Russian River Water Quality Summary
For the
Sonoma County Water Agency
2012 Temporary Urgency Change

Prepared by

Sonoma County Water Agency

March 2013

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1.0 INTRODUCTION

On April 5, 2012, the Sonoma County Water Agency (Water Agency) petitioned the State Water Resources Control Board (SWRCB) to temporarily reduce minimum in-stream flows in the Russian River as required by the National Marine Fisheries Service's (NMFS) *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation District in the Russian River Watershed* (Russian River Biological Opinion, NMFS 2008).

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

- From May 1 through October 15, 2012, 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) be reduced from 185 cubic feet per second (cfs) to 125 cfs. The minimum instream flow requirement for the upper Russian River will be implemented as a 5-day running average of average daily stream flow measurements, with the stipulation that instantaneous stream flows will be no less than 110 cfs.

- From May 1 through October 15, 2012, in-stream flow requirements for the lower Russian River (downstream of its confluence with Dry Creek) be reduced from 125 cfs to 70 cfs with the understanding that the Water Agency will typically maintain approximately 85 cfs at the Hacienda gage as practicably feasible.

The SWRCB issued an Order (Order) approving the Water Agency's Temporary Urgency Change Petition (TUCP) on May 2, 2012. The Order included several terms and conditions, including requirements for the preparation of a water quality monitoring plan (Term 8). The Water Agency submitted a plan to meet the requirements of Term 8 on May 29, 2012. This report provides and summarizes all data collected during the 2012 water quality monitoring program as required by Term 9 of the Order.

2.0 2012 RUSSIAN RIVER FLOW SUMMARY

As described in the Order, the Water Agency requested temporary changes to D1610 in-stream flow requirements including reductions from 185 cfs to 125 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 125 cfs to 70 cfs in the lower Russian River (downstream of its confluence with Dry Creek). The purpose of the 2012 Temporary Urgency Change (TUC) was to comply with the Biological Opinion which found that stream velocities under D1610 flows reduced the amount of available summer rearing habitat in the upper mainstem of the Russian River.

Late rains allowed sufficient inflow into Lake Pillsbury to classify 2012 as a Normal year under D1610. Storage in Lake Mendocino, while below conditions experienced in 2010 was well above 2009 conditions (Figure 2-1).

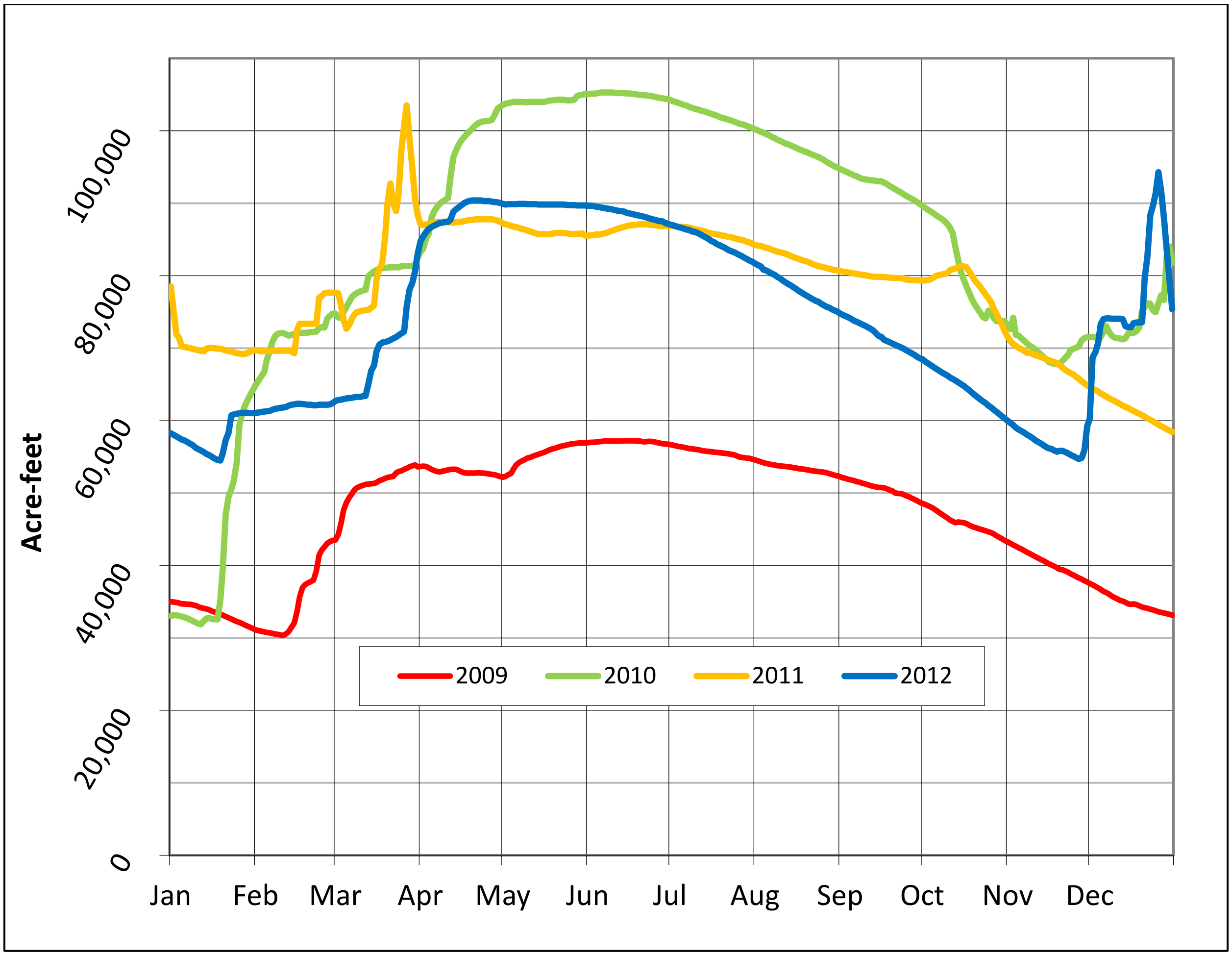

Figure 2-1. 2009 – 2012 Lake Mendocino Storage Levels

Despite the reduced Coyote Valley Dam releases authorized by the Order, flows were above D1610 minimum flows in some sections of the Russian River from tributary inflow due to a relatively wet spring. A moderate demand season allowed stable releases from Lake Mendocino. 2012 flows are shown in Figure 2-2.

In the section of the Russian River from Ukiah to the mouth of Dry Creek (upper Russian River) flows dropped below D1610 minimum flow requirements and the five-day running average flow of 125 cfs, but did not drop below the instantaneous flow of 110 cfs authorized by the TUC Order. Flows in the upper Russian River above the Dry Creek confluence were below 185 cfs from May 11 to October 15 at Hopland, including one day with flows below 125 cfs. Flows did not drop below 185 cfs at Digger's Bend until early June, but stayed under through the remainder of the Order. Flows at Digger's Bend were also observed to drop below the five-day running average of 125 cfs for several days throughout the Order, but did not drop below the instantaneous flow of 110 cfs (Figure 2-3).

Flows in the lower Russian River at Hacienda (downstream of the confluence with Dry Creek) dropped below D1610 minimum flow requirements from late June through early October, but remained higher than TUC minimum flows during the entire period of the Order (Figure 2-4).

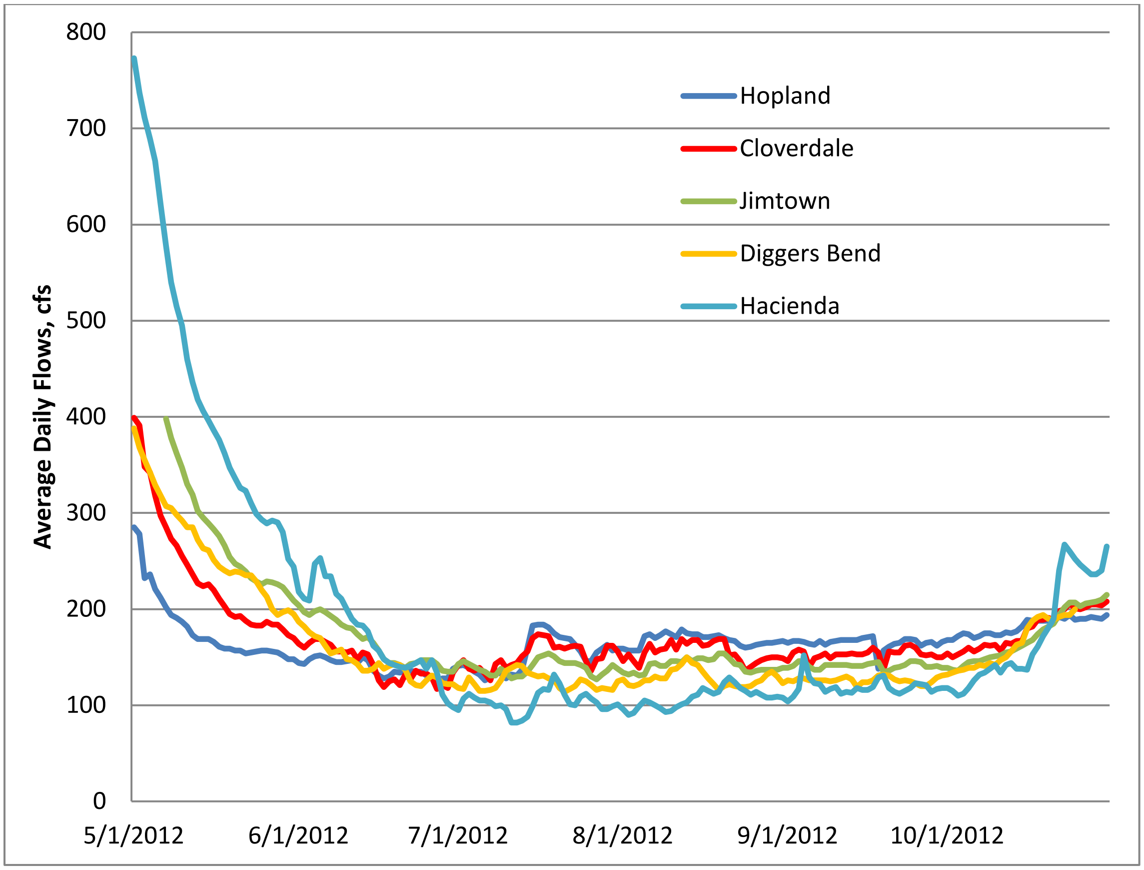

Figure 2-2. 2012 Average Daily Flows USGS Russian River gages, cubic feet per second (cfs)

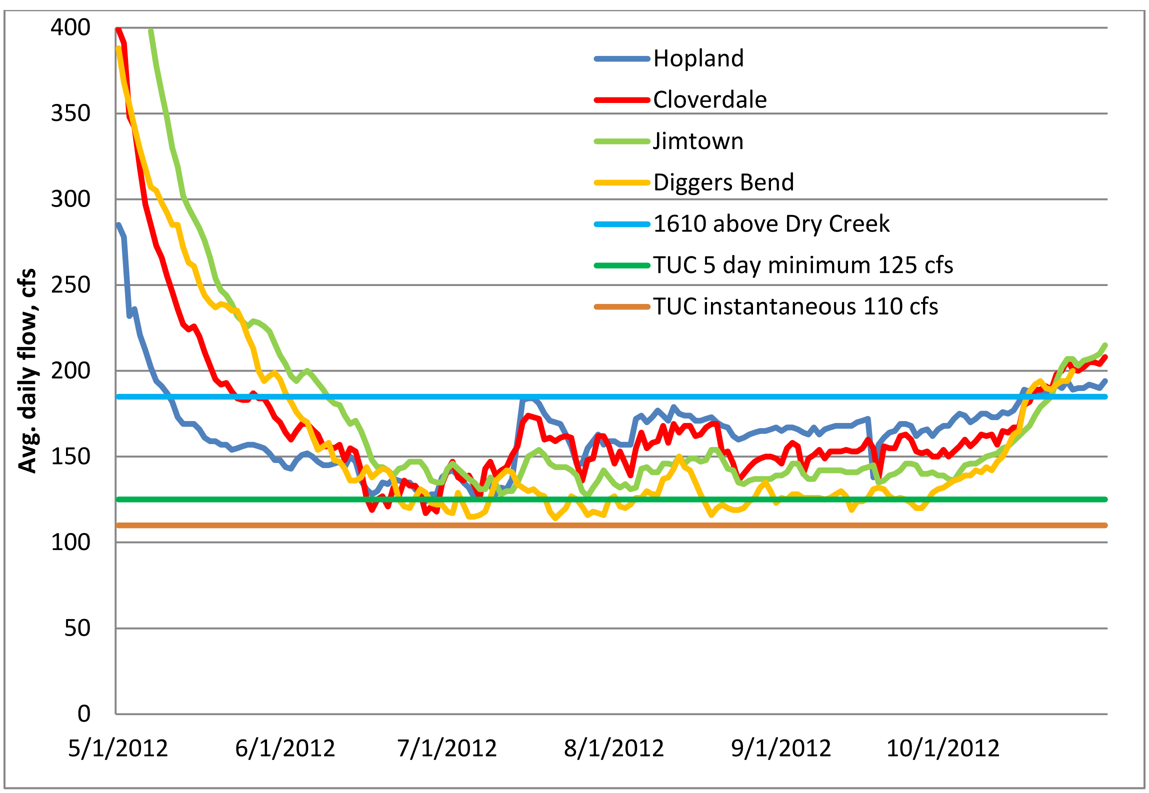

Figure 2-3. 2012 Average Daily Flows USGS Russian River gages above Dry Creek confluence, cfs

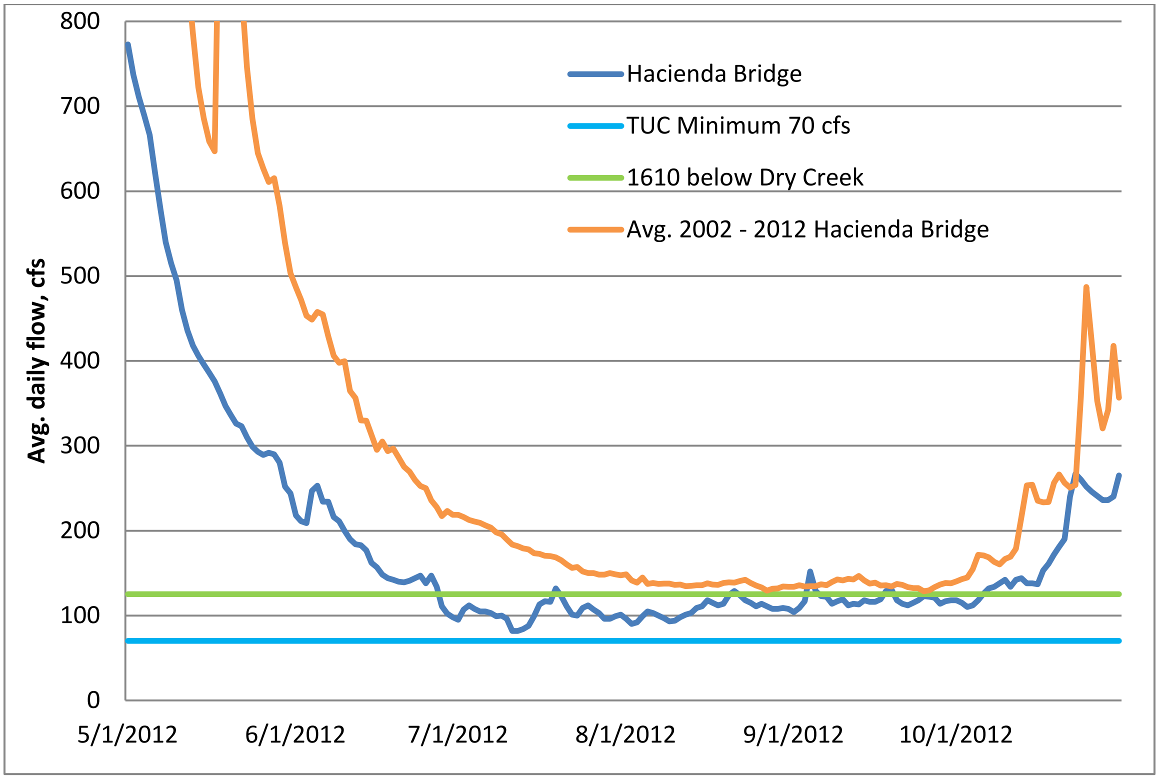

Figure 2-4. 2012 Average Daily Flows USGS Russian River gages below Dry Creek confluence, cfs

3.0 WATER QUALITY MONITORING

The collection of water quality data was conducted 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 in-stream flows that are mandated by the Biological Opinion. A complete analysis and evaluation of the water quality data is being conducted as part of the CEQA requirements associated with establishing permanent changes to D1610 and management of the estuary.

3.1 Mainstem Russian River Water Quality Monitoring

Several agencies conducted water quality monitoring in the mainstem of the Russian River during the term of the Order. From May 21 through August 29, the NCRWQCB conducted weekly bacteriological sampling in cooperation with the Sonoma County Department of Health Services (DHS) at beaches that experience recreational activities involving the greatest body contact. To support the analysis and evaluation of water quality data needed for the CEQA requirements as noted above, the Water Agency conducted weekly bacteriological, nutrient and algal mainstem sampling from May 24 through October 11.

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. The CDPH draft guideline for single sample; total coliform is 10,000 most probable numbers (MPN) per 100 milliliters (ml), 235 MPN per 100 ml for *e coli* and the MPN for Enterococcus is 61 per 100 ml. Exceedances of the draft guidance are highlighted in Table 3-1. However, it must be emphasized that these are draft guidelines, not adopted standards, and are therefore both subject to change (if it is determined that the guidelines are not accurate indicators) and are not currently enforceable. In addition, these draft guidelines were established for and are only applicable to fresh water beaches. Currently, there are no numeric guidelines that have been developed for estuarine areas. However, the EPA recommended freshwater criteria for Nutrients, Chlorophyll a, and Turbidity in Rivers and Streams in Aggregate Ecoregion III are used throughout for comparative purposes, with exceedances highlighted in Tables 3-2 to 3-8.

3.1.1 2012 Water Agency Mainstem Water Quality Sampling

Water samples were collected from the following six (6) surface-water sites in the mainstem of the Russian River and as shown on Figure 3-1: Hopland; Comminsky Station; Jimtown Bridge; Diggers Bend; Riverfront Park; and Hacienda.

All samples were analyzed for nutrients, chlorophyll *a*, standard bacterial indicators (total coliforms, *E. coli* and enterococci), total and dissolved organic carbon, turbidity, and total dissolved solids. 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). The decision to focus on *E. coli* and enterococcus for the analysis of potential water quality impacts and not total coliform concentrations was done in coordination and consultation with Regional Board staff. Duplicate samples of all constituents were taken at Hacienda, and triplicate samples were taken for bacteria at Hacienda and Jimtown Bridge.

Bacteria analysis for the Water Agency was conducted by the Sonoma County DHS Public Health Division Lab in Santa Rosa. *E. coli* and total coliform were analyzed using the Colilert method and enterococcus was analyzed using the Enterolert method. Table 3-1 and Figures 3-2 and 3-3 summarize the bacteria data collected during the term of the Order. Rather than plot the duplicate and triplicate results, the most conservative set of results was plotted for samples collected at Jimtown and Hacienda.

Based upon the CDPH guidance for fresh water beaches, Enterococcus exceedances varied throughout the term of the Order with several exceedances being observed at Hopland and Digger's Bend beginning in July and recurring throughout the rest of the order. A few exceedances were also observed late in the season at Jimtown Bridge. There were no exceedances of the CDPH guidelines for *E. coli* at any of the mainstem sites throughout the term of the Order. Nutrient results at Hopland and Comminsky Station predominantly exceeded the EPA criteria for Total Phosphorous and Total Nitrogen. Turbidity results at these two stations also exceeded recommended EPA criteria throughout the duration of the Order. Algal results were also frequently exceeded at these two stations, though not as often as turbidity or Total Phosphorus. Jimtown Bridge experienced exceedances of the nutrient and algal criteria, but to a lesser degree than the two upstream stations and did not have any exceedances of the turbidity criteria. Digger's Bend and Riverfront Park had a few exceedances of the nutrient criteria, but did not exceed the turbidity or algal criteria at all during the monitoring period. Finally, Hacienda had several exceedances of the Total Phosphorus criteria early in the season, but then had non-detect results from early July until early October and remained under the recommended criteria for the rest of the Order. Hacienda also did not have any exceedances of the turbidity or algal criteria. See Tables 3-2 through 3-8.

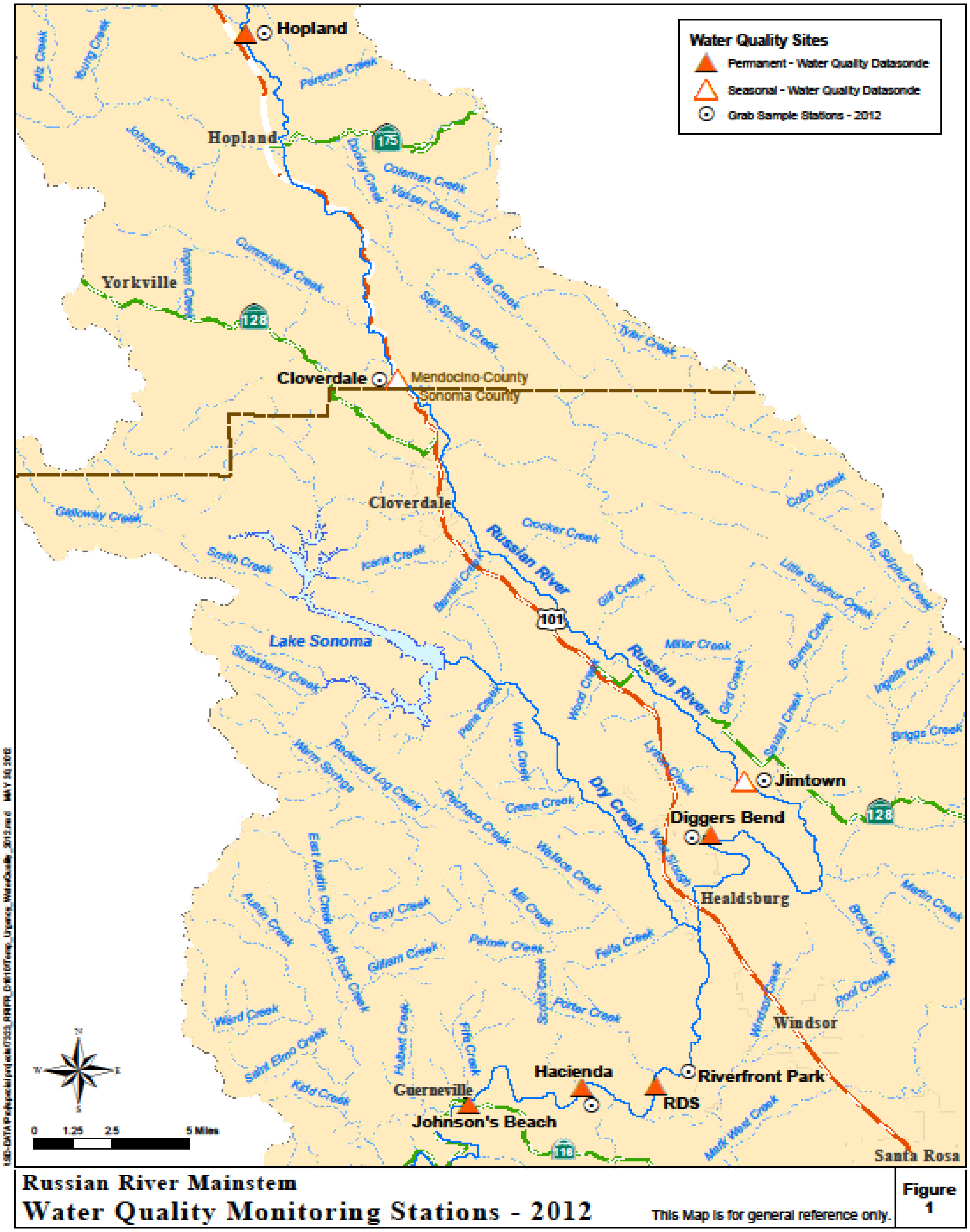

Figure 3-1. 2012 Water Agency Sample Site Locations

Table 3-1. Bacteria concentrations for samples collected by the Water Agency. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

Hopland	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11462500 RR Near Hopland***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	14.4	7.5	>2419.8	69.1	24.6	156
5/31/2012	15.3	7.5	>2419.6	61.3	33.6	148
6/7/2012	14.1	7.6	1413.6	75.9	32.7	147
6/14/2012	15.2	7.4	2419.6	52.9	45.0	147
6/21/2012	15.3	7.7	>2419.6	47.1	47.4	137
6/28/2012	14.6	7.5	2419.6	48.0	30.1	128
7/5/2012	15	7.6	>2419.6	54.8	**67**	132
7/12/2012	15.3	7.5	>2419.6	50.4	**105.4**	131
7/19/2012	14.5	7.8	1119.9	44.3	59.4	175
7/26/2012	15.0	7.8	1553.1	83.9	**121.1**	146
8/2/2012	14.7	7.8	920.8	71.2	**83.9**	157
8/9/2012	13.9	7.8	1203.3	64.4	**75.4**	177
8/16/2012	14.4	7.8	1553.1	25.9	43.7	171
8/23/2012	14.7	7.8	2419.6	42.2	**64.4**	162
8/30/2012	13.9	7.8	1553.1	52.0	60.2	166
9/6/2012	14.0	7.9	1046.2	39.3	--	163
9/13/2012	14.5	7.8	727	71.7	51.2	168
9/20/2012	13.7	8.0	920.8	61.3	57.3	161
9/27/2012	15.0	7.9	1203.3	55.6	40	165
10/4/2012	15.7	7.7	727	77.1	**74.9**	175
10/11/2012	15.0	7.8	1203.3	60.5	41.1	173

Comminsky Station	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11463000 RR Near Cloverdale (Comminsky)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	16.1	7.9	1986.3	22.8	8.4	183
5/31/2012	17.3	7.8	770.1	48.0	21.6	170
6/7/2012	15.7	7.9	1553.1	32.3	12.0	163
6/14/2012	17.6	7.8	>2419.6	54.6	31.5	153
6/21/2012	17.7	8.0	2419.6	93.3	44.4	132
6/28/2012	16.7	7.9	1203.3	25.0	22.6	121
7/5/2012	17.9	7.8	1986.3	42	31.3	139
7/12/2012	18.4	7.9	>2419.6	32.7	31.5	144
7/19/2012	16.6	7.9	770.1	16.1	32.3	160
7/26/2012	17.3	8.0	>2419.6	68.9	26.2	136
8/2/2012	17.3	7.9	920.8	59.8	49.6	153
8/9/2012	16.1	7.9	>2419.6	38.4	53.7	159
8/16/2012	16.7	7.9	>2419.6	39.3	31.8	162
8/23/2012	16.6	7.9	1299.7	42.8	37.9	146
8/30/2012	15.9	7.9	866.4	79.4	55.4	150
9/6/2012	15.2	8.0	1413.6	49.6	--	149
9/13/2012	16.3	8.0	648.8	77.6	29.2	154
9/20/2012	14.7	8.2	152.3	49.5	25.6	156
9/27/2012	15.7	8.0	172.0	31.7	53.6	152
10/4/2012	16.2	7.9	613.1	55.6	52.1	156
10/11/2012	14.9	7.9	686.7	25.9	23.1	157

* 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.

