino County: Caspar Beach at Caspar Creek



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure D-3 Percentage coverage by land use category in the Caspar Beach at Caspar Creek watershed**

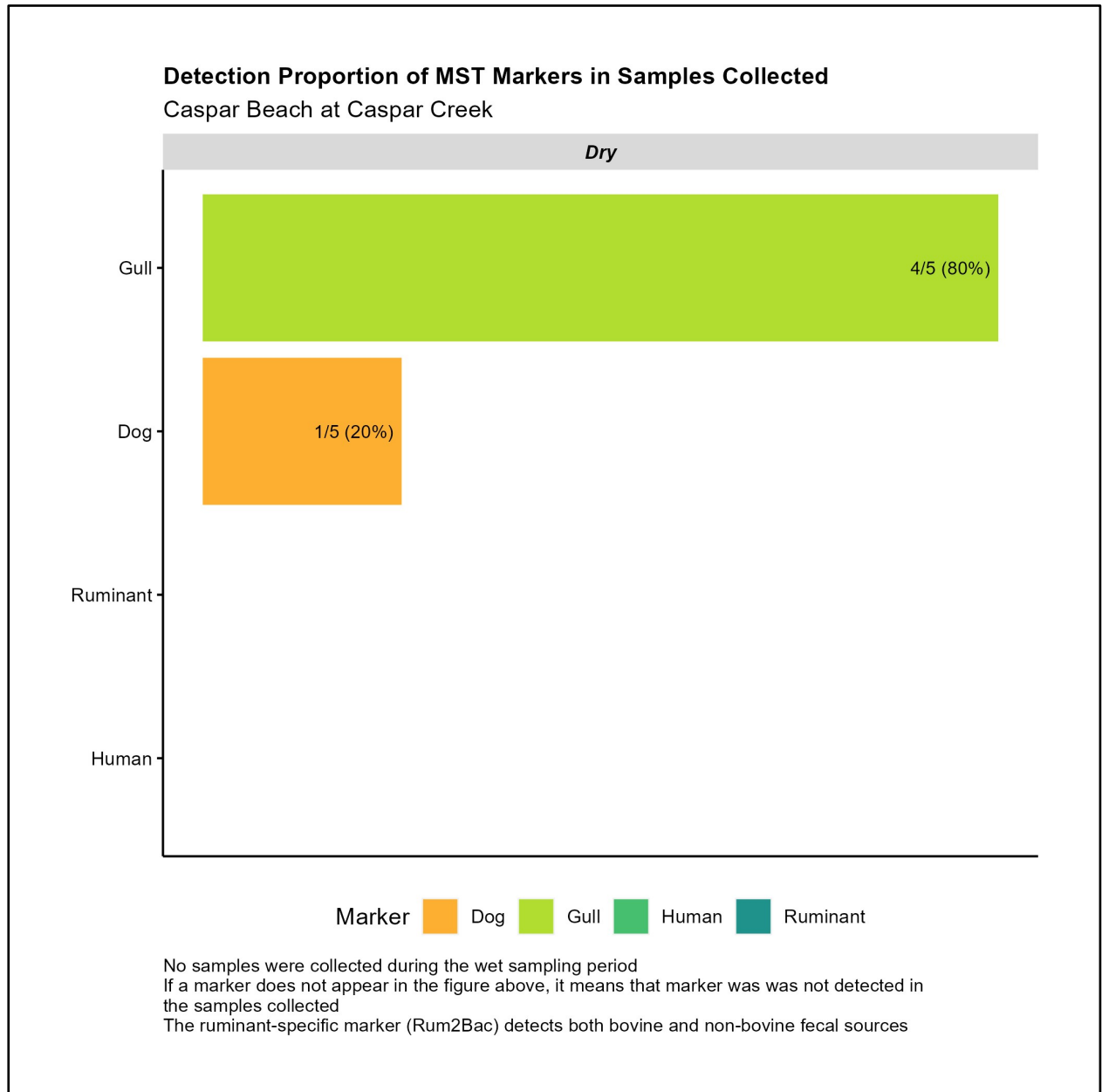
Five samples were collected from this sampling station. All five samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure D-4 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (4/5 [80%]),
- Dog (1/5 [20%]),

- Human (0/5 [0%]), and
- Ruminant (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure D-4 Detection percentage of species-specific markers evaluated in samples collected from the Caspar Beach at Caspar Creek station**



**Hare Beach at Hare Creek (113HC0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (16/178), and
- STV threshold (7/50).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (1118/6690), and
- 10% threshold (1107/6690).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure D-5 below illustrates the land cover and land use in the watershed of this sampling station.

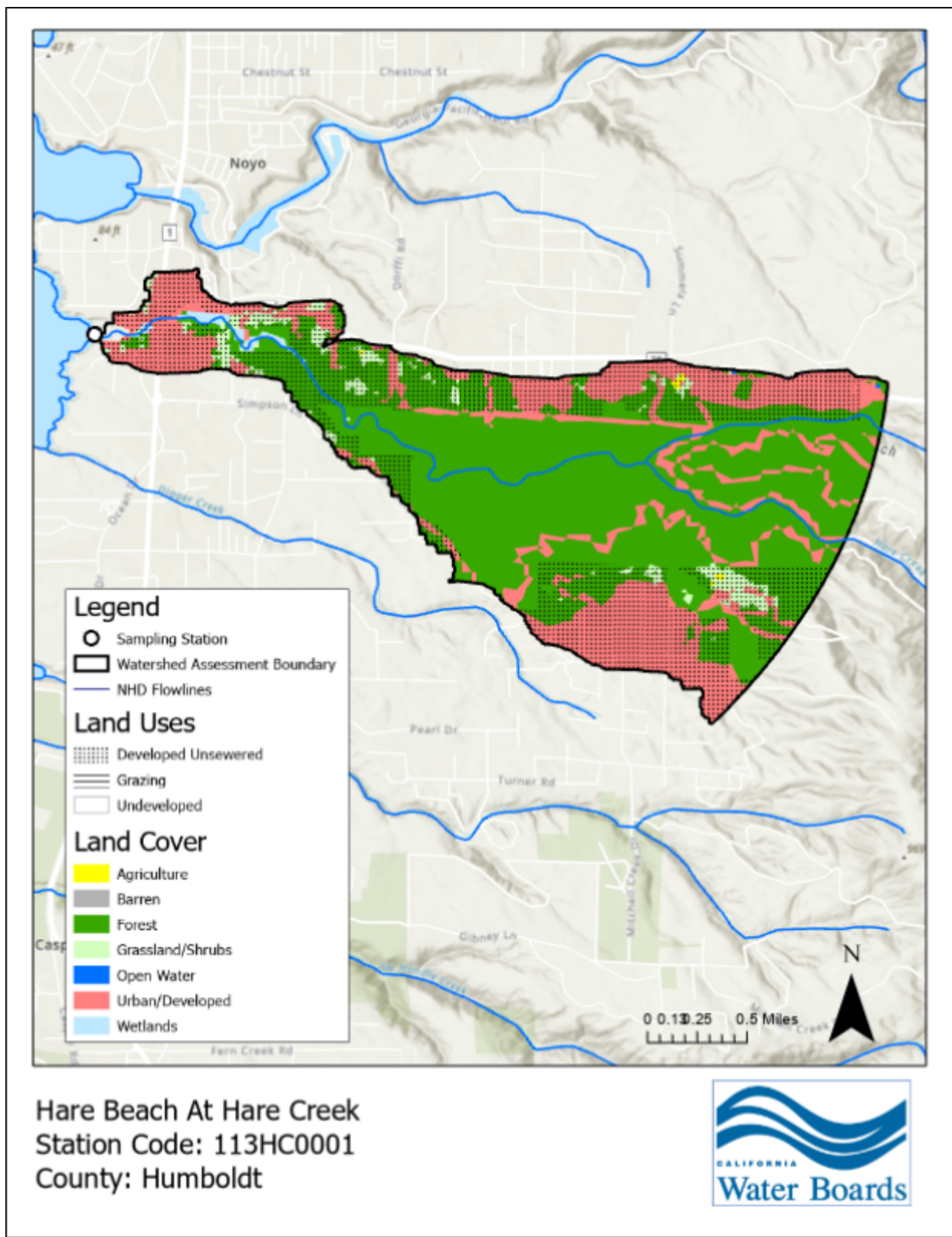


Figure D-5 Land cover and land use in the Hare Beach at Hare Creek watershed

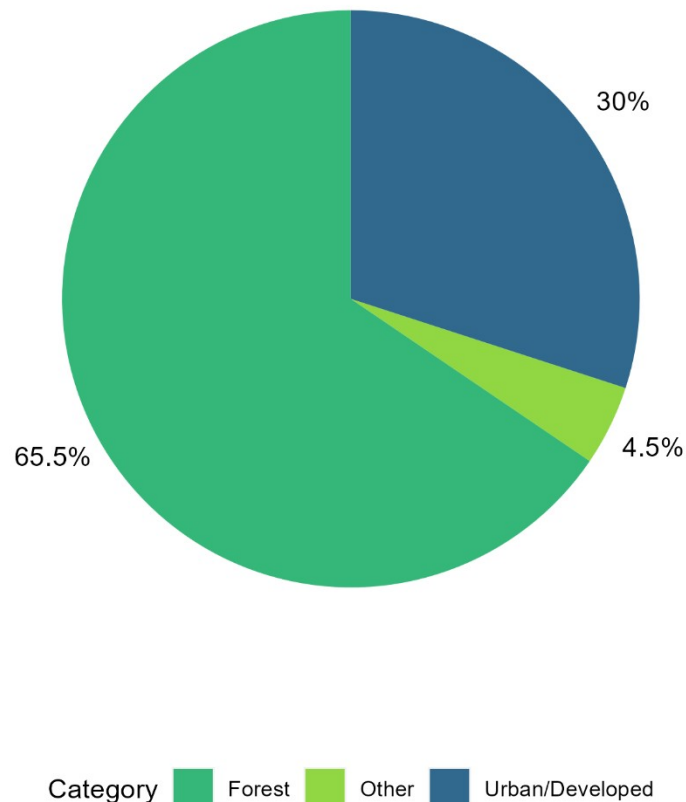
Land cover categories observed in the watershed of this sampling station are illustrated in Figure D-6 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1223.49 acres [65.5%]),
- Urban/Developed (560.27 acres [30%]),
- Grassland/Shrubs (68.69 acres [3.7%]),
- Wetlands (12.77 acres [0.7%]),
- Agriculture (2.36 acres [0.1%]),
- Open Water (0.43 acres [0%]), and
- Barren (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Mendocino County: Hare Beach at Hare Creek



If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

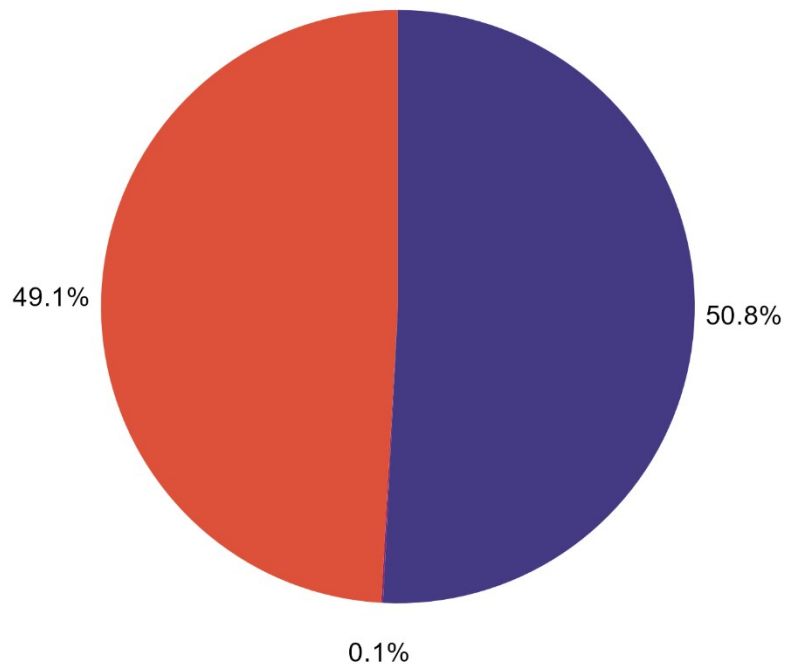
**Figure D-6 Percentage coverage by land cover category in the Hare Beach at Hare Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure D-7 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (986.21 acres [50.8%]),
- Developed Unsewered (954.42 acres [49.1%]),
- Grazing (1.93 acres [0.1%]), and
- Developed Sewered (0 acres [0%]).

