Russian River Water Quality Summary for the 2014 Temporary Urgency Change

SONOMA COUNTY WATER AGENCY

March 2015

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1.0 Introduction

On August 14, 2014, the Sonoma County Water Agency (Water Agency) filed a Temporary Urgency Change Petition (TUCP) with the State Water Resources Control Board (SWRCB) to temporarily reduce minimum instream flows in the Russian River to address low storage conditions in Lake Mendocino.

In summary, the Water Agency requested that the SWRCB make the following temporary changes to the Decision 1610 (D1610) instream flow requirements:

(1) From August 15, 2014, through February 10, 2015, reduce instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) from 75 cubic feet per second (cfs) to 50 cfs.

(2) From August 15, 2014, through February 10, 2015, reduce instream flow requirements for the lower Russian River (downstream of its confluence with Dry Creek) from 85 cfs to 60 cfs.

The TUCP also requested that compliance with these minimum instream flow requirements be measured based on a 5-day running average of average daily stream flow measurements, provided that instantaneous flows on the upper Russian River shall be no less than 40 cfs and on the lower Russian River shall be no less than 50 cfs. These 5-day running average provisions will allow the Water Agency to reduce the operational buffers needed to manage these stream flows, thereby allowing the Water Agency to conserve more water in Lake Mendocino.

The SWRCB issued an Order (Order) approving the Water Agency's TUCP on August 25, 2014. The Order was effective until 180 days from the date of the Order (February 20, 2015) or Lake Mendocino storage reached the top of the water supply pool (68,400 acre-feet), whichever was earlier. The Order included several terms and conditions, including requirements for monitoring water quality to assess possible effects from the TUCP on the availability of aquatic habitat for salmonids or recreation (Terms 7 and 8). Data collected under Terms 7a and 8 were provided in weekly Hydrologic Status Reports as they became available. This report provides and summarizes all data collected during the 2014 water quality monitoring program as required by Term 10 of the Order.

2.0 2013 Russian River Flow Summary

As described in the Order, the Water Agency requested temporary changes to D1610 instream flow requirements for dry water supply conditions, including reductions from 75 cfs to 50 cfs in the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) and from 85 cfs to 60 cfs in the lower Russian River (downstream of its confluence with Dry Creek). The purpose of the 2014 Temporary Urgency Change (TUC) was to address low storage conditions in Lake Mendocino.

Through a prior TUCP that was approved by the State Board on December 31, 2013 and in effect through June 29, 2014, the Water Agency requested a change in the hydrologic index used to define D1610 water supply conditions. The modification involved relying on storage in Lake Mendocino instead of cumulative Lake Pillsbury inflow to determine D1610 minimum instream flow requirements in the upper Russian River. While the prior TUCP was in effect, low storage levels in Lake Mendocino resulted

in water supply conditions being defined as a Dry Spring under D1610, thereby allowing flows to be decreased from 185 cfs to 75 cfs in the upper Russian River. Concurrently, low inflow into Lake Pillsbury resulted in dry water supply conditions in the lower Russian River, thereby allowing flows to be decreased from 125 cfs to 85 cfs below the confluence with Dry Creek. In 2014, water storage in Lake Mendocino was below conditions experienced in 2009 and remained below conditions observed in 2009 and 2013 for the entire season until early December storms increased storage to over 56,000 acre-feet by 31 December (Figure 2-1). Lake Mendocino storage continued to increase through January and was approximately 68,092 acre-feet by 20 February 2015, the date the Order expired.

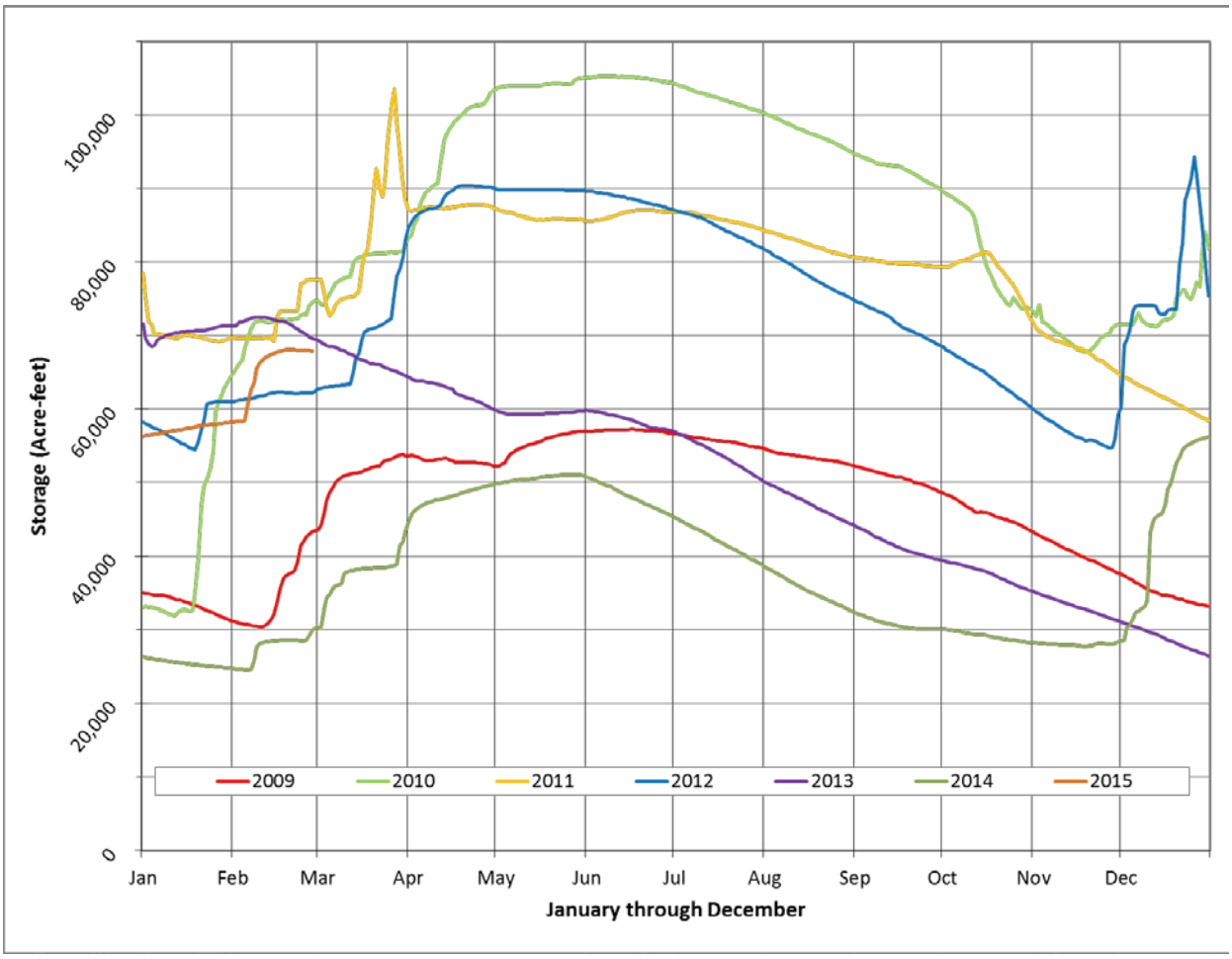

Figure 2-1. Lake Mendocino water storage levels, in acre-feet, from 2009 to early 2015.

The reduced Coyote Valley Dam releases authorized by the Order allowed flows to drop below D1610 dry water supply condition minimum flows in most sections of the Russian River. However, a moderate demand season allowed stable releases from Lake Mendocino. Figure 2-2 shows 2014 and early 2015 average daily flows.

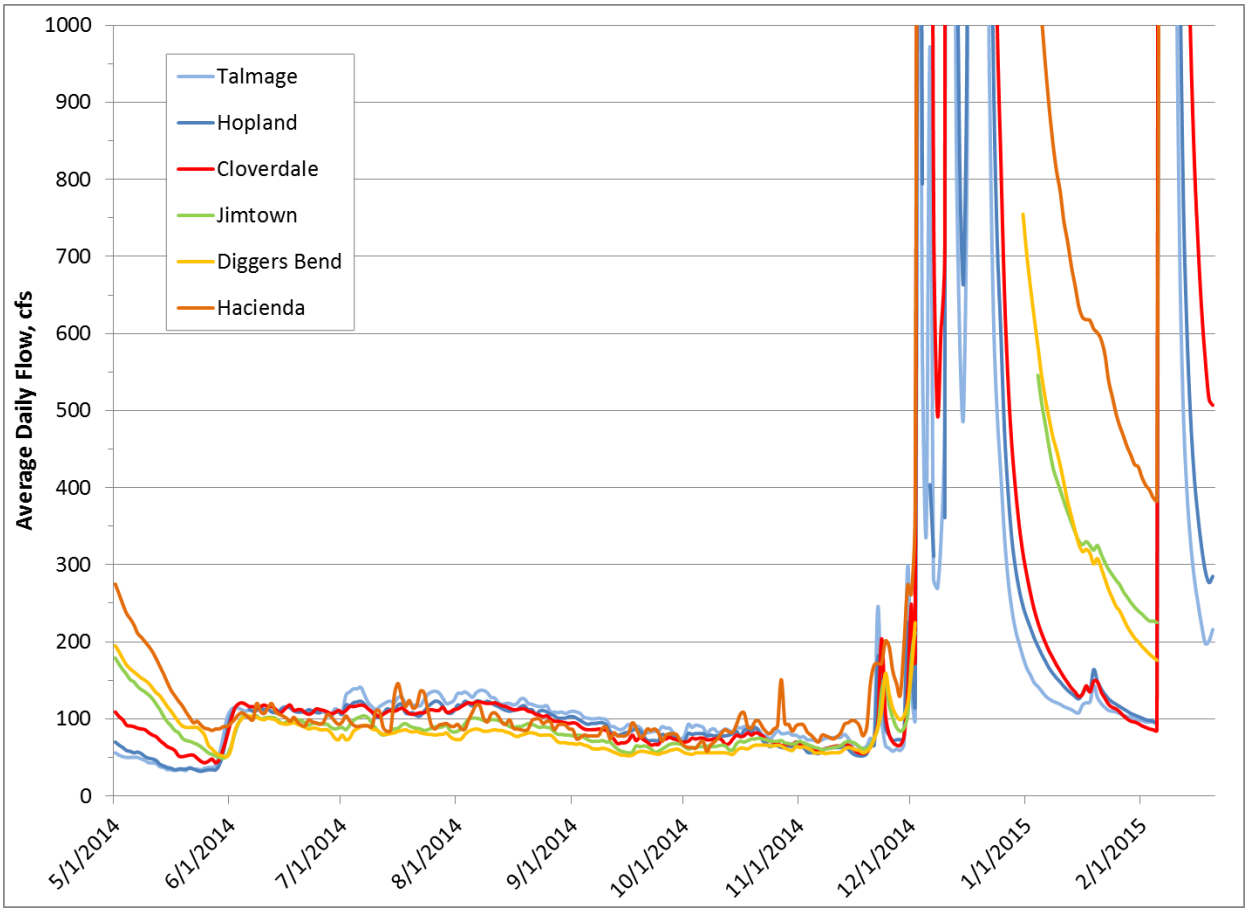

Figure 2-2. 2014 and early 2015 average daily flows in the Russian River as measured at U.S. Geological Survey (USGS) gages in cubic feet per second (cfs).

While the Order was in effect, upper Russian River flows did not drop below the 50 cfs five-day running average TUC flow or the instantaneous flow of 40 cfs authorized by the Order. Flows in the upper Russian River at Hopland were below 75 cfs periodically in late September and again in late October and November. Flows at Digger's Bend dropped to less than 75 cfs from August 28 to November 21, but did not drop below the five-day running average of 50 cfs or the instantaneous minimum flow of 40 cfs throughout the Order (Figure 2-3).

Flows in the lower Russian River at Hacienda (downstream of the confluence with Dry Creek) dropped below the TUC five-day running average of 60 cfs one day on October 7, but remained higher than the TUC instantaneous minimum flow of 50 cfs throughout the Order (Figure 2-4).

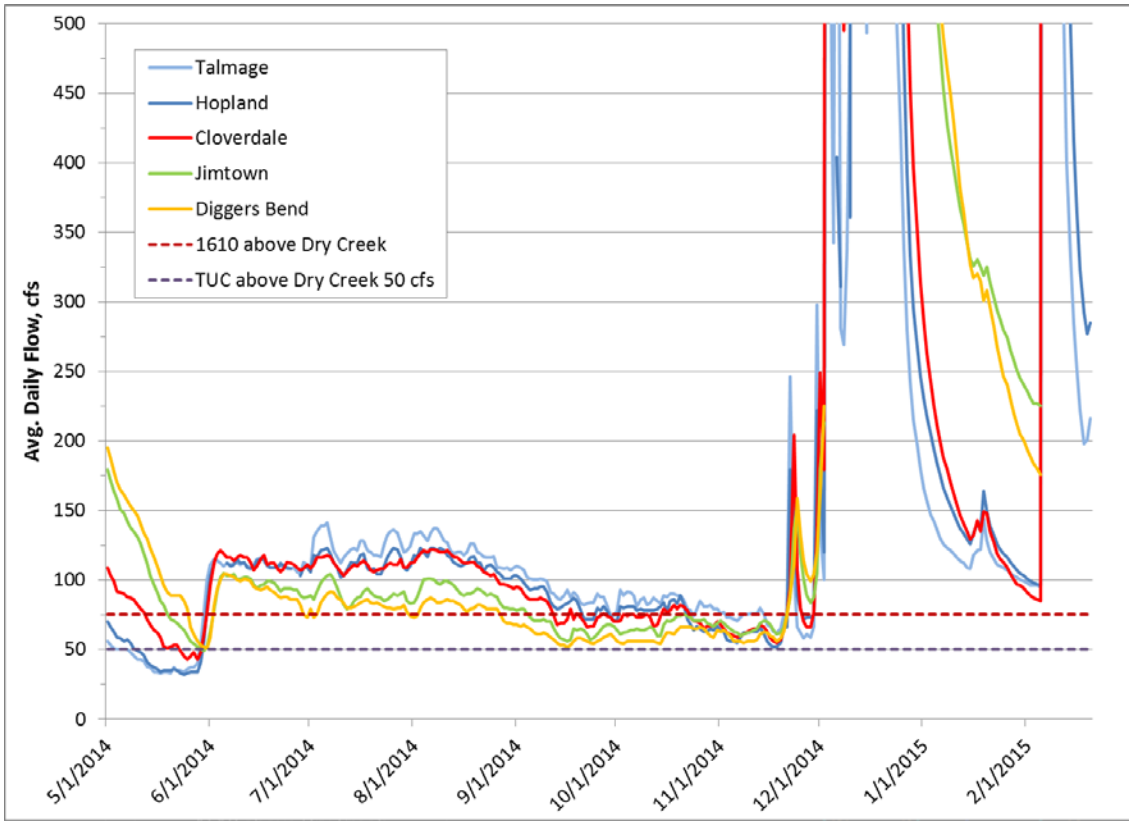

Figure 2-3. 2014 and early 2015 average daily flows in the Russian River as measured at USGS gages above the Dry Creek confluence in cubic feet per second.

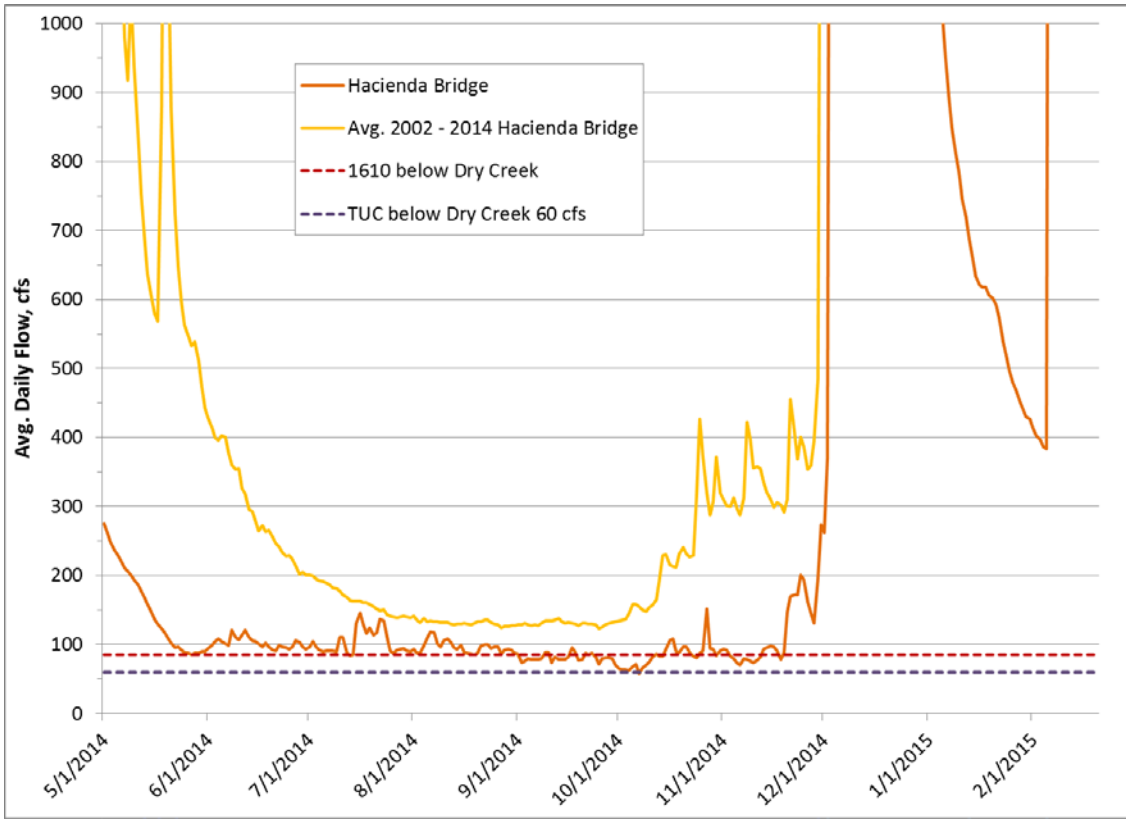

Figure 2-4. 2014 and early 2015 average daily flows in the Russian River as measured at USGS gages below the Dry Creek confluence in cubic feet per second.