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-1 cont. Bacteria concentrations for samples collected by the Water Agency. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

Jimtown Bridge	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11463682 RR at Jimtown***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	17.9	7.8	>2419.6	7.5	1.0	229
5/31/2012	19.6	7.7	>2419.6	8.6	2.0	209
6/7/2012	18.1	7.8	1119.9	13.5	8.5	193
6/14/2012	20.2	7.6	1413.6	17.3	8.6	171
6/21/2012	19.8	7.7	1413.6	21.3	34.3	139
6/28/2012	19.7	7.5	727.0	28.8	9.8	136
7/5/2012	21.2	7.6	980.4	8.5	13.2	137
7/12/2012	22.1	7.7	1732.9	7.5	12	130
7/19/2012	19.0	7.7	1299.7	6.3	27.9	151
7/26/2012	19.5	7.7	770.1	17.5	50.4	130
8/2/2012	20.9	7.9	866.4	6.3	43.5	132
8/9/2012	20.8	7.9	980.4	5.2	53.6	141
8/16/2012	20.7	8.1	1203.3	9.6	35.0	149
8/23/2012	20.3	8.4	1732.9	8.6	43.7	142
8/30/2012	20.0	8.3	1986.3	9.7	49.5	137
9/6/2012	18.2	8.0	1553.1	5.2	--	137
9/13/2012	19.6	8.4	1046.2	17.3	14.8	141
9/20/2012	17.9	8.5	1299.7	8.5	**65.0**	136
9/27/2012	17.0	7.8	920.8	13.4	**73.8**	140
10/4/2012	18.1	7.8	410.6	13.5	**195.5**	141
10/11/2012	16.4	8.0	38.7	12.1	57.8	152

Jimtown Bridge (Duplicate)	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11463682 RR at Jimtown***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	17.9	7.8	>2419.6	13.5	3.1	229
5/31/2012	19.6	7.7	>2419.6	8.6	3.0	209
6/7/2012	18.1	7.8	686.7	18.3	7.3	193
6/14/2012	20.2	7.6	1046.2	14.6	19.9	171
6/21/2012	19.8	7.7	1119.9	15.8	29.9	139
6/28/2012	19.7	7.5	517.2	18.5	9.7	136
7/5/2012	21.2	7.6	1203.3	7.4	19.7	137
7/12/2012	22.1	7.7	1299.7	4.1	9.7	130
7/19/2012	19.0	7.7	816.4	9.4	22.3	151
7/26/2012	19.5	7.7	816.4	14.8	39.9	130
8/2/2012	20.9	7.9	866.4	13.4	57.1	132
8/9/2012	20.8	7.9	1553.1	6.2	**70.3**	141
8/16/2012	20.7	8.1	2419.6	5.2	33.7	149
8/23/2012	20.3	8.4	>2419.6	18.5	42.0	142
8/30/2012	20.0	8.3	1986.3	10.9	39.9	137
9/6/2012	18.2	8.0	1553.1	5.2	--	137
9/13/2012	19.6	8.4	1732.9	23.8	32.8	141
9/20/2012	17.9	8.5	1413.6	15.6	28.2	136
9/27/2012	17.0	7.8	866.4	14.5	**75.4**	140
10/4/2012	18.1	7.8	686.7	21.1	**135.4**	141
10/11/2012	16.4	8.0	461.1	8.6	**131.4**	152

* 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.

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-1 cont. Bacteria concentrations for samples collected by the Water Agency. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

Jimtown Bridge (Triplicate)	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11463682 RR at Jimtown***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	17.9	7.8	>2419.6	10.9	4.1	229
5/31/2012	19.6	7.7	>2419.6	6.1	3.1	209
6/7/2012	18.1	7.8	1203.3	8.6	9.8	193
6/14/2012	20.2	7.6	920.8	14.6	18.7	171
6/21/2012	19.8	7.7	1299.7	6.0	18.1	139
6/28/2012	19.7	7.5	461.1	46.4	21.1	136
7/5/2012	21.2	7.6	1732.9	6.3	11	137
7/12/2012	22.1	7.7	--	--	13.4	130
7/19/2012	19.0	7.7	648.8	7.4	30.9	151
7/26/2012	19.5	7.7	980.4	14.6	40.4	130
8/2/2012	20.9	7.9	1203.3	5.2	53.7	132
8/9/2012	20.8	7.9	1732.9	4.1	**79.8**	141
8/16/2012	20.7	8.1	1413.6	7.2	30.5	149
8/23/2012	20.3	8.4	>2419.6	7.5	35.9	142
8/30/2012	20.0	8.3	1986.3	7.5	48.0	137
9/6/2012	18.2	8.0	2419.6	6.3	--	137
9/13/2012	19.6	8.4	920.8	16.1	24.6	141
9/20/2012	17.9	8.5	1413.6	9.8	46.4	136
9/27/2012	17.0	7.8	1119.9	12.1	**118.7**	140
10/4/2012	18.1	7.8	866.4	21.3	**148.3**	141
10/11/2012	16.4	8.0	488.4	12.0	**98.8**	152

Digger's Bend	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11463980 RR at Digger's Bend***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	18.3	8.0	1413.6	4.1	<1.0	240
5/31/2012	--	--	--	--	--	220
6/7/2012	19.3	8.1	920.8	23.3	6.3	187
6/14/2012	21.5	7.9	2419.6	4.1	8.5	156
6/21/2012	20.9	8.0	>2419.6	11.6	18.9	138
6/28/2012	20.9	8.0	1732.9	5.2	7.3	125
7/5/2012	22.0	8.0	>2419.6	12.2	18.3	122
7/12/2012	22.9	8.0	1732.9	13.2	56.3	115
7/19/2012	20.0	8.0	1553.1	8.5	--	141
7/26/2012	20.7	8.1	1732.9	4.1	**85.7**	118
8/2/2012	21.8	8.1	1732.7	8.4	**90.6**	116
8/9/2012	22.2	8.0	2419.6	5.2	**88.4**	120
8/16/2012	21.6	8.1	1986.3	3.1	50.4	137
8/23/2012	20.6	8.1	1553.1	14.5	**61.3**	128
8/30/2012	20.5	8.1	1732.9	8.5	40.2	119
9/6/2012	18.8	8.1	1732.9	7.5	--	123
9/13/2012	20.2	8.2	547.5	5.2	14.4	126
9/20/2012	17.8	8.4	1119.9	13.4	**110.6**	119
9/27/2012	17.6	8.1	1119.9	7.4	47.3	127
10/4/2012	18.8	8.0	770.1	30.9	**102.2**	124
10/11/2012	16.7	8.0	547.5	13.5	**101.1**	139

* 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.

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Enterococcus: 61 per 100 ml

Table 3-1 cont. Bacteria concentrations for samples collected by the Water Agency. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

Riverfront Park	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11465390 RR near Windsor (Riverfront Park)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	17.6	7.8	920.8	9.8	4.1	308
5/31/2012	19.0	7.8	1299.7	2.0	9.8	282
6/7/2012	18.1	7.9	920.8	23.3	7.5	--
6/14/2012	19.8	7.8	1203.3	13.4	5.2	222
6/21/2012	18.7	7.8	290.9	10.9	14.3	193
6/28/2012	19.3	7.8	1413.6	14.8	6.3	178
7/5/2012	20.0	7.9	1553.1	22.8	2.0	187
7/12/2012	20.2	7.9	1986.3	29.5	8.3	201
7/19/2012	18.9	7.9	727.0	14.8	19.7	243
7/26/2012	19.0	7.9	1203.3	26.2	18.7	222
8/2/2012	19.4	7.4	816.4	15.6	10.9	211
8/9/2012	19.8	7.8	727.0	14.8	21.8	213
8/16/2012	19.3	8.0	980.4	19.9	9.8	231
8/23/2012	18.5	7.9	866.4	17.3	8.4	230
8/30/2012	18.5	7.9	866.4	27.5	17.5	218
9/6/2012	17.0	7.9	1046.2	47.1	--	230
9/13/2012	18.1	8.0	816.4	18.7	14.1	--
9/20/2012	16.0	8.1	866.4	35.9	14.6	223
9/27/2012	16.0	8.1	1119.9	35.5	15.6	225
10/4/2012	17.1	7.8	686.7	33.6	36.4	221
10/11/2012	15.4	7.8	325.5	24.6	22.8	243

Hacienda	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	19.0	8.0	686.7	12.2	4.1	299
5/31/2012	20.5	7.9	1413.6	4.1	6.3	244
6/7/2012	20.0	8.0	579.4	9.7	3.1	234
6/14/2012	22.2	7.9	1732.9	8.6	10.7	177
6/21/2012	21.1	8.0	2419.6	21.1	22.6	139
6/28/2012	21.5	8.0	816.4	17.1	8.5	111
7/5/2012	22.3	7.9	1553.1	28.1	6.3	105
7/12/2012	22.3	7.8	1553.1	12.1	4.1	82
7/19/2012	19.9	8.0	158.5	35	53.8	132
7/26/2012	20.9	8.1	1299.7	7.4	8.6	107
8/2/2012	21.7	8.0	866.4	10.9	7.4	90
8/9/2012	21.9	8.0	613.1	11.9	5.2	93
8/16/2012	21.5	8.1	579.4	4.1	14.6	118
8/23/2012	20.8	8.0	648.8	4.1	5.2	118
8/30/2012	20.3	7.9	517.2	3.1	4.1	109
9/6/2012	18.9	8.0	648.8	47.1	--	123
9/13/2012	19.8	8.1	365.4	<1.0	<1.0	113
9/20/2012	17.4	8.1	547.5	13.4	5.2	118
9/27/2012	16.9	7.9	365.4	7.5	5.2	121
10/4/2012	18.2	7.8	461.1	20.4	13.5	112
10/11/2012	15.9	7.9	488.4	9.8	13.4	134

* 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.

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-1 cont. Bacteria concentrations for samples collected by the Water Agency. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

Hacienda (Duplicate)	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	19.0	8.0	770.1	13.4	3.1	299
5/31/2012	20.5	7.9	1986.3	10.8	3.1	244
6/7/2012	20.0	8.0	686.7	10.9	3.0	234
6/14/2012	22.2	7.9	1203.3	10.9	12.1	177
6/21/2012	21.1	8.0	1553.1	18.7	18.7	139
6/28/2012	21.5	8.0	727	13.2	8.4	111
7/5/2012	22.3	7.9	488.4	23.8	6.3	105
7/12/2012	22.3	7.8	1203.3	12.1	5.2	82
7/19/2012	19.9	8.0	1203.3	62.7	**88.8**	132
7/26/2012	20.9	8.1	1413.6	9.8	7.4	107
8/2/2012	21.7	8.0	770.1	7.5	5.2	90
8/9/2012	21.9	8.0	727.0	42	5.2	93
8/16/2012	21.5	8.1	613.1	2.0	14.5	118
8/23/2012	20.8	8.0	648.8	5.2	4.2	118
8/30/2012	20.3	7.9	461.1	3.1	3.1	109
9/6/2012	18.9	8.0	770.1	9.7	--	123
9/13/2012	19.8	8.1	517.2	5.2	4.1	113
9/20/2012	17.4	8.1	648.8	9.7	7.5	118
9/27/2012	16.9	7.9	488.4	20.1	11	121
10/4/2012	18.2	7.8	>2419.6	13.4	13.5	112
10/11/2012	15.9	7.9	488.4	9.8	10.8	134

Hacienda (Triplicate)	Temperature	pH	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/24/2012	19.0	8.0	1119.9	9.8	3.0	299
5/31/2012	20.5	7.9	1732.9	11.0	3.1	244
6/7/2012	20.0	8.0	547.5	12.2	3.1	234
6/14/2012	22.2	7.9	1119.9	9.8	9.8	177
6/21/2012	21.1	8.0	1299.7	22.6	19.9	139
6/28/2012	21.5	8.0	770.1	10.9	13.1	111
7/5/2012	22.3	7.9	2419.6	16.9	8.6	105
7/12/2012	22.3	7.8	1413.6	9.7	8.5	82
7/19/2012	19.9	8.0	920.8	35.5	**66.3**	132
7/26/2012	20.9	8.1	1203.3	7.3	5.2	107
8/2/2012	21.7	8.0	1119.9	7.5	3.0	90
8/9/2012	21.9	8.0	686.7	30.7	2.0	93
8/16/2012	21.5	8.1	648.8	5.2	6.3	118
8/23/2012	20.8	8.0	727.0	3.1	1.0	118
8/30/2012	20.3	7.9	435.2	5.2	1.0	109
9/6/2012	18.9	8.0	1046.2	10.9	--	123
9/13/2012	19.8	8.1	387.3	5.1	<1.0	113
9/20/2012	17.4	8.1	307.6	16.1	13.4	118
9/27/2012	16.9	7.9	517.2	12.1	4.1	121
10/4/2012	18.2	7.8	547.5	22.8	12.2	112
10/11/2012	15.9	7.9	410.6	19.7	15.8	134

* 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.

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

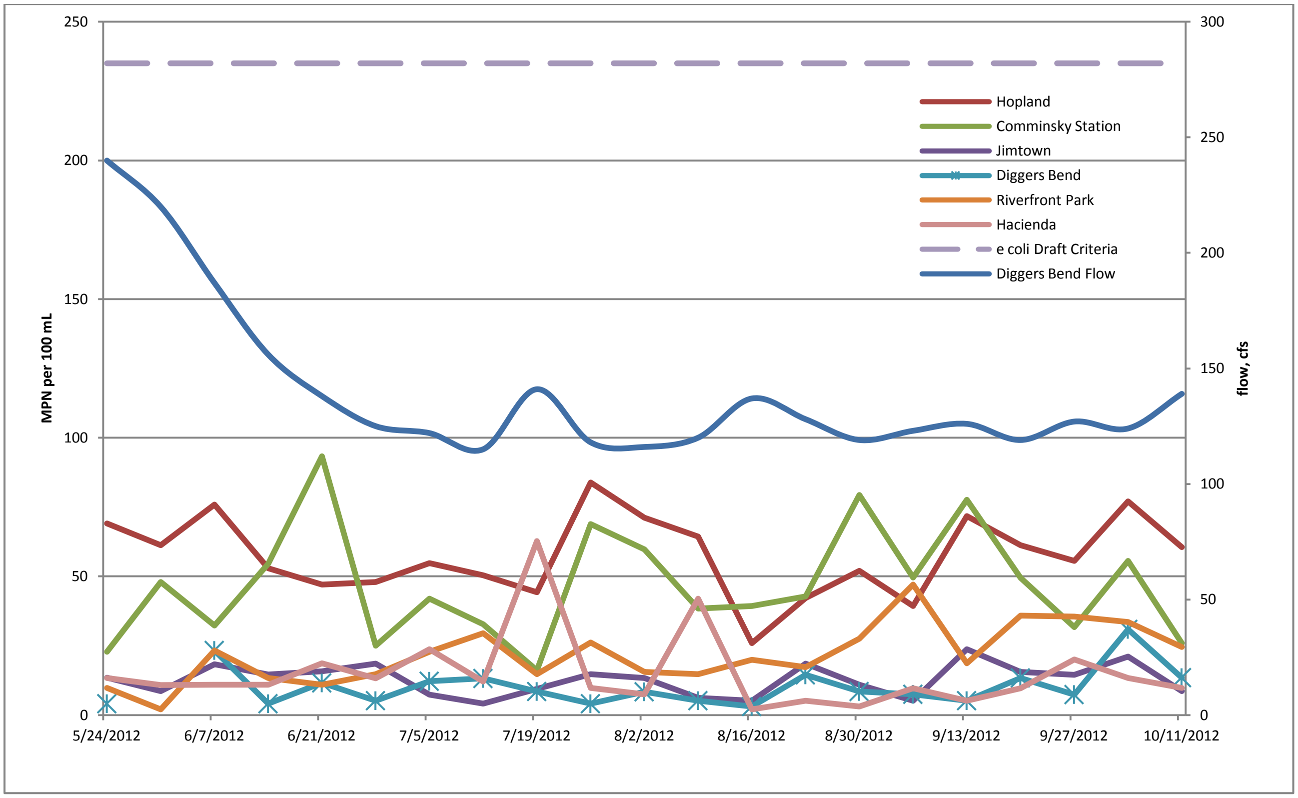

Figure 3-2. Water Agency *E. coli* Sample Results for the Russian River, Hopland to Hacienda Bridge

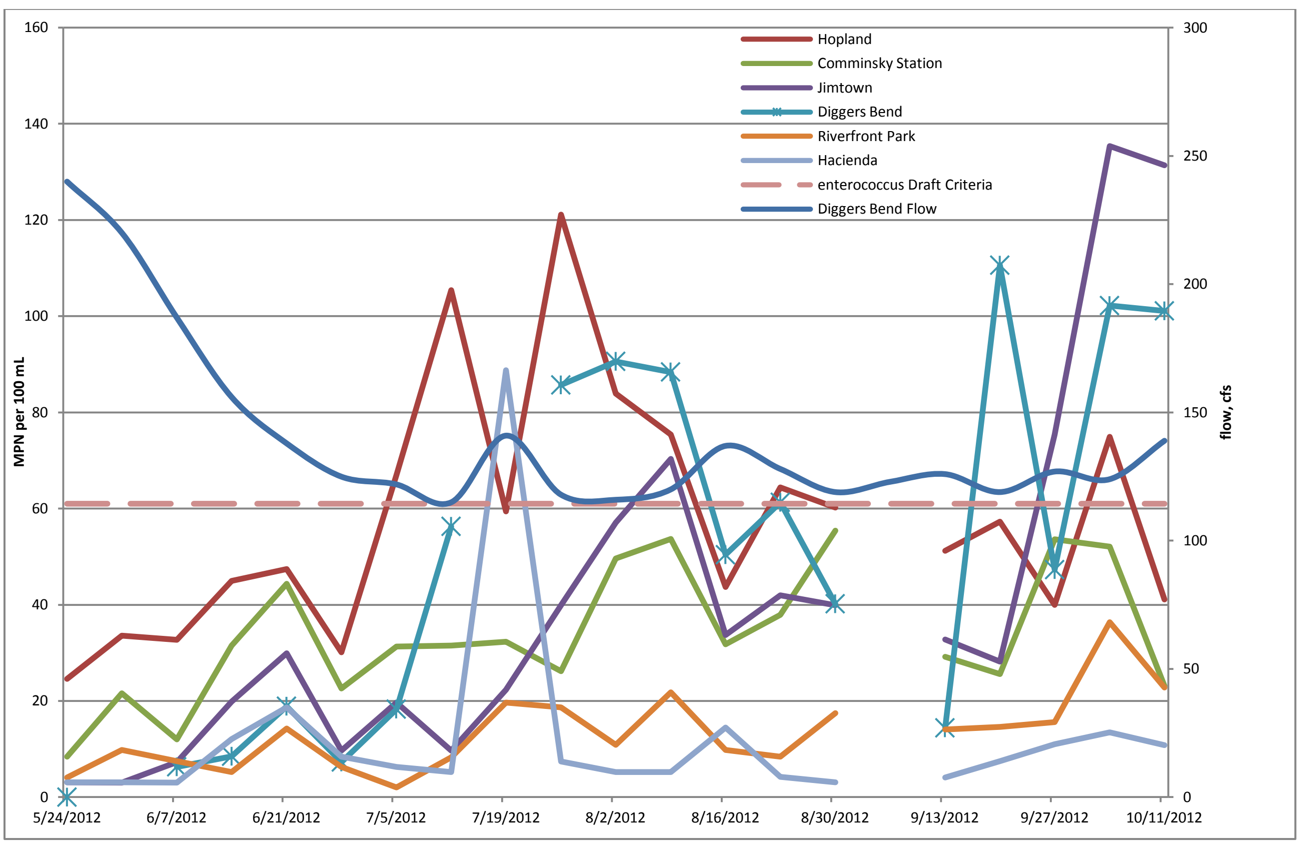

Figure 3-3. Water Agency Enterococcus Sample Results for the Russian River, Hopland to Hacienda Bridge