## Land Use

Mendocino County: Hare Beach at Hare Creek



Category ■ Developed Unsewered ■ Grazing ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure D-7 Percentage coverage by land use category in the Hare Beach at Hare Creek watershed**

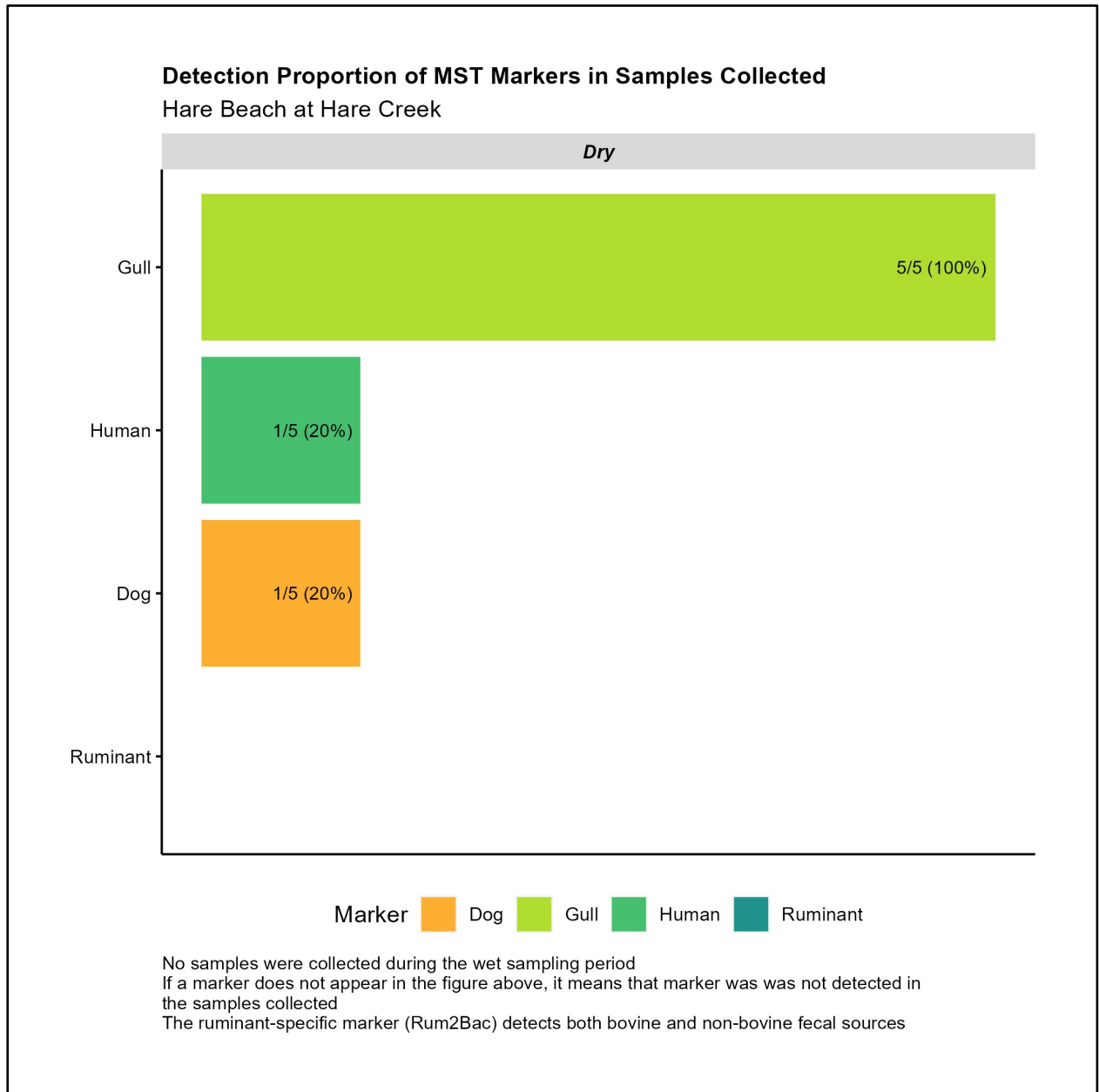
Five samples were collected from this sampling station. All five samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure D-8 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/5 [100%]),
- Dog (1/5 [20%]),

- Human (1/5 [20%]), and
- Ruminant (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure D-8 Detection percentage of species-specific markers evaluated in samples collected from the Hare Beach at Hare Creek station**

**MacKerricher State Park at Virgin Creek (113VR0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

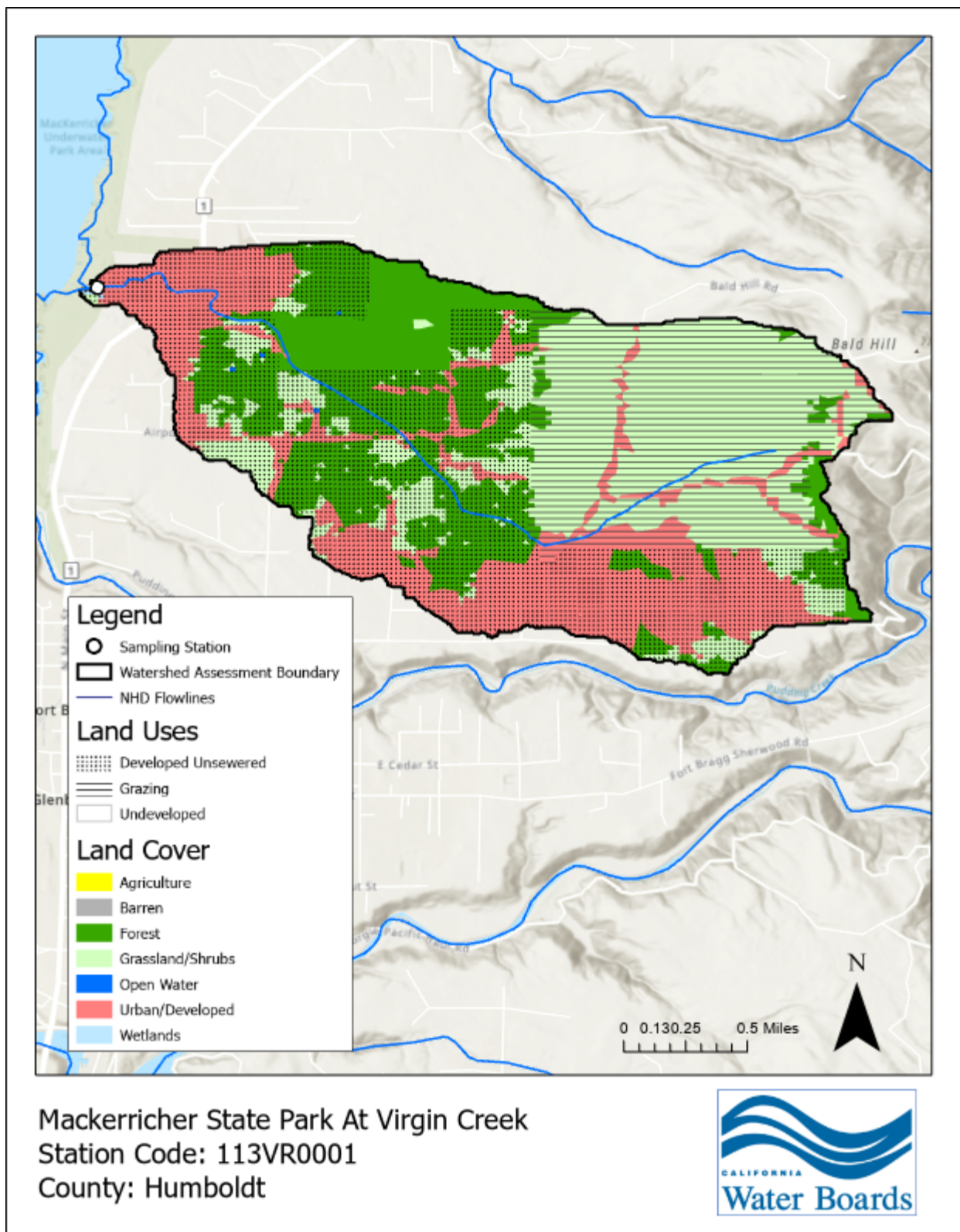
- GM threshold (0/89), and
- STV threshold (0/33).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (332/3690), and
- 10% threshold (317/3690).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure D-9 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure D-9 Land cover and land use in the MacKerricher State Park at Virgin Creek watershed**



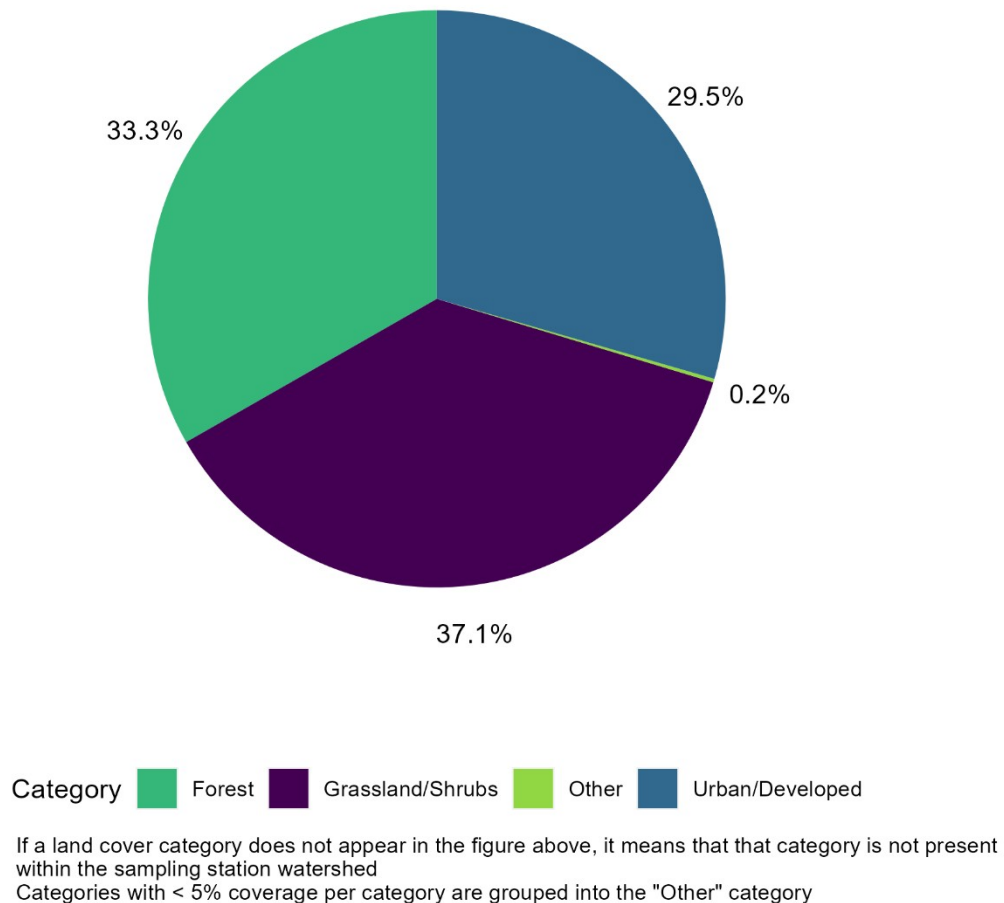
Land cover categories observed in the watershed of this sampling station are illustrated in Figure D-10 below. Specifically, the coverage of land cover categories in this watershed are:

- Grassland/Shrubs (638.13 acres [37.1%]),
- Forest (572.97 acres [33.3%]),
- Urban/Developed (506.72 acres [29.5%]),
- Wetlands (1.09 acres [0.1%]),
- Open Water (1.07 acres [0.1%]),
- Agriculture (0 acres [0%]), and
- Barren (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Mendocino County: MacKerricher State Park at Virgin Creek



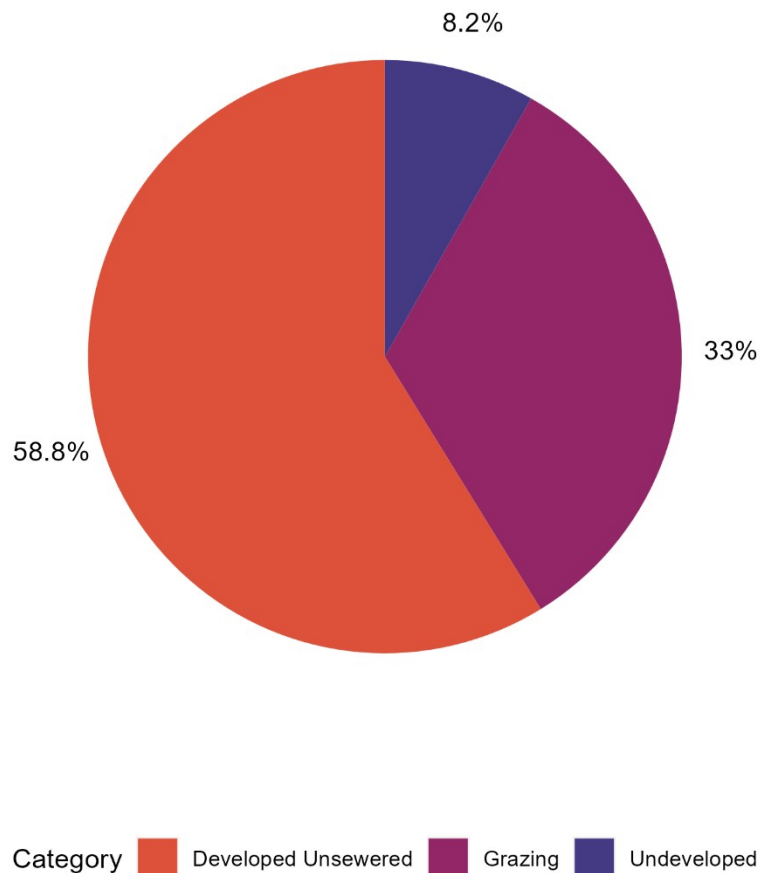
**Figure D-10 Percentage coverage by land cover category in the MacKerricher State Park at Virgin Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure D-11 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Unsewered (994.72 acres [58.8%]),
- Grazing (558.17 acres [33%]),
- Undeveloped (138.35 acres [8.2%]), and
- Developed Sewered (0 acres [0%]).
- Non-dairy cattle grazing is present in this sampling station watershed.