3.0 Water Quality Monitoring

Water quality data was collected to monitor TUC flows for potential effects to recreation and available aquatic habitat for salmonids. The data will also be used to supplement existing data to provide a more complete basis for analyzing spatial and temporal water quality trends due to Biological Opinion-stipulated changes in river flow and estuary management. The resulting data will help provide information to evaluate potential changes to water quality and availability of habitat for aquatic resources resulting from the proposed permanent changes to D1610 minimum instream flows that are mandated by the Biological Opinion. A complete evaluation of the water quality data is being conducted as part of the California Environmental Quality Act (CEQA) analysis associated with proposed permanent changes to D1610.

3.1 Seasonal Mainstem Bacterial Sampling (Beach Sampling)

The Sonoma County Department of Health Services (DHS) conducts seasonal bacteriological sampling to monitor levels of pathogens at nine (9) Russian River beaches with recreational activities involving the greatest body contact. Results are used by the Sonoma County DHS to determine whether or not bacteria levels fall within State guidelines. The 2014 Sonoma County DHS seasonal beach sampling locations consisted of: Cloverdale River Park; Camp Rose Beach; Healdsburg Veterans Memorial Beach; Steelhead Beach; Forestville Access Beach; Sunset Beach; Johnson's Beach; Monte Rio Beach; and Patterson Point. Bacteriological samples were collected weekly beginning May 27 and continued until September 2. The samples were analyzed using the Colilert quantitray MPN method for total coliform and *E. coli*. Results from the sampling program are reported by the Sonoma County DHS at their website and on the Sonoma County DHS Beach Sampling Hotline. The 2014 seasonal results are shown in Table 3-1 and in Figures 3-1 and 3-2.

The California Department of Public Health (CDPH) developed the "Draft Guidance for Fresh Water Beaches," which describes bacteria levels that, if exceeded, may require posted warning signs in order to protect public health (CDPH 2011). The CDPH draft guideline for single sample maximum concentrations is: 10,000 most probable numbers (MPN) per 100 milliliters (ml) for total coliform, 235 MPN per 100 ml for *E. coli*, and 61 MPN per 100 ml for Enterococcus. In 2012, the United States Environmental Protection Agency (EPA) issued Clean Water Act (CWA) §304(a) Recreational Water Quality Criteria (RWQC) for States (EPA 2012). The RWQC recommends using two criteria for assessing water quality relating to fecal indicator bacteria: the geometric mean (GM) of the dataset, and changing the single sample maximum (SSM) to a Statistical Threshold Value (STV) representing the 75th percentile of an acceptable water-quality distribution. However, the EPA recommends using STV values as SSM values for potential recreational beach posting and those values are provided in this report for comparative purposes. Exceedances of the STV values are highlighted in Table 3-1. It must be emphasized that these are draft guidelines and criteria, not adopted standards, and are therefore both subject to change (if it is determined that the guidelines and/or criteria are not accurate indicators) and are not currently enforceable. In addition, these draft guidelines and criteria were established for and are only applicable to fresh water beaches. Currently, there are no numeric guidelines or criteria that have been developed for estuarine areas.

Table 3-1. Russian River Seasonal Recreational Beach Bacteria Sampling Results collected by the Sonoma County Department of Health Services in 2014. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches (CDPH 2011).

Date	Cloverdale River Park		Camp Rose Beach		Healdsburg Veterans		Steelhead Beach		Forestville Access Beach		Sunset Beach		Johnson's Beach		Monte Rio Beach		Patterson Point	
	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC	TC	EC
5/27/2014	**24196**	20	2613	30	1723	63	1439	10	2382	10	2755	<10	2359	20	2902	20	1785	10
5/29/2014	**24196**	10																
6/3/2014	4376	61	2382	85	1565	63	1396	63	1785	41	1616	10	1354	<10	1597	<10	749	10
6/10/2014	9804	30	4352	10	1616	20	1396	20	2481	20	2755	10	1850	30	2909	10	905	10
6/17/2014	4106	20	2359	41	2359	41	1112	10	1236	41	2014	<10	1723	63	813	20	1081	<10
6/24/2014	8164	120	3076	<10	1616	63	1396	31	1842	10	2098	<10	2098	85	565	<10	1664	20
7/1/2014	9208	10	4352	31	2755	75	2143	10	2143	10	2755	<10	2187	52	10	20	1607	<10
7/8/2014	6131	31	2613	31	3448	52	1119	10	2014	10	2909	20	2142	<10	2613	63	2224	20
7/15/2014	**10462**	<10	2613	30	2098	52	1439	31	1565	10	1624	31	2909	31	1274	20	3873	10
7/16/2014	3076	20																
7/22/2014	6131	20	3255	20	3130	52	4106	41	2755	<10	1314	<10	1401	41	1296	10	480	<10
7/29/2014	9804	<10	5794	31	2359	31	1309	10	1259	<10	1793	10	908	10	1658	30	727	31
8/5/2014	7270	10	6867	10	3076	52	2247	31	1658	63	1421	10	1317	10	987	10	1497	20
8/12/2014	9804	30	4884	31	2613	63	1607	20	1597	<10	1137	41	1664	<10	1333	<10	1782	20
8/19/2014	6867	10	2613	31	2014	63	1274	10	1317	20	1515	31	1112	<10	839	41	908	10
8/26/2014	6488	31	2255	10	2247	76	1354	41	1081	73	1153	20	1664	<10	556	41	664	20
9/2/2014	8164	31	2909	10	2909	20	1081	31	1783	41	1515	31	933	<10	1014	10	1145	30

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Values (STV):
(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text
Total Coliforms (STV): 10,000 per 100ml
E. coli (STV): 235 per 100 ml

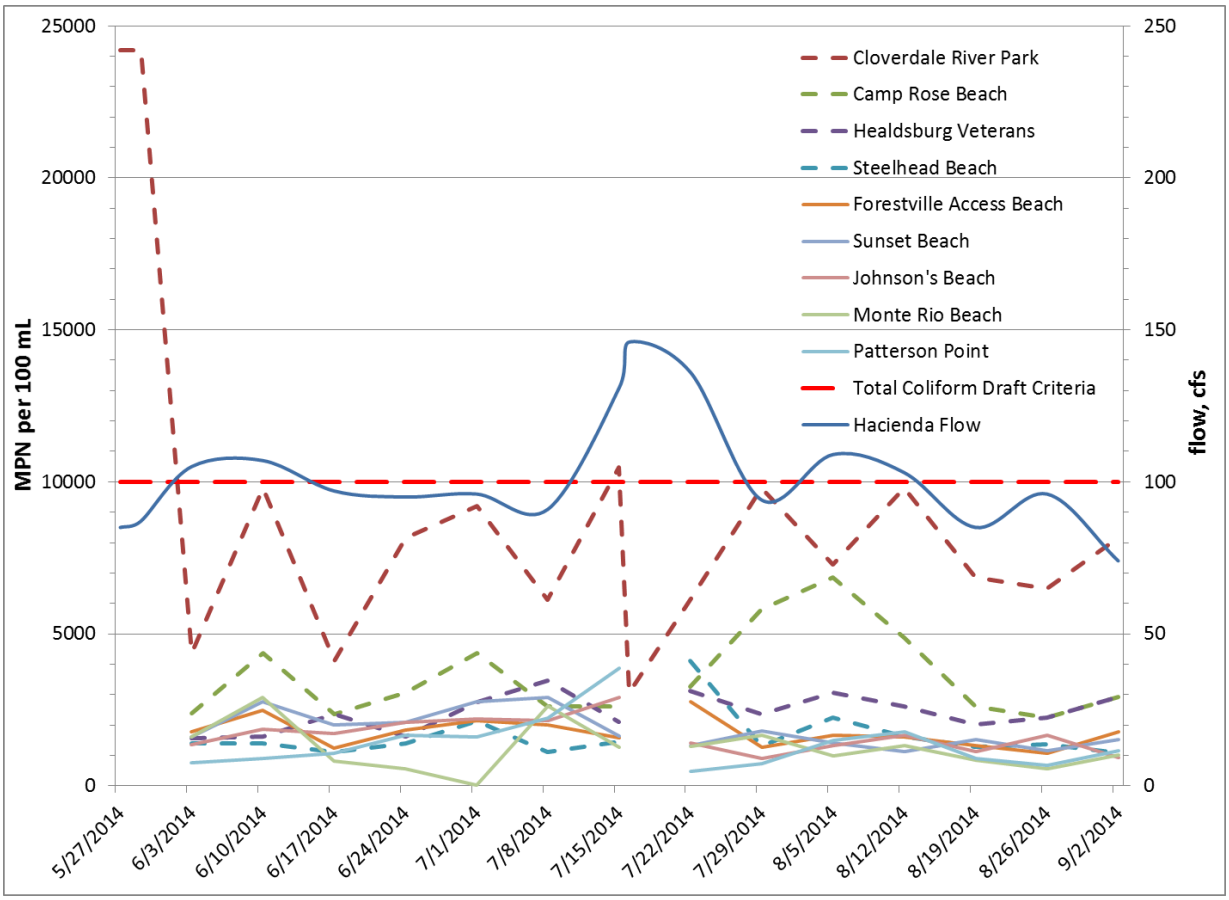

Figure 3-1. Russian River Beach Recreational Beach Bacteria Sample Results for Total Coliform in 2014.

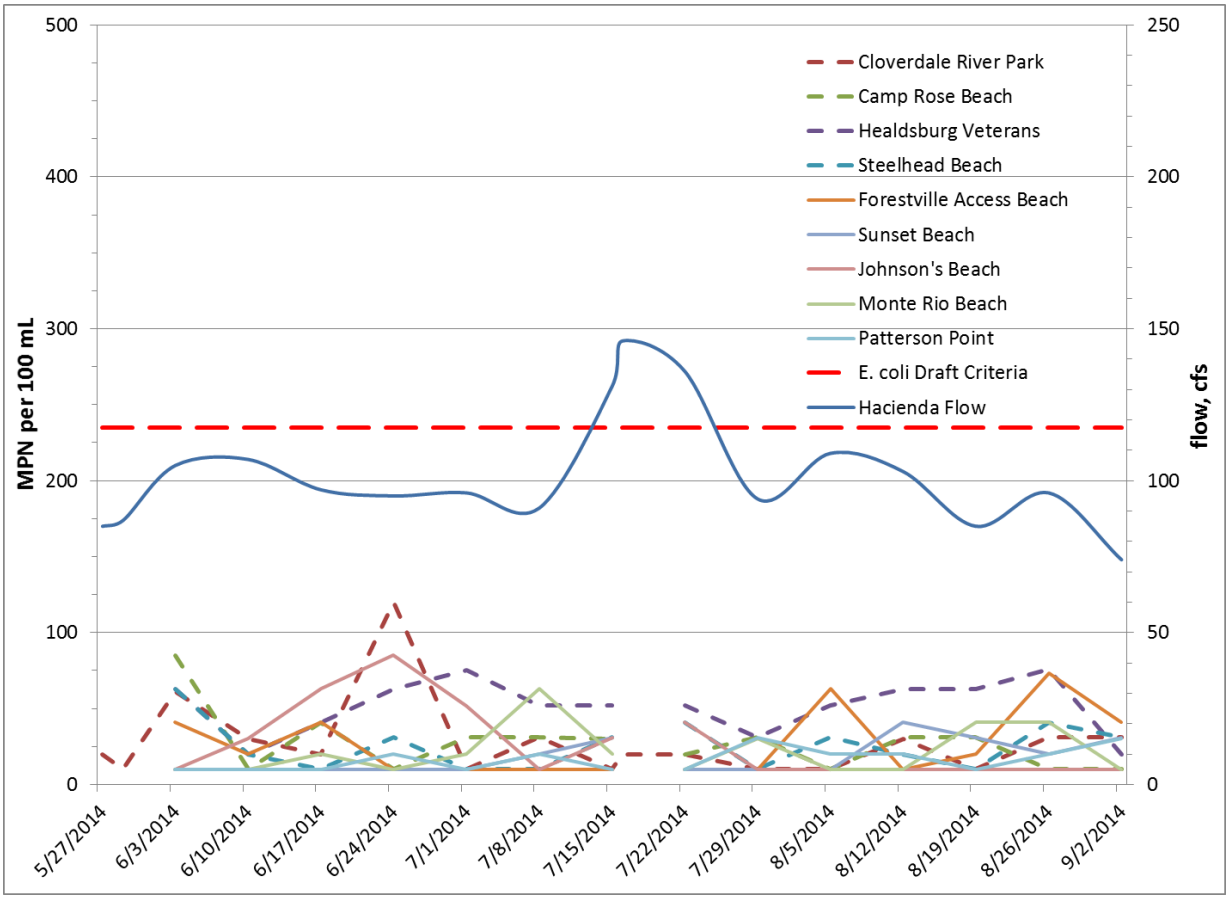

Figure 3-2. Russian River Recreational Beach Bacteria Sample Results for E. coli in 2014.

3.2 Water Agency Estuary Water Quality Sampling and Monitoring

Flows in the lower Russian River at Hacienda (downstream of the confluence with Dry Creek) continued to be affected by drought conditions during the term of the Order in late-2014 and dropped below the TUC five-day running average of 60 cfs one day on October 7, but remained higher than TUC instantaneous minimum flow of 50 cfs. Long-term water quality monitoring and grab sampling was conducted in the lower, middle, and upper reaches of the Russian River Estuary and the upper extent of inundation and backwatering during lagoon formation, between the mouth of the river at Jenner and Vacation Beach, including in two tributaries.

Water Agency staff conducted weekly grab sampling from May 15 to October 21 at five stations in the mainstem of the lower river including: Jenner; Casini Ranch; Patterson Point, Monte Rio, and Vacation Beach (Figure 3-3). All samples were analyzed for nutrients, *chlorophyll a*, standard bacterial indicators (Total coliforms, *E. coli*, and *Enterococcus*), total and dissolved organic carbon, total dissolved solids, and turbidity. Additional sampling was conducted for *Bacteroides* bacteria at the 3 surface-water sites that occur in the maximum backwater area including Patterson Point, Monte Rio, and Vacation Beach. The Water Agency submitted samples to the Sonoma County DHS Public Health Division Lab in Santa Rosa for bacteria analysis. *E. coli* and total coliform were analyzed using the Colilert method and Enterococcus was analyzed using the Enterolert method. Samples for all other constituents were submitted to Alpha Labs in Ukiah for analysis.

Samples were not analyzed specifically for total coliforms, but concentrations are determined as part of the analytical process for determining *E. coli* concentrations and the results are included in the lab report. As such, it should be noted that the dilution rates that are utilized to accurately quantify *E. coli* concentrations for comparison to the draft guidelines do not allow for the quantification of total coliform concentrations at a high enough level to compare with the draft guidelines and are instead reported as greater than 2419.6 MPN (>2419.6). However, some samples were collected during the middle of the monitoring season for diluted and undiluted analysis of *E. coli* and total coliforms for comparative purposes and the results are included in the Tables 3-2 through 3-6. The decision to focus on *E. coli* for the analysis of potential water quality impacts and not total coliform concentrations was done in coordination and consultation with North Coast Regional Water Quality Control Board (NCRWQCB) staff.

Staff at the NCRWQCB also indicated that *Enterococcus* is not currently being utilized as a fecal indicator bacteria due to uncertainty in the validity of the lab analysis to produce accurate results, as well as evidence that *Enterococcus* colonies can be persistent in the water column and therefore its presence at a given site may not always be associated with a fecal source. However, Water Agency staff will continue to collect *Enterococcus* samples and record and report the data. NCRWQCB staff also indicated during the 2014 monitoring season that they were uncertain of the validity of the laboratory analysis for *Bacteroides* and would not be conducting lab analysis of the samples until the question of validity had been resolved. Water Agency staff continued to collect surface-water samples to test for *Bacteroides*, however the samples have not been analyzed to date and remain stored at the County DHS lab. As a result, there are no *Bacteroides* data to report.