Table 3-2. 2012 Water Agency Nutrient Sample Results for Hopland. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Hopland	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 11462500 RR Near Hopland***
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)
5/24/2012	14.4	7.5	0.210	ND	0.0003	0.29	ND	0.24	**0.53**	**0.043**	0.066	1.75	2.4	120	**4.8**	0.00019	156
5/31/2012	15.3	7.5	0.210	ND	0.0006	0.28	ND	0.28	**0.56**	**0.042**	0.083	1.59	2.38	120	**5.0**	**0.0025**	148
6/7/2012	14.1	7.6	0.245	0.1	0.001	ND	0.058	0.35	**0.41**	**0.054**	0.13	1.67	2.55	120	**6.2**	**0.0022**	147
6/14/2012	15.2	7.4	ND	0.14	0.0009	0.26	ND	0.28	**0.54**	**0.054**	0.12	1.78	2.66	120	**7.1**	**0.0022**	147
6/21/2012	15.3	7.7	ND	0.14	0.0018	0.25	0.046	0.24	**0.54**	**0.070**	0.14	1.72	2.63	120	**7.0**	ND	137
6/28/2012	14.6	7.5	ND	ND	ND	0.30	ND	0.21	**0.51**	**0.060**	0.13	1.71	2.49	460	**7.6**	0.00063	128
7/5/2012	15	7.6	ND	0.14	0.0014	0.28	ND	0.24	**0.53**	**0.058**	0.099	1.74	2.49	120	**8.6**	0.00084	132
7/12/2012	15.3	7.5	ND	0.14	0.0011	0.23	ND	0.28	**0.51**	**0.054**	0.13	2.57	2.57	120	**11**	0.00035	131
7/19/2012	14.5	7.8	ND	ND	ND	0.19	ND	0.21	**0.40**	**0.053**	0.12	1.84	2.69	120	**8.8**	0.00081	175
7/26/2012	15.0	7.8	0.21	ND	ND	0.20	ND	0.24	**0.44**	**0.048**	0.089	1.84	2.67	120	**7.8**	0.00092	146
8/2/2012	14.7	7.8	0.49	0.10	0.0016	0.20	ND	0.60	**0.80**	**0.048**	0.075	1.79	2.70	120	**7.8**	0.0015	157
8/9/2012	13.9	7.8	0.24	ND	ND	0.20	ND	0.32	**0.51**	**0.049**	0.080	1.72	2.54	120	**9.0**	**0.0027**	177
8/16/2012	14.4	7.8	0.21	ND	ND	0.18	ND	0.28	**0.46**	**0.039**	0.088	2.06	2.78	120	**6.6**	**0.0020**	171
8/23/2012	14.7	7.8	0.67	ND	ND	0.19	ND	0.70	**0.89**	**0.054**	0.13	2.06	2.75	120	**7.5**	0.00087	162
8/30/2012	13.9	7.8	ND	0.14	0.0021	0.17	ND	0.21	**0.38**	**0.044**	0.095	2.00	2.84	120	**7.3**	**0.0030**	166
9/6/2012	14.0	7.9	ND	ND	ND	0.17	ND	0.24	**0.41**	**0.053**	0.10	1.93	2.69	120	**5.4**	**0.0020**	163
9/13/2012	14.5	7.8	ND	0.14	0.0023	0.16	ND	0.24	**0.40**	**0.071**	0.17	1.95	2.90	120	**4.4**	0.0013	168
9/20/2012	13.7	8.0	ND	ND	ND	0.17	ND	0.21	**0.38**	**0.11**	0.24	1.92	2.67	120	**4.8**	0.0011	161
9/27/2012	15.0	7.9	0.24	ND	ND	0.20	ND	0.32	**0.52**	**0.11**	0.23	2.00	2.91	120	**6.7**	0.0016	165
10/4/2012	15.7	7.7	ND	ND	ND	0.35	0.037	0.32	**0.57**	**0.15**	0.36	1.93	2.69	110	**5.0**	**0.0021**	175
10/11/2012	15.0	7.8	0.21	0.14	0.0023	0.37	0.043	0.35	**0.59**	**0.16**	0.44	1.97	2.66	120	**5.1**	0.0017	173

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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
Total Nitrogen: 0.38 mg/L
Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L
Turbidity: 2.34 FTU/NTU

Table 3-3. 2012 Water Agency Nutrient Sample Results for Comminsky Station. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Comminsky Station	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 11463000 RR Near Cloverdale (Comminsky)***
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)
5/24/2012	16.1	7.9	0.210	ND	0.0008	0.24	ND	0.24	**0.48**	**0.03**	0.031	1.65	1.99	130	**2.4**	**0.0025**	183
5/31/2012	17.3	7.8	ND	ND	0.0007	0.24	ND	0.18	**0.42**	**0.036**	0.064	1.68	2.00	130	**3.2**	**0.0026**	170
6/7/2012	15.7	7.9	0.280	ND	0.0015	ND	0.054	0.35	**0.52**	**0.14**	0.086	1.43	2.15	140	**5.8**	**0.0020**	163
6/14/2012	17.6	7.8	0.210	ND	0.0007	0.26	ND	0.24	**0.51**	**0.052**	0.11	1.58	2.34	120	**5.4**	**0.0023**	153
6/21/2012	17.7	8.0	ND	0.18	0.0057	0.26	ND	0.28	**0.54**	**0.063**	0.10	1.82	2.15	140	**4.8**	ND	132
6/28/2012	16.7	7.9	ND	ND	ND	0.30	ND	0.18	**0.48**	**0.049**	0.093	1.47	2.09	130	**5.2**	0.0014	121
7/5/2012	17.9	7.8	ND	ND	ND	0.25	ND	0.21	**0.46**	**0.043**	0.053	1.6	2.27	120	**5.2**	**0.0021**	139
7/12/2012	18.4	7.9	ND	ND	ND	0.18	ND	0.18	0.35	**0.063**	0.06	1.64	2.34	120	**5.4**	ND	144
7/19/2012	16.6	7.9	0.245	ND	ND	0.15	ND	0.32	**0.46**	**0.034**	0.048	1.71	2.43	120	**5.7**	**0.0031**	160
7/26/2012	17.3	8.0	ND	0.10	0.0031	0.14	ND	0.21	0.35	**0.022**	0.046	1.69	2.44	130	**4.5**	**0.0027**	136
8/2/2012	17.3	7.9	0.91	0.10	0.0025	0.16	ND	1.0	**1.2**	**0.041**	0.083	1.69	2.52	120	**6.6**	**0.0024**	153
8/9/2012	16.1	7.9	ND	ND	ND	0.16	ND	0.21	0.37	**0.037**	0.058	1.59	2.32	130	**7.6**	**0.0020**	159
8/16/2012	16.7	7.9	ND	0.10	0.0025	0.16	ND	0.21	0.37	**0.033**	0.065	1.91	2.64	130	**6.6**	0.0014	162
8/23/2012	16.6	7.9	ND	0.14	0.0033	0.16	ND	0.21	0.37	**0.035**	0.066	2.35	2.60	120	**5.2**	0.0010	146
8/30/2012	15.9	7.9	ND	0.10	0.0023	0.15	ND	0.18	0.33	**0.035**	0.056	1.87	2.62	110	**5.4**	**0.0019**	150
9/6/2012	15.2	8.0	0.21	ND	ND	0.15	ND	0.21	0.36	**0.044**	0.074	1.81	2.41	120	**4.2**	0.0017	149
9/13/2012	16.3	8.0	ND	0.10	0.0029	0.14	ND	0.24	**0.38**	**0.048**	0.11	1.81	2.64	130	**3.4**	0.0011	154
9/20/2012	14.7	8.2	0.21	0.10	0.0042	0.16	ND	0.32	**0.48**	**0.064**	0.13	1.79	2.45	110	**3.3**	0.00024	156
9/27/2012	15.7	8.0	ND	ND	ND	0.20	ND	0.21	**0.41**	**0.069**	0.18	1.92	2.69	120	**3.7**	0.00091	152
10/4/2012	16.2	7.9	ND	ND	ND	0.29	ND	0.18	**0.50**	**0.096**	0.23	1.88	2.53	140	**3.2**	0.0016	156
10/11/2012	14.9	7.9	ND	0.14	0.0028	0.32	ND	0.24	**0.56**	**0.097**	0.27	1.79	2.39	120	2.1	0.0012	157

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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
Total Nitrogen: 0.38 mg/L
Chlorophyll *a*: 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L
Turbidity: 2.34 FTU/NTU

Table 3-4. 2012 Water Agency Nutrient Sample Results for Jimtown. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Jimtown Bridge	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 11463682 RR at Jimtown***
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)
5/24/2012	17.9	7.8	ND	ND	ND	0.23	ND	0.14	0.37	ND	0.020	1.04	1.41	160	0.73	0.0011	229
5/31/2012	19.6	7.7	0.210	ND	ND	0.23	ND	0.21	**0.44**	ND	0.022	0.971	1.35	170	1.2	0.00085	209
6/7/2012	18.1	7.8	0.210	ND	0.0010	ND	0.047	0.24	**0.47**	**0.022**	0.059	0.983	1.44	160	1.8	0.00072	193
6/14/2012	20.2	7.6	ND	ND	0.0009	0.21	ND	0.21	**0.42**	**0.022**	0.038	1.02	1.48	160	1.2	0.00072	171
6/21/2012	19.8	7.7	ND	ND	ND	0.18	ND	0.18	0.36	ND	0.026	0.890	1.23	170	0.78	ND	139
6/28/2012	19.7	7.5	ND	ND	ND	ND	ND	0.18	0.18	ND	0.044	0.985	1.29	160	0.62	0.00042	136
7/5/2012	21.2	7.6	ND	ND	ND	0.16	ND	0.21	0.37	ND	ND	0.978	1.46	150	0.53	0.00032	137
7/12/2012	22.1	7.7	ND	ND	ND	0.14	ND	0.14	0.28	ND	ND	1.05	1.45	130	0.62	0.00012	130
7/19/2012	19.0	7.7	ND	0.10	0.0018	0.12	ND	0.14	0.26	**0.022**	ND	1.22	1.77	150	0.94	0.0012	151
7/26/2012	19.5	7.7	ND	ND	ND	0.13	ND	0.18	0.31	ND	ND	1.09	1.63	160	0.89	0.00092	130
8/2/2012	20.9	7.9	0.91	ND	ND	0.14	ND	0.98	**1.1**	ND	ND	1.18	1.74	160	0.69	0.00059	132
8/9/2012	20.8	7.9	0.24	ND	ND	0.13	ND	0.32	**0.44**	0.020	ND	1.11	1.72	150	1.1	0.0016	141
8/16/2012	20.7	8.1	ND	ND	ND	0.12	ND	0.21	0.33	ND	0.042	1.73	2.01	150	0.97	0.0016	149
8/23/2012	20.3	8.4	ND	0.10	0.0092	0.12	ND	0.14	0.26	0.021	0.031	1.35	1.92	150	0.83	0.00012	142
8/30/2012	20.0	8.3	ND	ND	ND	0.12	ND	0.10	0.22	ND	ND	1.37	1.98	140	0.77	**0.0023**	137
9/6/2012	18.2	8.0	ND	ND	ND	0.13	ND	0.21	0.34	ND	0.028	1.26	1.90	150	0.74	0.0011	137
9/13/2012	19.6	8.4	ND	0.18	0.016	0.12	ND	0.21	0.33	ND	ND	1.41	2.05	150	0.70	0.00098	141
9/20/2012	17.9	8.5	ND	ND	ND	0.14	ND	0.24	**0.38**	**0.025**	0.042	1.26	1.81	150	0.73	0.00012	136
9/27/2012	17.0	7.8	ND	ND	ND	0.15	ND	0.18	0.32	**0.034**	0.072	1.94	2.01	140	0.85	0.0013	140
10/4/2012	18.1	7.8	ND	ND	ND	0.15	ND	0.21	**0.90**	**0.027**	0.053	1.23	1.74	150	0.69	**0.0038**	141
10/11/2012	16.4	8.0	0.28	ND	ND	0.15	ND	0.35	**0.50**	**0.041**	0.070	1.26	1.96	140	0.47	**0.0024**	152

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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
Total Nitrogen: 0.38 mg/L
Chlorophyll *a* : 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L
Turbidity: 2.34 FTU/NTU

Table 3-5. 2012 Water Agency Nutrient Sample Results for Digger's Bend. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Digger's Bend	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 11463980 RR at Digger's Bend***
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)
5/24/2012	18.3	8.0	ND	ND	0.0011	ND	ND	0.18	0.36	ND	0.028	0.99	1.33	170	0.68	0.0011	240
5/31/2012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	220
6/7/2012	19.3	8.1	0.280	ND	ND	ND	ND	0.28	**0.46**	**0.024**	0.056	1.13	1.33	160	2.1	0.00063	187
6/14/2012	21.5	7.9	ND	0.10	0.034	ND	ND	0.18	0.35	ND	0.038	1.17	1.38	170	1.1	0.0014	156
6/21/2012	20.9	8.0	0.240	ND	ND	0.14	ND	0.24	**0.39**	ND	0.041	0.899	1.21	170	0.66	ND	138
6/28/2012	20.9	8.0	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.09	1.27	160	0.76	ND	125
7/5/2012	22.0	8.0	ND	0.10	0.0044	ND	ND	0.21	0.21	ND	ND	1.19	1.42	150	0.63	0.00032	122
7/12/2012	22.9	8.0	ND	ND	ND	ND	ND	0.21	0.21	ND	ND	1.05	1.53	160	0.80	0.00023	115
7/19/2012	20.0	8.0	ND	ND	ND	ND	ND	0.21	0.21	ND	ND	1.45	1.75	160	1.2	ND	141
7/26/2012	20.7	8.1	ND	ND	ND	ND	ND	0.18	0.18	ND	0.042	1.21	1.74	160	1.3	0.00034	118
8/2/2012	21.8	8.1	0.28	ND	ND	ND	ND	0.35	0.35	ND	ND	1.25	1.86	160	0.87	0.00012	116
8/9/2012	22.2	8.0	ND	ND	ND	ND	ND	0.18	0.18	**0.024**	0.035	1.14	1.80	160	1.1	ND	120
8/16/2012	21.6	8.1	ND	ND	ND	ND	ND	0.14	0.14	ND	ND	1.45	1.98	150	1.1	0.00046	137
8/23/2012	20.6	8.1	ND	0.10	0.0052	ND	ND	0.14	0.14	ND	ND	1.40	2.03	150	0.82	ND	128
8/30/2012	20.5	8.1	ND	ND	ND	ND	ND	0.21	0.21	ND	ND	1.69	1.96	150	0.85	0.00014	119
9/6/2012	18.8	8.1	ND	0.18	0.0077	ND	ND	0.14	0.14	ND	ND	1.27	1.90	150	0.72	0.00056	123
9/13/2012	20.2	8.2	ND	0.10	0.0060	0.12	ND	0.18	0.30	ND	ND	1.38	2.07	150	0.94	ND	126
9/20/2012	17.8	8.4	ND	ND	ND	ND	ND	0.18	0.18	ND	0.026	1.22	1.84	150	0.67	ND	119
9/27/2012	17.6	8.1	ND	0.10	0.0042	ND	ND	0.18	0.18	**0.033**	0.036	1.41	2.00	140	0.80	0.00013	127
10/4/2012	18.8	8.0	ND	0.10	0.0036	ND	ND	0.18	0.24	ND	0.030	1.19	1.79	140	0.52	0.00063	124
10/11/2012	16.7	8.0	ND	ND	ND	ND	ND	0.18	0.18	**0.029**	0.054	1.30	1.78	150	0.46	0.00061	139

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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
Total Nitrogen: 0.38 mg/L
Chlorophyll *a* : 0.00178 mg/L (1.78 ug/L) ≈ 0.0018 mg/L
Turbidity: 2.34 FTU/NTU

Table 3-6. 2012 Water Agency Nutrient Sample Results for Riverfront Park. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Riverfront Park	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 11465390 RR near Windsor (Riverfront Park)***
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)
5/24/2012	17.6	7.8	ND	ND	0.0014	ND	ND	0.14	0.29	ND	0.028	0.956	1.39	150	0.98	0.00094	308
5/31/2012	19.0	7.8	ND	0.10	0.0023	ND	ND	0.24	**0.41**	ND	0.026	0.910	1.29	140	1.4	0.00085	282
6/7/2012	18.1	7.9	ND	ND	0.0009	ND	ND	0.21	0.37	**0.022**	0.044	0.927	1.35	150	1.6	0.00054	--
6/14/2012	19.8	7.8	ND	ND	0.0016	ND	ND	0.18	0.32	ND	0.022	1.02	1.43	160	1.4	0.0014	222
6/21/2012	18.7	7.8	0.210	ND	ND	0.13	ND	0.21	0.34	ND	0.022	0.938	1.32	150	0.96	ND	193
6/28/2012	19.3	7.8	ND	ND	ND	ND	ND	0.14	0.14	ND	0.048	1.01	1.37	140	1.0	0.00053	178
7/5/2012	20.0	7.9	ND	ND	ND	0.13	ND	0.18	0.31	ND	ND	1.02	1.41	140	1.2	0.00011	187
7/12/2012	20.2	7.9	0.245	ND	ND	0.13	ND	0.28	**0.41**	ND	0.022	1.00	1.39	140	1.2	ND	201
7/19/2012	18.9	7.9	ND	0.10	0.0029	ND	ND	0.21	0.21	ND	ND	1.03	1.57	140	1.4	0.00012	243
7/26/2012	19.0	7.9	ND	ND	ND	ND	ND	0.14	0.14	ND	ND	1.11	1.53	140	1.4	0.00034	222
8/2/2012	19.4	7.4	ND	ND	ND	0.12	ND	0.24	0.37	ND	ND	1.07	1.56	130	0.93	0.00035	211
8/9/2012	19.8	7.8	ND	ND	ND	0.12	ND	0.14	0.26	ND	ND	0.870	1.35	140	1.9	0.00012	213
8/16/2012	19.3	8.0	ND	0.10	0.0036	ND	ND	0.14	0.14	**0.022**	ND	1.23	1.66	130	0.94	0.00023	231
8/23/2012	18.5	7.9	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.21	1.68	140	1.3	ND	230
8/30/2012	18.5	7.9	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.23	1.71	140	1.1	ND	218
9/6/2012	17.0	7.9	ND	0.10	0.0025	ND	ND	0.18	0.18	ND	0.039	1.19	1.66	130	1.0	0.00085	230
9/13/2012	18.1	8.0	ND	0.10	0.0033	ND	ND	0.24	0.24	ND	ND	1.14	1.77	140	1..1	0.00056	--
9/20/2012	16.0	8.1	0.35	ND	ND	ND	ND	0.38	**0.38**	ND	ND	1.14	1.69	140	1.2	ND	223
9/27/2012	16.0	8.1	ND	0.10	0.0036	ND	ND	0.18	0.18	**0.032**	0.040	1.26	1.98	140	1.7	ND	225
10/4/2012	17.1	7.8	ND	ND	ND	ND	ND	0.24	0.24	0.020	0.022	1.15	1.62	140	0.94	0.00076	221
10/11/2012	15.4	7.8	ND	0.14	0.0023	0.14	ND	0.18	0.31	**0.023**	0.023	1.15	1.57	140	0.75	0.00037	243

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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 3-7. 2012 Water Agency Nutrient Sample Results for Hacienda. Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Hacienda	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)
5/24/2012	19.0	8.0	ND	ND	0.0024	ND	ND	0.18	0.31	**0.030**	0.069	1.33	1.74	150	1.1	0.0012	299
5/31/2012	20.5	7.9	ND	0.18	0.0057	ND	ND	0.24	**0.40**	**0.036**	0.067	1.17	1.58	160	2.3	0.00066	244
6/7/2012	20.0	8.0	ND	0.1	0.0038	ND	ND	0.21	0.21	**0.032**	0.089	1.14	1.58	160	1.8	0.00072	234
6/14/2012	22.2	7.9	ND	0.1	0.0036	ND	ND	0.18	0.30	**0.031**	0.072	1.19	1.63	150	1.2	0.0015	177
6/21/2012	21.1	8.0	ND	0.14	0.0055	0.12	ND	0.18	0.29	**0.036**	0.086	1.19	1.54	160	1.1	ND	139
6/28/2012	21.5	8.0	ND	ND	ND	ND	ND	0.18	0.18	**0.043**	0.085	1.28	1.65	150	1.2	0.00084	111
7/5/2012	22.3	7.9	ND	ND	ND	0.12	ND	0.18	0.30	**0.038**	0.053	1.18	1.56	150	1.9	0.00084	105
7/12/2012	22.3	7.8	ND	ND	ND	ND	ND	0.21	0.21	ND	0.052	1.05	1.41	150	1.5	ND	82
7/19/2012	19.9	8.0	ND	ND	ND	ND	ND	0.21	0.21	ND	0.029	1.09	1.52	150	1.7	ND	132
7/26/2012	20.9	8.1	ND	ND	ND	ND	ND	0.21	0.21	ND	0.038	1.11	1.55	150	1.9	0.00023	107
8/2/2012	21.7	8.0	ND	0.10	0.0044	ND	ND	0.18	0.18	ND	0.021	1.14	1.54	140	1.4	ND	90
8/9/2012	21.9	8.0	ND	ND	ND	0.11	ND	0.14	0.25	ND	ND	0.947	1.31	140	1.4	ND	93
8/16/2012	21.5	8.1	ND	ND	ND	ND	ND	0.18	0.18	ND	0.030	1.31	1.68	140	1.2	0.00023	118
8/23/2012	20.8	8.0	ND	0.14	0.0055	ND	ND	0.18	0.18	ND	0.024	1.25	1.70	130	1.4	ND	118
8/30/2012	20.3	7.9	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.23	1.71	140	1.4	ND	109
9/6/2012	18.9	8.0	ND	ND	ND	ND	ND	0.18	0.18	ND	0.020	1.15	1.59	130	1.2	ND	123
9/13/2012	19.8	8.1	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.17	1.77	130	1.2	0.00014	113
9/20/2012	17.4	8.1	0.21	ND	ND	ND	ND	0.21	0.21	ND	0.023	1.13	1.64	130	0.98	ND	118
9/27/2012	16.9	7.9	ND	ND	ND	ND	ND	0.21	0.21	ND	ND	1.26	1.82	100	1.5	ND	121
10/4/2012	18.2	7.8	ND	0.14	ND	ND	ND	0.18	0.18	**0.023**	0.022	1.15	1.63	130	1.7	0.00025	112
10/11/2012	15.9	7.9	ND	ND	ND	ND	ND	0.18	0.18	0.021	0.023	1.17	1.54	140	0.91	0.00012	134

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, results are preliminary and subject to final revision.
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*** 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. 2012 Water Agency Nutrient Sample Results for Hacienda (Duplicate). Highlighted values indicate those values exceeding the recommended EPA criteria based on Aggregate Ecoregion III.

Hacienda (Duplicate)	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)
5/24/2012	19.0	8.0	ND	ND	0.0012	ND	ND	0.18	0.30	**0.028**	0.085	1.32	1.75	160	1.4	0.0010	299
5/31/2012	20.5	7.9	ND	0.18	0.0057	ND	ND	0.21	0.36	**0.033**	0.094	1.15	1.56	170	2.2	0.00085	244
6/7/2012	20.0	8.0	0.245	ND	0.0026	ND	ND	0.32	**0.43**	**0.032**	0.086	1.18	1.61	150	1.7	0.00063	234
6/14/2012	22.2	7.9	ND	ND	0.0024	ND	ND	0.21	0.34	**0.032**	0.072	1.22	1.62	160	1.1	0.0013	177
6/21/2012	21.1	8.0	ND	ND	ND	0.12	ND	0.18	0.30	**0.038**	0.082	1.16	1.54	180	1.1	ND	139
6/28/2012	21.5	8.0	ND	ND	ND	ND	ND	0.18	0.18	**0.040**	0.089	1.27	1.65	150	1.2	0.0011	111
7/5/2012	22.3	7.9	ND	ND	ND	0.12	ND	0.18	0.30	**0.037**	0.053	1.19	1.56	140	1.8	0.00063	105
7/12/2012	22.3	7.8	ND	ND	ND	ND	ND	0.21	0.21	ND	0.052	1.03	1.41	140	1.4	0.00012	82
7/19/2012	19.9	8.0	ND	ND	ND	ND	ND	0.14	0.14	0.021	0.022	1.09	1.52	150	1.7	0.00012	132
7/26/2012	20.9	8.1	ND	0.18	0.0088	ND	ND	0.14	0.14	ND	ND	1.14	1.54	150	1.9	ND	107
8/2/2012	21.7	8.0	ND	0.10	0.0044	ND	ND	0.18	0.18	ND	0.029	1.11	1.54	140	1.4	ND	90
8/9/2012	21.9	8.0	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	0.902	1.27	150	1.3	ND	93
8/16/2012	21.5	8.1	ND	ND	ND	0.11	ND	0.14	0.25	ND	0.030	1.30	1.67	130	1.2	0.00080	118
8/23/2012	20.8	8.0	ND	0.14	0.0055	ND	ND	0.18	0.18	ND	ND	1.27	1.72	130	1.4	ND	118
8/30/2012	20.3	7.9	ND	ND	ND	ND	ND	0.10	0.10	ND	0.050	1.24	1.70	140	1.3	0.00014	109
9/6/2012	18.9	8.0	ND	0.14	0.0048	ND	ND	0.18	0.18	ND	ND	1.16	1.59	140	1.2	0.00014	123
9/13/2012	19.8	8.1	ND	ND	ND	ND	ND	ND	0.070	ND	0.039	1.21	1.74	140	0.94	ND	113
9/20/2012	17.4	8.1	ND	ND	ND	ND	ND	0.21	0.21	0.020	ND	1.16	1.60	140	0.93	ND	118
9/27/2012	16.9	7.9	ND	ND	ND	ND	ND	0.18	0.18	ND	ND	1.25	1.79	140	1.4	0.00013	121
10/4/2012	18.2	7.8	ND	0.10	0.0021	ND	ND	0.14	0.14	**0.023**	ND	1.12	1.65	130	1.5	0.00025	112
10/11/2012	15.9	7.9	ND	0.10	0.0023	ND	ND	0.18	0.18	ND	0.031	1.17	1.53	130	0.93	0.00024	134

* Method Detection Limit can vary for individual samples depending on matrix interference and dilution factors, 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

3.1.2 2012 Seasonal Bacterial Sampling (Beach Sampling)

The NCRWQCB, in cooperation with the Sonoma County DHS conducts seasonal bacteriological sampling at Russian River beaches which experience the greatest body contact recreation.