## Land Use

Mendocino County: MacKerricher State Park at Virgin Creek



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure D-11 Percentage coverage by land use category in the MacKerricher State Park at Virgin Creek watershed**

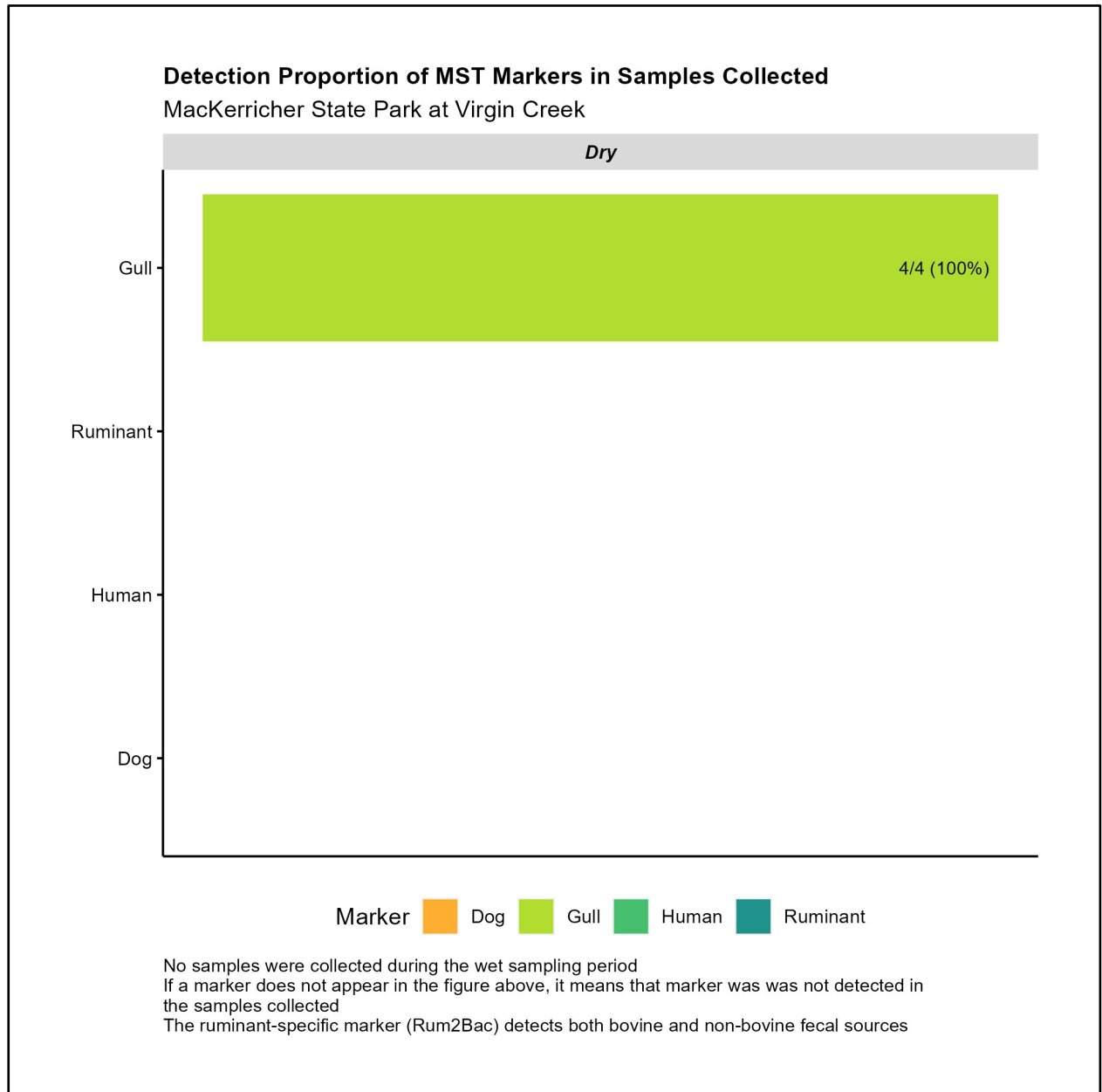
Four samples were collected from this sampling station. All four samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure D-12 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (4/4 [100%]),
- Dog (0/4 [0%]),

- Human (0/4 [0%]), and
- Ruminant (0/4 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure D-12 Detection percentage of species-specific markers evaluated in samples collected from the MacKerricher State Park at Virgin Creek station**

**Mendocino Bay at Big River (113BI0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

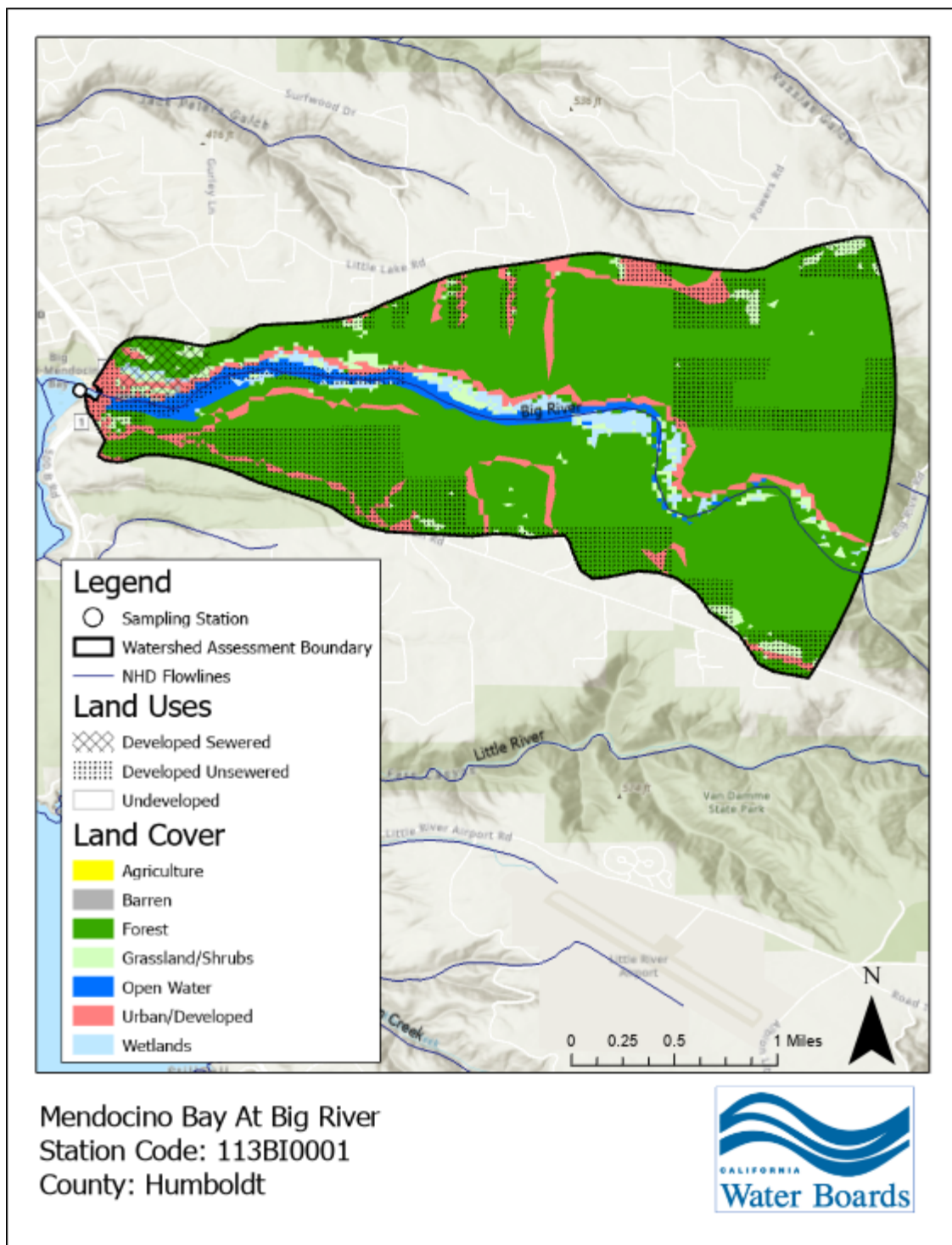
- GM threshold (0/181), and
- STV threshold (1/50).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (235/6720), and
- 10% threshold (425/6720).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure D-13 below illustrates the land cover and land use in the watershed of this sampling station.



**Figure D-13 Land cover and land use in the Mendocino Bay at Big River watershed**

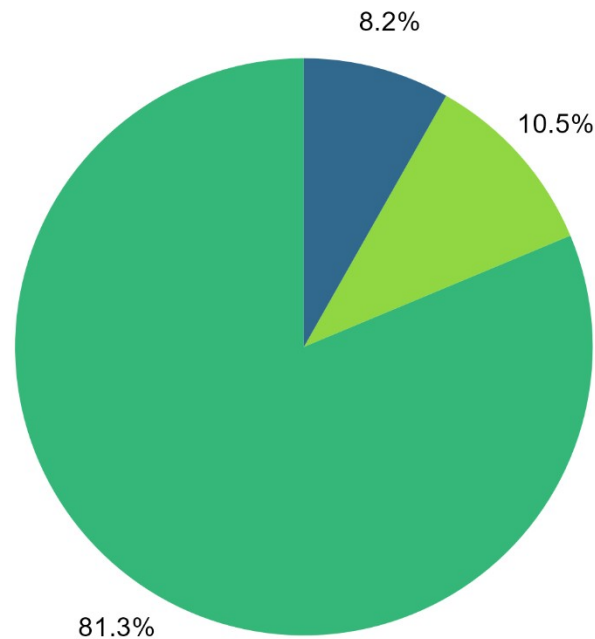
Land cover categories observed in the watershed of this sampling station are illustrated in Figure D-14 below. Specifically, the coverage of land cover categories in this watershed are:

- Forest (1922.44 acres [81.3%]),
- Urban/Developed (194.65 acres [8.2%]),
- Grassland/Shrubs (94.21 acres [4%]),
- Open Water (92.43 acres [3.9%]),
- Wetlands (58.01 acres [2.5%]),
- Barren (2.71 acres [0.1%]), and
- Agriculture (0 acres [0%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Mendocino County: Mendocino Bay at Big River