Water Agency staff continued to collect long-term monitoring data to: establish baseline information on water quality in the Estuary and assess the availability of aquatic habitat in the Estuary; gain a better understanding of the longitudinal and vertical water quality profile during the ebb and flow of the tide; and track changes to the water quality profile that may occur during periods of low flow conditions, barrier beach closure, lagoon outlet channel implementation, and reopening. Long-term monitoring datasondes were deployed at nine stations in the Russian River estuary, including two tributary stations during the 2014 monitoring season (Figure 3-3).

Saline water is denser than freshwater and a salinity “wedge” forms as freshwater outflow passes over the denser tidal inflow. During the lagoon management period (May 15 to October 15), the lower and middle reaches of the Estuary up to Sheephouse Creek are predominantly saline environments with a thin freshwater layer that flows over the denser saltwater. The upper reach of the Estuary transitions to a predominantly freshwater environment, which is periodically underlain by a denser, saltwater layer that migrates upstream to Duncans Mills during low flow conditions and barrier beach closure. Additionally, river flows, tides, topography, and wind action affect the amount of mixing of the water column at various longitudinal and vertical positions within the Estuary.

The Water Agency submits an annual report to the National Marine Fisheries Service and California Department of Fish and Wildlife documenting the status updates of the Water Agency’s efforts in implementing the Biological Opinion. The water quality monitoring data for 2014 is currently being compiled and will be discussed in the “Russian River Biological Opinion Status and Data Report Year 2014-15” due to be released in June 2015. The annual report will be available on the Water Agency’s

website: http://www.scwa.ca.gov/bo-annual-report/. This data will also be evaluated as part of the CEQA requirements associated with proposed permanent changes to minimum flows under D1610.

The grab sample sites are shown in Figure 3-3, and the results are summarized in Tables 3-2 through 3-11 and Figures 3-4 and 3-5. Highlighted values indicate those values exceeding California Department of Public Health Draft Guidance for Fresh Water Beaches for Indicator Bacteria (CDPH 2011), EPA Recreational Water Quality Criteria (EPA 2012), and EPA recommended criteria for Nutrients, Chlorophyll a, and Turbidity in Rivers and Streams in Aggregate Ecoregion III (EPA 2000). However, it must be emphasized that the draft CDPH guidelines and EPA criteria are not adopted standards, and are therefore both subject to change (if it is determined that the guidelines or criteria are not accurate indicators) and are not currently enforceable. In addition, these draft guidelines and criteria were established for and are only applicable to fresh water beaches and freshwater portions of the estuary. Currently, there are no numeric guidelines or criteria that have been established specifically for estuaries.

Based upon the recommended RWQC for fresh water beaches, *Enterococcus* exceedances varied throughout the term of the Order with several exceedances being observed at Jenner. The exceedances at Jenner occurred throughout the monitoring season and under a variety of flows ranging from 70 cfs to 130 cfs. Several exceedances of the Enterococcus RWQC were also observed in the latter half of the season at all of the other stations, with flows varying from 60 cfs to 114 cfs. External factors likely had an effect on increasing *Enterococcus* concentrations including the removal of two summer dams in Guerneville at the end of September during a period of extended estuary closure that occurred from mid-September through October. There were also several exceedances of the RWQC for *E. coli* at the Monte Rio site following summer dam removal. None of the other stations had any exceedances of the RWQC for *E. coli* during the term of the Order. However, Jenner did have one exceedance of the *E. coli* RWQC that occurred before the term of the Order on July 15 when flows were approximately 134 cfs (Table 3-6). Interestingly, two samples were collected at the Jenner site for *E. coli* that day, one was analyzed undiluted and the other was diluted 1:10. The undiluted sample had a concentration of 579 MPN, whereas the diluted sample had a concentration of 20 MPN.

All five stations predominantly exceeded the EPA criteria for Total Phosphorous before and during the term of the Order and under flows that ranged from 60 cfs to 147 cfs, continuing a trend of consistent exceedances observed in previous years. Total Nitrogen was exceeded periodically at all stations before and during the term of the Order under flows that ranged from 60 cfs to 147 cfs. Occasional exceedances of the Turbidity EPA criteria occurred before and during the term of the Order at all stations under flows that ranged from 60 cfs to 134 cfs. Most exceedances were slightly higher than the criteria, except for samples collected on October 7. Jenner had a turbidity value of 5,100 NTU, whereas the other four stations had values in the 230 to 250 NTU range, compared to the EPA criteria of 2.34 NTU. Algal (chlorophyll *a*) results exceeded the criteria at Vacation Beach Monte Rio before the term of the Order in May and July when flows ranged from 85 cfs to 147 cfs, but not while the Order was in effect. Algal results also exceeded the criteria at Patterson Point and Casini Ranch in May and July, and again at the end of September and October following summer dam removal while the estuary was closed. Jenner had several algal exceedances throughout the season at flows ranging from 60 cfs to 132 cfs. See Tables 3-7 through 3-11.

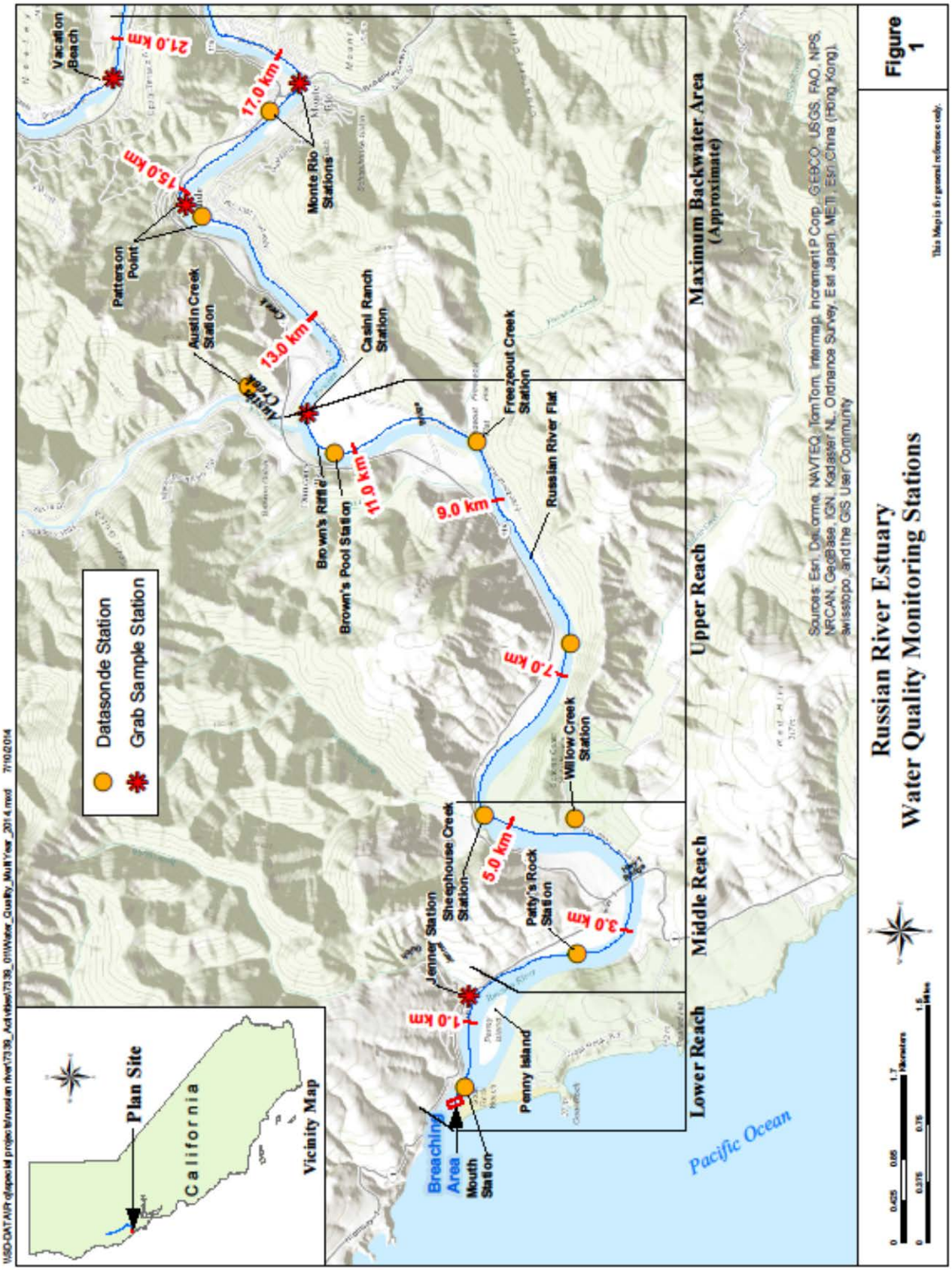

Figure 3-3. 2014 Russian River Estuary water quality monitoring stations sampled by the Sonoma County Water Agency.

Table 3-2. 2014 Vacation Beach bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.

Vacation Beach	Time	Temperature	pH	Total Coliforms (Colilert)	Total Coliforms Diluted 1:10 (Colilert)	E. coli (Colilert)	E. coli Diluted 1:10 (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				20		20		2	Flow Rate****
Date		°C		MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/15/2014	11:10:00	21.5	8.4	1413.6	----	9.7	----	8.5	147
5/20/2014	11:10:00	20.7	8.3	1986.3	----	8.4	----	9.7	109
5/27/2014	11:30:00	22.9	8.2	>2419.6	----	17.3	----	5.2	85
6/3/2014	11:30:00	21.1	8.0	>2419.6	----	16.0	----	26.6	105
6/10/2014	12:20:00	23.6	8.6	>2419.6	3143	15.6	20	6.3	106
6/17/2014	10:00:00	21.6	8.3	2419.6	1785	32.7	20	32.7	96
6/24/2014	10:50:00	23.9	8.3	>2419.6	2382	19.9	31	47.3	94
7/1/2014	10:40:00	24.9	8.1	1553.1	2187	22.6	<10	49.6	100
7/8/2014	11:50:00	24.3	8.0	2419.6	2613	13.5	<10	28.1	95
7/15/2014	10:40:00	24.1	8.1	1732.9	2909	14.5	10	28.1	134
7/22/2014	11:10:00	22.1	8.1	1413.6	1616	4.1	<10	17.7	132
7/29/2014	11:00:00	24.6	8.1	960.6	1872	14.8	41	28.5	96
8/5/2014	11:00:00	22.6	8.1	1732.9	1565	12.2	31	12.1	111
8/12/2014	11:50:00	22.6	8.1	----	1616	----	<10	7.3	105
8/19/2014	12:10:00	23.0	8.1	----	1732	----	<10	9.7	87
8/26/2014	12:40:00	22.1	8.0	----	1236	----	41	75	93
9/2/2014	12:30:00	22.4	8.1	----	2046	----	10	41	70
9/9/2014	12:20:00	21.1	8.1	1553.1	----	5.2	----	3.1	81
9/16/2014	11:20:00	21.5	8.0	1986.3	----	33.1	----	4.1	84
9/23/2014	12:20:00	21.7	7.9	1986.3	----	12.1	----	47.3	89
9/25/2014	12:50:00	21.8	7.9	1413.6	----	18.7	----	18.3	73
9/30/2014	10:50:00	19.6	7.8	1299.7	----	70.3	----	**214.3**	73
10/2/2014	11:30:00	19.3	7.7	1413.6	----	52.1	----	44.1	64
10/7/2014	11:00:00	19.0	7.9	601.5	----	18.1	----	**63.1**	60
10/9/2014	10:50:00	18.3	7.9	1119.9	----	32.8	----	46.7	75
10/14/2014	11:10:00	17.9	7.8	472.1	----	50.4	----	**91.1**	86
10/21/2014	11:20:00	17.5	7.9	770.1	----	63.1	----	**76.7**	101

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** United States Geological Survey (USGS) Continuous-Record Gaging Station

*** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Value (STV) and Geomteric Mean (GM)

(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text

E. coli (STV): 235 per 100 ml — Enterococcus (STV): 61 per 100 ml

E. coli (GM): 126 per 100mL — Enterococcus (GM): 33 per 100 mL

Table 3-3. 2014 Monte Rio bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.

Monte Rio	Time	Temperature	pH	Total Coliforms (Colilert)	Total Coliforms Diluted 1:10 (Colilert)	E. coli (Colilert)	E. coli Diluted 1:10 (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				20		20		2	Flow Rate****
Date		°C		MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/15/2014	10:50:00	21.6	8.3	1553.1	----	11.8	----	11.0	147
5/20/2014	11:00:00	21.3	8.3	>2419.6	----	12.2	----	11.0	109
5/27/2014	11:10:00	23.2	8.1	>2419.6	----	7.5	----	2.0	85
6/3/2014	11:10:00	21.6	8.1	2419.6	----	7.5	----	6.3	105
6/10/2014	12:00:00	24.4	8.7	2419.6	1515	18.7	10	4.1	106
6/17/2014	9:40:00	21.9	8.5	1732.9	1985	7.4	10	18.7	96
6/24/2014	10:30:00	23.3	8.2	1553.1	1187	14.5	31	44.8	94
7/1/2014	10:20:00	24.4	8.0	>2419.6	1956	21.6	10	24.7	100
7/8/2014	11:30:00	24.1	8.0	2419.6	1935	14.5	10	6.3	95
7/15/2014	10:30:00	24.0	8.0	2419.6	1989	4.1	<10	7.3	134
7/22/2014	10:50:00	22.3	8.1	2419.6	1500	4.1	20	23.8	132
7/29/2014	10:40:00	24.0	8.1	1732.9	1376	3.1	20	9.5	96
8/5/2014	10:50:00	22.5	8.1	1553.1	1597	12	10	9.3	111
8/12/2014	11:30:00	22.6	8.2	----	1076	----	31	6.3	105
8/19/2014	12:00:00	22.8	8.2	----	794	----	20	6.2	87
8/26/2014	12:20:00	22.1	8.1	----	1334	----	20	**105**	93
9/2/2014	12:20:00	23.2	8.0	----	1989	----	10	**156**	70
9/9/2014	12:00:00	21.0	8.0	1119.9	----	14.8	----	25.9	81
9/16/2014	11:10:00	20.9	8.0	920.8	----	5.1	----	4.1	84
9/23/2014	12:00:00	21.5	7.9	648.8	----	29.5	----	5.2	89
9/25/2014	12:30:00	21.7	7.9	2419.6	----	**365.4**	----	**248.9**	73
9/29/2014	11:40:00	----	----	>2419.6	----	162.4	----	**344.8**	84
9/30/2014	10:30:00	20.2	7.9	1732.9	----	187.2	----	**150.0**	73
10/2/2014	11:20:00	19.5	7.8	>2419.6	----	133.4	----	**191.8**	64
10/7/2014	10:40:00	19.0	7.9	1986.3	----	117.8	----	**139.1**	60
10/9/2014	10:30:00	18.9	8.0	>2419.6	----	**410.6**	----	**435.2**	75
10/13/2014	12:10:00	18.8	7.8	>2419.6	----	**1299.7**	----	**920.8**	85
10/14/2014	10:50:00	18.5	7.9	>2419.6	----	**686.7**	----	**1119.9**	86
10/16/2014	12:20:00	18.0	7.8	>2419.6	----	**>2419.6**	----	**1986.3**	107
10/17/2014	10:30:00	17.6	7.7	>2419.6	----	**2419.6**	----	**>2419.6**	114
10/21/2014	11:00:00	18.0	7.8	1299.7	----	**248.1**	----	**435.2**	101

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** United States Geological Survey (USGS) Continuous-Record Gaging Station

*** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Value (STV) and Geomteric Mean (GM)

(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text

E. coli (STV): 235 per 100 ml — Enterococcus (STV): 61 per 100 ml

E. coli (GM): 126 per 100mL — Enterococcus (GM): 33 per 100 mL

Table 3-4. 2014 Patterson Point bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.