The NCRWQCB 2012 seasonal sampling locations consist of: Cloverdale River Park; Crocker Road (downstream end of Cloverdale River Park below Big Sulphur Creek confluence); Alexander Valley; Camp Rose Beach; Healdsburg Veterans Memorial Beach; Steelhead Beach; Forestville Access Beach; Johnson's Beach; and Monte Rio Beach. Bacteriological samples were collected twice a week beginning in late May and continuing through August. The samples were analyzed using the Colilert quantitray MPN method for total coliform and *E. coli* and the Enterolert quantitray method for Enterococcus. Results from the sampling program are reported by the NCRWQCB and the DHS at their respective websites and on the DHS Beach Sampling Hotline. The 2012 seasonal results are shown in Table 3-9 and Figures 3-4 through Figure 3-6.

The NCRWQCB ran either single samples or triplicate samples depending on the timing of the year: Monday results (5/21 - 6/29) are from a single sample, (7/2 – 8/29) are the median values from triplicate samples and Wednesday results are the median values from triplicate samples. The analysis resulting from the 2012 beach sampling program and prior years are being evaluated as part of the CEQA requirements associated with establishing permanent changes to D1610.

Table 3-9. Sonoma County Seasonal Beach Results collected by the NCRWQCB. Highlighted values indicate those values exceeding the California Department of Public Health Draft Guidance for Fresh Water Beaches.

	Cloverdale River Park			Crocker Rd*			Alexander Valley			Camp Rose			Healdsburg			Steelhead Beach			Forestville			Johnson's Beach			Monte Rio Beach		
	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT	TC	EC	ENT
5/21/2012	12033	20	10				11199	10	10	2500	10	10	1515	10	10	1067	10	10	1616	10	10	1191	10	10	1918	31	10
5/23/2012	14136	10	10				7701	10	10	2178	10	10	1669	40	10	1540	10	10	3075	31	10	1334	10	10	1616	10	10
5/28/2012	4106	41	74				4884	10	10	4352	10	10	1354	20	10	1336	31	10	1246	52	10	1174	10	10	749	10	10
5/30/2012	2851	41	31				5794	10	10	2224	10	10	1565	30	10	1565	10	10	1071	10	10	857	10	10	1178	132	20
6/4/2012	4884	10	20				2909	20	10	2035	10	10	1860	30	20	1789	10	10	1396	31	10	2098	20	10	2014	10	10
6/6/2012	1565	61	10				1334	41	10	1291	10	10	882	10	20	1106	20	10	1274	10	10	960	10	10	1396	10	10
6/11/2012				2014	20	10	1624	10	10	1529	10	10	1162	10	10	1046	41	10	880	10	10	987	10	10	1789	10	10
6/13/2012				2014	41	41	1467	10	10	2481	20	10	1935	10	10	1723	20	10	1470	10	10	1565	10	10	1467	10	10
6/18/2012				2851	41	31	1785	20	10	2481	20	10	1782	20	10	2909	10	10	2014	20	10	2489	63	52	2613	20	10
6/20/2012				2851	74	31	1296	31	10	4352	20	10	1670	20	10	1860	30	10	1989	31	10	4106	63	96	2481	20	52
6/25/2012				2723	41	10	1071	10	10	1529	10	10	2613	63	63	1576	20	10	959	30	10	2489	10	20	1515	31	10
6/27/2012				1259	41	31	908	20	41	2046	10	10	3076	52	63	839	10	10	789	20	10	1529	41	52	1274	10	10
7/2/2012				2382	41	10	1086	31	10	3255	41	10	3130	20	41	1354	10	10	1259	10	10	1989	31	52	1539	10	10
7/3/2012				2613	41	20	1455	10	30	4884	31	10	1483	41	20	1259	20	10	1785	10	10	2359	20	10	2046	20	20
7/4/2012				2187	31	20	1860	10	26	2603	10	21	1835	31	38	1291	20	22	2382	20	31	2359	20	43	2603	10	10
7/5/2012				2489	10	88	1723	31	30	4352	10	36	2987	41	54	1789	10	39	1723	10	14	2359	20	71	2481	20	48
7/9/2012				3255	20	38	2382	20	52	3654	10	68	1317	20	16	1500	10	16	1450	20	15	1872	10	18	1153	20	4
7/11/2012				3654	10	81	2613	10	43	3448	10	66	1354	20	13	1274	10	14	1670	10	12	2382	10	16	2382	10	5
7/16/2012				4106	135	109	2359	10	93	4106	31	138	1576	10	24	1670	30	21	1658	10	29	2359	20	33	860	10	10
7/18/2012				2187	20	68	1354	20	32	2143	10	31	1376	31	20	1106	10	12	960	20	9	2187	10	14	1017	20	5
7/23/2012				4106	30	260	1850	10	88	3076	10	91	789	31	11	1670	10	11	1553	10	9	1354	10	10	813	10	10
7/25/2012				2987	20	68	1658	10	76	2613	10	104	1076	31	12	1334	20	19	1664	10	19	1860	10	8	1296	10	5
7/30/2012				3784	20	112	1723	10	108	2382	10	91	1246	41	9	1046	10	10	1106	10	9	1935	20	9	1607	10	1
8/1/2012				4884	20	76	1723	10	99	2755	10	84	1354	10	4	1267	20	8	1211	10	6	2014	10	7	1935	10	1
8/6/2012				2755	63	91	1396	10	142	1842	10	166	1483	31	10	839	10	53	789	10	7	1296	31	3	1674	41	26
8/8/2012				3255	41	43	1850	10	140	3448	10	130	1333	31	7	836	10	9	677	10	3	1236	52	36	1450	10	20
8/13/2012				2359	31	116	2187	10	93	2310	10	82	1274	10	4	709	10	8	1396	20	11	1467	10	8	1500	10	2
8/15/2012	2909	41	19	10462	52	66	2481	10	131	2143	10	79	1723	20	6	1014	10	10	839	10	13	1918	10	13	1246	10	4
8/20/2012				1935	10	36	3255	20	52	2359	10	46	2098	31	21	759	10	9	651	20	11	1076	20	16	1789	20	10
8/22/2012	1250	41	37	1553	63	31	2610	10	84	2909	10	78	1515	10	10	749	10	9	789	30	9	1178	10	33	1789	30	15
8/29/2012	1789	31	72	1314	41	72	1989	10	166	3448	10	12	932	10	3	313	10	3	512	10	2	1467	31	8	1144	10	2

Single Sample Values
Beach posting is recommended when indicator organisms exceed any of the following levels:
Total coliform: 10,000 per 100 mL
e coli: 235 per 100 mL
Enterococcus: 61 per 100 mL

* Crocker Road site is located at south end of Cloverdale River Park

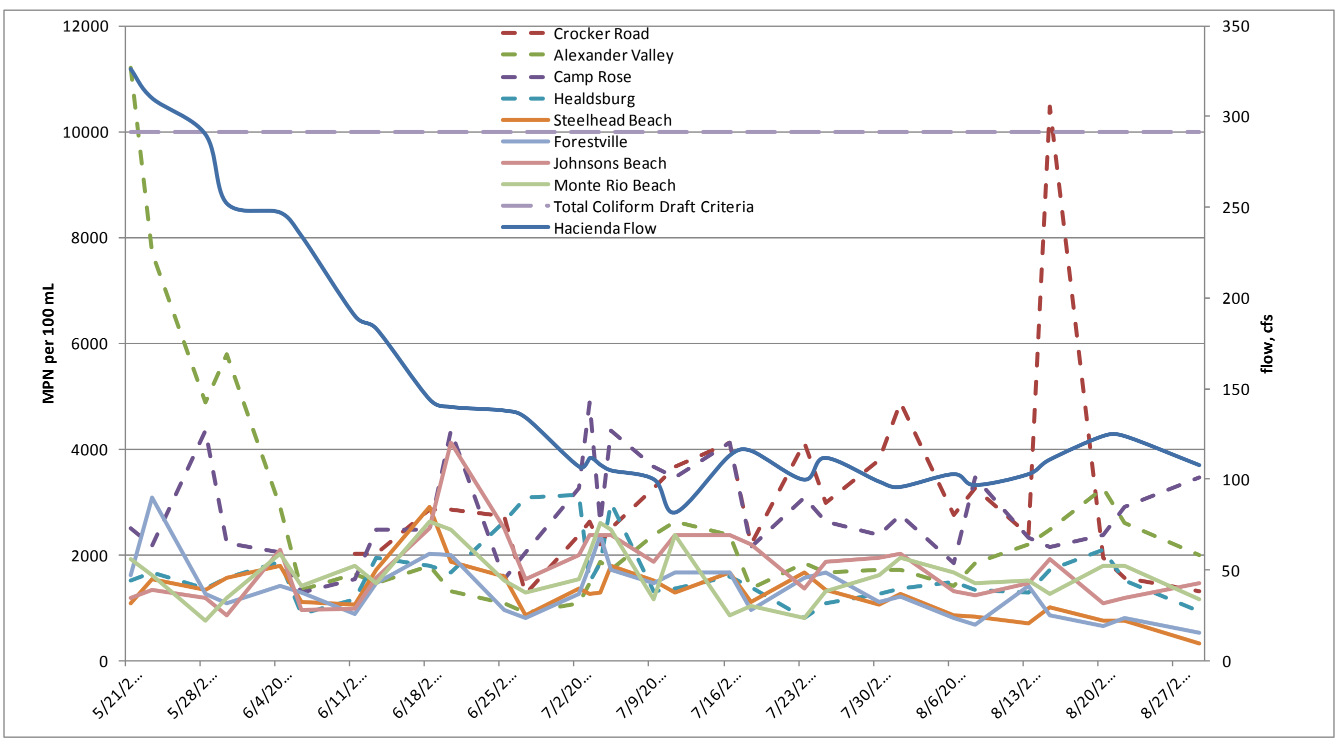

Figure 3-4. Sonoma County Beach Bacteria Sample Results for Total Coliform

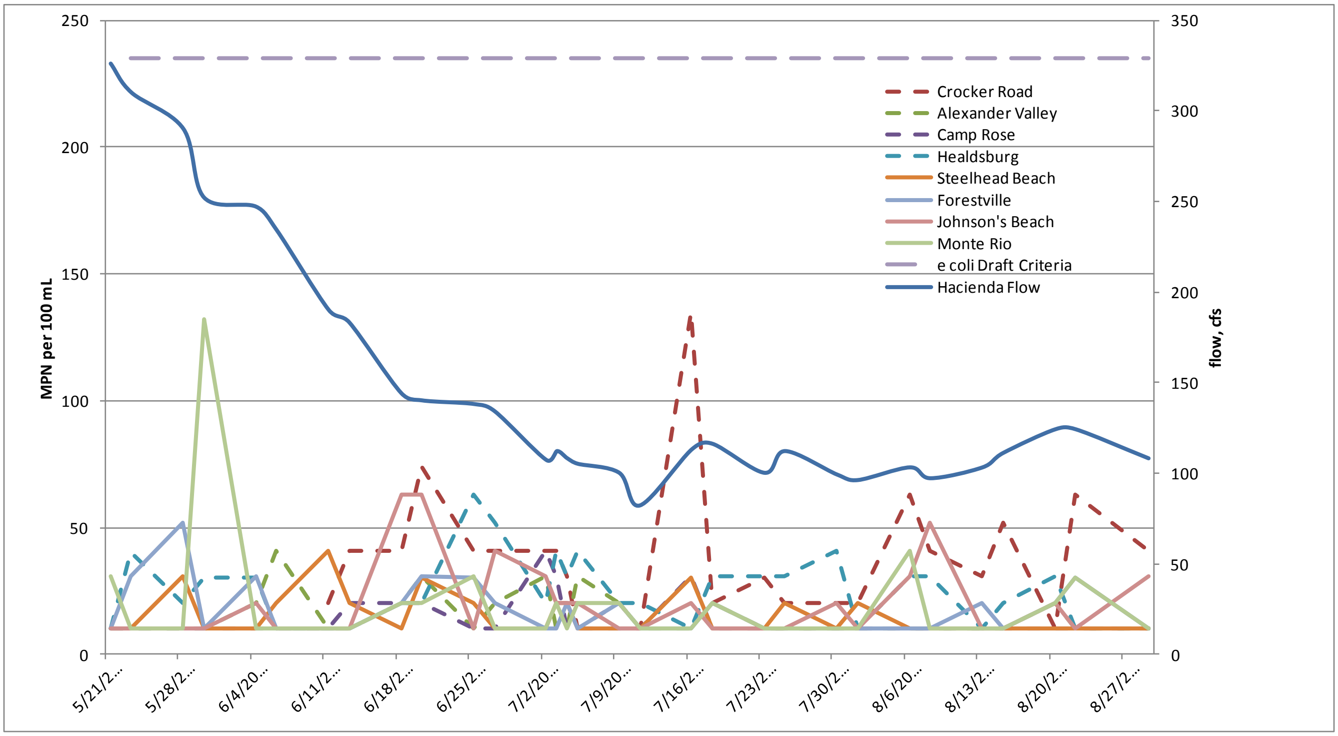

Figure 3-5. Sonoma County Beach Pathogen Sample Results for *E. coli*

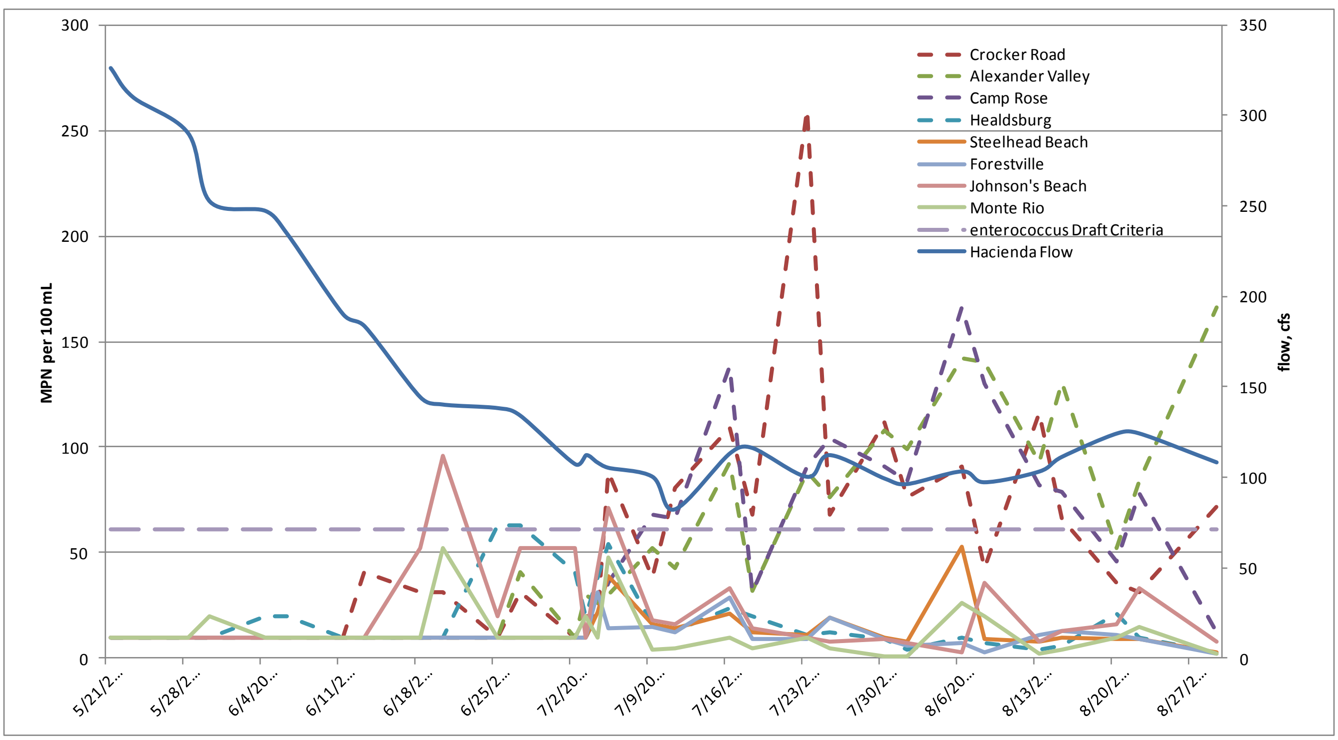

Figure 3-6. Sonoma County Beach Pathogen Sample Results for Enterococcus

3.2 Russian River Estuary Water Quality Monitoring

Flows in the lower Russian River at Hacienda (downstream of the confluence with Dry Creek) dropped below D1610 minimum flow requirements from late June through early October, but remained higher than TUC minimum flows during the entire period of the Order. 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 Monte Rio, including in two tributaries. Grab sampling was conducted bi-monthly until mid-July when flows dropped below D1610 minimum requirements and then grab sampling was conducted weekly for the rest of the Order. Water Agency staff also 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, and reopening.

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 summer 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 Game, documenting the status updates of the Water Agency's efforts in implementing the Biological Opinion. The water quality monitoring data for 2012 is currently being compiled and will be discussed in the "Russian River Biological Opinion Status and Data Report Year 2012-13" due to be released in June, 2013. The annual report will be available on the Water Agency's website: http://www.scwa.ca.gov/bo-annual-report/. As with the other datasets, the estuary data will be evaluated as part of the CEQA requirements associated with revised minimum flows in the mainstem. The grab sample sites are shown in Figure 3-7, the results are summarized in Figures 3-8 and 3-9 and Tables 3-10 through 3-16 and the entire dataset can be found as noted, in the 2012-2013 Russian River Biological Opinion Status and Data Report. Rather than plot the duplicate and triplicate results, the most conservative set of results was plotted for samples collected at Monte Rio.

Highlighted values indicate those values exceeding California Department of Public Health Draft Guidance for Fresh Water Beaches for Indicator Bacteria and EPA recommended criteria for Nutrients, Chlorophyll a, and Turbidity in Rivers and Streams in Aggregate Ecoregion III. 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.

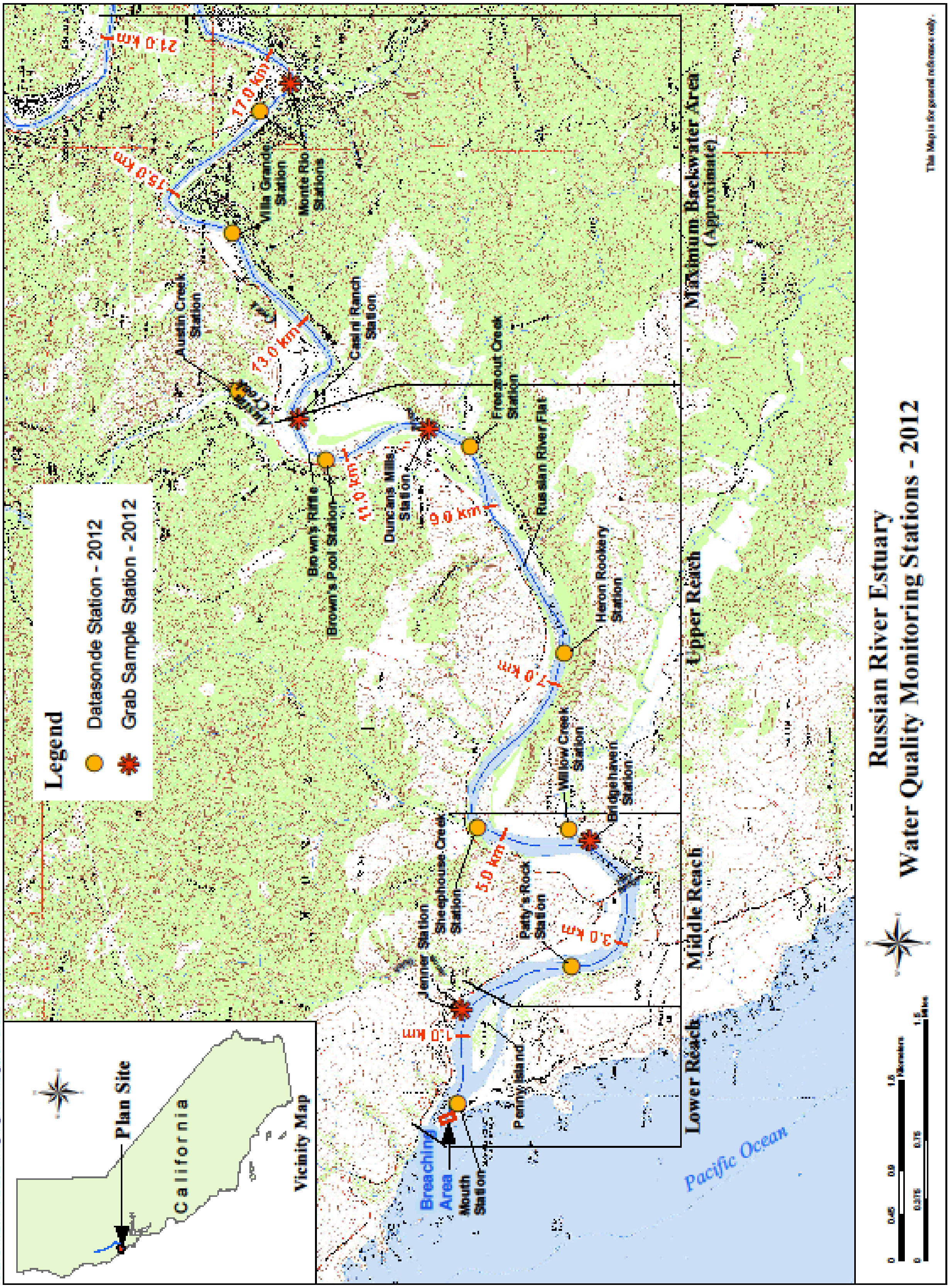

Figure 3-7. 2012 Estuary Sample Sites.

Table 3-10. 2012 Monte Rio Station Grab Sample Results.

Monte Rio	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	Turbidity	Chlorophyll-a	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	20.3	7.9	ND	ND	0.0016	ND	ND	0.24	0.24	**0.030**	0.054	1.3	**0.0090**	>2419.6	7.0	--	323
6/5/2012	20.1	8.0	ND	ND	0.0026	ND	ND	0.24	0.36	**0.033**	0.053	1.5	0.0015	1732.9	37.9	22.8	253
6/19/2012	23.0	7.8	0.21	ND	ND	ND	ND	0.28	0.28	**0.035**	0.072	1.4	**0.0023**	1986.3	55.6	8.4	142
7/3/2012	24.2	7.8	ND	ND	ND	ND	ND	0.18	0.18	**0.027**	0.10	1.5	0.00084	1986.3	18.5	**164.8**	112
7/17/2012	22.3	7.9	0.701	ND	ND	ND	ND	0.77	**0.77**	**0.029**	0.061	1.3	0.00012	866.4	13.4	14.6	117
7/24/2012	23.2	8	ND	0.10	0.0047	ND	ND	0.18	0.18	**0.023**	0.044	1.5	0.00080	1203.3	8.3	**77.2**	109
7/31/2012	23.6	8.0	ND	0.18	0.0052	0.24	ND	0.21	0.33	**0.026**	0.039	0.91	ND	1986.3	6.3	1.0	101
8/7/2012	22.6	8.0	ND	ND	ND	ND	ND	0.14	0.14	0.021	0.067	0.85	0.00082	1203.3	6.3	2.0	100
8/14/2012	22.6	7.8	ND	ND	ND	ND	ND	ND	ND	ND	0.049	1.0	0.00074	1553.1	10.9	9.6	109
8/21/2012	22.3	7.9	ND	ND	ND	ND	ND	0.14	0.14	**0.024**	ND	0.88	0.00080	1203.3	9.7	29.5	129
8/28/2012	21.8	7.9	ND	ND	ND	ND	ND	0.18	0.18	**0.023**	0.031	0.74	ND	1553.1	7.3	7.3	108
9/4/2012	21.0	8.0	0.21	0.10	0.0041	ND	ND	0.32	0.32	**0.026**	0.040	1.2	0.00042	1732.9	6.3	2.0	152
9/11/2012	20.2	8.0	ND	0.14	0.0051	ND	ND	0.18	0.18	**0.023**	0.028	0.70	0.00014	1299.7	2.0	7.5	112
9/18/2012	19.1	8.0	ND	0.10	0.0036	ND	ND	0.14	0.14	ND	0.027	0.63	ND	727	3.1	8.5	129
9/25/2012	18.0	7.8	ND	ND	ND	ND	ND	0.18	0.18	ND	0.027	0.8	ND	410.6	9.7	14.6	123
10/2/2012	18.7	7.8	ND	ND	ND	0.14	ND	0.18	0.31	**0.036**	0.053	0.93	0.00039	727.0	6.3	12.2	115
10/4/2012	19.0	7.8	ND	ND	ND	ND	ND	0.18	0.18	**0.027**	ND	0.98	ND	365.4	5.2	12.1	112
10/9/2012	16.9	7.8	ND	ND	ND	ND	ND	0.14	0.14	**0.024**	ND	0.85	ND	275.5	20.1	4.1	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-11. 2012 Monte Rio Duplicate Station Grab Sample Results.