Category ■ Forest ■ Other ■ Urban/Developed

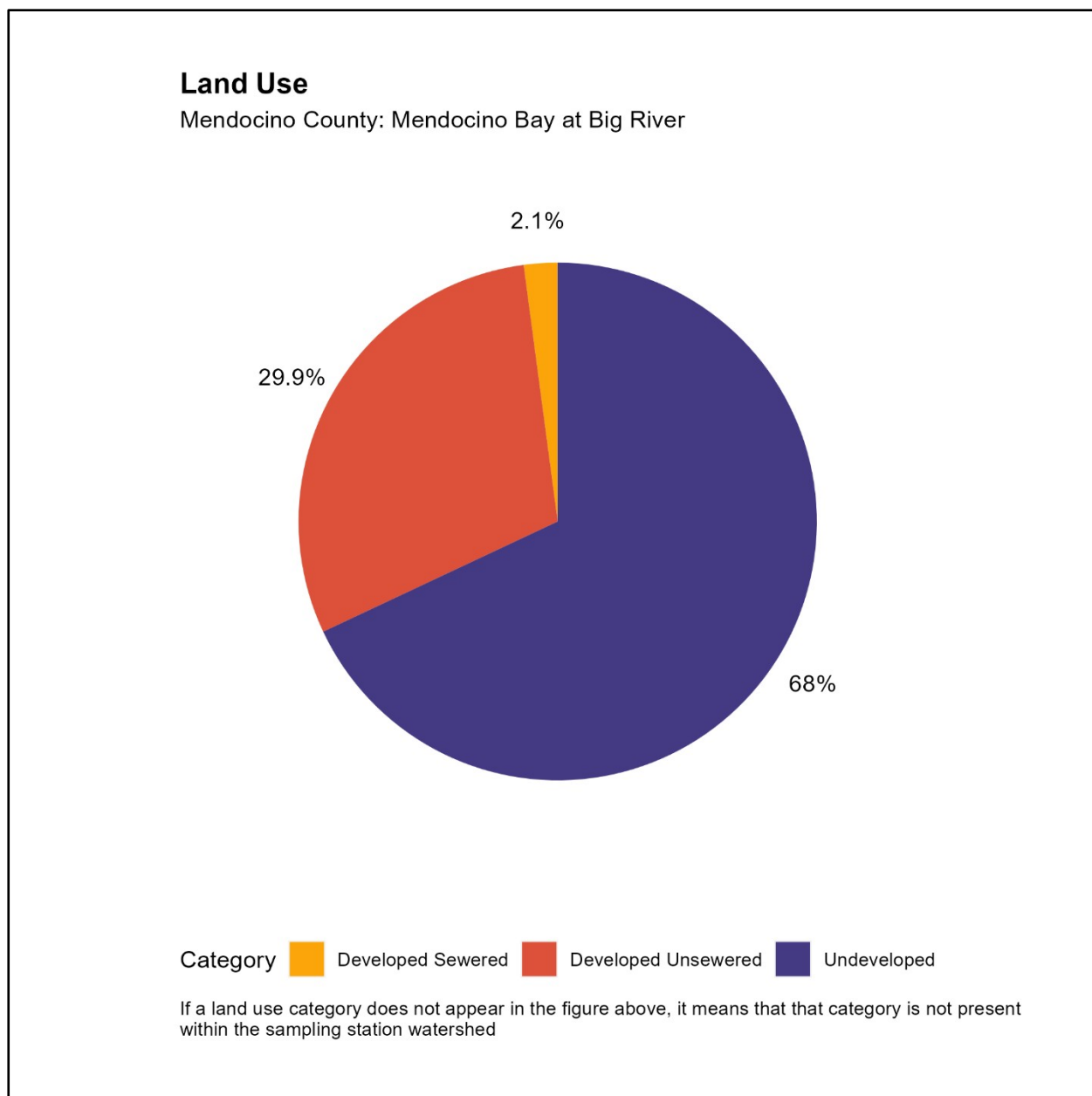
If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

**Figure D-14 Percentage coverage by land cover category in the Mendocino Bay at Big River watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure D-15 below. Specifically, the coverage of land use categories in this watershed are:

- Undeveloped (1571.19 acres [68%]),
- Developed Unsewered (691.66 acres [29.9%]),
- Developed Sewered (47.65 acres [2.1%]), and
- Grazing (0 acres [0%]).





**Figure D-15 Percentage coverage by land use category in the Mendocino Bay at Big River watershed**

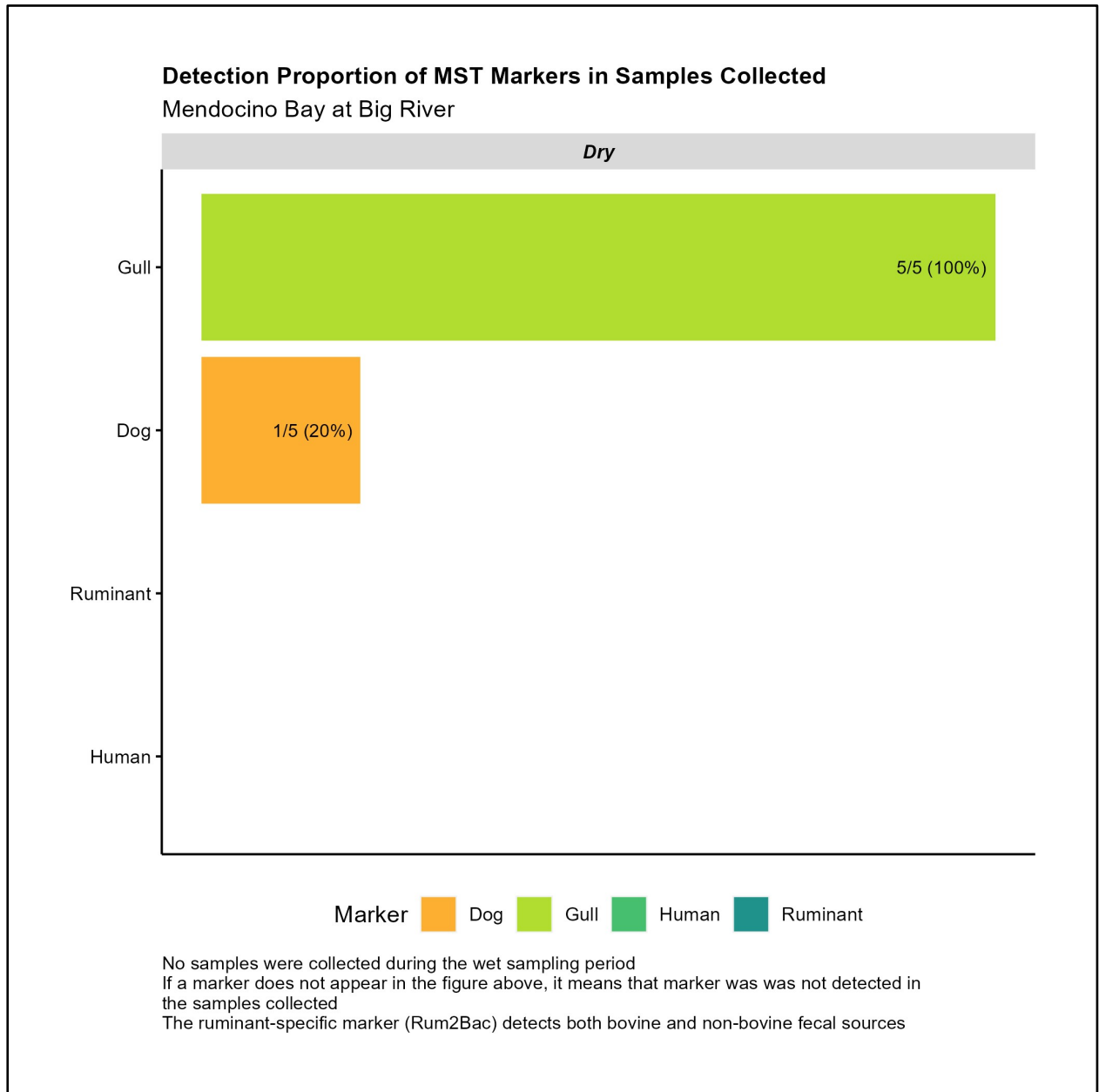
Five samples were collected from this sampling station. All five samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure D-16 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/5 [100%]),
- Dog (1/5 [20%]),

- Human (0/5 [0%]), and
- Ruminant (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure D-16 Detection percentage of species-specific markers evaluated in samples collected from the Mendocino Bay at Big River station**

**Pudding Beach at Pudding Creek (113PD0001):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of SHELL beneficial use. It is not impaired for REC-1 beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (8/182), and
- STV threshold (5/50).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (471/6750), and
- 10% threshold (800/6750).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31, which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure D-17 below illustrates the land cover and land use in the watershed of this sampling station.

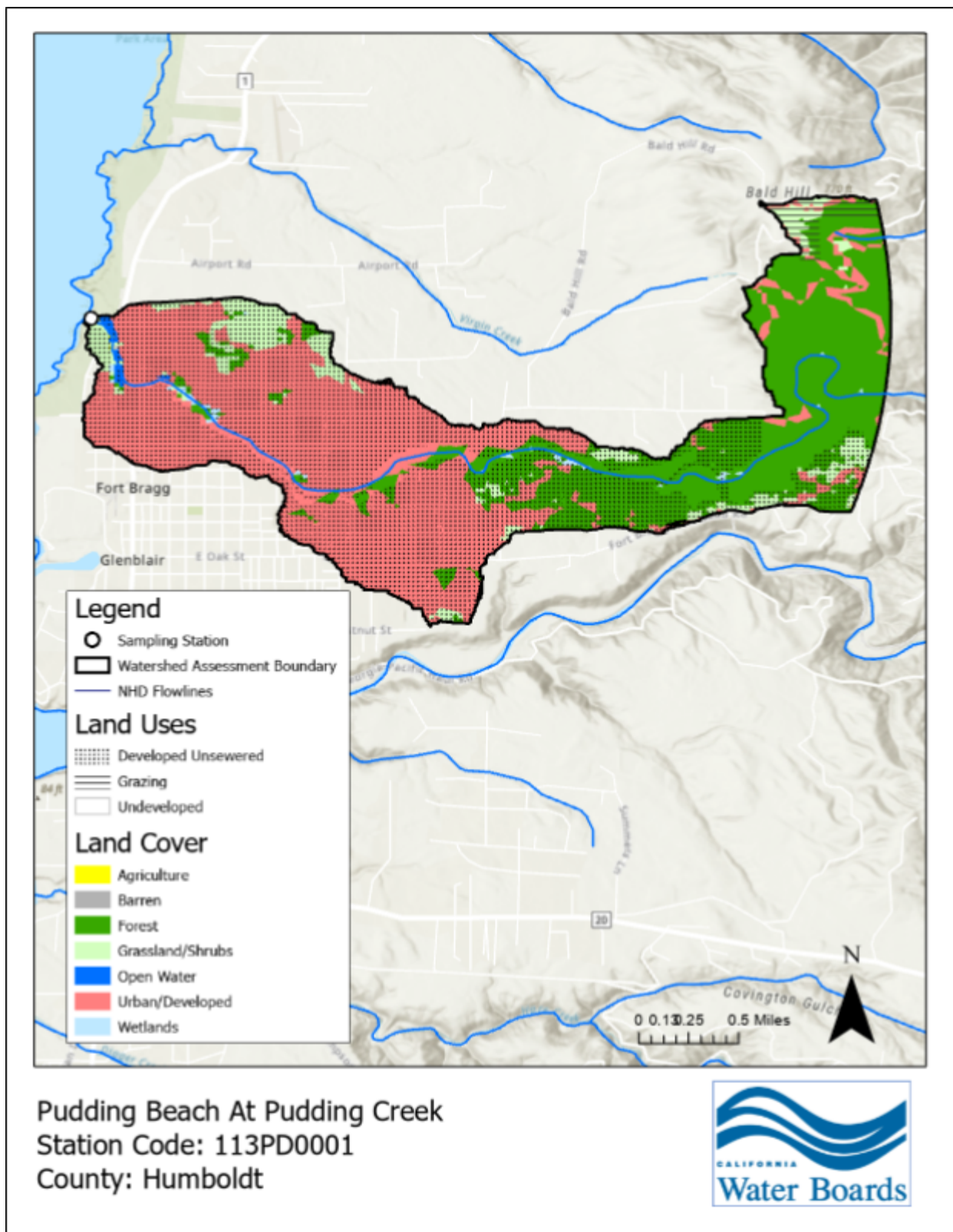


Figure D-17 Land cover and land use in the Pudding Beach at Pudding Creek watershed

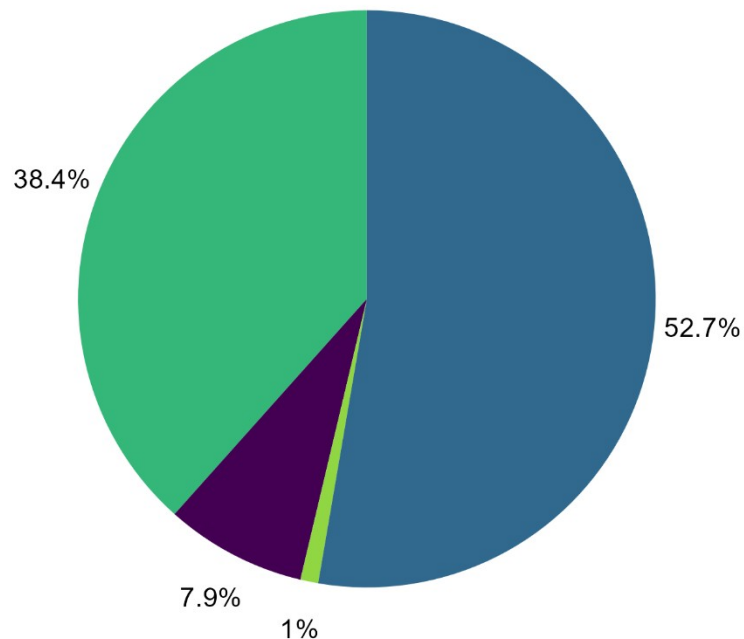
Land cover categories observed in the watershed of this sampling station are illustrated in Figure D-18 below. Specifically, the coverage of land cover categories in this watershed are:

- Urban/Developed (886.59 acres [52.7%]),
- Forest (644.68 acres [38.4%]),
- Grassland/Shrubs (132.53 acres [7.9%]),
- Agriculture (0.52 acres [0%]),
- Barren (0.23 acres [0%]), and
- Open Water (7.1 acres [0.4%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

### Land Cover

Mendocino County: Pudding Beach at Pudding Creek



Category ■ Forest ■ Grassland/Shrubs ■ Other ■ Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

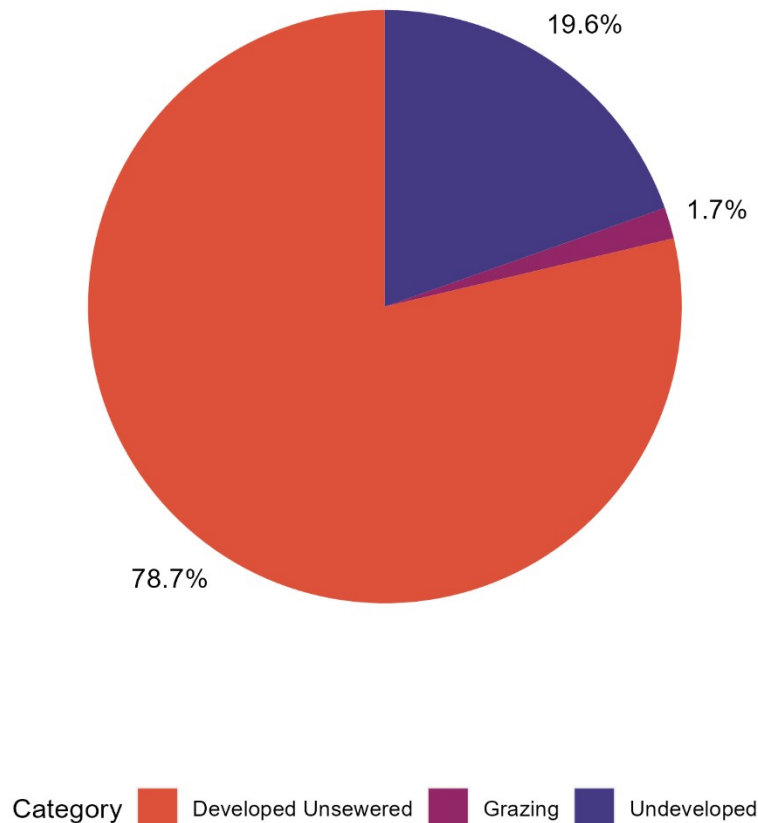
**Figure D-18 Percentage coverage by land cover category in the Pudding Beach at Pudding Creek watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure D-19 below. Specifically, the coverage of land use categories in this watershed are:

- Developed Unsewered (1858.63 acres [78.7%]),
- Undeveloped (462.89 acres [19.6%]),
- Grazing (40.42 acres [1.7%]), and
- Developed Sewered (0 acres [0%]).

## Land Use

Mendocino County: Pudding Beach at Pudding Creek



If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure D-19 Percentage coverage by land use category in the Pudding Beach at Pudding Creek watershed**

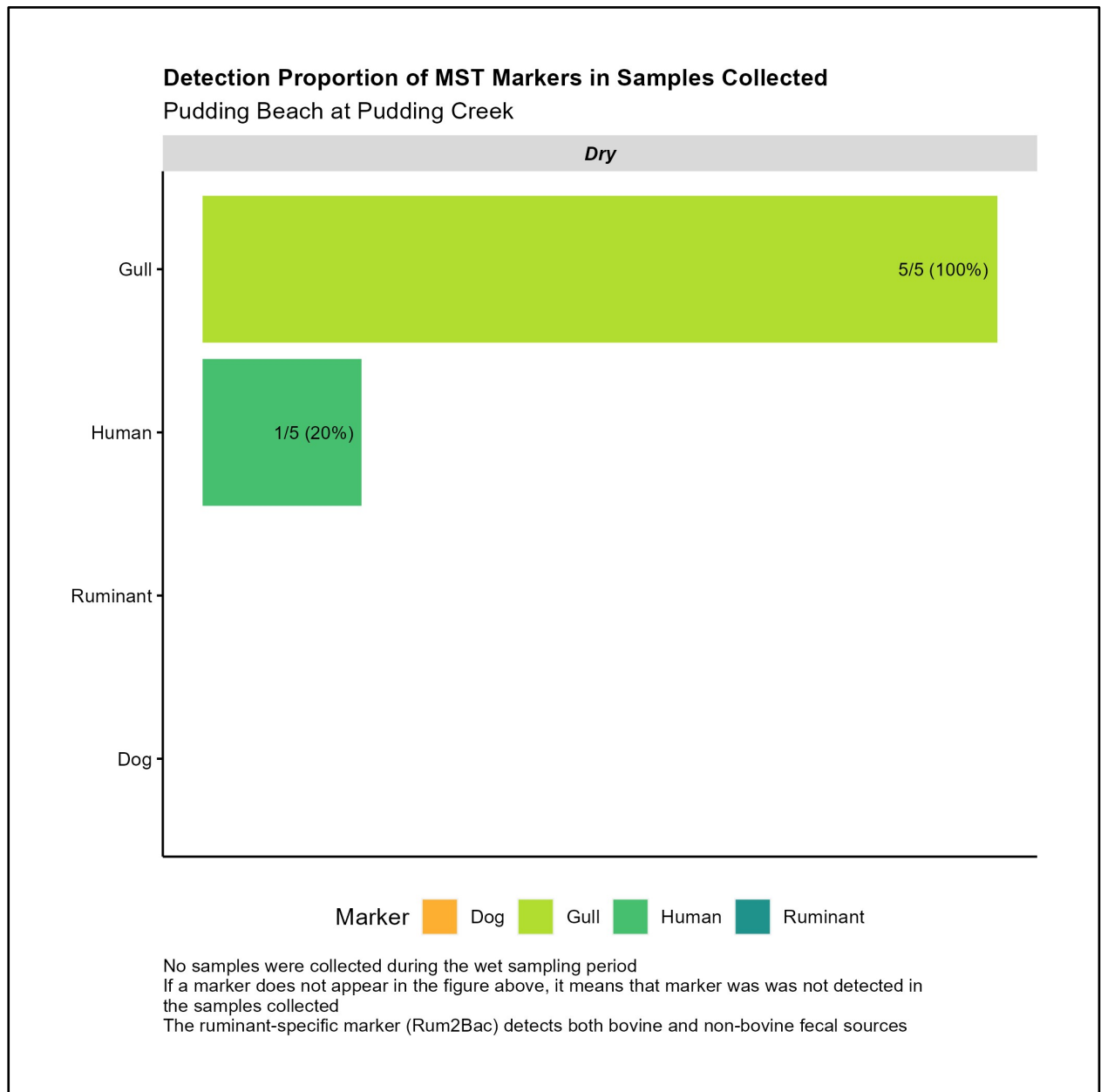
Five samples were collected from this sampling station. All five samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure D-20 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (5/5 [100%]),
- Human (1/5 [20%]),

- Dog (0/5 [0%]), and
- Ruminant (0/5 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure D-20 Detection percentage of species-specific markers evaluated in samples collected from the Pudding Beach at Pudding Creek station**



## **Appendix E – Land Cover and Land Use Coverage, and Species-Specific Marker Detection in the Sonoma County Ocean Beach**

Results of the assessment of land cover, land use, and MST data collected from the sampling station at the only Sonoma County ocean beach sampled are detailed below. In addition, any exceedances of the REC-1 and SHELL Objectives at these sampling stations are also included.

### **Campbell Cove at Bodega Bay (115BBCCB1):**

This station was sampled as part of the Ocean Beaches Monitoring Study of the Coastal Pathogen Project.

This sampling station is currently listed on the Section 303(d) List for impairment of REC-1 beneficial use as well as SHELL beneficial use. Enterococcus data collected from this sampling station under the Coastal Pathogen Project was compared to the enterococcus-based, REC-1 WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018), and the following number of exceedances/number of calculations were detected for the Summer assessment period:

- GM threshold (10/170), and
- STV threshold (7/49).

A comparison of total coliform data collected from this sampling station to the total coliform-based, SHELL WQO Water Quality Objectives for Ocean Waters) (North Coast Regional Water Quality Control Board, 2018) indicates the following number of exceedances/number of calculations of the for the Summer assessment period:

- Median threshold (171/6240), and
- 10% threshold (321/6240).

Year-round, and Winter assessment period evaluations of the REC-1 and SHELL WQOs cannot be conducted since ocean beaches are only sampled from April 1 through October 31 which exclusively covers the Summer assessment period. Further details about the REC-1 and SHELL WQO, and the exceedance calculations can be found in the technical report entitled “Assessment of Fecal Indicator Bacteria Data from 19 North Coast Ocean Beaches (North Coast Regional Water Quality Control Board, 2023b).

Figure E-1 below illustrates the land cover and land use in the watershed of this sampling station.