Patterson Point	Time	Temperature	pH	Total Coliforms (Colilert)	Total Coliforms Diluted 1:10 (Colilert)	E. coli (Colilert)	E. coli Diluted 1:10 (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				20		20		2	Flow Rate****
Date		°C		MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/15/2014	10:30:00	21.3	8.3	1553.1	----	7.5	----	2.0	147
5/20/2014	10:30:00	21.6	8.2	1732.9	----	4.1	----	3.1	109
5/27/2014	10:40:00	22.7	8.0	>2419.6	----	4.1	----	6.3	85
6/3/2014	10:50:00	21.5	8.0	1203.3	----	8.6	----	10.6	105
6/10/2014	11:30:00	24.2	8.6	2419.6	1850	39.3	52	22.1	106
6/17/2014	9:20:00	21.9	8.5	1732.9	1872	4.1	<10	29.9	96
6/24/2014	10:10:00	24.0	8.2	>2419.6	1553	16.1	<10	**66.8**	94
7/1/2014	10:00:00	24.1	7.9	>2419.6	4611	12.1	<10	55.6	100
7/8/2014	11:00:00	23.4	7.8	1986.3	2595	13.4	20	7.2	95
7/15/2014	10:10:00	23.6	7.9	1986.3	2247	8.6	10	19.3	134
7/22/2014	10:30:00	22.1	8.1	1686.3	3255	11.0	31	14.6	132
7/29/2014	10:20:00	23.8	7.9	2419.6	4352	3.1	10	8.5	96
8/5/2014	10:30:00	22.1	8.1	2419.6	3448	11.8	<10	11.0	111
8/12/2014	11:10:00	22.2	8.1	----	1842	----	10	17.3	105
8/19/2014	11:40:00	22.3	8.2	----	2909	----	10	5.2	87
8/26/2014	11:50:00	21.9	7.9	----	1670	----	31	**121.0**	93
9/2/2014	11:50:00	22.5	7.9	----	2282	----	10	**529**	70
9/9/2014	11:40:00	20.6	7.9	1046.2	----	17.3	----	10.9	81
9/16/2014	10:50:00	20.9	7.9	1413.6	----	43.5	----	8.5	84
9/23/2014	11:30:00	21.9	7.9	1203.3	----	42.8	----	**71.2**	89
9/25/2014	12:20:00	22.0	7.9	>2419.6	----	116.9	----	**62.7**	73
9/30/2014	10:10:00	20.1	7.9	1732.9	----	58.3	----	**143.9**	73
10/2/2014	11:00:00	19.8	7.8	1553.1	----	71.4	----	**116.9**	64
10/7/2014	10:20:00	18.7	7.9	1203.3	----	103.9	----	**95.9**	60
10/9/2014	10:10:00	18.6	8.0	648.8	----	19.9	----	48.7	75
10/14/2014	10:30:00	18.6	7.9	>2419.6	----	70.3	----	**114.5**	86
10/21/2014	10:50:00	17.8	7.8	866.4	----	29.2	----	**86.0**	101

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** United States Geological Survey (USGS) Continuous-Record Gaging Station

*** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Value (STV) and Geomteric Mean (GM)

(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text

E. coli (STV): 235 per 100 ml — Enterococcus (STV): 61 per 100 ml

E. coli (GM): 126 per 100mL — Enterococcus (GM): 33 per 100 mL

Table 3-5. 2014 Casini Ranch bacteria concentrations for samples collected by the Sonoma County Water Agency. This site may experience estuarine conditions.

Casini Ranch	Time	Temperature	pH	Total Coliforms (Colilert)	Total Coliforms Diluted 1:10 (Colilert)	E. coli (Colilert)	E. coli Diluted 1:10 (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)**
MDL*				20		20		2	Flow Rate***
Date		°C		MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/15/2014	10:00:00	22.5	8.4	1553.1	----	21.8	----	13.2	147
5/20/2014	10:10:00	22.0	8.4	1732.9	----	2.0	----	6.3	109
5/27/2014	10:10:00	22.3	8.2	>2419.6	----	6.3	----	5.2	85
6/3/2014	10:30:00	21.1	8.1	1553.1	----	4.1	----	2.0	105
6/10/2014	11:10:00	22.6	8.9	>2419.6	2909	9.8	20	3.0	106
6/17/2014	9:00:00	20.6	8.9	>2419.6	2143	5.1	<10	6.2	96
6/24/2014	9:50:00	23.4	8.4	>2419.6	1918	6.3	10	17.7	94
7/1/2014	9:40:00	22.4	8.2	>2419.6	2909	<1.0	<10	13.2	100
7/8/2014	10:40:00	22.8	8.0	1732.9	1401	4.1	<10	5.2	95
7/15/2014	9:50:00	24.1	8.2	1413.6	1500	5.1	10	11.8	134
7/22/2014	10:10:00	23.0	8.4	1203.3	1956	3.0	10	4.1	132
7/29/2014	10:00:00	24.1	8.4	1203.3	1396	4.1	<10	5.2	96
8/5/2014	10:10:00	21.3	8.2	1986.3	1291	3.1	10	3.0	111
8/12/2014	10:50:00	21.45	8.19	----	933	----	<10	14.6	105
8/19/2014	11:20:00	22.1	8.6	----	959	----	10	2.0	87
8/26/2014	11:20:00	21.9	8.1	----	932	----	20	41.0	93
9/2/2014	11:20:00	22.6	8.1	----	1076	----	<10	20	70
9/9/2014	11:00:00	20.6	8.1	488.4	----	7.4	----	10.9	81
9/16/2014	10:30:00	21.1	8.2	686.7	----	3.1	----	1.0	84
9/23/2014	11:00:00	21.5	8.0	2419.6	----	224.7	----	**980.4**	89
9/25/2014	11:50:00	22.9	8.0	2419.6	----	98.7	----	**260.3**	73
9/30/2014	9:50:00	20.3	8.0	1732.9	----	142.1	----	**218.7**	73
10/2/2014	10:40:00	20.4	8.0	>2419.6	----	98.8	----	**218.7**	64
10/7/2014	10:00:00	19.4	8.0	2419.6	----	108.1	----	**222.4**	60
10/9/2014	9:50:00	18.5	8.1	1553.1	----	44.1	----	**66.3**	75
10/14/2014	10:10:00	18.6	8.1	>2419.6	----	50.4	----	**344.8**	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** United States Geological Survey (USGS) Continuous-Record Gaging Station

*** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Value (STV) and Geomteric Mean (GM)

(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text

E. coli (STV): 235 per 100 ml — Enterococcus (STV): 61 per 100 ml

E. coli (GM): 126 per 100mL — Enterococcus (GM): 33 per 100 mL

Table 3-6. 2014 Jenner bacteria concentrations for samples collected by the Sonoma County Water Agency. Estuarine conditions exist at this site.

Jenner Boat Ramp	Time	Temperature	pH	Total Coliforms (Colilert)	Total Coliforms Diluted 1:10 (Colilert)	E. coli (Colilert)	E. coli Diluted 1:10 (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)**
MDL*				20		20		2	Flow Rate***
Unit of Measure		°C		MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/15/2014	9:40:00	18.4	8.4	>2419.6	----	16.8	----	15	147
5/20/2014	9:40:00	16.9	8.3	>2419.6	----	4.1	----	8.6	109
5/27/2014	9:40:00	18.9	8.1	>2419.6	----	1.0	----	1.0	85
6/3/2014	10:00:00	16.2	8.0	>2419.6	----	3.0	----	3.1	105
6/10/2014	9:40:00	19.0	8.6	>2419.6	6131	74.9	85	**195.6**	106
6/17/2014	8:40:00	15.6	8.2	2419.6	7270	5.2	<10	33.7	96
6/24/2014	9:20:00	18.2	8.1	>2419.6	**24196**	81.3	<10	**145.5**	94
7/1/2014	9:20:00	17.5	8.2	>2419.6	4884	222.4	120	**344.1**	100
7/8/2014	10:20:00	19.0	8.1	>2419.7	**14136**	22.3	10	22.6	95
7/15/2014	9:30:00	18.2	7.9	>2419.6	**10462**	**579.4**	20	**435.2**	134
7/22/2014	9:50:00	19.7	7.9	>2419.6	**10462**	28.8	10	**613.1**	132
7/29/2014	9:40:00	20.4	8.0	>2419.6	**>24196**	15.9	<10	**2419.6**	96
8/5/2014	9:50:00	17.8	7.9	>2419.6	**14136**	152.5	41	**103.4**	111
8/12/2014	10:30:00	19.0	7.9	----	**14136**	----	41	**231.0**	105
8/19/2014	10:50:00	18.9	8.0	----	7270	----	10	**79.8**	87
8/26/2014	11:00:00	19.5	8.0	----	3873	----	<10	**2046.0**	93
9/2/2014	11:00:00	19.1	8.1	----	**10462**	----	<10	**289**	70
9/9/2014	10:40:00	18.2	8.1	>2419.6	----	30.2	----	**248.1**	81
9/16/2014	10:10:00	18.0	8.1	>2419.6	----	17.3	----	**172.2**	84
9/23/2014	10:40:00	19.2	8.4	>2419.6	----	59.5	----	**365.4**	89
9/25/2014	11:30:00	19.5	8.3	>2419.6	----	87.5	----	18.7	73
9/30/2014	9:20:00	18.2	8.2	>2419.6	----	151.5	----	**204.6**	73
10/2/2014	10:10:00	18.3	8.3	1732.9	----	16.8	----	45.9	64
10/7/2014	9:40:00	18.1	8.2	2419.6	----	8.5	----	60.2	60
10/9/2014	9:30:00	17.8	8.0	>2419.6	----	23.5	----	32.7	75
10/14/2014	9:50:00	18.0	8.0	>2419.6	----	51.9	----	**435.2**	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** United States Geological Survey (USGS) Continuous-Record Gaging Station

*** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Value (STV) and Geomteric Mean (GM)

(Beach posting is recommended when indicator organisms exceed the STV) - Indicated by red text

E. coli (STV): 235 per 100 ml — Enterococcus (STV): 61 per 100 ml

E. coli (GM): 126 per 100mL — Enterococcus (GM): 33 per 100 mL

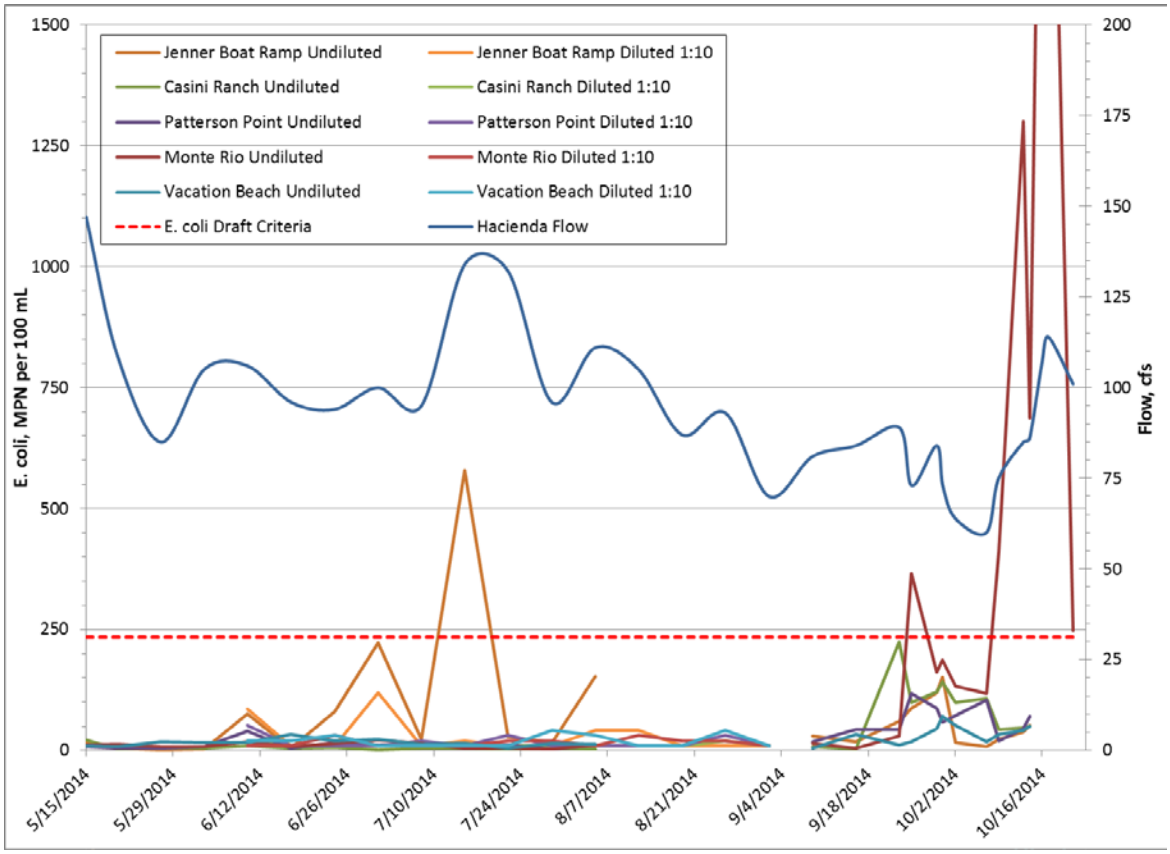

Figure 3-4. E. coli results on for the Russian River from Vacation Beach to Jenner in 2014.

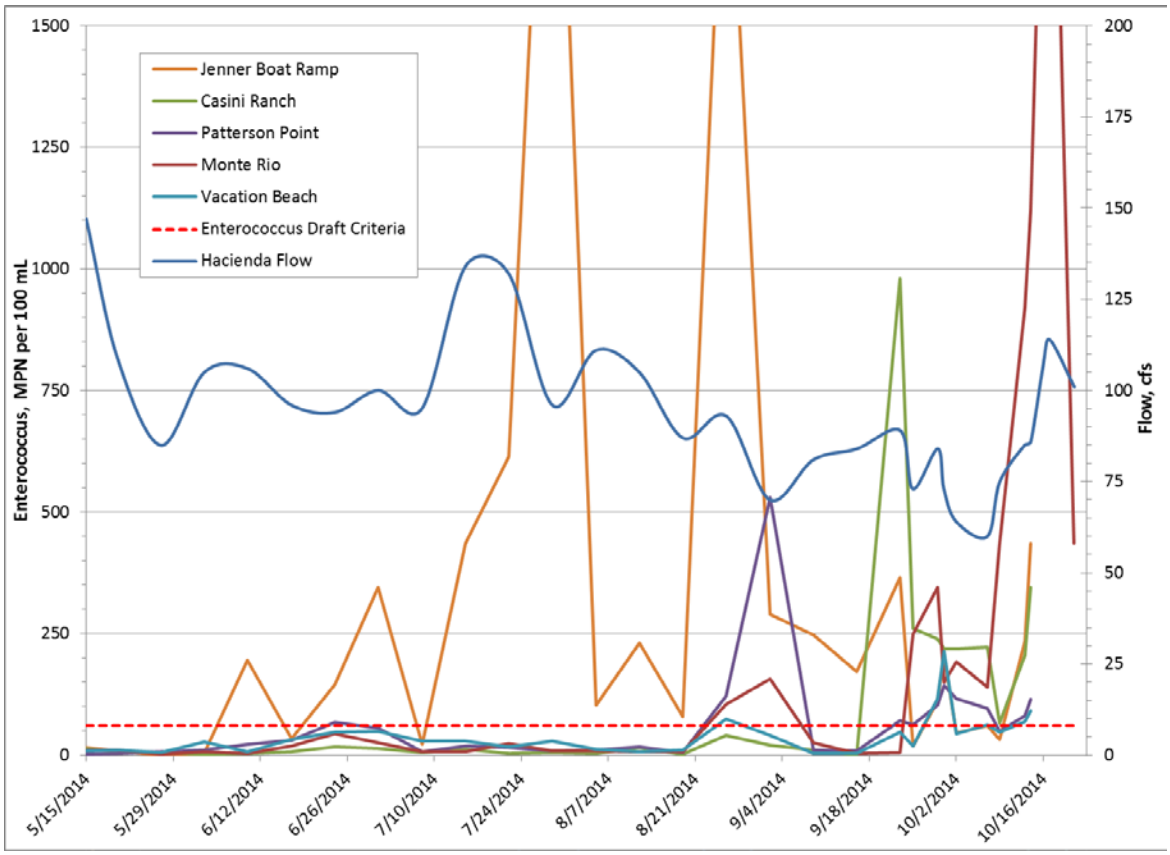

Figure 3-5. Enterococcus results for the Russian River from Vacation Beach to Jenner in 2014.

Table 3-7. 2014 Vacation Beach nutrient grab sample results. This site experiences freshwater conditions.