Monte Rio (Duplicate)	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	Turbidity	Chlorophyll-a	Total Coliforms (Colilert)	E. coli (Colilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	20.3	7.9	ND	ND	0.0016	ND	ND	0.21	0.21	**0.028**	0.023	1.3	**0.0090**	2419.6	4.0	--	323
6/5/2012	20.1	8.0	ND	ND	0.0026	ND	ND	0.21	0.33	**0.031**	0.060	1.3	0.0014	1732.9	22.8	20.1	253
6/19/2012	23.0	7.8	0.210	0.10	0.0030	ND	ND	0.32	0.32	**0.034**	0.072	1.4	**0.0020**	2419.6	60.5	16.9	142
7/3/2012	24.2	7.8	ND	ND	ND	ND	ND	0.21	0.21	**0.027**	0.10	1.4	0.0017	1413.6	24.3	**79.0**	112
7/17/2012	22.3	7.9	ND	ND	ND	ND	ND	0.14	0.14	**0.031**	0.053	1.3	0.00023	727	13.4	13.4	117
7/24/2012	23.2	8	0.18	ND	ND	0.11	ND	ND	0.18	**0.027**	0.052	1.4	0.00069	1299.7	8.6	56.8	109
7/31/2012	23.6	8.0	ND	0.14	0.0068	ND	ND	0.21	0.21	**0.024**	0.043	0.84	ND	2419.6	4.1	1.0	101
8/7/2012	22.6	8.0	ND	ND	ND	ND	ND	0.18	0.18	0.021	0.060	0.84	0.00094	1299.7	6.3	2.0	100
8/14/2012	22.6	7.8	ND	0.10	0.0030	0.12	ND	0.14	0.26	**0.021**	0.049	1.0	0.00025	1413.6	7.4	7.3	109
8/21/2012	22.3	7.9	ND	0.14	0.0047	ND	ND	0.10	0.10	0.021	0.020	0.86	0.00046	1986.3	11	22.6	129
8/28/2012	21.8	7.9	ND	ND	ND	ND	ND	0.14	0.14	ND	0.035	0.73	0.00095	1203.3	7.5	7.3	108
9/4/2012	21.0	8.0	ND	ND	ND	ND	ND	ND	ND	0.021	0.033	1.3	0.00056	1533.1	3.1	2.0	152
9/11/2012	20.2	8.0	ND	0.14	0.0051	ND	ND	0.18	0.18	**0.022**	0.036	0.76	0.00014	1413.6	4.1	4.1	112
9/18/2012	19.1	8.0	ND	0.10	0.0036	0.11	ND	0.14	0.25	ND	0.023	0.69	ND	1203.3	5.2	10.9	129
9/25/2012	18.0	7.8	ND	ND	ND	ND	ND	0.18	0.18	ND	0.031	0.83	ND	579.4	7.5	12.1	123
10/2/2012	18.7	7.8	ND	0.10	0.0023	0.14	ND	0.18	0.32	**0.034**	0.057	0.96	0.00013	613.1	6.3	8.6	115
10/4/2012	19.0	7.8	ND	ND	ND	ND	ND	0.14	0.14	**0.029**	ND	0.77	ND	517.2	5.2	4.1	112
10/9/2012	16.9	7.8	ND	ND	ND	ND	ND	0.18	0.10	**0.026**	0.026	0.72	0.00025	365.4	19.7	2.0	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-12. 2012 Monte Rio Triplicate Station Grab Sample Results (bacteria only).

Monte Rio (Triplicate)	Temperature	pH	Total Coliforms (Collilert)	E. coli (Collilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			20	20	2	Flow Rate****
Date	°C		MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	20.3	7.9	1732.9	15.2	--	323
6/5/2012	20.1	8.0	1986.3	44.1	25.9	253
6/19/2012	23.0	7.8	>2419.6	48.1	14.4	142
7/3/2012	24.2	7.8	1986.3	9.8	59.3	112
7/17/2012	22.3	7.9	866.4	16.1	28.3	117
7/24/2012	23.2	8	1413.6	10.8	**87.1**	109
7/31/2012	23.6	8.0	1986.3	8.4	2.0	101
8/7/2012	22.6	8.0	307.6	4.1	1.0	100
8/14/2012	22.6	7.8	1553.1	13.5	8.4	109
8/21/2012	22.3	7.9	1413.6	3.1	42.2	129
8/28/2012	21.8	7.9	1299.7	6.3	3.1	108
9/4/2012	21.0	8.0	1203.3	12.2	7.4	152
9/11/2012	20.2	8.0	1732.9	2.0	7.5	112
9/18/2012	19.1	8.0	980.4	7.5	17.3	129
9/25/2012	18.0	7.8	613.1	16.0	15.6	123
10/2/2012	18.7	7.8	488.4	5.2	9.8	115
10/4/2012	19.0	7.8	488.4	9.7	5.2	112
10/9/2012	16.9	7.8	461.1	7.3	6.3	138

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

** 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.

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-13. 2012 Casini Ranch Station Grab Sample Results. This site may experience estuarine conditions.

Casini Ranch	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	Turbidity	Chlorophyll-a	Total Coliforms (Collilert)	E. coli (Collilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	21.2	8.1	ND	0.10	0.0052	ND	ND	0.21	0.21	ND	0.038	0.81	**0.0065**	1553.1	6.0	--	323
6/5/2012	21.0	8.1	ND	ND	0.0034	ND	ND	0.18	0.18	**0.026**	0.060	1.0	**0.0020**	980.4	26.2	11.9	253
6/19/2012	22.4	8.0	ND	0.10	0.0044	ND	ND	0.21	0.21	**0.040**	0.072	1.2	0.0014	1299.7	49.5	**248.9**	142
7/3/2012	23.2	8.1	ND	ND	ND	ND	ND	0.21	0.33	**0.027**	0.10	1.2	0.00074	980.4	12.1	38	112
7/17/2012	21.7	8.2	0.245	ND	ND	ND	ND	0.28	0.28	**0.032**	0.049	0.95	0.00012	1046.2	6.3	8.5	117
7/24/2012	22.1	8.2	ND	0.10	0.0069	0.11	ND	0.18	0.29	**0.030**	ND	1.1	0.00023	1046.2	<1.0	3.0	109
7/31/2012	22.8	8.2	0.28	0.10	0.0073	0.15	ND	0.38	**0.54**	**0.026**	0.035	1.1	ND	920.8	5.2	4.1	101
8/7/2012	22.3	8.2	ND	ND	ND	ND	ND	0.18	0.18	**0.035**	0.044	**2.4**	0.0011	>2419.6	5.2	6.2	100
8/14/2012	21.5	8	ND	ND	ND	ND	ND	0.18	0.18	**0.029**	0.031	1.2	0.0014	1553.1	7.5	7.4	109
8/21/2012	22.3	8.0	ND	ND	ND	ND	ND	0.18	0.18	**0.025**	0.020	1.0	0.0011	1986.3	<1.0	5.1	129
8/28/2012	21.8	7.9	ND	ND	ND	ND	ND	0.18	0.18	**0.027**	0.046	0.70	0.00054	1046.2	5.2	6.3	108
9/4/2012	20.6	8.2	ND	0.10	0.0064	ND	ND	0.14	0.14	**0.026**	ND	1.4	0.00099	1203.3	4.1	4.1	152
9/11/2012	20.5	8.4	ND	0.14	0.013	ND	ND	0.18	0.18	ND	0.025	0.74	ND	1046.2	8.6	5.1	112
9/18/2012	19.3	8.8	ND	0.14	0.026	0.11	ND	0.24	0.36	**0.025**	0.062	0.62	ND	980.4	7.5	6.3	129
9/25/2012	18.3	8.5	ND	ND	ND	ND	ND	0.18	0.18	ND	0.047	1.0	ND	866.4	17.3	26.2	123
10/2/2012	19.1	8.1	ND	ND	ND	ND	ND	0.14	0.14	**0.022**	0.057	1.0	ND	866.4	20.1	44.8	115
10/4/2012	19.1	8.1	ND	0.10	0.0045	ND	ND	0.24	0.24	**0.037**	ND	1.4	0.00025	613.1	15.5	21.3	112
10/9/2012	18.1	8.2	ND	ND	ND	ND	ND	0.18	0.18	ND	0.026	0.90	0.00013	648.8	6.3	11.0	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-14. 2012 Duncans Mills Station Grab Sample Results. This site may experience estuarine conditions.

Duncans Mills	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	Turbidity	Chlorophyll-a	Total Coliforms (Collilert)	E. coli (Collilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	20.3	8.1	ND	ND	0.0032	ND	ND	0.21	0.21	0.020	0.062	0.62	0.0010	1046.2	13.2	--	323
6/5/2012	20.8	8.4	ND	ND	0.0065	ND	ND	0.21	0.31	**0.029**	0.064	0.86	0.0013	2419.6	29.2	14.5	253
6/19/2012	22.1	8.2	0.28	ND	ND	ND	ND	0.32	0.32	**0.034**	0.052	0.91	0.00062	461.1	60.5	10.8	142
7/3/2012	23.6	8.4	0.245	ND	ND	ND	ND	0.32	0.32	**0.035**	0.093	1.0	0.00053	980.4	27.2	5.2	112
7/17/2012	21.3	8.5	3.26	ND	ND	0.12	ND	3.3	**3.4**	**0.037**	0.068	1.1	0.00035	1986.3	30.1	12.1	117
7/24/2012	22.4	8.3	0.28	ND	ND	0.12	ND	0.35	**0.47**	**0.027**	0.025	1.2	0.00046	1986.3	4.1	10.7	109
7/31/2012	22.7	8.5	ND	0.14	0.018	0.12	ND	0.21	0.33	**0.069**	0.062	1.1	ND	1203.3	8.5	9.5	101
8/7/2012	21.6	8.3	ND	ND	ND	0.17	ND	0.21	**0.38**	**0.031**	0.075	**2.7**	0.0012	>2419.6	12.0	18.9	100
8/14/2012	21.1	8.1	ND	ND	ND	0.12	ND	0.18	0.30	**0.029**	0.034	1.1	0.00086	>2419.6	15.8	24.3	109
8/21/2012	21.4	8.4	ND	ND	ND	ND	ND	0.24	0.24	**0.024**	0.028	0.86	0.00092	1553.3	3.1	2.0	129
8/28/2012	21.1	8.1	ND	ND	ND	0.12	ND	0.21	0.33	0.020	0.027	0.61	0.0011	1299.7	6.3	6.3	108
9/4/2012	20.1	8.3	ND	ND	ND	ND	ND	0.21	0.21	**0.029**	ND	1.6	0.00085	2419.6	8.5	7.3	152
9/11/2012	19.3	8.2	ND	ND	ND	0.12	ND	0.14	0.14	0.021	0.025	0.73	0.00014	1986.3	10.8	13.7	112
9/18/2012	19.2	8.6	ND	0.10	0.014	ND	ND	0.18	0.18	0.021	0.027	0.59	ND	1732.9	10.8	13.4	129
9/25/2012	17.9	8.1	ND	ND	ND	ND	ND	0.18	0.18	ND	0.035	1.3	ND	461.1	14.6	22.8	123
10/2/2012	18.6	8.0	ND	ND	ND	0.14	ND	0.14	0.28	**0.027**	0.057	0.90	ND	1732.9	45.7	28.2	115
10/4/2012	19.1	8.1	0.21	ND	ND	ND	ND	0.24	0.24	**0.029**	ND	1.0	0.00013	866.4	12.2	26.6	112
10/9/2012	17.2	8.1	ND	ND	ND	0.14	ND	0.18	0.31	ND	0.033	0.79	0.00013	770.1	8.5	7.5	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-15. 2012 Bridgehaven Station Grab Sample Results. Estuarine conditions exist at this site.

Bridgehaven	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	Turbidity	Chlorophyll-a	Total Coliforms (Collilert)	E. coli (Collilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100ml	MPN/100ml	MPN/100ml	(cfs)
5/22/2012	18.8	8.0	ND	0.1	0.0030	ND	ND	0.28	0.28	**0.038**	0.065	2.2	0.001	>2419.6	10.1	--	323
6/5/2012	18.5	8.4	ND	ND	0.0053	ND	ND	0.24	0.34	0.020	0.026	0.89	0.00027	980.4	75.4	**121.1**	253
6/19/2012	20.6	8.5	0.28	ND	ND	ND	ND	0.28	0.28	**0.036**	0.080	1.1	0.00041	1119.9	22.6	19.7	142
7/3/2012	19.9	8.3	0.315	ND	ND	ND	ND	0.35	0.35	**0.046**	0.089	2.1	0.00032	>2419.8	20.1	2.0	112
7/17/2012	18.8	8.8	0.315	ND	ND	0.12	ND	0.38	**0.51**	**0.077**	0.030	1.1	0.0015	>2419.6	14.1	17.5	117
7/24/2012	20.0	8.7	ND	0.14	0.020	ND	ND	0.21	0.21	0.020	ND	1.8	0.00057	>2419.6	8.6	24.1	109
7/31/2012	19.9	8.7	ND	0.25	0.034	0.13	ND	0.28	**0.41**	**0.026**	0.051	1.2	ND	>2419.6	24.1	53.7	101
8/7/2012	21.0	8.5	ND	0.1	0.01	ND	ND	0.28	0.28	**0.029**	0.036	**2.6**	0.0012	>2419.6	<1.0	13.2	100
8/14/2012	19.2	8.3	ND	ND	ND	0.60	ND	0.18	**0.78**	ND	0.026	0.84	0.00012	>2419.6	2.0	**146.4**	109
8/21/2012	19.5	8.4	ND	0.18	0.012	0.59	ND	0.21	**0.80**	ND	ND	0.79	0.0010	>2419.6	21.2	58.3	129
8/28/2012	19.4	8.2	ND	0.18	0.0078	ND	ND	0.21	0.21	**0.040**	ND	0.64	**0.0018**	2419.6	10.2	23.5	108
9/4/2012	17.0	7.8	ND	0.21	0.0032	ND	ND	0.21	0.21	ND	ND	0.71	0.0017	2419.6	3.1	26.2	152
9/11/2012	17.8	8.3	ND	ND	ND	ND	ND	0.21	0.21	**0.025**	0.025	0.69	**0.0025**	>2419.6	1.0	19.9	112
9/18/2012	17.2	8.3	0.42	ND	ND	ND	ND	0.35	0.35	**0.028**	0.023	0.64	**0.0022**	>2419.8	6.3	5.2	129
9/25/2012	16.1	8.1	ND	ND	ND	ND	ND	0.24	0.24	ND	0.027	1.2	0.0017	2419.6	3.0	16.1	123
10/2/2012	16.8	8.2	ND	ND	ND	ND	ND	0.24	0.24	**0.023**	0.038	0.90	**0.0019**	365.4	16.0	5.2	115
10/4/2012	17.8	8.0	ND	0.18	0.0051	0.30	ND	0.28	**0.58**	**0.035**	ND	1.1	**0.0039**	>2419.6	186	**201.4**	112
10/9/2012	15.7	8.1	ND	ND	ND	ND	ND	0.18	0.18	**0.025**	0.030	0.94	**0.0019**	1046.2	**461.1**	**365.4**	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

Table 3-16. 2012 Jenner Boat Ramp Station Grab Sample Results. Estuarine conditions exist at this site.

Jenner Boat Ramp	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	Turbidity	Chlorophyll-a	Total Coliforms (Collilert)	E. coli (Collilert)	Enterococcus (Enterolert)	USGS 11467000 RR near Guerneville (Hacienda)***
MDL*			0.200	0.10	0.00010	0.030	0.030	0.10		0.020	0.020	0.020	0.000050	20	20	2	Flow Rate****
Date	°C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	MPN/100mL	MPN/100mL	MPN/100mL	(cfs)
5/22/2012	17.9	7.9	0.35	ND	0.0015	ND	ND	0.42	**0.90**	**0.053**	0.069	**6.5**	**0.0019**	--	--	--	323
6/5/2012	18.3	8.5	ND	0.21	0.018	ND	ND	0.28	0.28	**0.022**	0.030	1.6	0.0013	1732.9	127.4	**547.5**	253
6/19/2012	20.5	8.5	0.35	ND	ND	ND	ND	0.35	0.35	**0.034**	0.087	1.4	**0.0023**	>2419.6	137.6	**157.6**	142
7/3/2012	20.4	8.5	0.245	ND	ND	ND	ND	0.28	0.28	0.020	0.055	1.2	0.00021	2419.8	143.9	51.2	112
7/17/2012	18.5	8.7	0.420	0.10	0.013	0.12	ND	0.52	**0.65**	**0.024**	0.026	1.7	0.0014	>2419.6	30.5	**648.8**	117
7/24/2012	19.6	8.4	ND	0.10	0.0083	0.26	ND	0.24	**0.50**	**0.026**	0.021	1.9	0.00069	>2419.6	3.0	23.8	109
7/31/2012	19.2	8.4	ND	0.21	0.014	0.16	ND	0.32	**0.47**	**0.026**	0.043	1.2	ND	>2419.6	59.1	**613.1**	101
8/7/2012	18.2	8.2	0.32	ND	ND	0.63	ND	0.35	**0.48**	**0.027**	0.048	1.4	**0.0027**	>2419.6	<1.0	54.6	100
8/14/2012	18.0	8.1	0.21	ND	ND	1.2	ND	0.24	**1.4**	**0.030**	0.023	1.4	0.0014	>2419.6	3.0	**275.5**	109
8/21/2012	17.7	8.1	ND	0.21	0.0065	1.2	ND	0.21	**1.4**	**0.022**	ND	0.76	0.0015	>2419.6	54.1	**62**	129
8/28/2012	17.3	8.3	ND	ND	ND	1.3	ND	0.21	**1.5**	**0.025**	ND	0.92	**0.0030**	>2419.6	34.2	21.8	108
9/4/2012	16.5	8.3	ND	ND	ND	0.64	ND	0.24	**0.88**	**0.025**	ND	1.1	0.0013	165.0	3.1	43.2	152
9/11/2012	16.8	8.2	ND	0.18	0.0065	ND	ND	0.21	0.21	**0.026**	0.025	0.72	0.0011	>2419.6	3.1	11	112
9/18/2012	15.5	8.1	ND	ND	ND	ND	ND	0.21	0.21	**0.026**	0.043	0.65	0.00098	2419.6	2.0	10.9	129
9/25/2012	14.8	8.0	0.28	ND	ND	1.4	ND	0.35	**0.49**	ND	0.031	0.73	0.00073	>2419.6	1.0	15.8	123
10/2/2012	15.7	8.2	0.28	ND	ND	ND	ND	0.32	0.32	**0.022**	0.038	0.83	0.00078	980.4	33.6	21.8	115
10/4/2012	17.9	8.1	ND	0.14	0.0049	0.70	ND	0.32	**1.0**	**0.027**	ND	1.3	**0.0020**	816	9.8	12.1	112
10/9/2012	15.3	8.1	ND	ND	ND	0.74	ND	0.24	**0.39**	0.021	0.037	1.3	0.0013	360.9	45.5	**71.2**	138

* 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

Total Nitrogen: 0.38 mg/L

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

Turbidity: 2.34 FTU/NTU

CDPH Draft Guidance for Fresh Water Beaches - Single Sample Values:

Beach posting is recommended when indicator organisms exceed any of the following levels:

Total coliforms: 10,000 per 100 ml

E. coli: 235 per 100 ml

Enterococcus: 61 per 100 ml

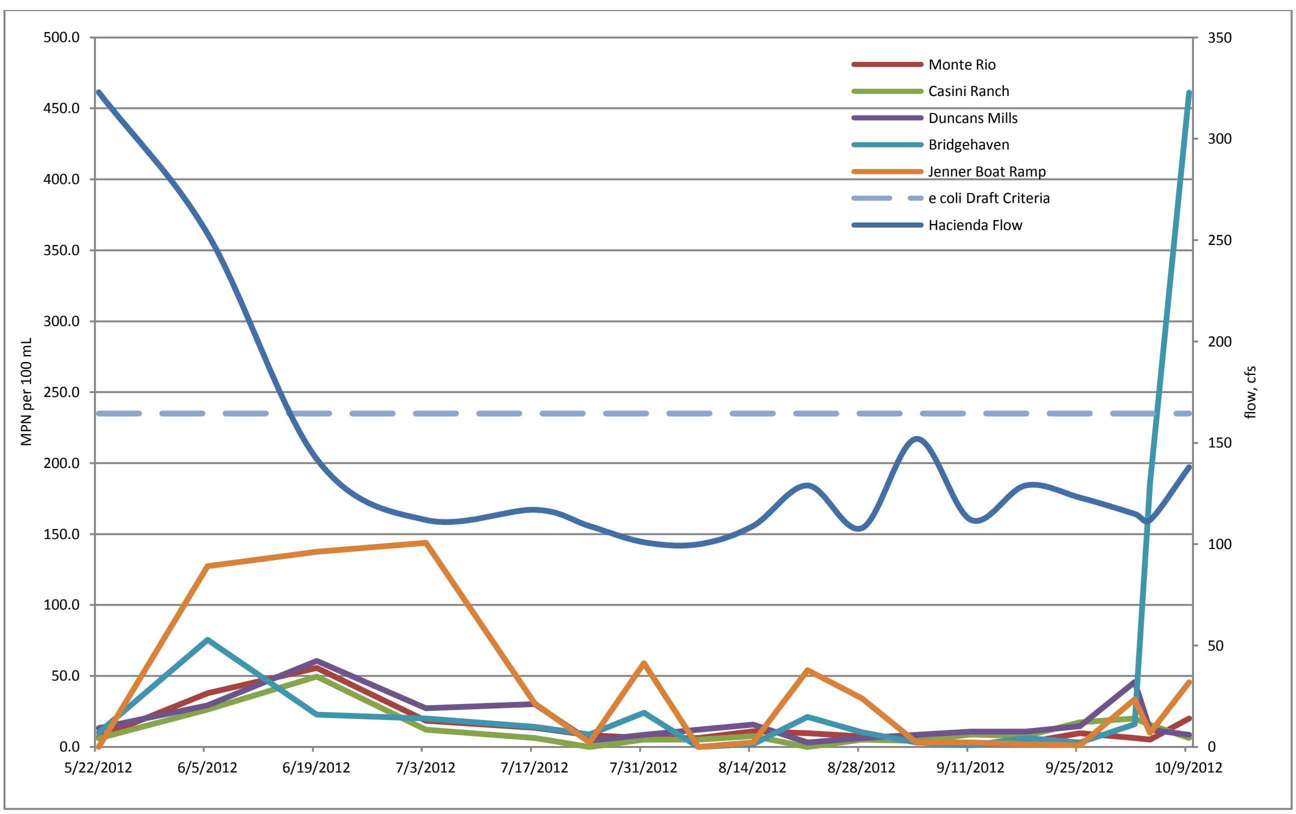

Figure 3-8. Water Agency *E. coli* Sample Results for the Russian River, Monte Rio to Jenner

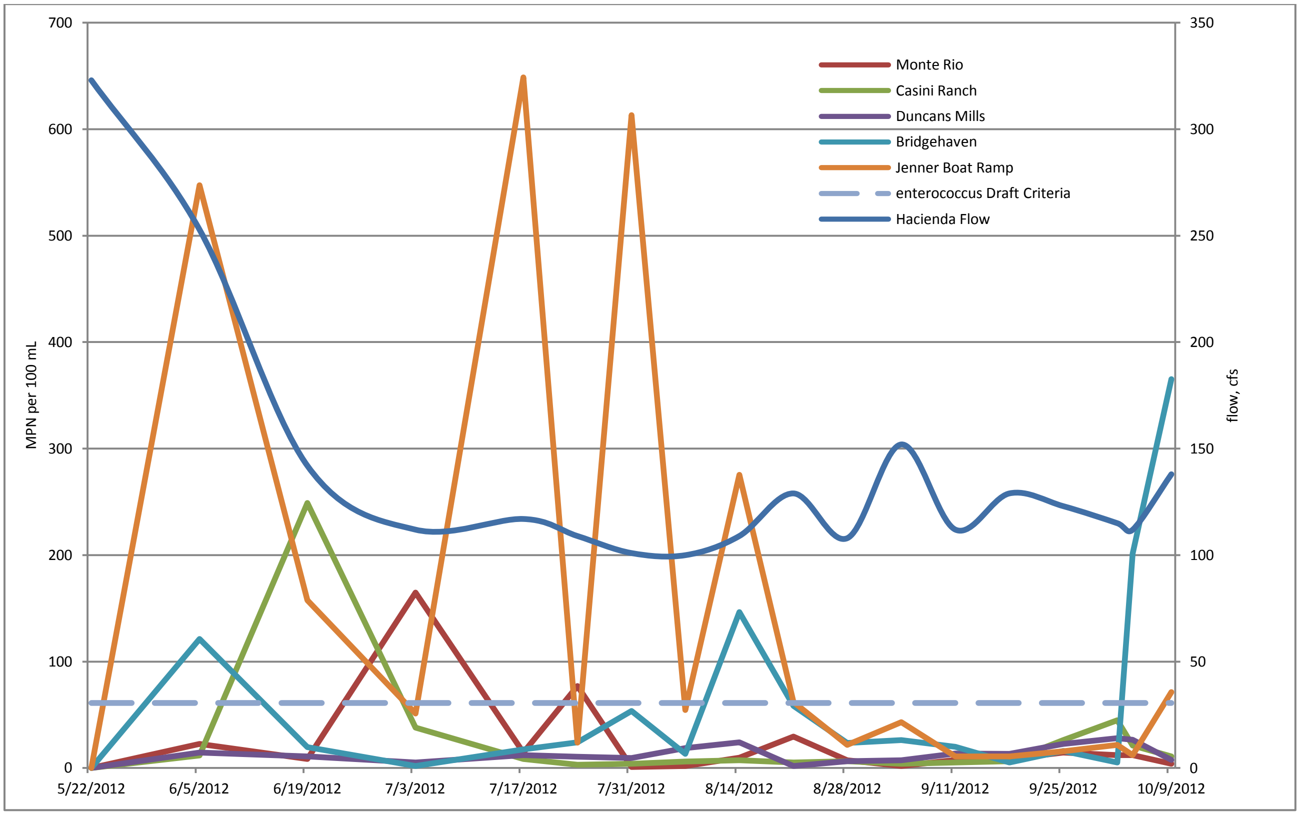

Figure 3-9. Water Agency Enterococcus Sample Results for the Russian River, Monte Rio to Jenner

4.0 ADDITIONAL MONITORING

4.1 Permanent Datasondes

In coordination with the USGS the Water Agency maintains five 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), the Water Agency's water supply facility at Mirabel (RDS), and Johnson's Beach. These five 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 seasonal sondes with real-time telemetry at the USGS river gage station at Russian River near Cloverdale (north of Cloverdale at Commisky Station Road) and at the gage station at Russian River at Jimtown (Alexander Valley Road Bridge). These two additional sondes 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 2012 dataset and historical sonde data will be evaluated to support the Water Agency's future CEQA compliance documents.