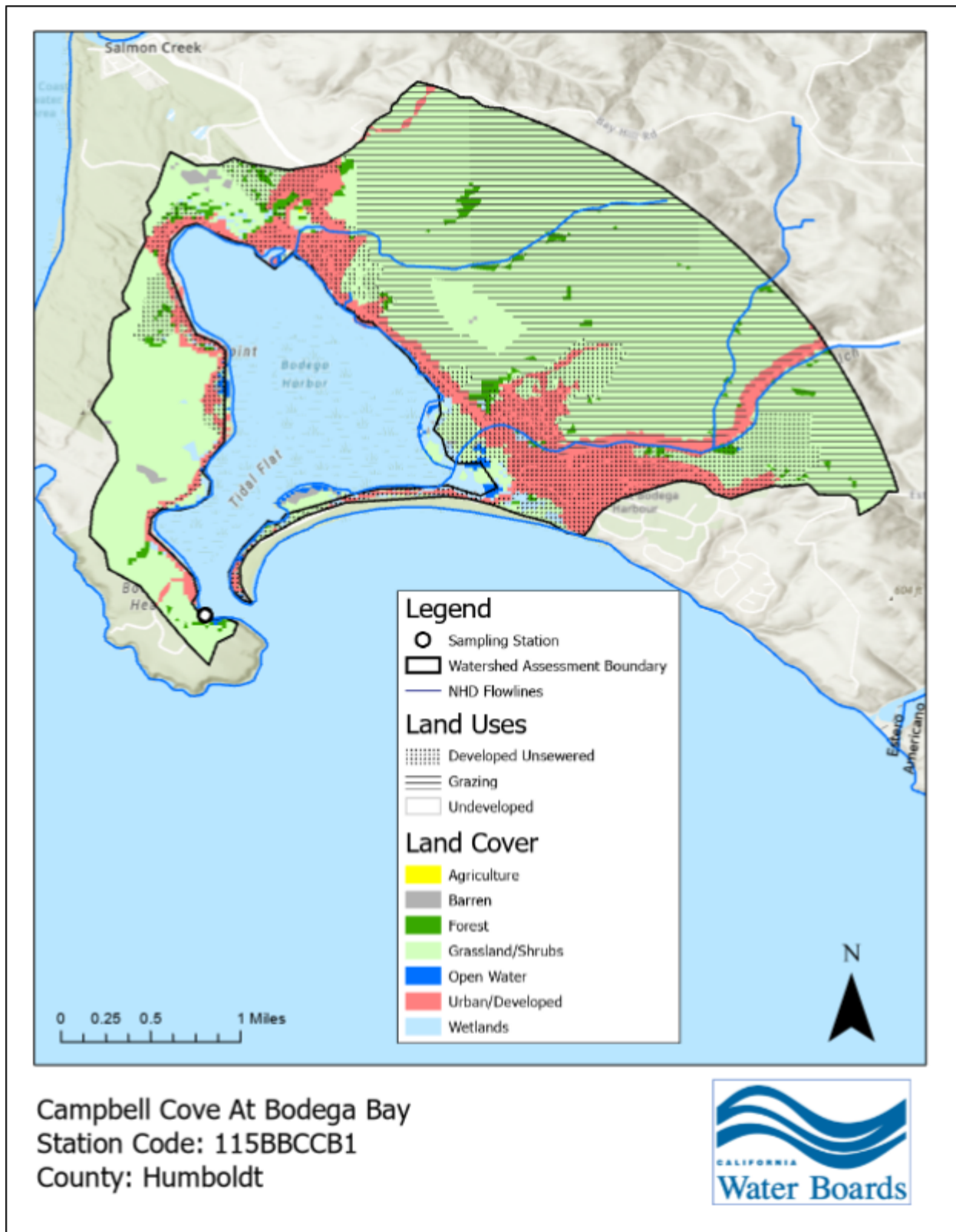


Figure E-1 Land cover and land use in the Campbell Cove at Bodega Bay watershed

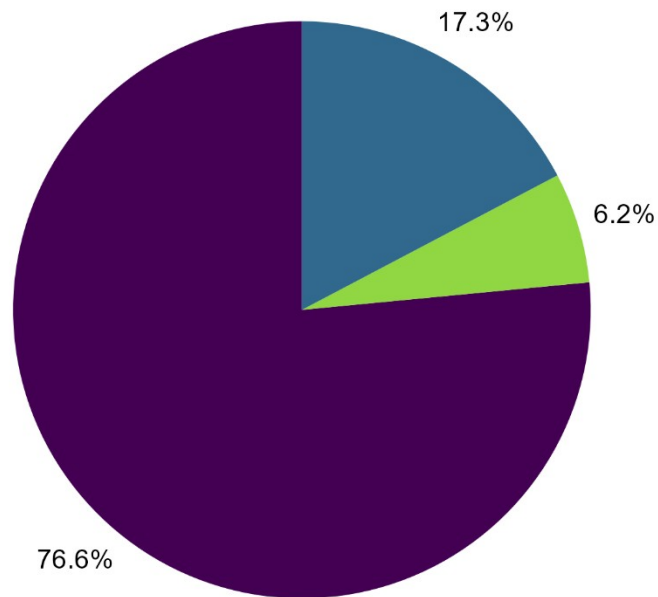
Land cover categories observed in the watershed of this sampling station are illustrated in Figure E-2 below. Specifically, the coverage of land cover categories in this watershed are:

- Grassland/Shrubs (2433.35 acres [76.6%]),
- Urban/Developed (548.63 acres [17.3%]),
- Forest (82.72 acres [2.6%]),
- Wetlands (65.37 acres [2.1%]),
- Agriculture (0.22 acres [0%]),
- Barren (23.8 acres [0.8%]), and
- Open Water (21.06 acres [0.7%]).

In the figure below any categories with coverage of less than 5% have been grouped into the “Other” category.

## Land Cover

Sonoma County: Campbell Cove at Bodega Bay



Category  Grassland/Shrubs  Other  Urban/Developed

If a land cover category does not appear in the figure above, it means that that category is not present within the sampling station watershed  
Categories with < 5% coverage per category are grouped into the "Other" category

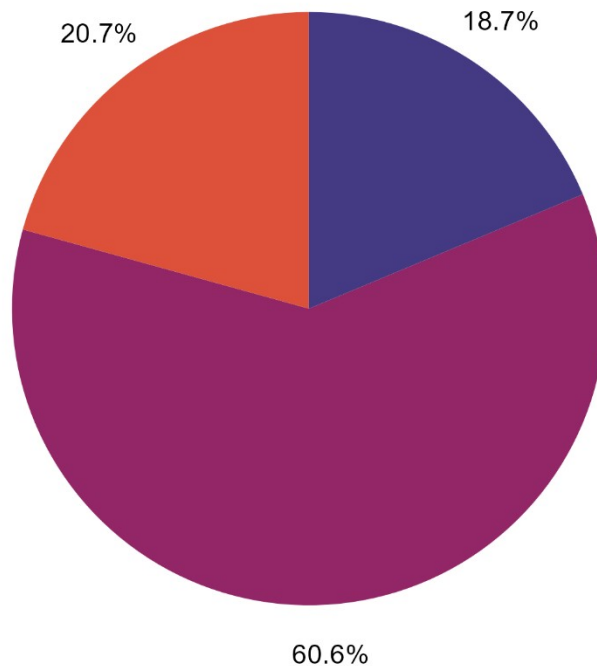
**Figure E-2 Percentage coverage by land cover category in the Campbell Cove at Bodega Bay watershed**

Land use categories observed in the watershed of this sampling station are illustrated in Figure E-3 below. Specifically, the coverage of land use categories in this watershed are:

- Grazing (2059.56 acres [60.6%]),
- Developed Unsewered (701.76 acres [20.7%]),
- Undeveloped (636.06 acres [18.7%]), and
- Developed Sewered (0 acres [0%]).
- Non-dairy cattle grazing is present in this sampling station watershed.

## Land Use

Sonoma County: Campbell Cove at Bodega Bay



Category ■ Developed Unsewered ■ Grazing ■ Undeveloped

If a land use category does not appear in the figure above, it means that that category is not present within the sampling station watershed

**Figure E-3 Percentage coverage by land use category in the Campbell Cove at Bodega Bay watershed**

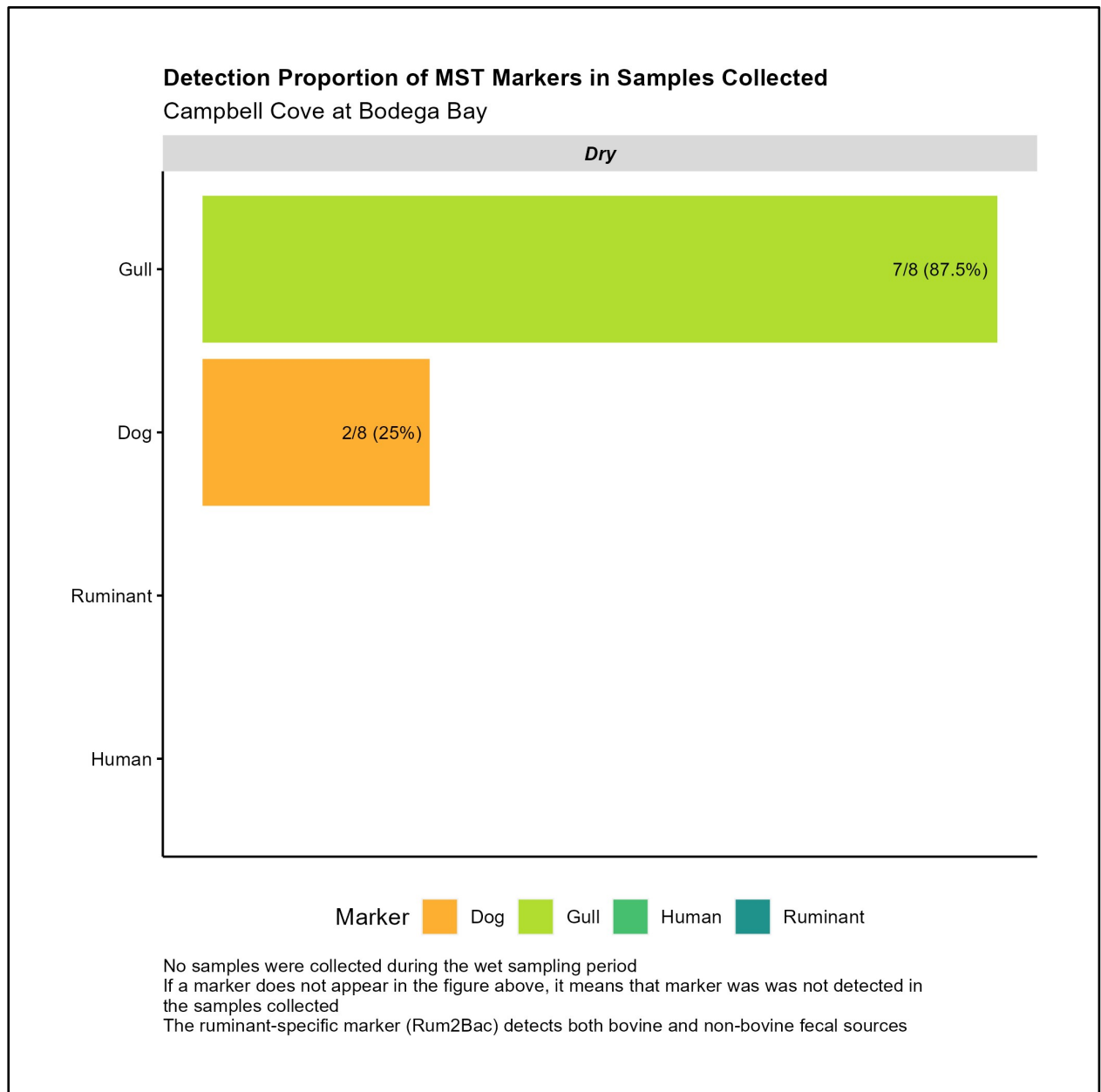
Eight samples were collected from this sampling station. All eight samples were collected in the dry sampling period. The detection percentage of MST markers in samples collected from the dry sampling period from this sampling station are illustrated in Figure E-4 below.

Specifically, the marker detection percentage in the dry sampling period were:

- Gull (7/8 [87.5%]),
- Dog (2/8 [25%]),

- Human (0/8 [0%]), and
- Ruminant (0/8 [0%]).

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure E-4 Detection percentage of species-specific markers evaluated in samples collected from the Campbell Cove at Bodega Bay station**

## **Appendix F – Humboldt Waterkeeper Little River, Janes Creek, and McDaniel Slough Microbial Source Tracking Data**

A summary of the analysis of Microbial Source Tracking (MST) data collected by the Humboldt Waterkeeper organization from sampling stations in Little River (four stations), Janes Creek (one station), and McDaniel Slough (four stations) in 2016 is provided below. Land cover and land use assessment for these stations has not been conducted since these data were received after the major data assessment effort for this report was complete. However, land cover and land use assessment has been conducted for other stations sampled along Little River and McDaniel Slough.

### **Sample Collection and Laboratory Analysis**

Water grab samples were collected by the Humboldt Waterkeeper organization from March 2016 to October 2016 from four sampling stations in Little River, one sampling station in Janes Creek, and four sampling stations in McDaniel Slough. A Quality Assurance Project Plan (QAPP) for this study was not available at the time of assessment. However, the samples collected under the Humboldt County APMP Study were analyzed by the Humboldt County Public Health Laboratory using the same procedures detailed in the Coastal Pathogen Project QAPP, and the MST data collected under the Humboldt Waterkeeper Study are being used solely for source identification. Suspected sources of fecal pollution influencing each sampling station were noted during sampling. The sampling period during sampling was not noted, and was determined by Regional Water Board staff using historical precipitation data for the Eureka Woodley Island precipitation station (California Department of Water Resources, 2023a), and the definitions of wet and dry period as described in Section 2.1 of this report. The samples were analyzed for the presence and concentration of dog-, gull-, human-, and ruminant-specific markers by the Humboldt County Public Health Laboratory. Table F1 describes the sample collection details including suspected upstream sources of fecal pollution. The sampling stations are listed from upstream to downstream locations.

**Table F- 1 Sample Collection Details for the Humboldt Waterkeeper Study**

<b>Station Name</b>	<b>Sampling Period</b>	<b>Number of Samples Collected</b>	<b>Suspected Upstream Sources</b>	<b>Endpoint</b>
Little River at Crannel Road	Dry	2	Agricultural, Residential	Pacific Ocean
Little River at Crannel Road	Wet	2	Agricultural, Residential	Pacific Ocean

<b>Station Name</b>	<b>Sampling Period</b>	<b>Number of Samples Collected</b>	<b>Suspected Upstream Sources</b>	<b>Endpoint</b>
Little River at Highway 101	Dry	2	Agricultural, Residential	Pacific Ocean
Little River at Highway 101	Wet	2	Agricultural, Residential	Pacific Ocean
Little River Tributary at Highway 101	Dry	2	Residential, Septic	Pacific Ocean
Little River Tributary at Highway 101	Wet	2	Residential, Septic	Pacific Ocean
Little River upstream from Green Diamond nursery	Dry	2	Forest	Pacific Ocean
Little River upstream from Green Diamond nursery	Wet	2	Forest	Pacific Ocean
Janes Creek at Arcata Community at Forest Trail 12	Dry	2	Forest	Humboldt Bay
Janes Creek at Arcata Community at Forest Trail 12	Wet	2	Forest	Humboldt Bay
McDaniel Slough at Foster Avenue and Heather Lane	Dry	2	Transient camp, Residential	Humboldt Bay
McDaniel Slough at Foster Avenue and Heather Lane	Wet	2	Transient camp, Residential	Humboldt Bay



Station Name	Sampling Period	Number of Samples Collected	Suspected Upstream Sources	Endpoint
McDaniel Slough at Highway 101	Dry	2	Industrial	Humboldt Bay
McDaniel Slough at Highway 101	Wet	2	Industrial	Humboldt Bay
McDaniel Slough at Hilfiker Drive	Dry	2	Residential	Humboldt Bay
McDaniel Slough at Hilfiker Drive	Wet	2	Residential	Humboldt Bay
McDaniel Slough at Samoa Boulevard	Dry	2	Transient camp, Residential	Humboldt Bay
McDaniel Slough at Samoa Boulevard	Wet	2	Transient camp, Residential	Humboldt Bay

## Data Analysis and Results

MST data for each sampling station were analyzed by the Regional Water Board staff using methods described in Section 2.3 of this report.