Vacation Beach	Time	Temperature	pH	Total Organic Nitrogen	Ammonia as N	Ammonia as N Unionized	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen	Total Nitrogen**	Phosphorus, Total	Total Orthophosphate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids	Turbidity	Chlorophyll-a	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.0400	0.0400	4.2	0.020	0.000050	Flow Rate****
Date		°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	(cfs)
5/15/2014	11:10	21.5	8.4	ND	0.07	0.0066	0.11	ND	0.21	0.32	**0.046**	0.094	1.54	1.83	180	1.8	**0.0026**	147
5/20/2014	11:10	20.7	8.3	ND	0.070	0.0055	0.11	ND	0.24	0.36	**0.056**	0.12	1.67	2.12	180	**2.9**	**0.0026**	109
5/27/2014	11:30	22.9	8.2	ND	0.070	ND	0.13	ND	0.21	0.34	**0.041**	0.11	1.72	1.96	170	2.2	**0.0034**	85
6/3/2014	11:30	21.1	8.0	0.35	ND	ND	0.13	ND	0.35	**0.48**	**0.059**	0.078	1.56	1.82	150	1.8	0.0017	105
6/10/2014	12:20	23.6	8.6	ND	0.070	0.012	0.12	ND	ND	0.26	**0.041**	0.11	1.57	2.14	190	1.7	0.00037	106
6/17/2014	10:00	21.6	8.3	ND	ND	ND	ND	ND	ND	ND	**0.039**	0.091	1.82	1.93	160	**2.4**	0.00063	96
6/24/2014	10:50	23.9	8.3	0.24	ND	ND	ND	ND	0.24	0.24	**0.041**	0.087	1.58	1.77	150	2.0	0.0017	94
7/1/2014	10:40	24.9	8.1	ND	ND	ND	0.12	ND	ND	0.26	**0.035**	0.084	1.59	1.92	140	**2.6**	**0.0021**	100
7/8/2014	11:50	24.3	8.0	0.38	ND	ND	ND	ND	0.38	**0.38**	**0.036**	0.075	1.83	2.18	150	2.3	**0.0024**	95
7/15/2014	10:40	24.1	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.035**	0.071	1.68	1.88	140	2.3	**0.0026**	134
7/22/2014	11:10	22.1	8.1	ND	ND	ND	ND	ND	ND	0.07	**0.025**	0.075	1.51	1.75	160	2.0	0.0016	132
7/29/2014	11:00	24.6	8.1	0.35	ND	ND	ND	ND	0.35	0.35	**0.033**	0.071	1.65	2.09	220	1.6	0.0014	96
8/5/2014	11:00	22.6	8.1	0.21	ND	ND	0.12	ND	0.21	0.33	**0.034**	0.065	0.78	0.94	140	1.5	0.0016	111
8/12/2014	11:50	22.6	8.1	ND	ND	0.0034	0.12	ND	ND	0.23	**0.033**	0.064	1.72	2.07	150	2.2	0.0010	105
8/19/2014	12:10	23.0	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.027**	0.072	1.70	2.09	130	0.96	0.00089	87
8/26/2014	12:40	22.1	8.0	ND	ND	ND	0.13	ND	ND	0.27	**0.027**	0.075	1.64	2.02	140	1.5	0.00069	93
9/2/2014	12:30	22.4	8.1	ND	ND	ND	0.15	ND	ND	0.29	**0.030**	0.052	1.81	2.11	140	1.4	0.00089	70
9/9/2014	12:20	21.1	8.1	0.21	ND	ND	ND	ND	0.21	0.21	**0.026**	0.058	1.53	1.84	130	1.1	0.00084	81
9/16/2014	11:20	21.5	8.0	0.28	ND	ND	ND	ND	0.28	0.28	**0.025**	0.082	1.65	1.95	130	1.2	0.0011	84
9/23/2014	12:20	21.7	7.9	ND	ND	ND	ND	ND	ND	ND	**0.025**	0.068	1.82	2.12	120	1.7	0.0015	89
9/25/2014	12:50	21.8	7.9	0.24	ND	ND	ND	ND	0.24	0.24	**0.031**	0.065	1.56	1.91	130	**2.4**	0.00098	73
9/30/2014	10:50	19.6	7.8	0.21	ND	ND	ND	ND	0.21	0.21	**0.036**	0.094	1.65	2.06	160	0.96	0.0013	73
10/2/2014	11:30	19.3	7.7	ND	ND	ND	0.16	ND	ND	0.18	**0.048**	0.10	1.51	1.95	150	**3.0**	0.00027	64
10/7/2014	11:00	19.0	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.032**	0.08	1.50	1.88	140	**230**	0.00081	60
10/9/2014	10:50	18.3	7.9	ND	ND	0.0009	0.17	ND	ND	0.17	**0.025**	0.06	1.46	1.80	150	1.8	0.00095	75
10/14/2014	11:10	17.9	7.8	ND	ND	ND	ND	ND	ND	0.18	**0.029**	0.085	1.40	1.83	150	2.1	0.00094	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** Total nitrogen is calculated through the summation of the different components of total nitrogen: organic and ammoniacal nitrogen (together referred to as Total Kjeldahl Nitrogen or TKN) and nitrate/nitrite nitrogen.

*** United States Geological Survey (USGS) Continuous-Record Gaging Station

**** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Criteria based on Aggregate Ecoregion III

Total Phosporus: 0.02188 mg/L (21.88 ug/L) ≈ 0.022 mg/L

Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

Table 3-8. 2014 Monte Rio nutrient grab sample results. This site experiences freshwater conditions.

Monte Rio	Time	Temperature	pH	Total Organic Nitrogen	Ammonia as N	Ammonia as N Unionized	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen	Total Nitrogen**	Phosphorus, Total	Total Orthophosphate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids	Turbidity	Chlorophyll-a	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.0400	0.0400	4.2	0.020	0.000050	Flow Rate****
Date		°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	(cfs)
5/15/2014	10:50	21.6	8.3	ND	0.21	0.016	0.12	ND	ND	0.29	**0.048**	0.11	1.49	1.91	180	1.9	**0.0018**	147
5/20/2014	11:00	21.3	8.3	ND	0.070	0.0053	0.12	ND	0.21	0.33	**0.060**	0.12	1.63	2.13	180	**2.7**	**0.0027**	109
5/27/2014	11:10	23.2	8.1	ND	0.070	0.0039	0.13	ND	ND	0.31	**0.057**	0.13	1.68	1.94	170	**3.1**	**0.0037**	85
6/3/2014	11:10	21.6	8.1	ND	ND	ND	0.12	ND	ND	0.30	**0.099**	0.094	1.52	1.85	160	2.1	0.0017	105
6/10/2014	12:00	24.4	8.7	ND	0.070	0.014	ND	ND	ND	0.14	**0.040**	0.1	1.58	2.14	160	1.8	0.00055	106
6/17/2014	9:40	21.9	8.5	ND	ND	ND	ND	ND	ND	0.18	**0.041**	0.11	1.58	1.98	150	1.7	0.00073	96
6/24/2014	10:30	23.3	8.2	ND	ND	ND	ND	ND	ND	0.10	**0.045**	0.12	1.61	1.82	140	1.8	0.0010	94
7/1/2014	10:20	24.4	8.0	ND	ND	ND	ND	ND	ND	0.18	**0.050**	0.13	1.53	1.95	150	**3.1**	**0.0023**	100
7/8/2014	11:30	24.1	8.0	ND	ND	ND	ND	ND	ND	0.14	**0.045**	0.087	1.79	2.25	140	**2.6**	**0.0020**	95
7/15/2014	10:30	24.0	8.0	ND	ND	ND	ND	ND	ND	0.14	**0.044**	0.083	1.77	1.77	150	2.2	**0.0020**	134
7/22/2014	10:50	22.3	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.028**	0.091	1.42	1.28	160	2.2	0.0016	132
7/29/2014	10:40	24.0	8.1	0.21	ND	ND	ND	ND	0.21	0.21	**0.035**	0.098	1.57	2.08	180	1.9	0.0013	96
8/5/2014	10:50	22.5	8.1	ND	ND	ND	0.12	ND	ND	0.30	**0.034**	0.073	0.76	0.81	140	1.6	0.0011	111
8/12/2014	11:30	22.6	8.2	0.21	ND	ND	ND	ND	0.21	0.21	**0.028**	0.068	1.74	2.23	150	1.0	0.00089	105
8/19/2014	12:00	22.8	8.2	ND	ND	ND	ND	ND	ND	0.14	**0.036**	0.072	1.80	2.11	130	1.2	0.00099	87
8/26/2014	12:20	22.1	8.1	0.24	ND	ND	ND	ND	0.24	0.24	**0.027**	0.059	1.63	2.03	140	1.2	0.0011	93
9/2/2014	12:20	23.2	8.0	0.38	ND	ND	0.15	ND	0.38	**0.53**	**0.028**	0.055	1.76	2.11	130	1.4	0.00067	70
9/9/2014	12:00	21.0	8.0	ND	ND	ND	ND	ND	ND	0.14	**0.030**	0.061	1.56	1.86	130	0.82	0.00084	81
9/16/2014	11:10	20.9	8.0	0.52	ND	ND	ND	ND	0.52	**0.52**	**0.025**	0.07	1.58	1.95	140	**2.5**	0.00082	84
9/23/2014	12:00	21.5	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.028**	0.08	1.66	2.11	130	0.95	0.00076	89
9/25/2014	12:30	21.7	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.027**	0.077	1.66	2.07	130	1.1	0.0011	73
9/30/2014	10:30	20.2	7.9	ND	ND	ND	ND	ND	ND	0.10	**0.025**	0.067	1.60	2.07	130	1.3	0.00081	73
10/2/2014	11:20	19.5	7.8	0.24	ND	ND	0.17	ND	0.24	0.25	**0.037**	0.087	1.73	2.13	170	1.3	0.00027	64
10/7/2014	10:40	19.0	7.9	0.21	ND	ND	0.17	ND	0.21	**0.38**	**0.046**	0.1	1.65	2.09	150	**250**	0.0011	60
10/9/2014	10:30	18.9	8.0	ND	ND	ND	0.16	ND	ND	0.16	**0.034**	0.083	1.63	1.99	150	1.1	0.00068	75
10/14/2014	10:50	18.5	7.9	ND	ND	ND	0.17	ND	ND	0.34	**0.034**	0.085	1.49	1.96	140	1.0	0.00082	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** Total nitrogen is calculated through the summation of the different components of total nitrogen: organic and ammoniacal nitrogen (together referred to as Total Kjeldahl Nitrogen or TKN) and nitrate/nitrite nitrogen.

*** United States Geological Survey (USGS) Continuous-Record Gaging Station

**** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Criteria based on Aggregate Ecoregion III

Total Phosporus: 0.02188 mg/L (21.88 ug/L) ≈ 0.022 mg/L

Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

Table 3-9. 2014 Patterson Point nutrient grab sample results. This site experiences freshwater conditions.

Patterson Point	Time	Temperature	pH	Total Organic Nitrogen	Ammonia as N	Ammonia as N Unionized	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen	Total Nitrogen**	Phosphorus, Total	Total Orthophosphate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids	Turbidity	Chlorophyll-a	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.0400	0.0400	4.2	0.020	0.000050	Flow Rate****
Date		°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	(cfs)
5/15/2014	10:30	21.3	8.3	ND	0.21	0.016	0.13	ND	0.32	**0.44**	**0.051**	0.11	1.49	1.87	180	1.9	**0.0018**	147
5/20/2014	10:30	21.6	8.2	ND	0.070	0.0044	0.11	ND	0.21	0.32	**0.055**	0.13	1.64	2.17	190	**2.8**	**0.0024**	109
5/27/2014	10:40	22.7	8.0	ND	0.070	0.003	0.13	ND	0.24	**0.38**	**0.063**	0.15	1.76	1.96	180	**2.4**	**0.0043**	85
6/3/2014	10:50	21.5	8.0	0.24	ND	ND	0.12	ND	0.24	0.37	**0.081**	0.98	1.51	1.87	160	2.2	**0.0021**	105
6/10/2014	11:30	24.2	8.6	0.21	ND	ND	ND	ND	0.21	0.21	**0.034**	0.097	1.32	2.29	170	1.9	0.00092	106
6/17/2014	9:20	21.9	8.5	ND	ND	ND	ND	ND	ND	0.14	**0.046**	0.12	1.62	2.05	170	**3.0**	ND	96
6/24/2014	10:10	24.0	8.2	0.32	ND	ND	ND	ND	0.32	0.32	**0.054**	0.12	1.60	1.94	150	**3.0**	0.001	94
7/1/2014	10:00	24.1	7.9	0.21	ND	ND	0.13	ND	0.21	0.34	**0.054**	0.12	1.54	1.97	160	2.2	0.0013	100
7/8/2014	11:00	23.4	7.8	0.32	ND	ND	0.12	ND	0.32	**0.44**	**0.050**	0.11	1.81	2.18	140	**4.6**	**0.0018**	95
7/15/2014	10:10	23.6	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.044**	0.087	1.34	1.65	150	**2.7**	**0.002**	134
7/22/2014	10:30	22.1	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.030**	0.091	1.55	1.84	150	**2.4**	**0.0022**	132
7/29/2014	10:20	23.8	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.042**	0.094	1.56	2.05	160	**2.8**	0.00096	96
8/5/2014	10:30	22.1	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.041**	0.085	1.34	1.40	140	2.0	0.0011	111
8/12/2014	11:10	22.2	8.1	ND	ND	0.0017	ND	ND	ND	0.18	**0.032**	0.095	1.71	2.10	150	**2.7**	0.00067	105
8/19/2014	11:40	22.3	8.2	0.31	ND	ND	0.12	ND	0.31	**0.43**	**0.049**	0.087	1.75	2.11	130	2.2	0.00079	87
8/26/2014	11:50	21.9	7.9	0.21	ND	ND	0.12	ND	0.21	0.33	**0.029**	0.075	1.60	2.04	140	2.0	0.00059	93
9/2/2014	11:50	22.5	7.9	0.24	ND	ND	0.15	ND	0.24	**0.39**	**0.036**	0.09	1.78	2.19	140	**2.4**	0.0011	70
9/9/2014	11:40	20.6	7.9	ND	ND	ND	ND	ND	ND	0.10	**0.030**	0.065	1.49	1.86	140	0.9	0.00074	81
9/16/2014	10:50	20.9	7.9	0.42	ND	ND	ND	ND	0.42	**0.42**	**0.028**	0.074	1.56	1.95	140	1.5	0.00062	84
9/23/2014	11:30	21.9	7.9	ND	ND	ND	ND	ND	ND	0.14	**0.028**	0.072	1.72	2.15	130	1.0	0.00065	89
9/25/2014	12:20	22.0	7.9	0.21	ND	ND	ND	ND	0.21	0.21	**0.031**	0.069	1.67	2.00	130	1.0	0.0016	73
9/30/2014	10:10	20.1	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.031**	0.071	1.65	2.06	120	0.86	**0.0021**	73
10/2/2014	11:00	19.8	7.8	ND	ND	ND	ND	ND	ND	0.18	**0.036**	0.075	1.58	2.03	99	1.0	0.00095	64
10/7/2014	10:20	18.7	7.9	ND	ND	ND	ND	ND	ND	0.18	**0.043**	0.10	1.95	2.15	160	**250**	**0.0026**	60
10/9/2014	10:10	18.6	8.0	ND	ND	ND	ND	ND	ND	ND	**0.037**	0.099	1.68	2.10	150	1.2	**0.0018**	75
10/14/2014	10:30	18.6	7.9	0.24	ND	ND	ND	ND	0.24	0.24	**0.034**	0.089	1.59	1.97	140	0.68	**0.0018**	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** Total nitrogen is calculated through the summation of the different components of total nitrogen: organic and ammoniacal nitrogen (together referred to as Total Kjeldahl Nitrogen or TKN) and nitrate/nitrite nitrogen.

*** United States Geological Survey (USGS) Continuous-Record Gaging Station

**** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Criteria based on Aggregate Ecoregion III

Total Phosporus: 0.02188 mg/L (21.88 ug/L) ≈ 0.022 mg/L

Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

Table 3-10. 2014 Casini Ranch nutrient grab sample results. This site may experience estuarine conditions.