4.2 Aquatic Habitat for Salmonids

4.2.1 Introduction

Altered flow regimes in rivers have the potential to change the environmental conditions experienced by salmonids occupying mainstem habitats. NMFS (2008) found that high summer time flows related to reservoir releases can increase velocities to the point that there is a reduction in the amount of optimal habitat available to summer rearing salmonids. However summer flows could be reduced to the point that water temperature could increase and dissolved oxygen (DO) could decrease, thereby degrading summer salmonid rearing habitat. In April of 2012 the Water Agency requested a Temporary Urgency Change Petition (TUCP) to meet the requirements in the Biological Opinion. The 2012 TUCP requested a change in minimum instream flow requirements under Decision 1610 (D1610) in order to improve salmonid rearing habitat in the Russian River as outlined in the Biological Opinion. These flow changes are also intended to provide a lower, closer-to-natural inflow to the estuary between late spring and early fall, thereby enhancing the potential for maintaining a seasonal freshwater lagoon that would likely support increased production of juvenile steelhead and salmon (NMFS 2008). In the State Water Resource Control Board's (SWRCB) Order the Water Agency was tasked with evaluating impacts to water quality and the availability of aquatic habitat for salmonids in the Russian River associated with reductions in minimum instream flows in the Order. The period covered by the Order is May 2 through October 15, 2012 (Crader 2012). This report summarizes Russian River flow, temperature, DO, and salmonid monitoring data in order to evaluate the potential effect of reducing minimum instream flows on salmonid habitat.

4.2.2 Life stages

Salmonids in the Russian River can be affected by flow, temperature, and DO changes at multiple life stages. The Russian River supports three species of salmonids, coho salmon, steelhead, and Chinook salmon (Martini-Lamb and Manning 2011). 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 as 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, identified as alevins, remain in the gravel for another 4-10 weeks before emerging. After emerging 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 levels. While broadly 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; consequently, these subtle but important differences may expose each species to a different set of freshwater conditions.

Coho timing

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 and 2012 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 and smolt life stages will be summarized for this report. Spawning and rearing take place in the tributaries which are outside of the spatial boundaries governed by the Order (Table 4-1).

Steelhead timing

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 (Ukiah Reach), but at a lower density than in the Canyon Reach. 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 have cooler water temperatures when compared to other mainstem reaches. The cool water found in the Canyon and Ukiah reaches is a direct result of releases made at the Coyote Valley Dam. Therefore, for steelhead parr, water temperature data will only be summarized at Hopland and Cloverdale because they are the only sites where water temperature data was collected that are within the section of the upper Russian River known to support summer rearing steelhead parr.

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, parr (rearing), and smolt life stages are present in the mainstem during the time period covered by the Order and only these life stages will be analyzed for the potential effect of altered temperature and DO levels related to the Order (Table 4-1).

Chinook timing

Based on video monitoring at the Water Agency's inflatable dam in Mirabel, 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, SCWA unpublished data). 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 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 and smolt life stages are present in the mainstem of the Russian River during the time period covered by the Order. Therefore, temperature and DO levels during the time period related to the Order will be analyzed for these Chinook life stages in this report (Table 4-1).

Table 4-1. The species and life stage of salmonids found in the Russian River watershed that will be analyzed for this report during the period covered by the Order (May 2, 2012 to October 15, 2012) and the justification for excluding certain life stages from the analysis. The Order only applies to the Mainstem Russian River and not its tributaries.

Species	Life stage	Summarized in report	Comments
Chinook	adult	x	September to late December
	spawning		Fall/winter
	egg		Winter/early spring
	alevin		Winter/early spring
	fry		Winter/early spring
	smolt	x	Spring/early summer
steelhead	adult	x	Fall/winter
	spawning		Winter/early spring
	egg		Winter/early spring
	alevin		Winter/early spring
	fry		Spring/early summer
	parr	x	spring/summer/fall/possibly winter
	smolt	x	Winter/early spring
coho	adult		Fall/winter
	spawning		spawns in tributaries
	egg		eggs deposited tributaries
	alevin		Alvin emerge in tributaries
	fry		freshwater rearing takes place in tributaries
	parr		freshwater rearing takes place in tributaries
	smolt	x	Spring/early summer

4.2.3 Methods

The Water Agency operated a downstream migrant trap and later an underwater camera system at the Mirabel inflatable dam approximately 4.8 river kilometers (rkm) upstream of Hacienda. Data from this monitoring site was used to determine what species and life stages were present in the Russian River during the Order. Physical habitat conditions (flow, water temperature, and DO) were collected at multiple sites (Hopland, Cloverdale, Diggers Bend and Hacienda) in the Russian River during the Order. These conditions were compared to findings in the literature that were used to construct temperature and DO criteria for Russian River salmonids during different life history phases. These criteria were used to assess potential impacts to salmonids related to temperature, and DO.

Temperature

Daily minimum and daily maximum water temperature were collected at 4 sites (Hopland, Cloverdale, Diggers bend and Hacienda) on the Russian River and compared to temperature zones and limits that were constructed from a compilation of temperature data found in the literature. Salmonids have different temperature requirements depending on the species or life stage, therefore the temperature zones and upper limit used in this report differ by species and life stage.

Stream temperatures that restrict salmonids vary with species and possibly by geographical region. Critical temperatures that limit production and survival of salmonids vary widely in the literature. As a result, establishing a single set of criteria that describes the suitability of a particular stream's thermal regime to support salmonids is difficult. For example, Bell (1986) states that the upper lethal temperature of steelhead is 23.8 ˚C, while Nielsen et al. (1994) reported steelhead in the Eel River feeding at water temperatures of 24 ˚C. Further, growth of Chinook has been reported to be maximized at a temperature of 14.8 ˚C when food rations are maintained at 60 percent of satiation, but at 18.9 to 20.5˚C when fish were fed to satiation. Much of the literature analyzing the effects of temperature on fish is focused on determining "optimal" or lethal levels. However, even in natural environments, fish often spend the majority of their time exposed to "suboptimal" conditions. Depending on the elevated temperature, fish are able to survive, grow, and reproduce at temperatures above their theoretical "optimum." Brett (1956) developed a generalized concept of the effects of temperature on salmonids. He used four categories (zones) with five responses to relate the effects of temperature on growth and survival; the upper lethal limit where death occurs rapidly, zone of resistance where death can occur depending on the length of exposure, zone of tolerance where there is no mortality but no growth as well, and the zone of preference where growth occurs proportional to food availability, and optimal zone where growth occurs at all but starvation rations. Below the Zone of Preference growth is reduced by excessively cold temperatures. Sullivan et al. (2000) illustrated this concept graphically (Figure 4- 1). It is within the Zone of Preference that fish spend the majority of their lives.

Chinook salmon and steelhead have similar temperature tolerances. In addition, they both spawn in the mainstem Russian River. Coho salmon generally have a lower tolerance for temperature and do not spawn in the mainstem Russian River. Therefore, criteria evaluating the effects of temperature on Chinook salmon and steelhead will be combined, while a separate set of criteria will be developed for Coho salmon. However, the time of year that they are present in the river differ.

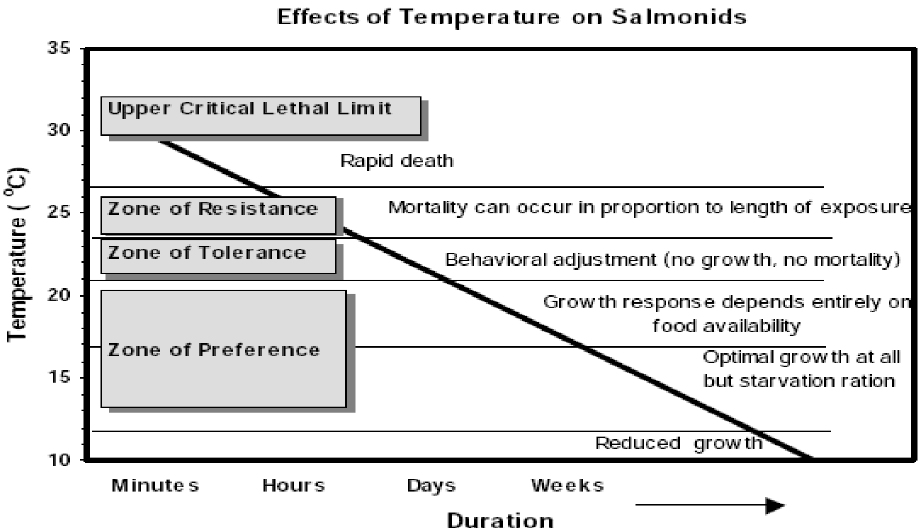

Figure 4-1. General environmental effects of temperature on salmonids in relation to duration and magnitude of temperature (from Sullivan et al. 2000, page 2-2).

Coho salmon

Bell (1986) gives the preferred range of temperatures for emigrating juvenile coho salmon as 7.2 to 16.7 ˚C. The Environmental Protection Agency (EPA 1977) developed the concept of the "Maximum Weekly Average Temperature" (MWAT). A MWAT is the highest temperature that an organism can survive over the long term and maintain a healthy population (the MWAT is based on a 7-day moving average, and is the warmest seven consecutive days recorded annually). The EPA determined that the MWAT for coho salmon was 17.7 ˚C. Welsh *et al.* (2001) compared the distribution of juvenile coho salmon in 21 tributaries in the Mattole River Basin with the maximum weekly maximum temperature (MWMT), defined as the highest average maximum temperature over a seven day period, and the MWAT. The warmest tributaries supporting coho salmon had a MWMT of 18 ˚C, and a MWAT of 16.7 ˚C. All tributaries that had a MWMT of less than 16.3 ˚C and a MWAT of less than 14.5 ˚C supported juvenile coho salmon.

The maximum sustained cruising (swimming) speed of under yearling coho salmon occurred at 20 ˚C; above this temperature, swimming speed decreased significantly (Griffiths and Alderice (1972) and Brett *et al.* (1958), cited by Bell (1986)). Growth of coho salmon fry was reported as high between 8.9 and 12.8 ˚C, but decreased (from 55 mg/day to 35 mg/day) when temperature was increased to 18.1˚C (Stein *et al.* 1972). Coho salmon growth apparently stops at temperatures above 20 ˚C (Bell 1973, cited by McMahon 1983). However, in a field study conducted in Washington, no differences in coho salmon growth rates were found between streams where the daily maximum water temperature exceeded 20 ˚C during July and August and other nearby streams of similar size (Bisson *et al.* 1988). Sullivan *et al.* (2000) concluded that setting an upper threshold for the 7-day maximum temperature at 16.5 ˚C would minimize growth loss for coho salmon. Thomas *et al.* (1986) examined the effects of fluctuating temperature on mortality, stress and energy reserves of juvenile coho salmon. Coho salmon held in a fluctuating environment of 6.5 to 20 ˚C had higher levels of plasma cortisol (which may indicate that the fish were under stress); however, the fish did not exhibit common signs o`f stress, such as flashing, gasping at the surface, or disorientation. Thomas *et al.* (1986) also reported that all test fish survived when daily temperature fluctuation ranged from 5.0 to 23 ˚C.

Holt *et al.* (1975) found that the percentage of coho salmon and steelhead dying after exposure to a bacterial infection increased with temperature from no mortality at a temperature of 9.4 ˚C to 100 percent mortality at a temperature of 20.6 ˚C. All control fish survived the maximum temperatures tested (23.3 ˚C).

Steelhead

The upper lethal water temperature for steelhead has been reported to be 23.8 ˚C (Bell 1986). Myrick and Cech (2000) reported that various strains of rainbow trout/steelhead can withstand temperatures near 26 ˚C for short periods of time. In the Eel River, juvenile steelhead were observed feeding in surface waters with ambient temperatures up to 24 ˚C (Nielsen *et al.* 1994). Optimal water temperatures for rearing steelhead have been reported to be 10 to 12.7 ˚C (Bell 1984) and 14.2 ˚C (Bovee 1978). Steelhead streams should have summer water temperatures between 10 and 15 ˚C, with maximum water temperatures below 20 ˚C (Barnhart 1986). Myrick and Cech (2000) reported a preferred temperature for wild Feather River steelhead of approximately 17 ˚C under both fed and food deprived conditions, even though the fish were collected from water with temperatures below 15 ˚C. Myrick and Cech (2005) tested steelhead growth rates at three temperatures (11, 15 and 19 ˚C). Food consumption rates were the same at each temperature, however growth rate was higher at 19 ˚C suggesting improved food conversion efficiency at the higher temperature. Reese and Harvey (2002) found that the growth of and the size of the territory defended by dominant steelhead was reduced in the presence of juvenile pikeminnow at temperatures between 20.0-23 ˚C, but growth was not reduced when the two species were held in treatment water ranging between 15 and 18 ˚C. Werner et al. (2005) detected significant increases in the heat shock protein (hsp) 72 in wild steelhead parr collected in the Navarro River Watershed when the short- and long term daily average temperatures were 18 to 19 ˚C, and daily maximum temperatures were 20 to 22.5 ˚C. Although this study did not report on the ecological consequences of juvenile steelhead rearing at temperatures above 18 ˚C (e.g., reduced growth, survival, etc.), the presence of hsp indicate that the fish were undergoing a response to an outside stressor (temperature in this case), implying a physiological cost to the fish. Nielsen *et al.* (1994) reported an increase in agonistic behavior and a decrease in foraging as stream temperatures increased above 22 ˚C. Harvey et al. (2002) found steelhead in relatively high densities in some tributaries to the Eel River where MWATs ranged between 20-22 ˚C. Steelhead were not observed to move into thermally stratified pools at temperatures below 22 ˚C. Wurtsbaugh and Davis (1977) reported that for fish fed to satiation, an increase in temperature led to an increase in the maximum consumption rates. The high feeding rates decreased the negative effects of increased water temperatures, up to 22.5 ˚C for rainbow trout. Above 22.5 ˚C, feeding rates decreased, possibly due to temperature related stress.

Sullivan *et al.* (2000) concluded that setting an upper threshold for the 7-day maximum temperature at 20.9 ˚C would minimize growth loss for steelhead. Roelofs *et al.* (1993) classified water temperatures in the Eel River as: extremely stressful for steelhead above 26 ˚C, causing chronic physiological stress that jeopardizes survival at temperatures between 23 and 26 ˚C, and as having chronic effects at temperatures between 20 and 23 ˚C. A MWAT has not been calculated for steelhead.

Chinook salmon

The upper critical lethal limit for Chinook salmon has been variously reported to be 26 ˚C (Hansen 1999, cited in Myrick and Cech 2000), 25 ˚C (Brett 1952 and Bell 1986), and 23 ˚C (±1˚C) (Baker *et al.* 1995). Chinook salmon can tolerate brief exposure to temperatures of 28.8˚C when acclimated to a temperature 19 ˚C (Myrick and Cech 1999). The upper chronic thermal limit (temperature survived for at least 7 days) is similar to the upper lethal temperatures (24 to 25.1˚C) (Myrick and Cech 2000).

The preferred temperature range for Chinook salmon has been reported to range from 12 to 14 ˚C (Brett 1952) and 13.0 to 14.4 ˚C (Bell 1986). However, Myrick and Cech (2000) reviewed several studies analyzing the effects of temperature on growth of Chinook salmon, and found that growth was maximized at temperatures ranging between 15.3 and 20.5 ˚C, when food was not limiting. Brett et al. 1982 reported growth was maximized between 18.9 and 20.5 ˚C (when fed to satiation), depending on the stock used. Stauffer (1973) (modified by McLean 1979) developed a model for Chinook and coho salmon in a Washington State fish hatchery that predicts growth rate based on ration levels and water temperature. When ration levels were cut to 60 percent of satiation, maximum growth occurred at 14.8 ˚C, and theoretically, zero growth would occur at 21.4 ˚C. Rich (1987) reported maximum growth occurred at 15.3 ˚C, but water quality may have been a factor in the reducing growth in this study. Marine and Cech (2004) reported that Chinook smolts reared at fluctuating temperatures between 17 and 20.0 ˚C grew at rates similar to Chinook smolts reared at 13 to 16 ˚C, and that Chinook smolts survived and grew at temperatures up to 24 ˚C at ration levels found in the wild. However, the rate of growth decreased for fish reared at temperatures above 22 ˚C (Brett et al. 1982).

Water temperatures above 21.1 ˚C have been reported to stop downstream migration of Chinook salmon smolts (Department of Water Resources (DWR) 1988 cited by NCRWQCB 2000). However, in the Russian River, Chinook salmon have been captured in downstream migrant traps (presumed migrating) at temperatures in excess of 21.9 ˚C (Chase et al. 2004). Chinook reared at temperatures greater than 17 ˚C had impaired hypoosmoregulatory capability (ability to adapt to seawater) compared to fish reared between 13 and 16 ˚C (Marine and Cech 2004). However, smolts reared at temperatures between 17 and 20 ˚C did not experience a statistically significant decrease in survival during acute seawater test compared to fish reared at 13 to 16 ˚C. Compared to smolts reared at cooler temperatures, smolts reared at warmer temperatures were more vulnerable to predation during test held at cooler temperatures ranging between 15.0 and 17 ˚C, but were not more vulnerable to predation when the test were held at temperatures ranging from 18 to 21 ˚C. Marine (1997) demonstrated that Chinook salmon can successfully smolt at temperatures up to 20.0 ˚C, however, they did exhibit some impaired patterns compared to fish reared at lower temperatures. Clarke and Shelbourn (1985) and Clarke et al. (1981) reported that optimal temperatures for smolting Chinook salmon range between 10.0 and 17.5 ˚C.

Fall Adult Chinook salmon reportedly migrate at temperatures ranging from 10.6 to 19.4 ˚C, with an optimal temperature of 12.2 ˚C (Bell 1991). Upstream migration by adult Chinook salmon in the San Joaquin River was halted when temperatures exceeded 21.1 ˚C, but resumed when temperatures declined below 17.8 ˚C (Hallock 1970, cited by Entrix (in DW Kelly and Associates and 1992)). However, Dunham (1968, cited by SWRCB 1988) reported that adult salmon migrated through the Klamath River at water temperatures as high as 24.4 ˚C. In the Russian River, adult Chinook salmon have been observed migrating past the Inflatable Dam at temperatures up to 21.8 ˚C, but relatively large numbers of adults are rarely observed at temperatures above 17 ˚C.

Assessing the potential impacts of temperature on adult salmonids is complicated by the fact that temperatures that have little or no impact on the adults may result in reduced survival of their subsequent embryos. Eggs from salmon held for a prolonged time period at 15.6 to 16.7 ˚C had a lower survival rate to hatching (70 percent) compared to eggs from salmon held at 12.8 to 15 ˚C (80 percent survival). Eggs incubated at temperatures above 16.7 ˚C experienced 100 percent mortality (Hinze 1959, cited by DW Kelly and Associates and 1992). Since spawning success involves impacts to both adults and egg development, upstream migration and spawning are considered to be one life stage, and the temperature criteria will be based on the developing eggs, as opposed to impacts to adults which have a higher temperature tolerance.

Adult Chinook salmon begin to migrate upstream through the Russian River in earnest in October through November (low numbers of Chinook salmon have been counted at the Inflatable Dam in late August (≤ 9 annually) and September (0 to 176 annually). Entry into freshwater is based on a number of variables, including time of year, ocean conditions, streamflow, whether the river mouth is opened or closed, and possibly water temperature. Although Chinook salmon have been observed migrating past the Inflatable dam at temperatures ranging to 22.6 °C, approximately 91 percent of the adult Chinook salmon have been observed at the fish counting station after the average daily temperature declined below 17.1 °C (SCWA unpublished data). Annually, between approximately 73 and 97 percent of the fish counted at the Inflatable dam pass after the average daily temperature declines below 15.6 °C.

Using information gathered from the literature water temperature criteria were constructed for coho, Steelhead, and Chinook. These criteria for each spe cies were subdivided by the following life stages; downstream migrants (smolts), upstream migration and spawning (adults), and juvenile rearing (parr) (Table 4-2 through 4-4).

Table 4-2. Water Temperature Criteria and Life History Phase used to Assess Potential Impacts Related to coho salmon in the Russian River (upstream and downstream migrations).

Downstream migrants (March through June)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	< 15
Zone of Preference – Suitable	15 – 17.8
Zone of Tolerance	17.8– 20
Zone of Resistance	20 – 23.8
Upper Critical Lethal Limit	> 23.9
Upstream migration and spawning (November through January)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	<12.2
Zone of Preference – Suitable	12.2 – 15.6
Zone of Tolerance	15.6 – 16.9
Zone of Resistance	16.9 – 21.1
Upper Critical Lethal Limit	> 23.9
Juvenile Rearing (June through September)	
Zone	**Temperature (˚C) criteria**
Zone of Preference –Optimal	< 15
Zone of Preference – Suitable	15– 17.8
Zone of Tolerance	17.8 – 20
Zone of Resistance	20 – 23.8
Upper Critical Lethal Limit	> 23.9

Table 4-3. Water Temperature Criteria and Life History Phase used to Assess Potential Impacts Related to steelhead in the Russian River.

Downstream migrants (March through May)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	< 17.5
Zone of Preference – Suitable	17.5 – 18.9
Zone of Tolerance	18.9 – 21.1
Zone of Resistance	21.1 – 23.8
Upper Critical Lethal Limit	> 23.9
Upstream migration and spawning (December through March)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	<12.2
Zone of Preference – Suitable	12.2 – 15.5

Zone of Tolerance	15.5 – 16.9
Zone of Resistance	16.9 – 21.1
Upper Critical Lethal Limit (adults)	> 23.9
Juvenile Rearing (June through September)	
Zone	**Temperature (˚C) criteria**
Zone of Preference –Optimal	< 15.5
Zone of Preference – Suitable	15.5 – 20
Zone of Tolerance	20 – 21.9
Zone of Resistance	21.9 – 23.8
Upper Critical Lethal Limit	> 23.9

Table 4-4. Water Temperature Criteria and Life History Phase used to Assess Potential Impacts Related to Chinook salmon in the Russian River.