### Little River upstream of Green Diamond nursery

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are forested areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below.

The marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%])
- Gull (0/2 [0%])
- Human (0/2 [0%]), and

- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (0/2 [0%])
- Gull (0/2 [0%])
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%])

None of the four species-specific markers were detected in any of the samples collected from this sampling station either in the dry, or wet, sampling period. Therefore, a figure for this sampling station was not prepared.

### **Little River along Crannel Road**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are agricultural and residential areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-1.

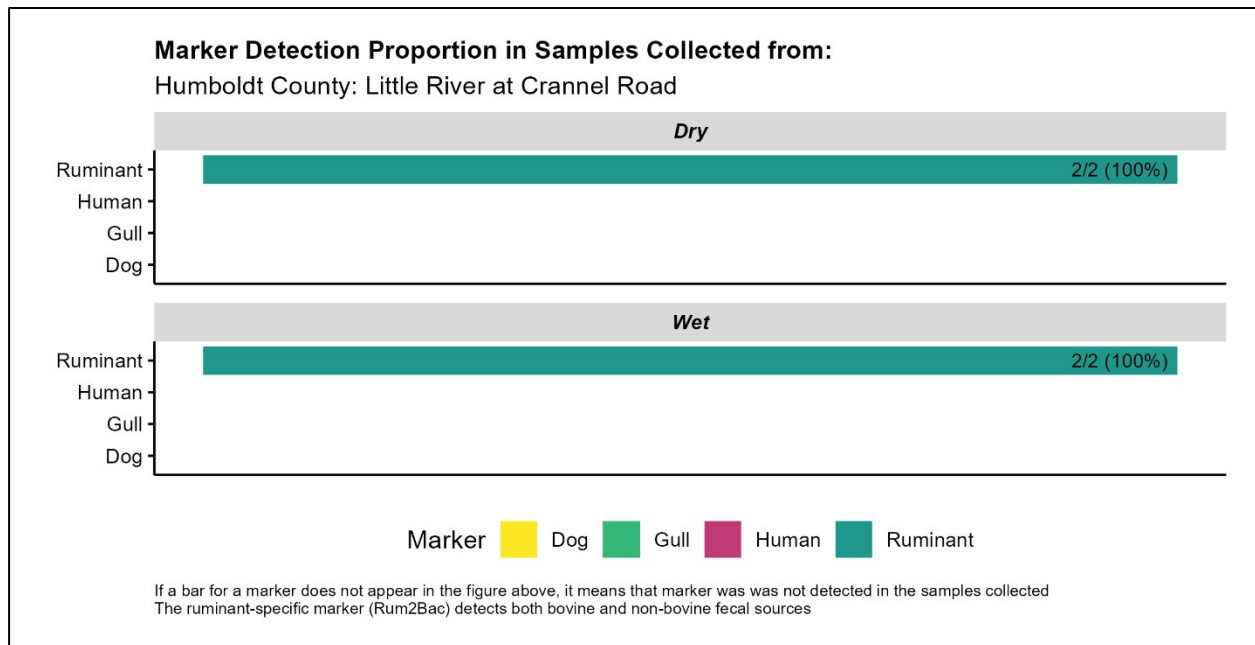
The marker detection percentage in the dry sampling period were:

- Ruminant (2/2 [100%])
- Dog (0/2 [0%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%])
- Dog (0/2 [%])
- Gull (0/2 [%]), and
- Human (0/2 [%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-1 Detection percentage of MST markers evaluated in samples collected from the Little River along Crannel Road station**

#### Little River at Hwy 101 bridge

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are agricultural and residential areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-2.

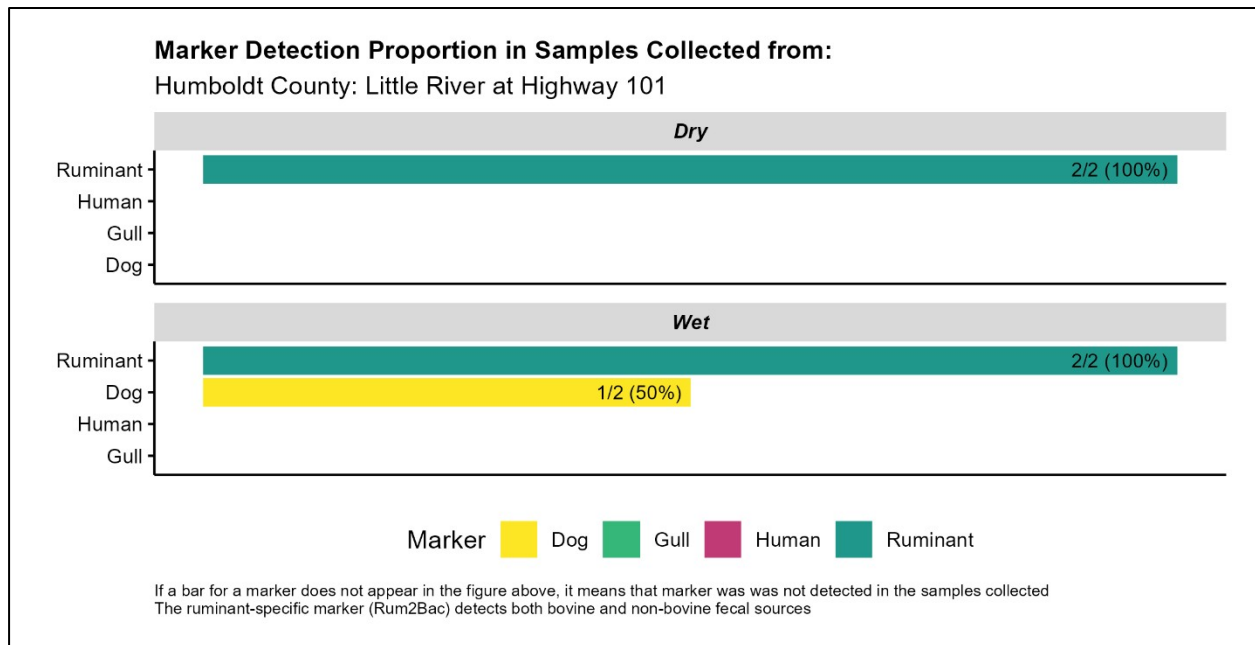
The marker detection percentage in the dry sampling period were:

- Ruminant (2/2 [100%])
- Dog (0/2 [0%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%])
- Dog (1/2 [50%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-2 Detection percentage of MST markers evaluated in samples collected from the Little River at Highway 101 bridge station**

#### **Little River tributary upstream of Hwy 101**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are residential areas and septic influenced areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-3.

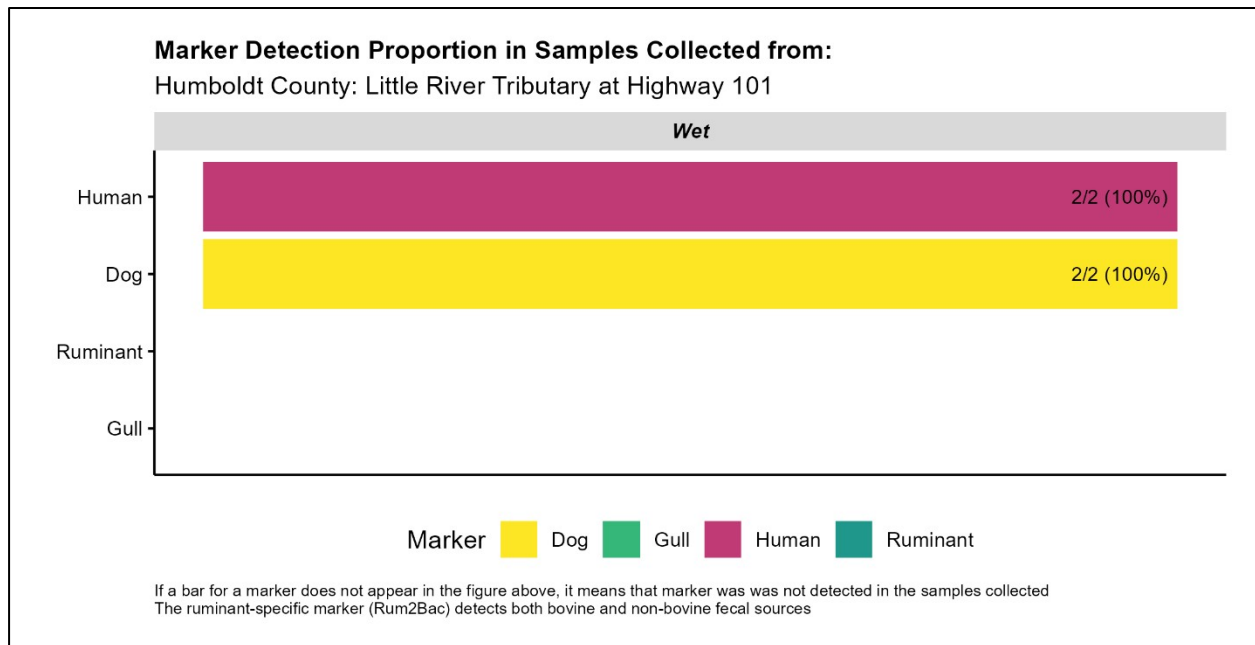
The marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%])
- Human (0/2 [0%])
- Gull (0/2 [0%]), and
- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%])
- Human (2/2 [100%])
- Gull (0/2 [0%]), and
- Ruminant (0/2 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-3 Detection percentage of MST markers evaluated in samples collected from the Little River tributary upstream of Highway 101 station**

#### **Janes Creek at Arcata Community Forest Trail 12**

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are forested areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below.

The marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%])
- Gull (0/2 [0%])
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (0/2 [%])
- Gull (0/2 [%])
- Human (0/2 [%]), and
- Ruminant (0/2 [%])

None of the four species-specific markers were detected in any of the samples collected from this sampling station either in the dry, or wet, sampling period. Therefore, a figure for this sampling station was not prepared.

### McDaniel Slough at Highway 101

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are industrial areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-4.

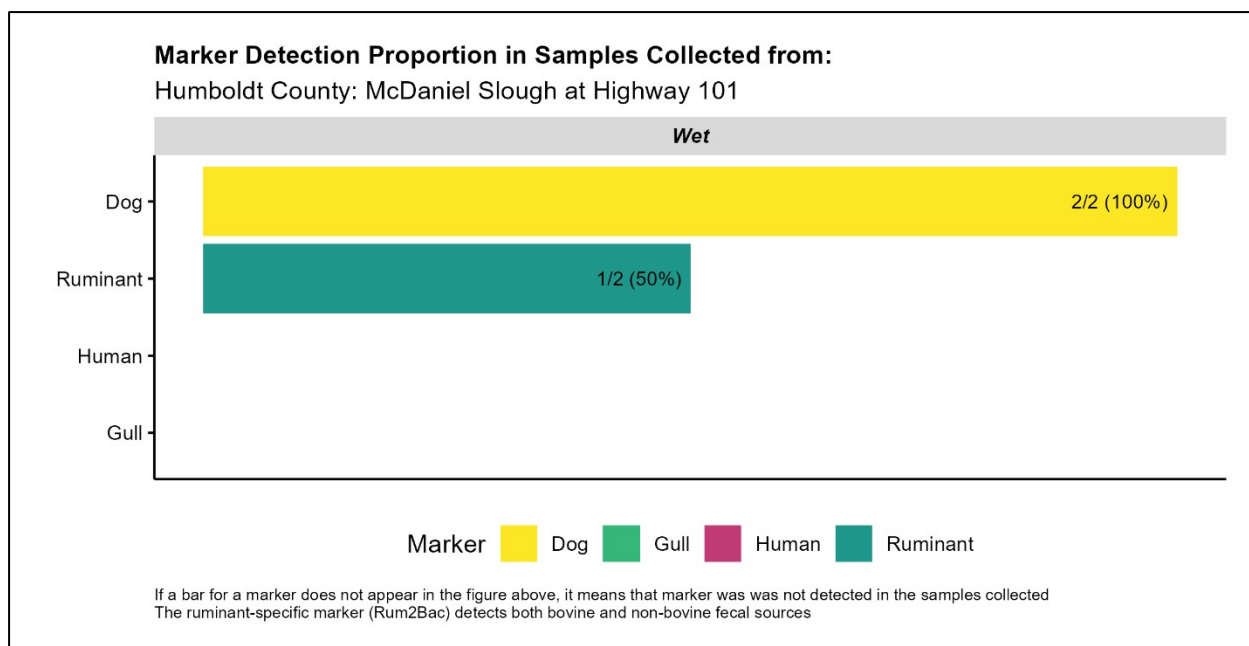
The marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%])
- Gull (0/2 [0%])
- Human (0/2 [0%]), and
- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%])
- Ruminant (2/2 [100%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-4 Detection percentage of MST markers evaluated in samples collected from the McDaniel Slough at Highway 101 station**

### McDaniel Slough at Hilfiker Drive

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are residential areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-5.