Casini Ranch	Time	Temperature	pH	Total Organic Nitrogen	Ammonia as N	Ammonia as N Unionized	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen	Total Nitrogen**	Phosphorus, Total	Total Orthophosphate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids	Turbidity	Chlorophyll-a	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.0400	0.0400	4.2	0.020	0.000050	Flow Rate****
Date		°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	(cfs)
5/15/2014	10:00	22.5	8.4	ND	0.07	0.0071	0.12	ND	ND	0.30	**0.058**	0.12	1.78	1.88	190	2.0	0.0011	147
5/20/2014	10:10	22.0	8.4	ND	0.07	0.0068	0.11	ND	ND	0.28	**0.056**	0.12	1.54	2.02	180	**2.5**	**0.002**	109
5/27/2014	10:10	22.3	8.2	0.21	ND	ND	0.13	ND	0.21	0.34	**0.064**	0.14	1.63	2.03	190	2.3	**0.0031**	85
6/3/2014	10:30	21.1	8.1	0.24	ND	ND	0.12	ND	0.24	0.37	**0.081**	0.12	1.61	1.92	160	2.0	0.0014	105
6/10/2014	11:10	22.6	8.9	ND	ND	ND	0.12	ND	ND	0.30	**0.044**	0.11	2.03	1.55	170	1.6	ND	106
6/17/2014	9:00	20.6	8.9	ND	ND	ND	ND	ND	ND	0.14	**0.047**	0.12	1.72	2.11	160	1.0	0.00021	96
6/24/2014	9:50	23.4	8.4	ND	ND	ND	ND	ND	ND	0.18	**0.057**	0.13	2.04	2.36	150	**3.6**	0.0015	94
7/1/2014	9:40	22.4	8.2	0.28	ND	ND	0.12	ND	0.28	**0.40**	**0.058**	0.14	1.61	2.05	150	1.4	0.0014	100
7/8/2014	10:40	22.8	8.0	ND	0.21	0.0097	0.12	ND	0.32	**0.44**	**0.055**	0.11	1.88	2.50	140	1.8	**0.0026**	95
7/15/2014	9:50	24.1	8.2	ND	ND	ND	ND	ND	ND	0.14	**0.050**	0.10	1.77	2.40	140	1.1	0.0013	134
7/22/2014	10:10	23.0	8.4	ND	ND	ND	0.12	ND	ND	0.30	**0.030**	0.091	1.61	1.60	160	1.1	**0.0020**	132
7/29/2014	10:00	24.1	8.4	0.21	ND	ND	ND	ND	0.21	0.21	**0.039**	0.11	1.70	2.24	160	1.4	0.00087	96
8/5/2014	10:10	21.3	8.2	ND	ND	ND	ND	ND	ND	0.18	**0.073**	0.096	1.47	2.03	140	1.3	0.0012	111
8/12/2014	10:50	21.5	8.2	ND	ND	ND	0.13	ND	ND	0.30	**0.032**	0.079	1.69	2.14	140	1.2	0.00067	105
8/19/2014	11:20	22.1	8.6	0.21	ND	ND	ND	ND	0.21	0.21	**0.036**	0.076	1.78	2.20	140	0.81	0.0012	87
8/26/2014	11:20	21.9	8.1	0.24	ND	ND	0.12	ND	0.24	0.37	**0.029**	0.071	1.72	2.15	150	1.5	0.00089	93
9/2/2014	11:20	22.6	8.1	ND	ND	ND	0.15	ND	ND	0.29	**0.030**	0.071	1.84	2.35	140	1.5	0.0010	70
9/9/2014	11:00	20.6	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.032**	0.065	1.55	1.95	150	0.64	0.00074	81
9/16/2014	10:30	21.1	8.2	0.24	ND	ND	ND	ND	0.24	0.24	**0.088**	0.07	1.72	2.06	140	0.82	0.00072	84
9/23/2014	11:00	21.5	8.0	ND	ND	ND	0.17	ND	ND	0.31	**0.032**	0.076	1.81	2.34	120	1.4	0.00076	89
9/25/2014	11:50	22.9	8.0	0.21	ND	ND	ND	ND	0.21	0.21	**0.038**	0.096	1.70	2.11	120	0.64	0.0015	73
9/30/2014	9:50	20.3	8.0	ND	ND	ND	ND	ND	ND	0.14	**0.027**	0.078	1.78	2.25	120	0.79	**0.0019**	73
10/2/2014	10:40	20.4	8.0	ND	ND	0.0013	ND	ND	0.21	0.21	**0.030**	0.067	1.62	2.13	140	0.94	0.00068	64
10/7/2014	10:00	19.4	8.0	0.24	ND	ND	0.17	ND	0.24	**0.42**	**0.049**	0.096	1.95	2.39	160	**250**	**0.0022**	60
10/9/2014	9:50	18.5	8.1	ND	ND	ND	0.17	ND	ND	0.17	**0.042**	0.10	1.92	2.32	160	1.0	**0.0019**	75
10/14/2014	10:10	18.6	8.1	0.28	ND	ND	0.17	ND	0.28	**0.45**	**0.038**	0.093	1.74	2.13	140	0.84	**0.0020**	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** Total nitrogen is calculated through the summation of the different components of total nitrogen: organic and ammoniacal nitrogen (together referred to as Total Kjeldahl Nitrogen or TKN) and nitrate/nitrite nitrogen.

*** United States Geological Survey (USGS) Continuous-Record Gaging Station

**** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Criteria based on Aggregate Ecoregion III

Total Phosporus: 0.02188 mg/L (21.88 ug/L) ≈ 0.022 mg/L

Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

Table 3-11. 2014 Jenner Boat Ramp nutrient grab sample results. Estuarine conditions exist at this site.

Jenner Boat Ramp	Time	Temperature	pH	Total Organic Nitrogen	Ammonia as N	Ammonia as N Unionized	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen	Total Nitrogen**	Phosphorus, Total	Total Orthophosphate	Dissolved Organic Carbon	Total Organic Carbon	Total Dissolved Solids	Turbidity	Chlorophyll-a	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*				0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.0400	0.0400	4.2	0.020	0.000050	Flow Rate****
Date		°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	(cfs)
5/15/2014	9:40	18.4	8.4	ND	0.21	0.013	2.0	ND	0.24	**2.20**	**0.055**	0.13	1.22	1.13	10000	2.2	0.00068	147
5/20/2014	9:40	16.9	8.3	ND	0.070	0.0032	ND	ND	0.24	0.24	**0.056**	0.12	1.06	1.28	11000	**2.4**	0.0011	109
5/27/2014	9:40	18.9	8.1	0.28	0.070	0.0024	ND	ND	0.35	0.35	**0.067**	0.12	1.46	1.51	9700	**2.6**	**0.0079**	85
6/3/2014	10:00	16.2	8.0	0.21	ND	ND	ND	ND	0.21	0.21	**0.067**	0.13	1.09	1.07	11000	**2.7**	**0.0056**	105
6/10/2014	9:40	19.0	8.6	ND	0.10	0.011	ND	ND	0.24	0.24	**0.035**	0.13	1.20	1.03	10000	**2.5**	0.00074	106
6/17/2014	8:40	15.6	8.2	ND	ND	ND	ND	ND	ND	0.10	**0.051**	0.13	0.80	0.94	19000	**2.7**	0.00031	96
6/24/2014	9:20	18.2	8.1	0.49	ND	ND	ND	ND	0.49	**0.49**	**0.110**	0.17	1.19	1.05	16000	**20**	**0.019**	94
7/1/2014	9:20	17.5	8.2	0.21	ND	ND	ND	ND	0.21	0.21	**0.047**	0.088	1.13	0.97	15000	**2.4**	0.0014	100
7/8/2014	10:20	19.0	8.1	0.56	ND	ND	ND	ND	0.56	**0.56**	**0.053**	0.11	1.51	1.45	10000	**5.9**	**0.0019**	95
7/15/2014	9:30	18.2	7.9	0.21	ND	ND	ND	ND	0.21	0.21	**0.055**	0.11	0.46	0.46	600	1.9	0.00093	134
7/22/2014	9:50	19.7	7.9	0.35	ND	ND	ND	ND	0.35	0.35	**0.044**	0.083	1.16	1.01	13000	1.7	**0.0051**	132
7/29/2014	9:40	20.4	8.0	0.32	ND	ND	ND	ND	0.32	0.32	**0.043**	0.086	1.23	1.24	14000	2.1	0.0011	96
8/5/2014	9:50	17.8	7.9	0.28	ND	ND	ND	ND	0.28	0.28	**0.044**	0.085	0.82	0.95	13000	1.5	0.0011	111
8/12/2014	10:30	19.0	7.9	0.24	ND	ND	ND	ND	0.24	0.24	**0.051**	0.10	1.21	1.14	16000	**4.8**	**0.0062**	105
8/19/2014	10:50	18.9	8.0	0.32	ND	ND	ND	ND	0.32	0.32	**0.032**	0.072	1.23	1.16	15000	1.9	0.0012	87
8/26/2014	11:00	19.5	8.0	0.32	ND	ND	ND	ND	0.32	0.32	**0.043**	0.075	1.10	1.04	16000	**3.4**	0.00099	93
9/2/2014	11:00	19.1	8.1	0.28	ND	ND	ND	ND	0.28	0.28	**0.042**	0.059	1.48	1.64	9900	**2.4**	**0.0034**	70
9/9/2014	10:40	18.2	8.1	0.21	ND	ND	ND	ND	0.21	0.21	**0.030**	0.061	1.06	1.03	18000	1.2	0.0012	81
9/16/2014	10:10	18.0	8.1	ND	ND	ND	ND	ND	ND	0.18	**0.029**	0.066	1.01	1.03	16000	1.2	0.00062	84
9/23/2014	10:40	19.2	8.4	ND	ND	ND	ND	ND	ND	0.18	**0.028**	0.044	2.06	2.25	4900	1.6	**0.0027**	89
9/25/2014	11:30	19.5	8.3	0.21	ND	ND	ND	ND	0.21	0.21	**0.033**	0.049	2.18	2.19	3400	0.98	**0.002**	73
9/30/2014	9:20	18.2	8.2	0.24	ND	ND	ND	ND	0.24	0.24	**0.025**	0.055	2.70	2.55	3000	1.2	**0.0037**	73
10/2/2014	10:10	18.3	8.3	0.32	ND	ND	ND	ND	0.32	0.33	**0.030**	0.044	2.33	2.43	4000	1.4	**0.0023**	64
10/7/2014	9:40	18.1	8.2	0.21	ND	0.0014	ND	ND	0.24	0.24	**0.028**	0.044	2.59	2.80	2800	**5100**	**0.0019**	60
10/9/2014	9:30	17.8	8.0	0.28	ND	ND	ND	ND	0.28	0.28	**0.033**	0.06	2.60	2.97	2800	1.1	0.0014	75
10/14/2014	9:50	18.0	8.0	0.32	ND	ND	ND	ND	0.32	0.32	**0.039**	0.061	2.70	2.77	2600	1.1	**0.0034**	86

* Method Detection Limit - limits can vary for individual samples depending on matrix interference and dilution factors, all results are preliminary and subject to final revision.

** Total nitrogen is calculated through the summation of the different components of total nitrogen: organic and ammoniacal nitrogen (together referred to as Total Kjeldahl Nitrogen or TKN) and nitrate/nitrite nitrogen.

*** United States Geological Survey (USGS) Continuous-Record Gaging Station

**** Flow rates are preliminary and subject to final revision by USGS.

Recommended EPA Criteria based on Aggregate Ecoregion III

Total Phosporus: 0.02188 mg/L (21.88 ug/L) ≈ 0.022 mg/L

Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

4.0 Additional Monitoring

4.1 Permanent Datasondes

In coordination with the USGS the Water Agency maintains three, multi-parameter water quality sondes on the Russian River located at Russian River near Hopland, Russian River at Diggers Bend near Healdsburg, and Russian River near Guerneville (aka Hacienda Bridge), . These three sondes are referred to as "permanent" because the Water Agency maintains them as part of its early warning detection system for use year-round. The sondes take real time readings of water pH, temperature, dissolved oxygen content (DO), specific conductivity, turbidity, and depth, every 15 minutes.

In addition to the permanent sondes, the Water Agency, in cooperation with the USGS, installed three seasonal sondes with real-time telemetry at the USGS river gage station at Russian River near Cloverdale (north of Cloverdale at Comminsky Station Road), at the gage station at Russian River at Jimtown (Alexander Valley Road Bridge), and at Johnson's Beach in Guerneville. The two seasonal sondes at Cloverdale and Jimtown are included by the USGS on its "Real-time Data for California" website.

The data collected by the sondes described above are evaluated in Section 4.2 in response to the SWRCB request to evaluate whether and to what extent the reduced flows authorized by the Order caused any impacts to water quality or availability of aquatic habitat for salmonids. In addition, the 2014 data will help provide information to evaluate potential changes to water quality and availability of habitat for aquatic resources resulting from the proposed permanent changes to D1610 minimum instream flows that are mandated by the Biological Opinion. A complete evaluation of the water quality data is being conducted as part of the California Environmental Quality Act (CEQA) analysis associated with proposed permanent changes to D1610.

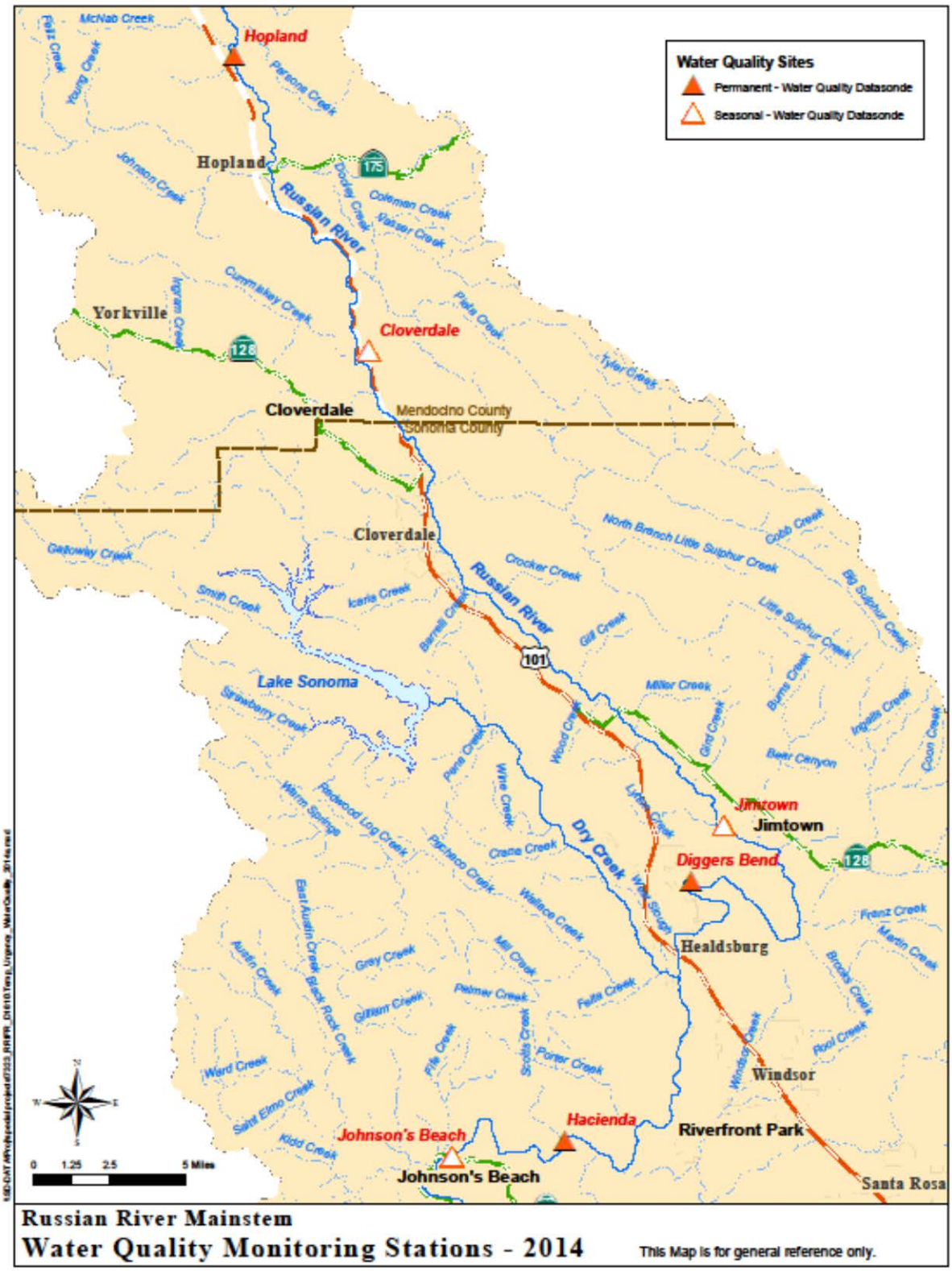

Figure 4-6. 2014 Russian River mainstem water quality monitoring stations sampled by the Sonoma County Water Agency.

4.2 Aquatic Habitat for Salmonids

4.2.1 Introduction

The State Water Resource Control Board (SWRCB) tasked the Water Agency with both fisheries and water quality monitoring and reporting requirements. These tasks included consulting with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Wildlife (CDFW) to develop methodology to monitor freshwater fish in the Russian River and implement the resulting plan. In addition to these tasks the SWRCB required the Water Agency to collect adult fish counts at Dry Creek and report these counts on a weekly and annual basis to NMFS, CDFW, and the SWRCB. Furthermore, The SWRCB tasked the Water Agency with evaluating impacts associated with reductions in minimum instream flows authorized by the Order to water quality and the availability of aquatic habitat for salmonids in the Russian River.

4.2.2 Russian River Salmonid Life Stages

Salmonids in the Russian River can be affected by flow, temperature, and dissolved oxygen (DO) changes at multiple life stages. The Russian River supports three species of salmonids, coho salmon, steelhead, and Chinook salmon. These species follow a similar life history where adults migrate from the ocean to the river and move upstream to spawn in the fall and winter. Females dig nests called redds in the stream substrate on riffles and pool tail crests. As eggs are deposited into the nest they are fertilized by males. The eggs are covered with gravel by the female and the eggs remain in the nest for 8-10 weeks before hatching. After hatching, the larval fish remain in the gravel for another 4-10 weeks before emerging. After emerging from the gravel these young salmonids are identified first as fry and then later as parr once they have undergone some freshwater growth. Parr rear for a few months (Chinook) to 2 years (steelhead) in freshwater before undergoing a physiological change identified as smoltification. At this stage, fish are identified as smolts, and are physiologically able to adapt to living in saltwater, and are ready for ocean entry (Quinn 2005). In the Russian River smolts move downstream to the ocean in the spring (Chase et al. 2005 and 2007, Obedzinski et al. 2006). Salmonids spend 1 to 4 years at sea before returning to the river to spawn as adults (Moyle 2002). Because all life stages of all three species of Russian River salmonids spend a period of time in the Russian River watershed, they must cope with the freshwater conditions they encounter including flow, temperature, and DO. While all three species follow a similar life history, each species tends to spawn and rear in different locations and are present in the Russian River watershed at slightly different times. These subtle but important differences may expose each species to a different set of freshwater conditions.