Downstream migrants (March through June)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	< 17.5
Zone of Preference – Suitable	17.5 – 18.9
Zone of Tolerance	18.9 – 21.1
Zone of Resistance	21.1 – 23.8
Upper Critical Lethal Limit	> 23.9
Upstream migration and spawning (October through December)	
Zone	**Temperature (˚C) criteria**
Zone of Preference – Optimal	<12.2
Zone of Preference – Suitable	12.2 – 15.5
Zone of Tolerance	15.5 – 16.9
Zone of Resistance	16.9 – 21.1
Upper Critical Lethal Limit (adults)	> 23.9

Dissolved Oxygen

Defining DO criteria for fish is complicated by the interaction between temperature and DO. Temperature strongly influences an organism's metabolism which in turn increases or decreases the DO demand placed on that organism. For example, Raleigh et al. (1986) summarized several studies on DO-requirements for salmonids and concluded that DO levels of 8 mg/l were optimal at temperatures between 7 and 10 ˚C, but at temperatures above 10 ˚C optimal DO levels were >12.0 mg/l. Bjornn and Reiser (1991) summarized several studies and concluded that food conversion was impaired at DO concentrations less than 5.0 mg/L and that salmonids were not impaired when DO concentrations exceeded 8 mg/L. Depending on temperature, the lower lethal limit for DO is around 3.0 mg/l (Raleigh et al. 1984).

Table 4-5. Dissolved oxygen criteria used to assess conditions for salmonids in Dry Creek and the Russian River.

DO range (mg/L)	Descriptive rating
≤3.0	Lower Lethal Limit
3.1 to <5.0	Zone Resistance
5.0 to < 8.0	Zone Tolerance
8.0 to <12.0	Zone of Preference – Suitable
≥12.0	Zone of Preference – Optimal

4.2.4 Results

Flow

Late rains allowed sufficient inflow into Lake Pillsbury to classify 2012 as a Normal year under D1610, but flows in the Russian River were effectively reduced in some sections by implementing the flow regimes outlined in the Order. In portions of the upper Russian River near Hopland flows were generally below the historic flows (the average of normal water years 2002, 2003, 2005, 2006) and D1610 minimum flows (185 cfs), but above the minimum flows authorized by the 2012 Order (Figure 4-2). At Healdsburg flows were generally lower than the historic flows and were lower than D1610 minimums for 129 days of the 167 day long Order. Flows within 10 cfs of the 125 cfs minimum flows were implemented for 75 days of the order. Flows in the lower Russian River (downstream of the confluence with Dry Creek) were below the D1610 minimum flow (125 cfs) for 94 days during the Order but did not drop below 80 cfs (Figure 4-3). Flows during the spring were above D1610 minimums due to rainfall and tributary input.

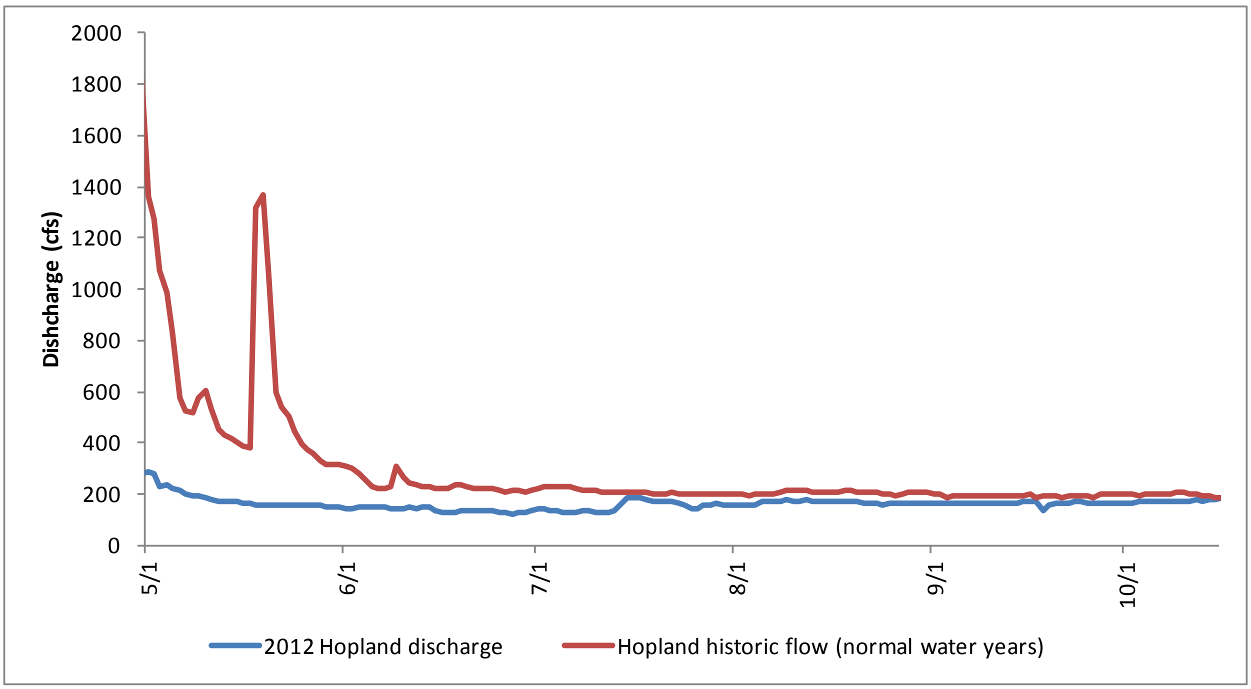

Figure 4-2. The 2012 Hopland average daily flow shown with the Historic flow at Hopland for normal water years (2002, 2003, 2005, 2006)

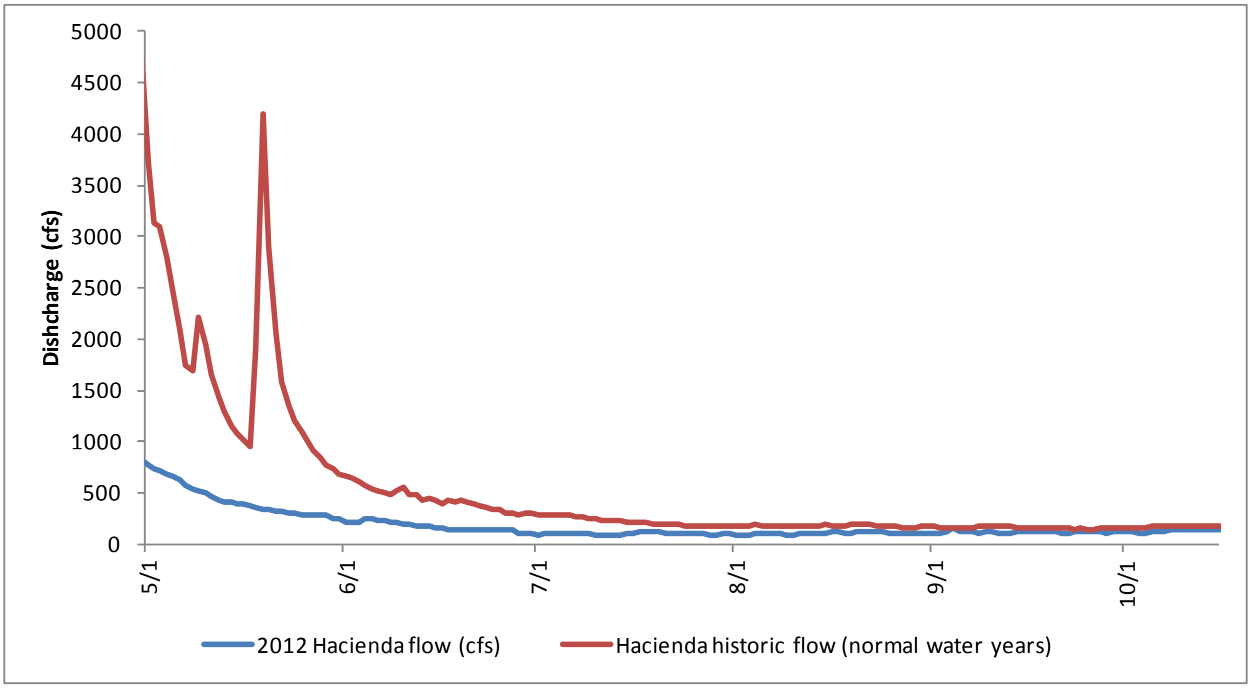

Figure 4-3. The 2012 Hacienda average daily flow shown with the Hacienda flow at Hopland for normal water years (the average flow for years (2002, 2003, 2005, 2006)

Temperature

In the upper Russian River near Hopland, water temperatures remained cooler in the fall than during many other years. During August the daily maximum water temperatures in the upper Russian River diverged from the historic water temperatures from normal water years (2002, 2003, 2005, 2006). On September 21, 2012, this difference became the most apparent and the maximum daily water temperature at Hopland was 4.5 °C cooler than the historic water temperature for normal water years (the average of the 2002, 2003, 2005, 2006 maximum daily water temperatures for that day, Figure 4-4). It is important to note that both the ambient air temperature was similar in 2012 than in normal water years and that flows were less in 2012 than in normal water years (Figure 4-5). The divergence in water temperature from normal water years at Hopland during the fall is likely due to the cold water pool (the portion of the lake below the thermocline) in Lake Mendocino being depleted under D1610 releases, but being preserved under the flow regime outlined in the Order. The preservation of the coldwater pool may also rely on carry over storage from the previous year as well as the degree of lake mixing which is likely wind driven. Flow is not the only factor in determining water temperature. Ambient air temperature is likely an important factor in determining mainstem Russian River water temperatures. However, preserving the cold water pool into the fall likely provides adult Chinook, as well as summer rearing steelhead, with cooler temperatures in the upper reaches of the mainstem Russian River.

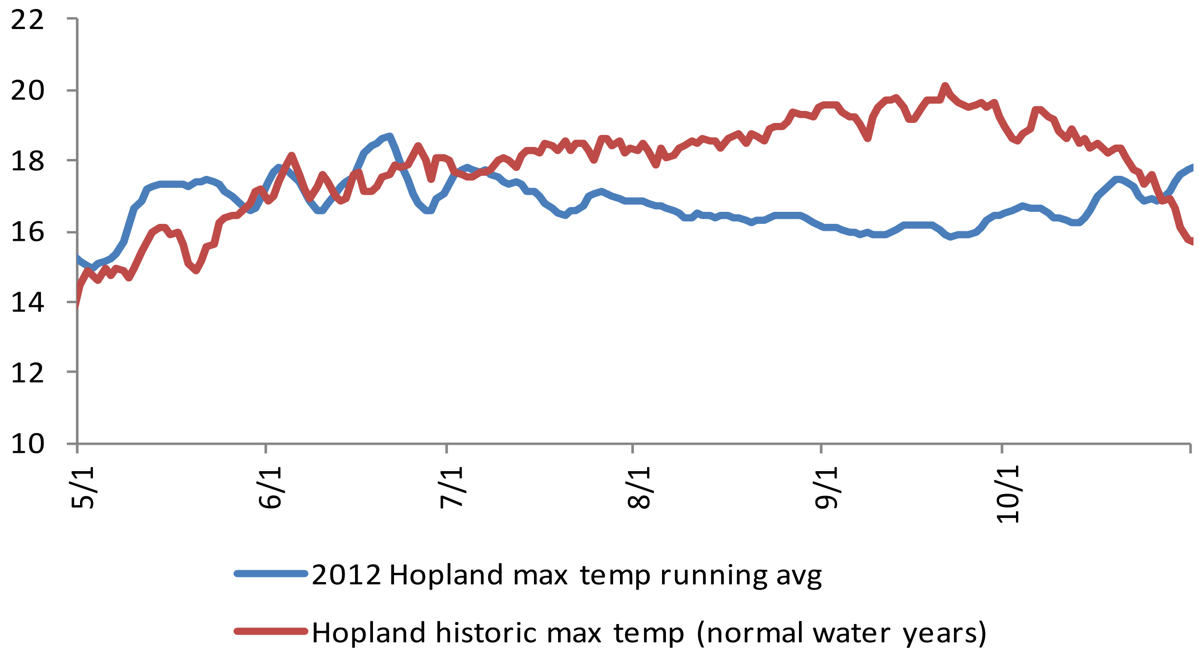

Figure 4-4. The 7-day running average of the daily maximum water temperature in 2012 at Hopland and the historic daily maximum water temperature (the average of the daily maximum water temperature from Decision 1610 normal water years (2002, 2003, 2005, 2006)

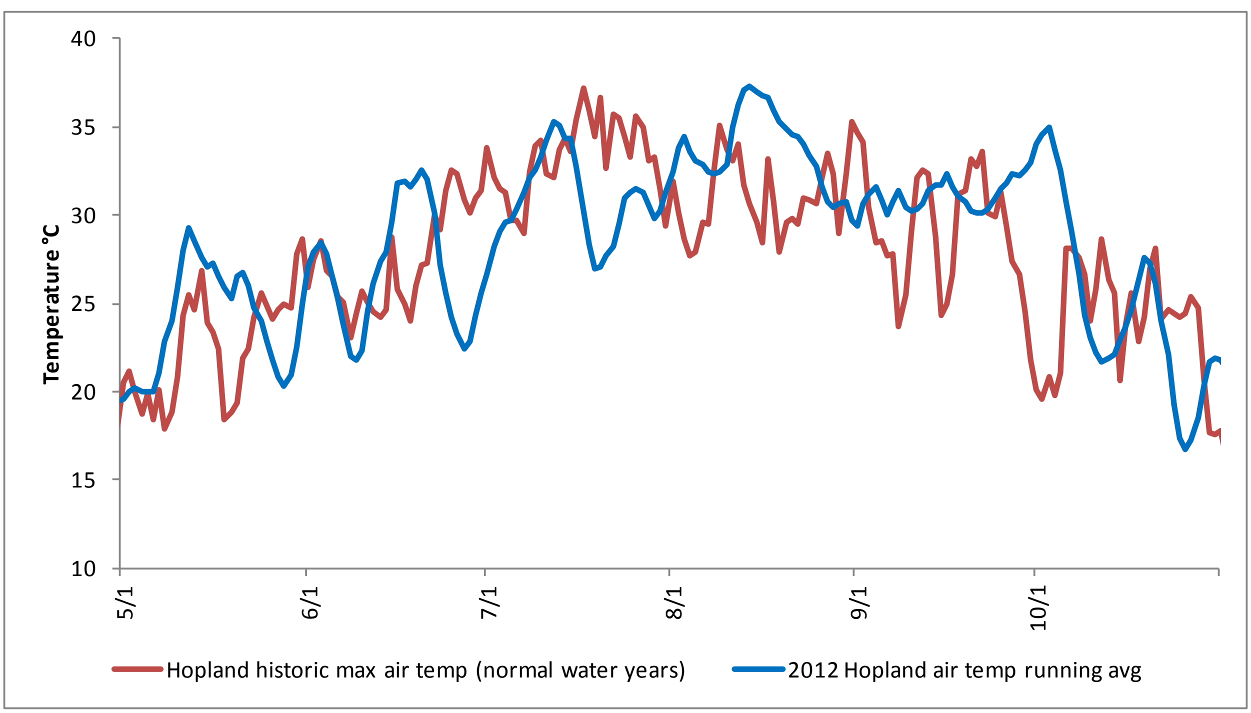

Figure 4-5. The 7-day running average of the daily maximum air temperature in 2012 at Hopland and the historic daily maximum air temperature (the average of the daily maximum air temperature from Decision 1610 normal water years (2002, 2003, 2005, 2006).

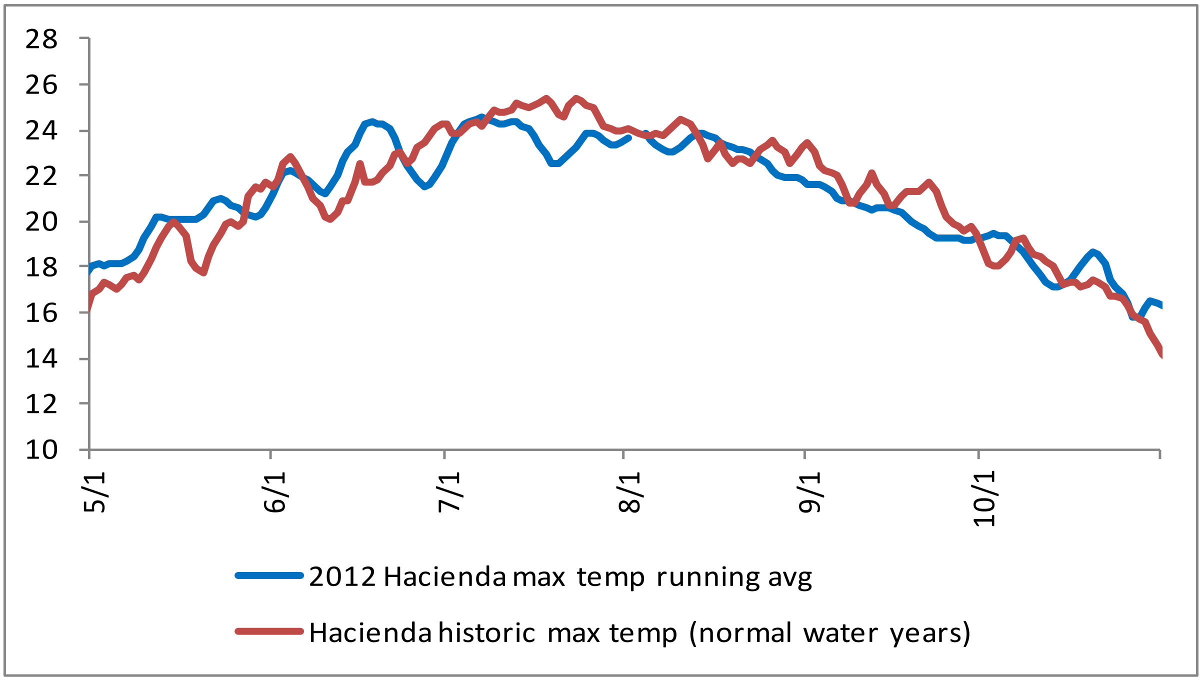

Figure 4-6. The 7 day running average of the daily maximum water temperature in 2012 at Hacienda and the historic daily maximum water temperature (the average of the daily maximum water temperature from Decision 1610 normal water years (2002, 2003, 2005, 2006).

In the lower river, 2012 water temperatures were generally similar to normal water years and showed less divergence from normal water years than did Hopland (Figure 4-6). It is important to note that while flow was lower in 2012 than in normal water years, water temperatures were similar between these two groups. Daily maximum water temperatures at Hacienda tracked ambient air temperature closely during the spring, but there was some divergence in the fall (Figure 4-7). Daily maximum water temperatures at Hacienda are typically warmer than at Hopland (Figure 4-8). This is likely due to the amount of time that cold water releases from Lake Mendocino were exposed to ambient air temperatures. Daily maximum air temperatures in Santa Rosa were similar in 2012 as in normal water years (Figure 4-9).

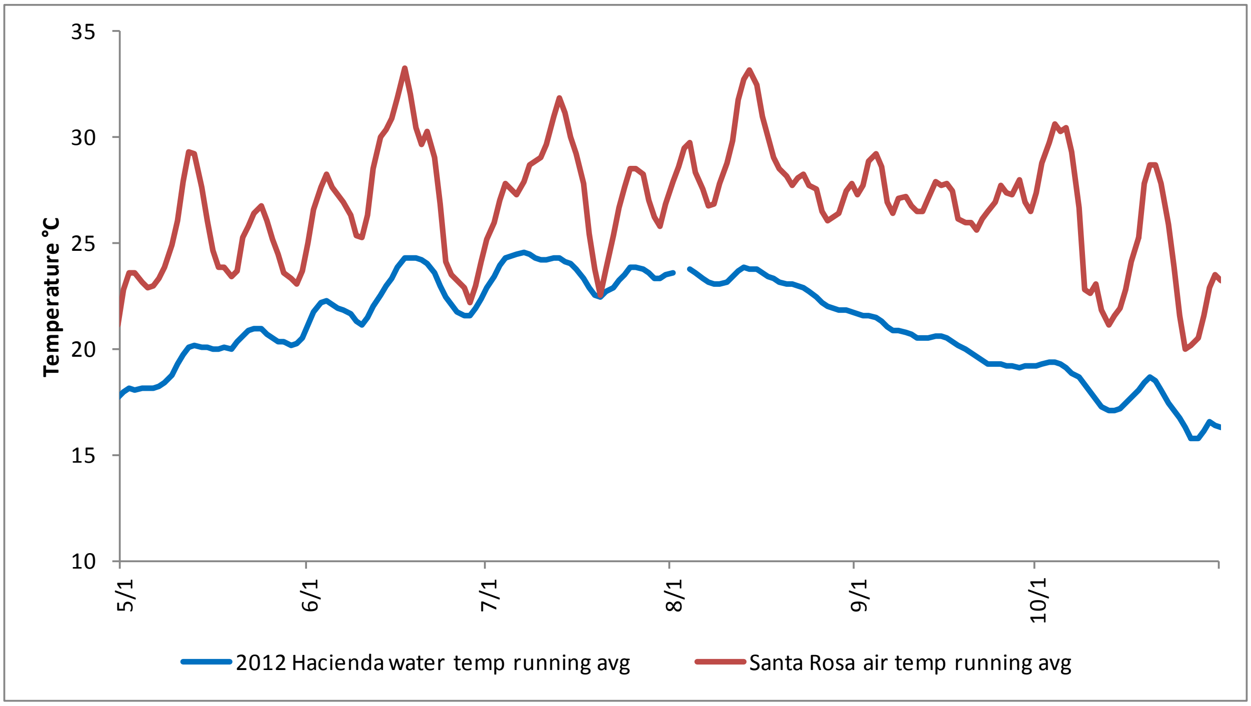

Figure 4-7. The 7-day running average of the daily maximum water temperature in 2012 at Hacienda and the 7-day running average of the daily maximum air temperature in 2012 measured at Santa Rosa.

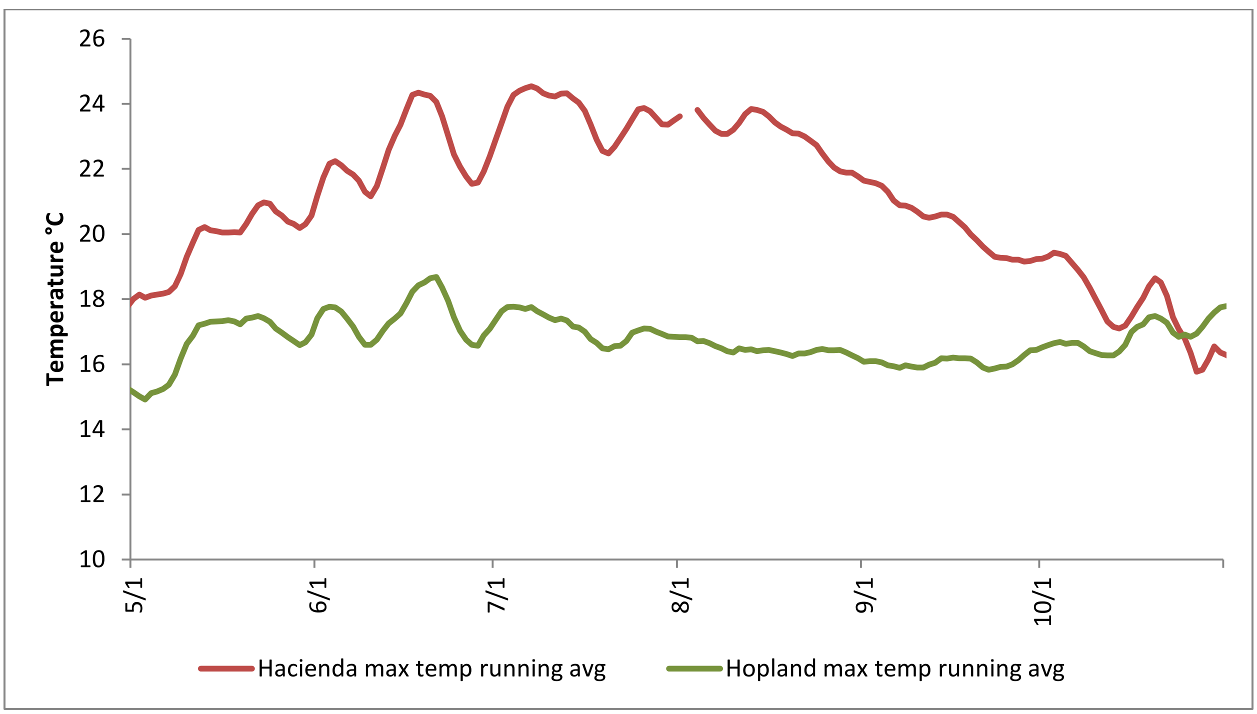

Figure 4-8. The 7-day running average of the daily maximum water temperature in 2012 at Hacienda and at Hopland.