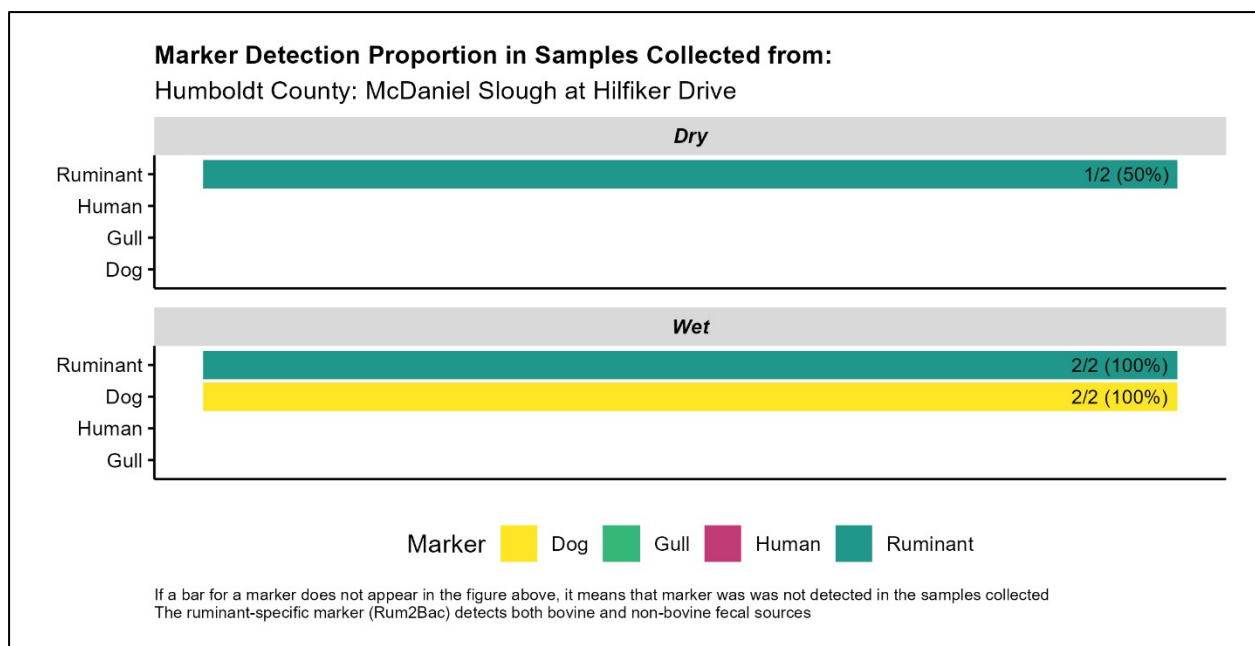
The marker detection percentage in the dry sampling period were:

- Ruminant (1/2 [50%])
- Dog (0/2 [0%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%])
- Ruminant (2/2 [100%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-5 Detection percentage of MST markers evaluated in samples collected from the McDaniel Slough at Hilfiker Drive station**

### McDaniel Slough at Foster Avenue and Heather Lane

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are a combination of transient camps, residential areas, and former industrial areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-6.

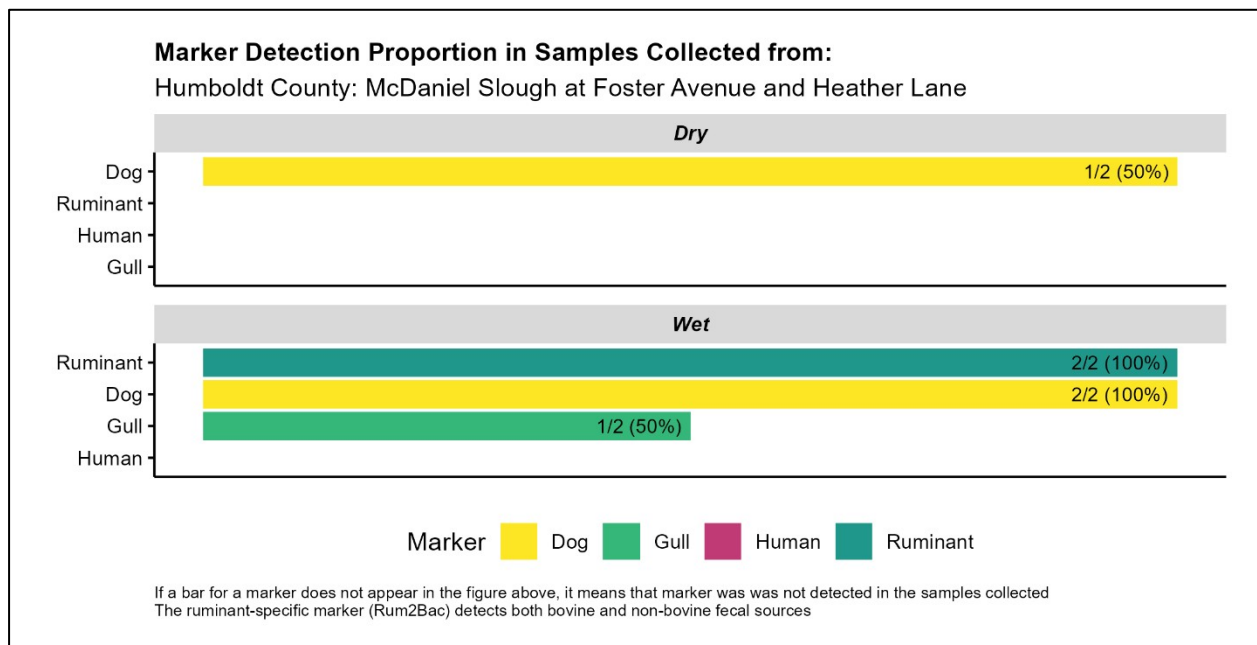
The marker detection percentage in the dry sampling period were:

- Dog (1/2 [50%])
- Gull (0/2 [0%]), and
- Human (0/2 [0%])
- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Ruminant (2/2 [100%]),
- Dog (2/2 [100%])
- Gull (1/2 [50%]), and
- Human (0/2 [0%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-6 Detection percentage of MST markers evaluated in samples collected from the McDaniel Slough at Foster Avenue and Heather Lane station**



### McDaniel Slough at Samoa Boulevard

Four samples (two in the dry period, and two in the wet period) were collected from this sampling station. The suspected upstream sources of fecal pollution at this sampling station are a combination of transient camps and residential areas.

The detection percentage of MST markers in samples collected from the dry and wet sampling periods from this sampling station are listed below, and illustrated in Figure F-7.

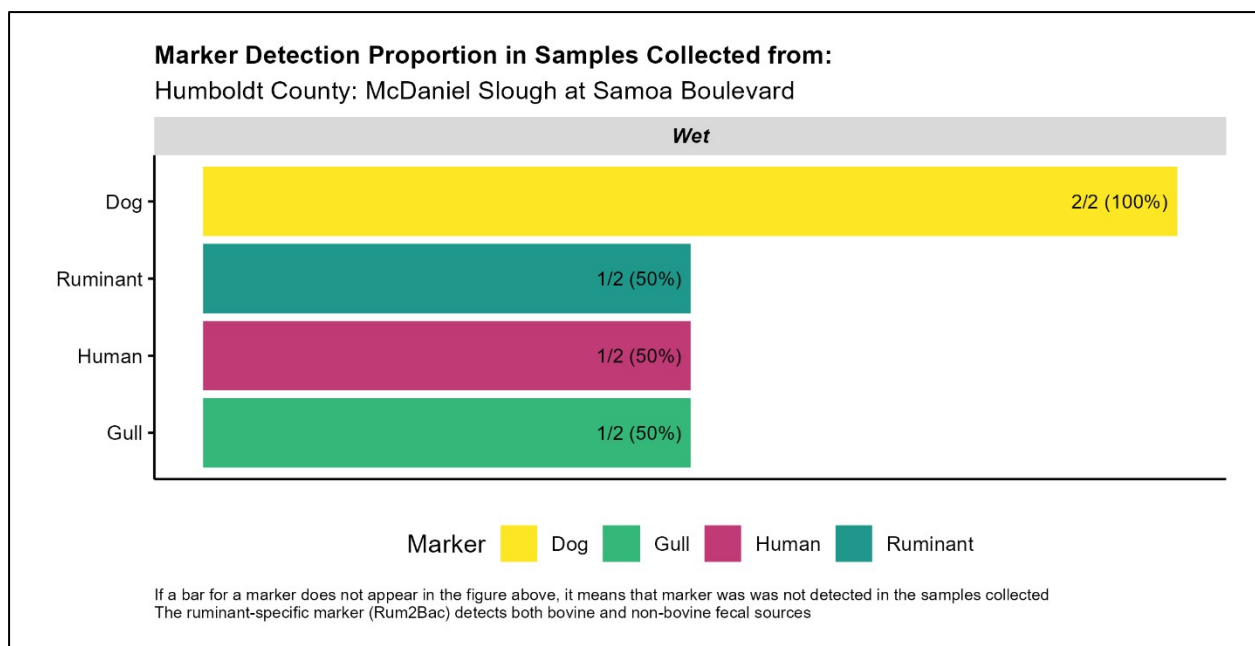
The marker detection percentage in the dry sampling period were:

- Dog (0/2 [0%])
- Human (0/2 [0%])
- Gull (0/2 [0%]), and
- Ruminant (0/2 [0%])

Specifically, the marker detection percentage in the wet sampling period were:

- Dog (2/2 [100%])
- Gull (1/2 [50%])
- Ruminant (1/2 [50%]), and
- Human (1/2 [50%])

If a marker does not appear in the figure below, then that marker was not detected in the samples collected.



**Figure F-7 Detection percentage of MST markers evaluated in samples collected from the McDaniel Slough at Samoa Boulevard station**

## **Discussion and Recommendations for Source Control**

From March to October 2016, four stations along Little River were sampled starting from a station upstream of the Green Diamond nursery, then further downstream at a station along Crannel Road, then further downstream at the Highway 101 bridge. A station along a tributary of the Little River upstream of Highway 101 was also sampled. Two samples were collected from each of these sampling stations in the dry period, and two samples were collected from each of these sampling stations in the wet period. The suspected sources range from forested areas in the upstream sampling stations to agricultural, residential, and septic systems in the downstream sampling stations. The species-specific marker detection trends range from more detections for ruminant-specific markers in the upstream sampling stations leading to higher detections for dog-, and human-specific markers in the downstream sampling stations. These detections reflect the suspected sources identified by the Humboldt Waterkeeper organization.

From March to October 2016, one station in Janes Creek was sampled in the Arcata Community forest, and four stations along McDaniel Slough were sampled at West End Road and Highway 101, then further downstream at Hilfiker Drive, then further downstream at Foster Avenue and Heather Lane, ending at a station at Samoa Boulevard. Two samples were collected from each of these sampling stations in the dry period, and two samples were collected from each of these sampling stations in the wet period. The suspected sources range from forested areas in the Janes Creek station and industrial, residential and a combination of transient camp and residential areas in the downstream sampling stations. The species-specific marker detection trends range from more detections for dog-, and ruminant-specific markers in the upstream sampling stations leading to higher detections for dog-, and human-specific markers in the downstream sampling stations. These detections reflect the suspected sources identified by the Humboldt Waterkeeper organization.

The trends noted above reflect the trends identified in those noted in the samples collected under the Coastal Pathogen Project and the Humboldt County APMP Study, and therefore the recommended source control actions for these sampling stations are the same as those recommended in Section 4 of this report.