Coho Timing and Distribution

Wild coho have become scarce in the Russian River and monitoring data relies mainly on fish released from the hatchery as part of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP). Data collected on the Water Agency's Mirabel inflatable dam video camera system in 2011 through 2013 indicate that the adult coho salmon run may start in late October and continue through at least January (SCWA unpublished data). Spawning and rearing occurs in the tributaries to the Russian River (NMFS 2008). Downstream migrant trapping in tributaries of the Russian River indicate that the coho smolt out-migration starts before April and continues through mid-June (Obedzinski et al. 2006). Coho salmon have been detected as late as mid-July in the mainstem Russian River downstream migrant traps

operated by the Water Agency (Martini-Lamb and Manning 2011). For coho, only the temperature and DO data relating to the adult life stage will be analyzed for this report as this is the life stage likely to be present in the Russian River during the time period governed by the Order (August 25, 2014 through February 20, 2015).

Steelhead Timing and Distribution

Based on video monitoring at the Water Agency's Mirabel inflatable dam and returns to the Warm Springs Hatchery, adult steelhead return to the Russian River later than Chinook. Deflation of the inflatable dam and removal of the underwater video camera system preclude a precise measure of adult return timing or numbers; however, continuous video monitoring at the inflatable dam during late fall through spring in 2006-2007, timing of returns to the hatchery, and data gathered from steelhead angler report cards (SCWA unpublished data, Jackson 2007) suggests that although very few adult steelhead may return as early September in some years, the vast majority of returns occur between January and April. Additionally, during coho spawner surveys conducted by the University of California Cooperative Extension (UCCE), steelhead have been observed spawning in tributaries of the Russian River in January, but more often in February and March (Obedzinski 2012).

Many steelhead spawn and rear in the tributaries of the Russian River while some steelhead rear in the upper mainstem Russian River (NMFS 2008, Cook 2003). Cook (2003) found that summer rearing steelhead in the main stem of the Russian River were distributed in the highest concentrations between Hopland and Cloverdale (Canyon Reach). Steelhead were also found in relatively high numbers (when compared to habitats downstream of Cloverdale) in the section of river between the Coyote Valley Dam and Hopland. The Canyon Reach is the highest gradient section of the mainstem Russian River and contains fast water habitats that include riffles and cascades (Cook 2003). Both the Canyon and Ukiah reaches generally have cooler water temperatures when compared to other mainstem reaches.

The steelhead smolt migration in the Russian River begins at least as early as March and continues through June, peaking between mid-March and mid-May (Martini-Lamb and Manning 2011). For Russian River steelhead, adult migratory and parr (rearing) life stages are present in the mainstem during the time period covered by the Order. Therefore only the temperature and DO data relating to the adult life stage and juvenile rearing will be analyzed for this report.

Chinook Timing and Distribution

Based on video monitoring at the Water Agency's Mirabel inflatable dam, adult Chinook are typically observed in the Russian River before coho and steelhead. Chinook enter the Russian River as early as September, but are typically not present in high numbers until mid-October. Generally the Chinook run peaks between mid-October and mid-November and is over in late December (Chase et al. 2005 and 2007, Martini-Lamb and Manning 2011). Chinook are mainstem spawners and deposit their eggs into the stream bed of the mainstem Russian River and in Dry Creek during the fall (Chase et al. 2005 and 2007, Cook 2003, Martini-Lamb and Manning 2011). Chinook offspring rear for approximately two to four months before out-migrating to sea in the spring. Based on downstream migrant trapping data Chinook smolts are present as early as march and the majority of the Chinook smolt out-migration appears to be complete by mid to late June (Chase et al. 2005 and 2007, Martini-Lamb and Manning 2011). The adult migratory life stage is present in the mainstem of the Russian River during the time period covered by the Order. Therefore, only the temperature and DO data relating to the adult life

stage will be analyzed for this report as this is the life stage likely to be present in the Russian River during the time period governed by the Order.

4.2.3 Methods

The Water Agency uses, underwater video, and dual frequency identification sonar (DIDSON), and water quality data collected in the Russian River and Dry Creek to summarize Russian River water quality conditions when salmonids where present. The Water Agency operates underwater video cameras and DIDSON to enumerate adult salmonids. USGS stream gages were used to provide water quality data in the mainstem Russian River.

Typically the Water Agency operates an underwater video camera system at Mirabel to estimate the number of adult Chinook that return to the Russian River. However, a large construction project to improve fish passage at Mirabel in 2014 precluded us from operating an underwater camera system at this site. Instead the Water Agency relied on adult counts from a DIDSON paired with an underwater video camera at Dry Creek (a tributary to the Russian River near Healdsburg). The DIDSON collects sonar images of fish as they pass the sample site. This allows us to count fish that would be too distant for an underwater camera to collect images of fish during periods of high turbidity when an underwater camera would be ineffective. The resolution of DIDSON often precludes the accurate identification of species. When conditions permitted we operated an underwater video camera at this site in combination with the DIDSON in order to determine the species composition of fish passing the Dry Creek site. This allowed us to prorate DIDSON counts at Dry Creek. In addition to operating a DIDSON at Dry Creek the Water Agency experimented with an underwater video camera in a fish ladder at Memorial Beach near Healdsburg. This site is located on the mainstem Russian River upstream of Dry Creek. Data from these monitoring site were used to determine when adult salmonids were present in the Russian River during 2014-15.

Physical habitat conditions (flow, water temperature, and DO) were collected at multiple sites in the Russian River. USGS stream gages located on the Russian River at Hacienda, Diggers Bend, Jimtown, and Hopland provided flow, water temperature, and DO data. These water quality conditions were compared to findings in the literature and were used to construct temperature and DO criteria for Russian River salmonids (Table 4-1).

Adult salmonid counts are used to relate water quality conditions to the timing and magnitude of the adult salmonid run. We compared adult counts from counting stations with water quality information only where fish would either pass through a water quality station before or after being detected at a particular counting station. For instance since Hacienda is downstream of both Dry Creek and Healdsburg all adult salmonids observed at these sites must first pass through the Hacienda water quality station. Therefore displaying Dry Creek and Healdsburg adult salmonid counts with Hacienda water quality conditions allows us to relate the timing and magnitude of the adult salmonid run to water quality conditions they likely experienced at Hacienda. Fish counted at Dry Creek are destined to spawn in Dry Creek and will not experience the conditions at water quality stations in the mainstem Russian River upstream of Dry Creek (Diggers Bend, Jimtown, and Hopland). Adult salmonids passing Healdsburg are destined to spawn in the upper mainstem Russian River and may swim past Diggers Bend, Jimtown, and Hopland stations on their way to spawning grounds. Therefore we relate only Healdsburg adult salmonid counts to water quality collected at the Diggers Bend, Jimtown, and Hopland stations.

Because the Majority of steelhead rearing habitat in the mainstem Russian River occurs upstream of Hopland this report presents the water quality data from the USGS Hopland gaging station when discussing juvenile steelhead.

Table 4-1. Temperature and dissolved oxygen thresholds used for ranking observed estuarine water quality for rearing salmonids in 2010. Temperature thresholds are based on Sullivan et al. (2000) and NCRWQCB (2000).The Order only applies to the Mainstem Russian River and not its tributaries.

Quality	Maximum weekly average temperature (˚C)	Dissolved oxygen (mg/l)
Excellent	13-17	7-12
Good	17-19	5-7
Poor	19-24	3-5
Very poor	>24	<3

4.2.4 Results

Flow

Flow in the Russian River was generally controlled by reservoir releases from the beginning of the Order on August 24, 2014 to the first major storm event on November 20, 2014. Flows in the Russian River were mainly the result of natural runoff starting with the storm on November 20 through the end of the Order on February 20, 2015. Flow generally remained slightly below 100 cfs at Hacienda during the beginning of the order. From August 25, 2014 to late November flow in the Russian River at Hacienda ranged from approximately 60 cfs to approximately 150 cfs. A major storm event in early December elevated stream flows at Hacienda to 40,500 cfs (instantaneous maximum) on December 12, 2014 and a second major storm event in early February elevated stream flows to 25,000 cfs (instantaneous maximum) on February 7, 2015. These two storm events required us to remove our monitoring equipment from the stream. On December 3, 2014 we removed the underwater video cameras from Dry Creek and the Russian River. On December 11, we removed the DIDSON from Dry Creek. We reinstalled the DIDSON on December 29, 2014, but elevated turbidity precluded us from reinstalling either of the underwater video camera systems. We were not able to operate the DIDSON from February 6, 2015 through February 18, 2015 due to another storm event (Figure 4-1). This report only summarizes data through February 1, 2015.

Adult salmonids including Chinook were observed migrating past the adult counting stations at Dry Creek and on the mainstem Russian River at Healdsburg during the order. Adult salmonids were frequently observed at these monitoring sites in November when stream flow was still controlled by reservoir releases. Prior to late October, few salmonids were observed but this is mainly attributed to the mouth of the Russian River being closed from September 17, 2014 to October 22, 2014. Prior to the breach that occurred on October 23, 2014 only 3 salmonids had been observed at the counting stations operated by the Water Agency. The river mouth closed again on October 24, 2014 and remained closed

for 25 days. During this time, a total of 321 adult salmonids were observed at the counting station. The first of these fish were observed at the counting stations the day following the breach. This suggests that flow was adequate for adult salmonid passage from the mouth of the river upstream to at least the location of the adult counting station – a distance of approximately 50 river km. During this time period (October 23, 2014 through November 22, 2014) flow in the river was mainly controlled by reservoir releases (Figure 4-2).

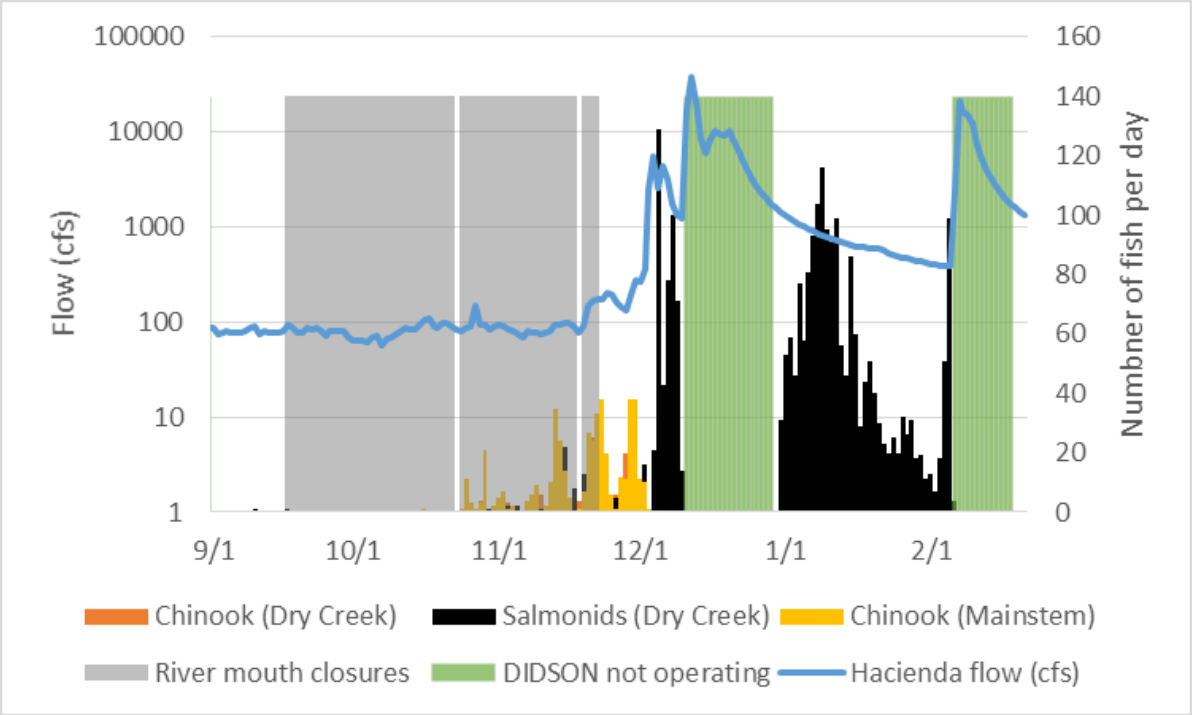

Figure 4-2. Flow in the Russian River gaged at the USGS Hacienda stream gage for the period of the Order shown with the period of time that the mouth of the Russian River was closed due to the formation of a sand bar. Also shown are adult Chinook counts from video collected at Healdsburg on the mainstem Russian River and adult Chinook and salmonid counts from video and DIDSON collected on Dry Creek and the period of time that the DIDSON was not operating.

Temperature

Temperature was relatively warm for salmonids during the beginning of the order, but salmonids were not present until later in the order when temperature was generally good to excellent. At Hacienda average daily water temperature ranged from a high of 22.5 °C to a low of 9.1 °C during the period of the order. Few salmonids were observed in the Russian River prior to October 23, 2014. During the period of time following the beach on October 23 to the end of the Order the average daily water temperature at Hacienda ranged from a high of 17.6 °C to a low of 9.1 °C (Figure 4-3). This temperature range is considered good to excellent for salmonids based on Sullivan et al. (2000) and NCRWQCB (2000).

At Diggers Bend near Healdsburg, water temperature was relatively warm for salmonids in the early part of the order but was generally favorable for salmonids for the remainder of the Order. Average daily water temperature at the USGS Diggers Bend stream gage ranged from a maximum of 24.9 °C to a minimum of 9.1 °C during the Order. Few salmonids were present prior to breaching the mouth of the Russian River on October 23, 2014. For the time period following this breach to the end of the Order,

the average daily water temperature at Diggers Bend ranged from a maximum of 18.8 °C to a minimum of 9.1 °C (Figure 4-4). According to the literature, this temperature range is good to excellent for salmonids Sullivan et al. (2000) and NCRWQCB (2000).

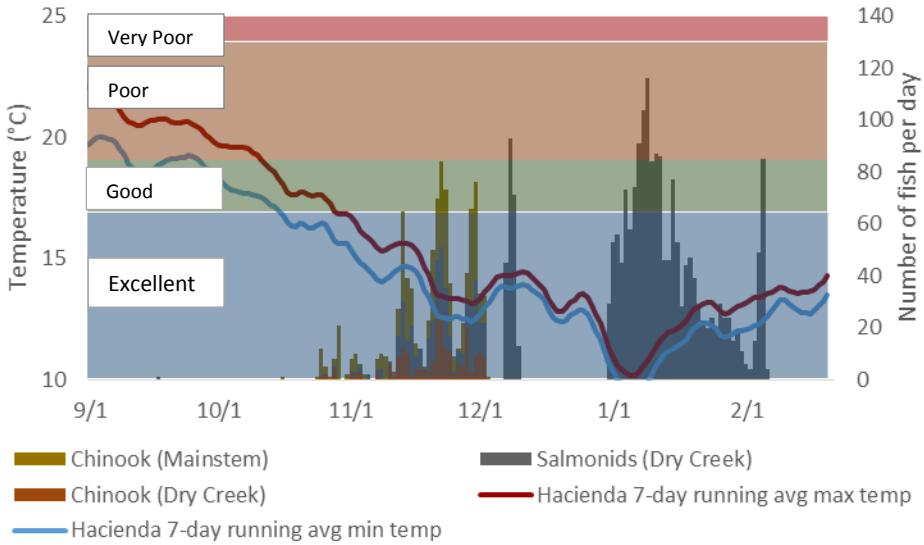

Figure 4-3. The 7-day running average of the minimum and maximum water temperatures collected at Hacienda shown with the Chinook counts from the mainstem Russian River and Chinook and salmonid counts from Dry Creek. Also shown are the excellent, good, poor, and very poor water temperature thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

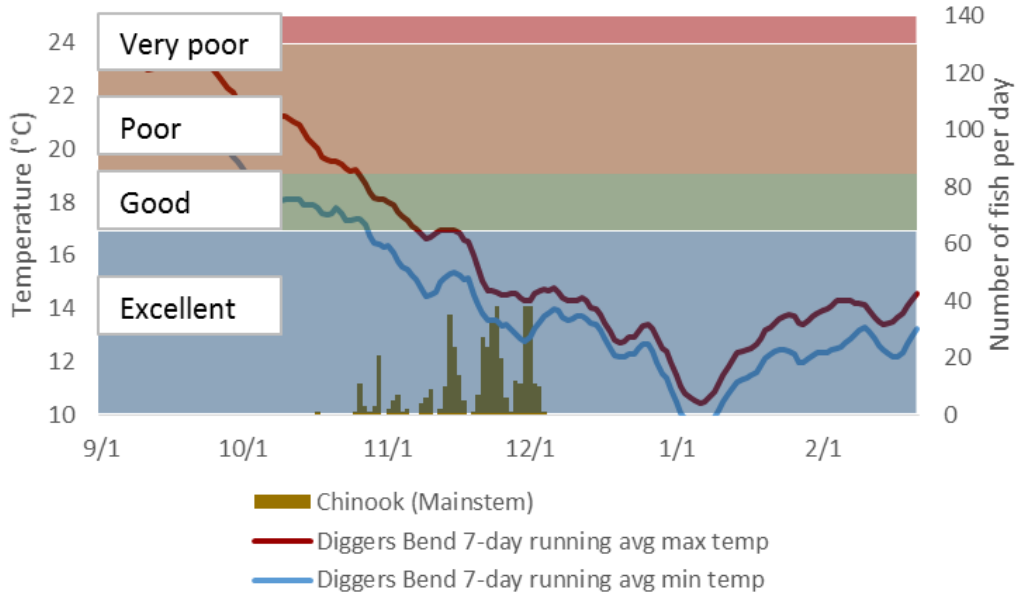

Figure 4-4. The 7-day running average of the minimum and maximum water temperatures collected at Diggers Bend shown with the Chinook counts from the mainstem Russian River. Also shown are the excellent, good, poor, and very poor water temperature thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

Water temperature collected at the USGS gage near Jimtown only exists for the early part of the record and ranges from poor to excellent conditions for salmonids. During the period of time that water temperature was recorded for Jimtown (October 1, 2014 to October 31, 2014) average daily water

temperatures ranged from a maximum of 21.8 °C to 15.7 °C (Figure 4-5). It is worth noting that data from this gage is missing for most of the time period when adult salmonids were present in the Russian and based on nearby gages, water temperatures were likely favorable for salmonids during this time period.

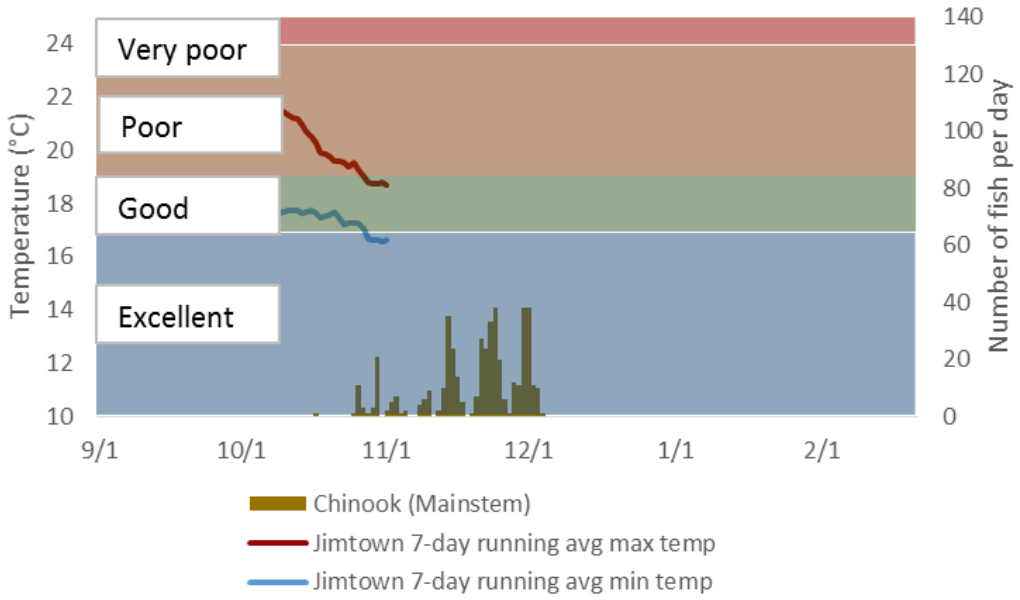

Figure 4-5. The 7-day running average of the minimum and maximum water temperatures collected at the USGS gage near Jimtown shown with the Chinook counts from the mainstem Russian River. Also shown are the excellent, good, poor, and very poor water temperature thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

At Hopland water temperatures conditions for salmonids ranged from poor to excellent during the period of the order. The majority of the time water temperatures at Hopland ranged from good to excellent with the poor conditions only occurring in the early portion of the Order. The average daily water temperature at Hopland ranged from 22.6 °C to 8.3 °C during the order. Few adult salmonids were present in the Russian River prior to breaching the mouth of the Russian River on October 23, 2014. For the time period following this breach to the end of the Order the average daily water temperature at Diggers Bend ranged from a maximum of 18.8 °C to a minimum of 9.1 °C (Figure 4-6). Cold water released from the bottom of Lake Mendocino typically makes the section of river between Cloverdale and Lake Mendocino favorable for juvenile salmonids throughout the summer. However these conditions did not likely persists throughout the summer as storage in Lake Mendocino was unusually low due to drought conditions and the cold water pool in Lake Mendocino was likely depleted during the summer (Figure 2-1).

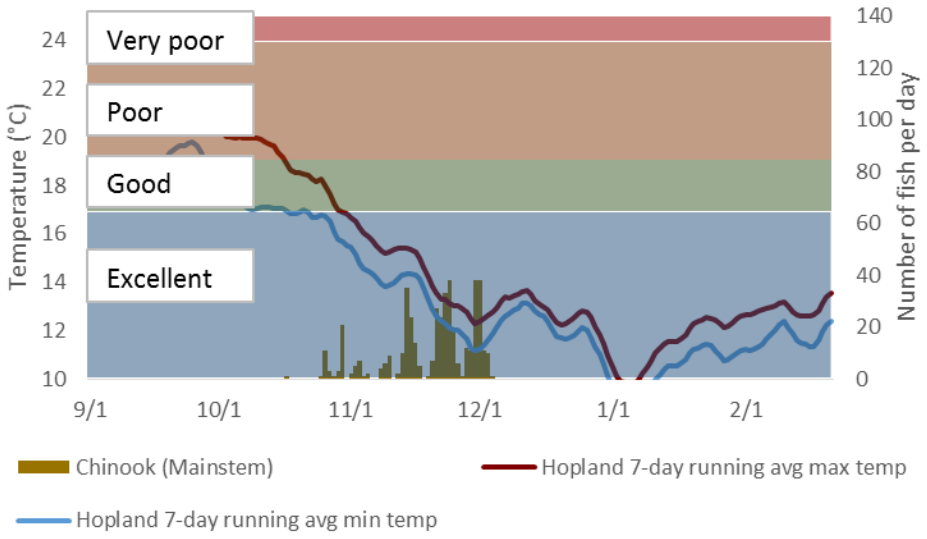

Figure 4-6. The 7-day running average of the minimum and maximum water temperatures collected at the USGS gage near Hopland shown with the Chinook counts from the mainstem Russian River. Also shown are the excellent, good, poor, and very poor water temperature thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

Dissolved Oxygen

Dissolved oxygen was generally favorable for salmonids in the Russian River through the Order. At Hacienda, the average daily dissolved oxygen ranged from a 7.6 mg/L to 12.2 mg/L (Figure 4-7). Dissolved oxygen levels in this range are considered excellent for salmonids based on Sullivan et al. (2000) and NCRWQCB (2000).

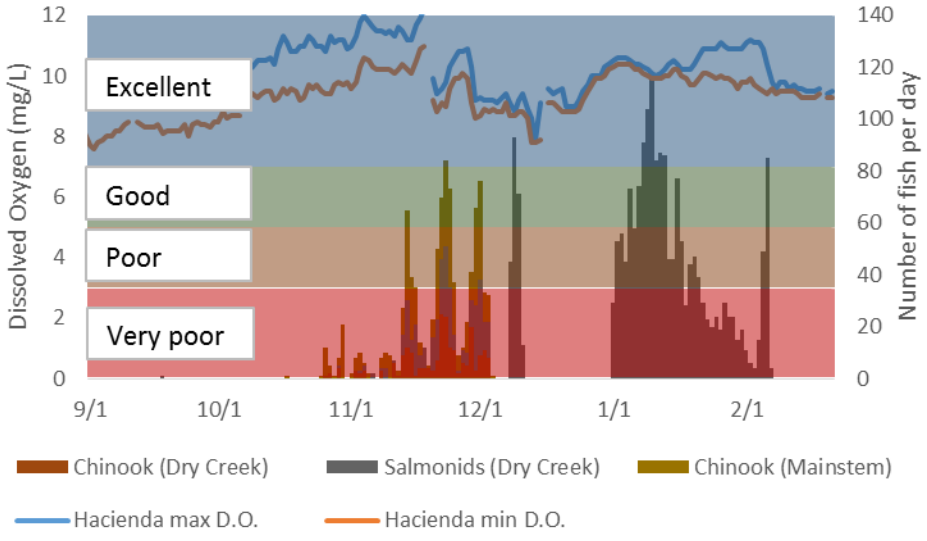

Figure 4-7. The 7-day running average of the minimum and maximum dissolved oxygen collected at Hacienda shown with the Chinook counts from the mainstem Russian River and Chinook and salmonid counts from Dry Creek. Also shown are the excellent, good, poor, and very poor dissolved oxygen thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

Dissolved oxygen levels at Diggers Bend were favorable for salmonids throughout the Order. Dissolved oxygen levels at the USGS stream gage at Diggers Bend ranged from 6.1 mg/L to 12.4 mg/L (Figure 4-8).

Dissolved oxygen levels in this range are considered good to excellent based on Sullivan et al. (2000) and NCRWQCB (2000).

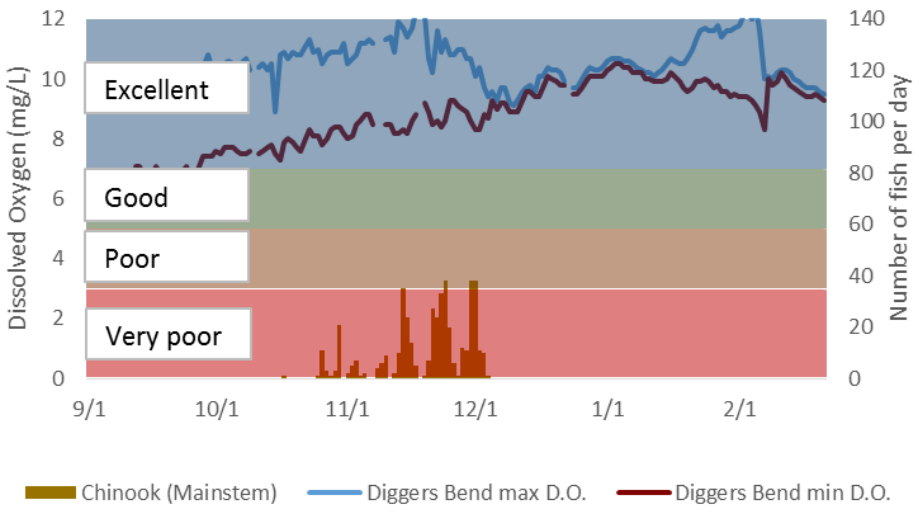

Figure 4-8. The 7-day running average of the minimum and maximum dissolved oxygen collected at the USGS stream gage near Diggers Bend shown with the Chinook counts from the mainstem Russian River. Also shown are the excellent, good, poor, and very poor dissolved oxygen thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

The period of record at the USGS stream gage at Jimtown only extends for a portion of the Order, but dissolved oxygen levels were favorable for salmonids. At Jimtown the average daily dissolved oxygen ranged from a 6.2 mg/L to 12.2 mg/L during the period of the order and when salmonids were present in the Russian River (Figure 4-9). Dissolved oxygen levels in this range are considered good to excellent for salmonids based on Sullivan et al. (2000) and NCRWQCB (2000).

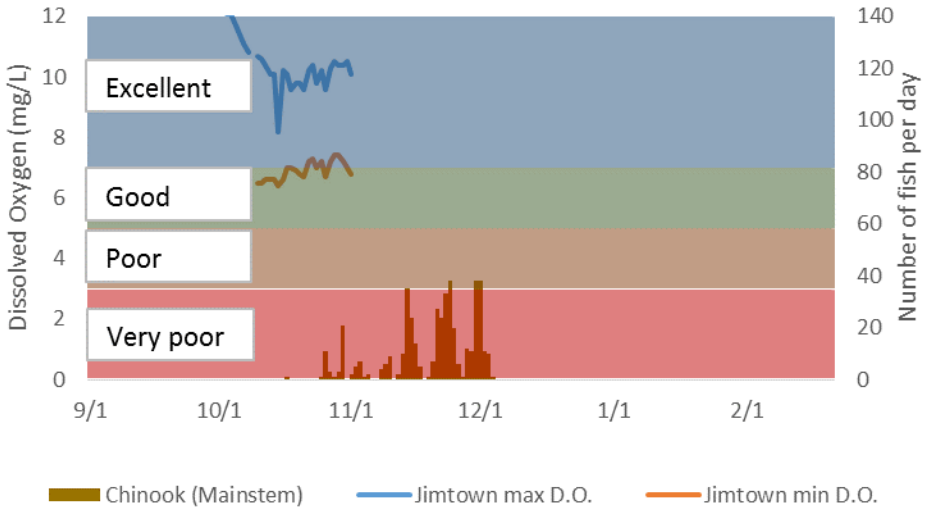

Figure 4-9. The 7-day running average of the minimum and maximum dissolved oxygen collected at the USGS stream gage near Jimtown shown with the Chinook counts from the mainstem Russian River. Also show are the excellent, good, poor, and very poor dissolved oxygen thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

Dissolved oxygen levels at Hopland where favorable for salmonids throughout the Order. Dissolved oxygen levels at the USGS stream gage at Hopland ranged from 7.3 mg/L to 11.8 mg/L (Figure 4-10). Dissolved oxygen levels in this range are considered excellent based on Sullivan et al. (2000) and NCRWQCB (2000).

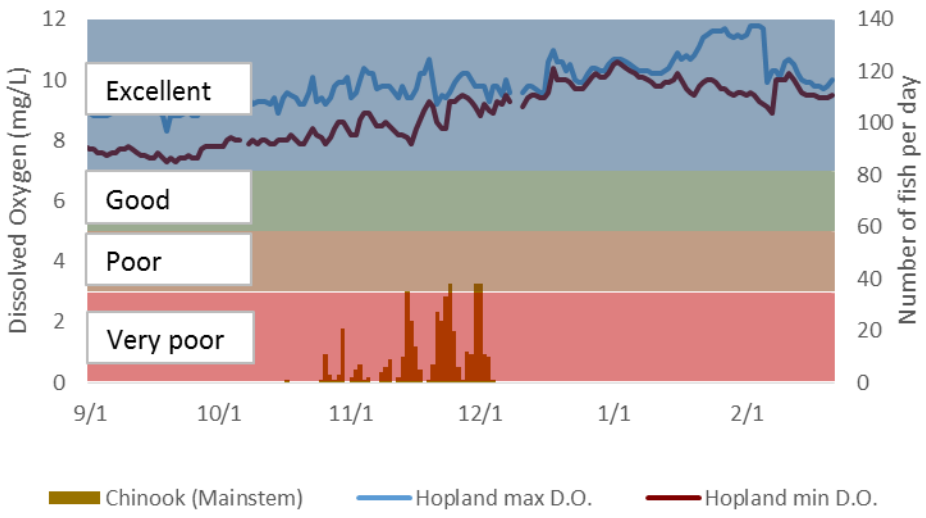

Figure 4-10. The 7-day running average of the minimum and maximum dissolved oxygen collected at the USGS stream gage near Hopland shown with the Chinook counts from the mainstem Russian River. Also show are the excellent, good, poor, and very poor dissolved oxygen thresholds based on Sullivan et al. (2000) and NCRWQCB (2000). See Table 4-1 for a description of water quality zones.

4.2.5 Summary

Flow in the Russian River was generally sufficient to allow for Chinook passage during the Order. The Chinook run in 2014 occurred later in the year relative to other years due to a sand bar forming at the mouth of the Russian River during most of the fall. Once Chinook had access to the river they were observed the following day at the adult counting stations located approximant 50 river km upstream of the river mouth. Chinook were observed at these counting stations for a 26 day period when the flow was controlled by reservoir releases. This suggest that flow was sufficient to allow for Chinook passage during the Order.

Water quality conditions in the Russian River were generally favorable for salmonids during the Order and particularly in the later portion of the order when adult salmonids were present in the river. Water temperatures were often poor during the beginning of the order, this likely affected juvenile steelhead that often rear in the section of the Russian River between Cloverdale and Lake Mendocino. Normally Lake Mendocino releases make this section of river relatively cool in the summer, however during the summer and early fall 2014 upper river water temperatures were warm due to low lake levels. It is important to note that steelhead rear in many of the tributaries to the Russian River and these fish would not be affected by the conditions in the upper Russian River. During the period of time that adult salmonids were observed at the counting stations water temperature was generally good to excellent. Dissolved oxygen was good to excellent for salmonids at the Hacienda, Diggers Bend, Jimtown, and Hopland USGS stream gages.

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