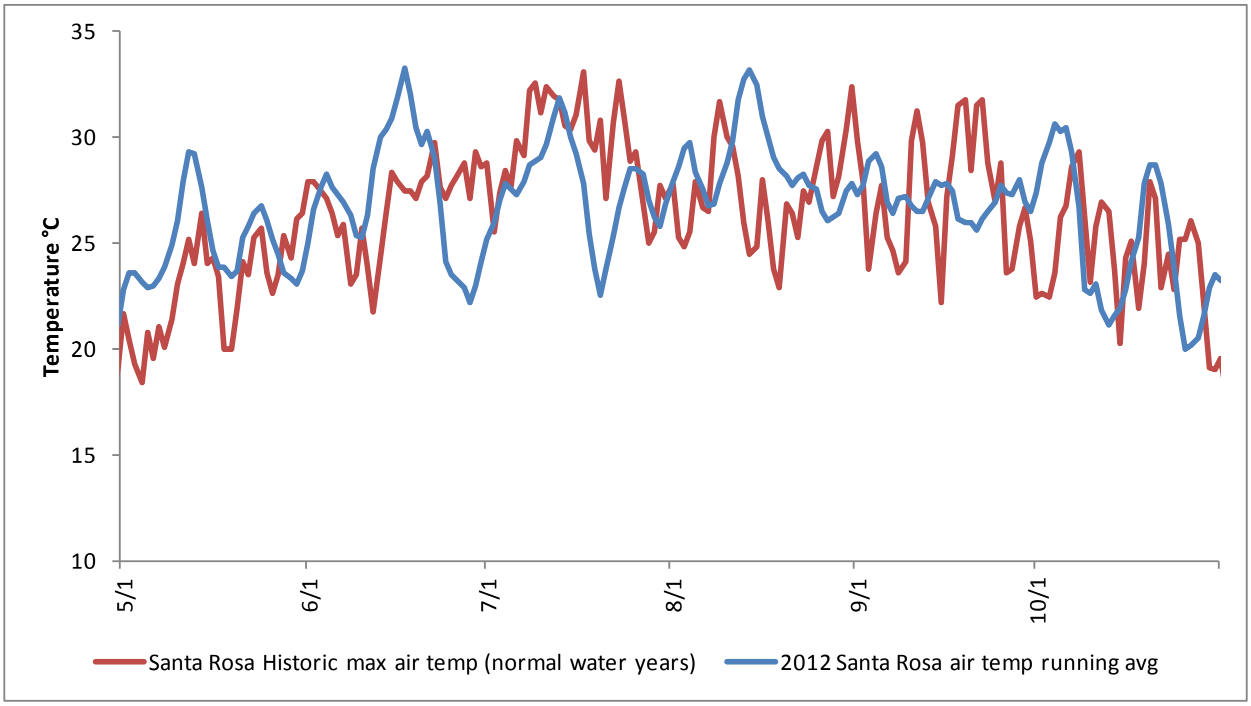

Figure 4-9. The running average of the daily maximum air temperature in 2012 at Santa Rosa and the daily air temperatures.

Coho

Fish observed on the underwater video camera system at Mirabel that have coho characteristics are sent to a panel of biologists for a verification of species identification. At the time of this writing the panel has not reviewed all the video that was sent to them. Therefore the adult coho numbers reported here are preliminary and subject to change. During the Order 4 coho adults were observed on the underwater video camera system at Mirabel. These 4 individuals were observed on the last 5 days of the Order where water temperature at Hacienda ranged from 15.6 to 18.4 °C. At this time water temperatures at Hacienda for coho adults were in the zones of tolerance and resistance (Figure 4-10). However it is important to note that coho adults voluntarily leave the ocean and enter the Russian River, and that the bulk of the adult coho migration occurs in the winter when water temperatures are much cooler.

Coho smolts were migrating through the mainstem Russian River during the beginning portion of the Order. Based on downstream migrant trapping at Mirabel in 2012, coho smolts were present in the mainstem Russian River until at least July 3. At Mirabel, 201 coho smolts, representing 67 % of the season total catch were captured after the Order went into effect on May 2, 2012.

In the section of river that coho smolts would be encountered (downstream of Maacama Creek) water temperatures were collected at Diggers Bend and Hacienda during the coho smolt migration. From May 2 to July 3, 2012, daily water temperatures ranged from a low of 15 °C to a high of 26.2 °C at Diggers Bend. At Hacienda water temperatures ranged from 14.6°C to 25.1 °C. During the period of the Order where coho smolts were detected at Hacienda water temperatures at Hacienda were generally in the suitable temperature zone; however, water temperatures did enter the zones of tolerance and resistance near the end of the coho outmigration season (Figure 4-11). It is important to note that nearly all coho spawning habitat in the Russian River is in tributaries in the lower river (downstream of Healdsburg) and in Dry Creek. The only upper river tributary that is known to presently support coho is Redwood Creek a tributary to Maacama Creek. Therefore most of the coho produced in the Russian River basin do not encounter the water temperatures at Diggers Bend.

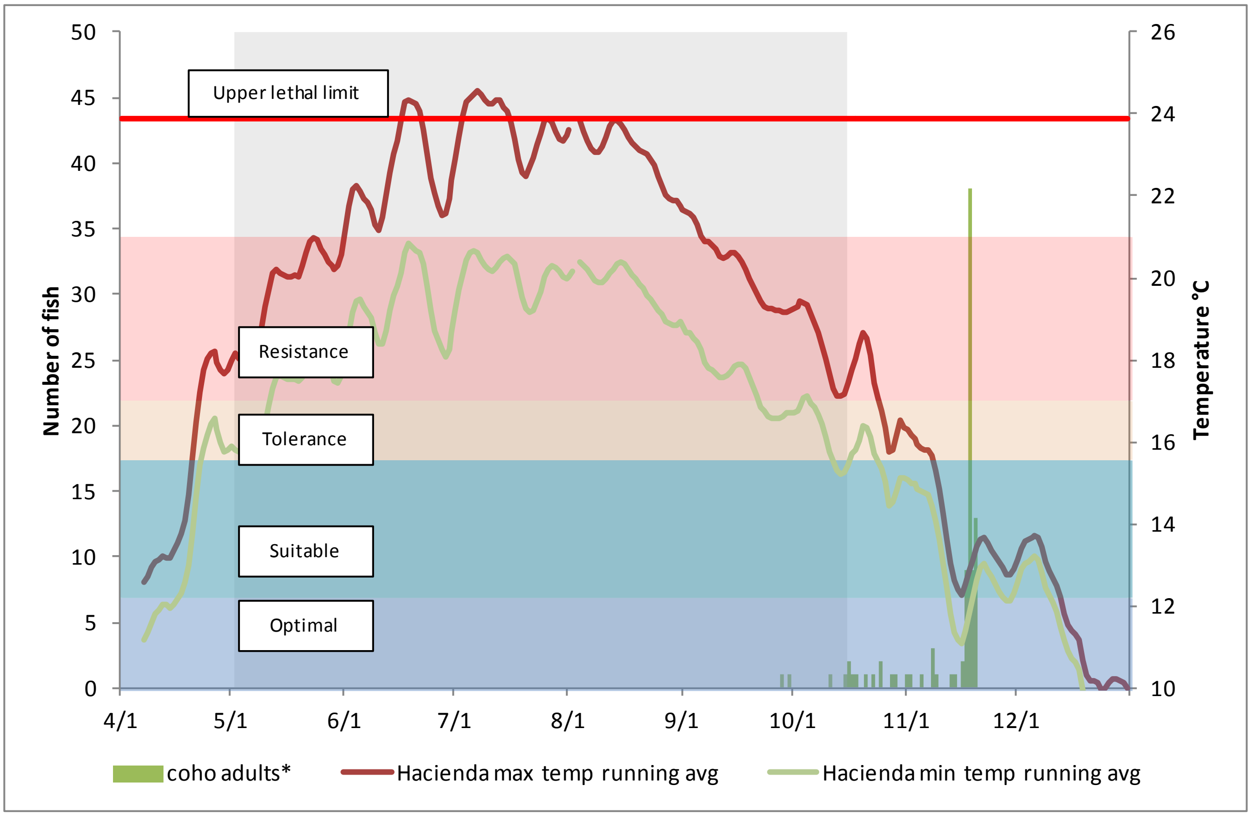

Figure 4-10. The number of coho adults observed on the Mirabel camera system (*preliminary data and subject to change) shown with the daily maximum and minimum water temperature 7-day running averages collected at Hacienda. Also shown are the temperature zones of optimal (<12.2 °C), suitable (12.2-15.6 °C), tolerance (15.6-16.9 °C), resistance (16.9-21.1 °C), and the upper critical lethal limit (>23.9 °C) for coho adults. The period of the Order is shaded in grey.

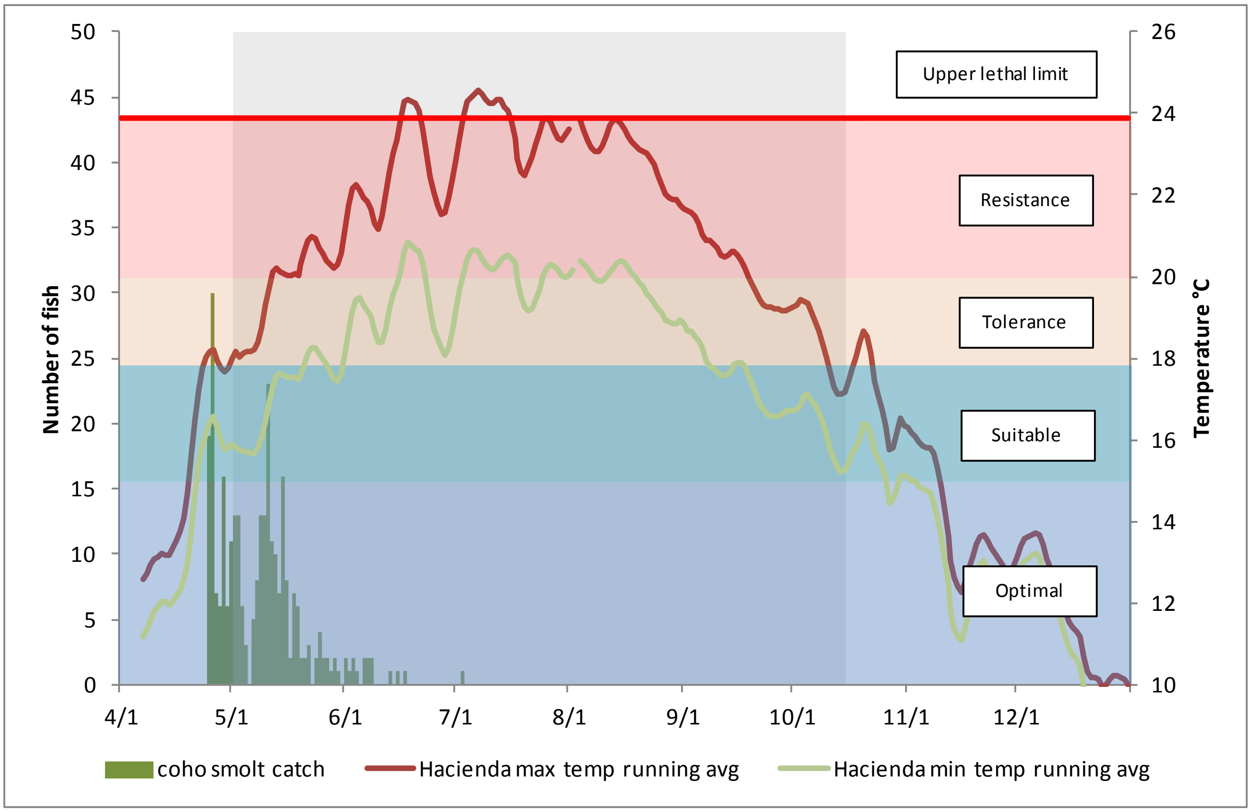

Figure 4-11. The number of coho smolts captured at Mirabel shown with the maximum and minimum daily water temperature 7-day running averages collected at Hacienda. Also shown are the temperature zones of optimal (<15 °C), suitable (15-17.8 °C), tolerance 17.8-20 °C), resistance (20-23.8 °C), and the upper critical lethal limit (>23.9 °C) for coho smolts. The period of the Order is shaded in grey.

Steelhead

Few adult steelhead were found in the Russian River during the time period that the Order was in effect. The first adult steelhead of the 2012 video monitoring season was observed on September 13. A total of 26 adult steelhead were estimated to have passed the Inflatable dam during the 2012 Order (SCWA unpublished data). Water temperatures at Hacienda, ranged from 14.3 °C to 20.6 °C during the period of the Order when adult steelhead were observed at the inflatable dam. During this time, water temperatures at Hacienda were in the zones of tolerance and resistance for adult steelhead (Figure 4-12). However it is important to note that steelhead adults voluntarily leave the ocean and enter the Russian River, and that the bulk of the adult steelhead migration occurs from December through April when water temperatures are much cooler (Chase 2005, Jackson 2007, SCWA unpublished data)

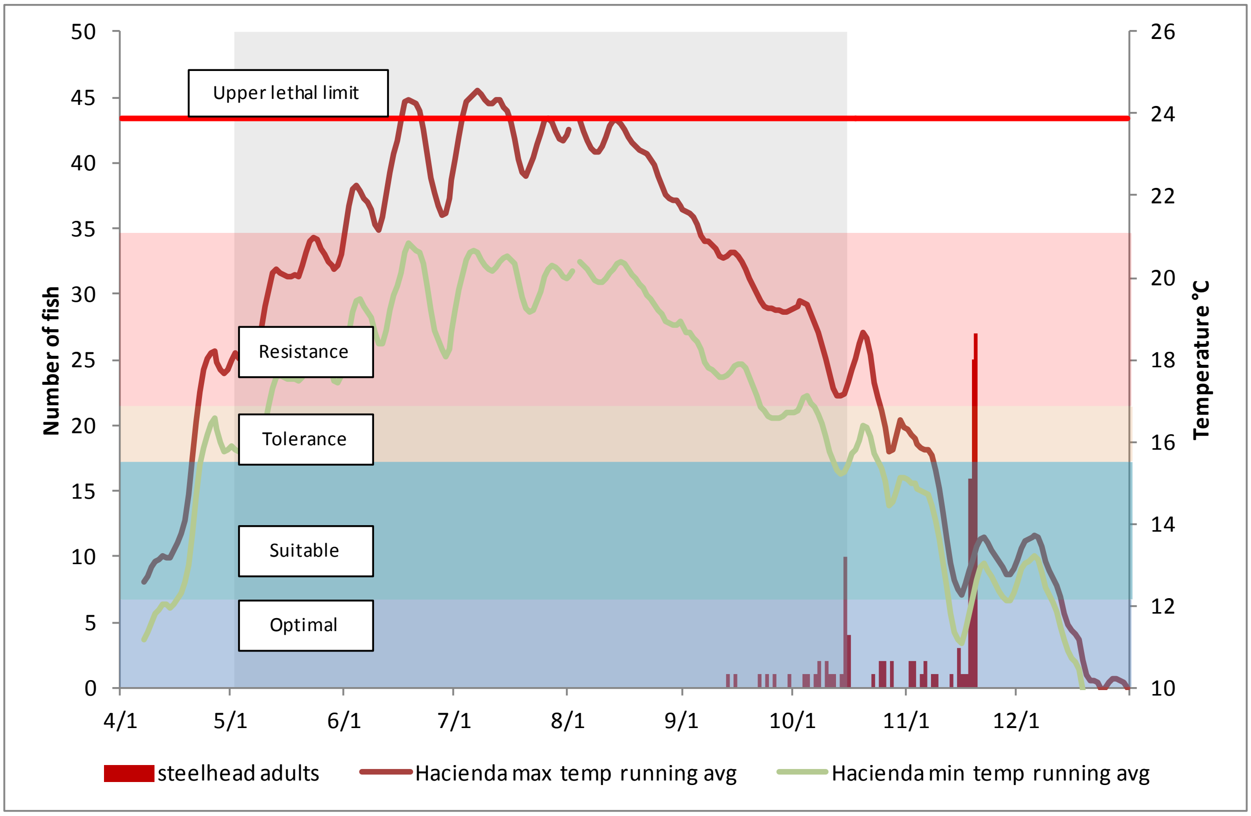

Figure 4-12. The number of steelhead adults observed on the Mirabel camera system shown with the daily maximum and minimum water temperature 7-day running averages collected at Hacienda. Also shown are the temperature zones of optimal (<12.2 °C), suitable (12.2-15.5 °C), tolerance (15.5-16.9 °C), resistance (16.9-21.1 °C), and the upper critical lethal limit (>23.9 °C) for steelhead adults . The period of the Order is shaded in grey.

In reaches that are considered steelhead rearing habitat, Ukiah to Cloverdale, water temperatures were often favorable for juvenile steelhead. During the time period that the Order was in effect, daily water temperatures measured at the USGS gauge (11462500) near Hopland ranged from 12 °C to 19.7 °C. At Hopland, the daily maximum and minimum water temperatures were generally in the optimal and suitable temperature zones (Figure 4-13). At Cloverdale, daily maximum water temperatures were generally in the zone of tolerance or suitability. There were no days in the Cloverdale record where water temperature entered the zone of resistance. However there was a 15 day period in June with missing data. It is important to note that the Cloverdale gage is at the downstream limit of the reaches considered to be steelhead habitat and that water temperatures are gradually cooler as one moves upstream from Cloverdale towards Hopland. Water temperatures remained below the upper critical lethal limit at Hopland and Cloverdale (Figures 4-13 and 4-14).

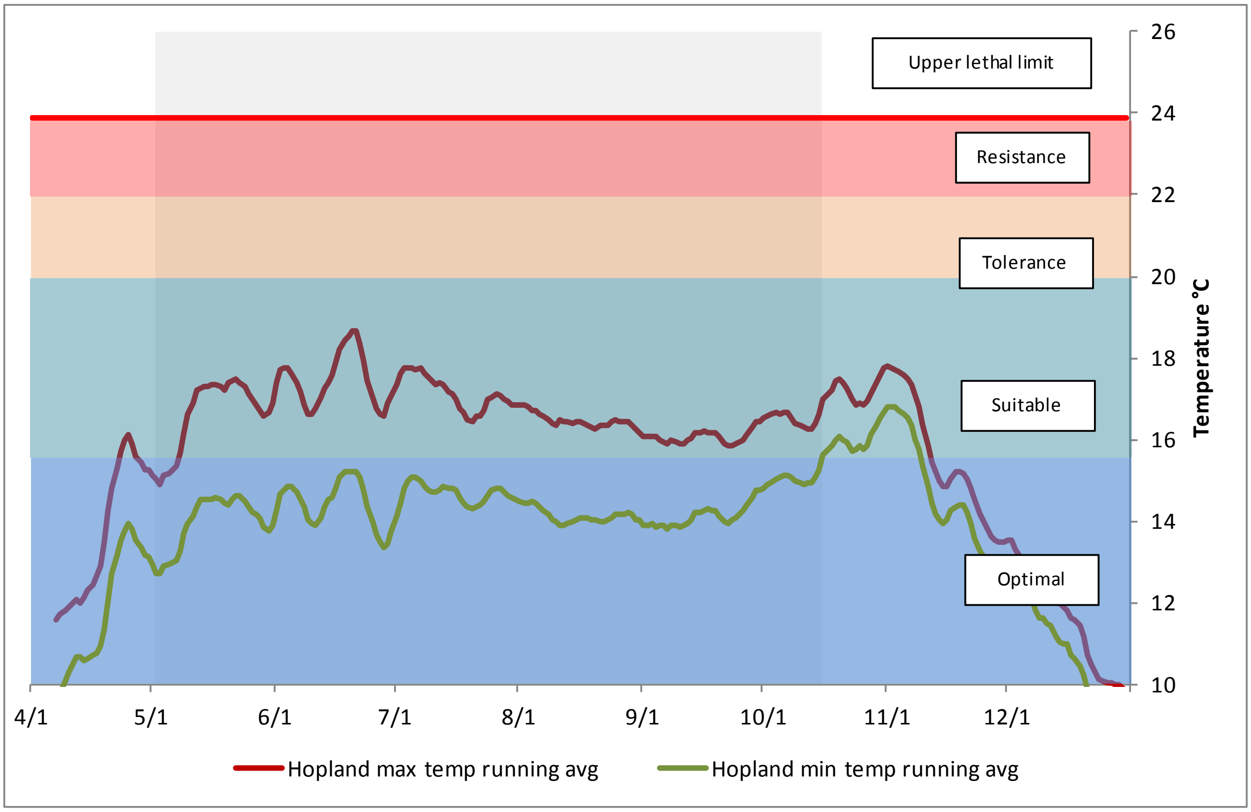

Figure 4-13. The maximum daily water temperature 7-day running average collected at Hopland shown with the temperature zones of optimal (>15.5 °C), suitable (15.5-20 °C), tolerance (20-21.1 °C), resistance (21.9-23.8 °C), and the upper critical lethal limit (>23.9 °C) for steelhead parr. The period of the Order is shaded in grey.

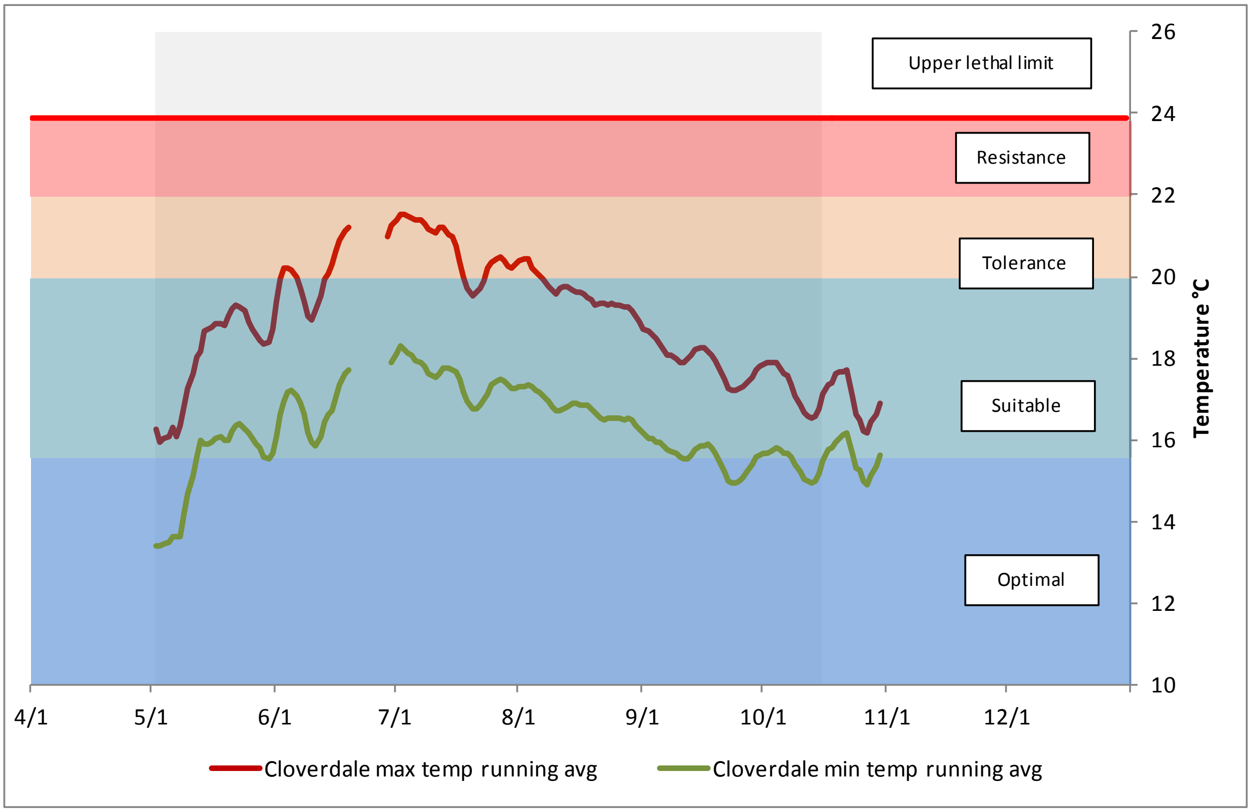

Figure 4-14. The maximum daily water temperature 7-day running average collected at Cloverdale shown with the temperature zones of optimal (>15.5 °C), suitable (15.5-20 °C), tolerance (20-21.1 °C), resistance (21.9-23.8 °C), and the upper critical lethal limit (>23.9 °C) for steelhead parr. The period of the Order is shaded in grey.

Steelhead smolts were present in the Russian River during the time period that the Order was in effect, although probably in low numbers. During 2012, 66 wild steelhead smolts were captured between May 2 and June 27 at Mirabel. The water temperatures at Hacienda ranged from 14.6 °C to 25.1 °C. During the portion of the Order where steelhead smolts were captured at Mirabel water temperatures at Hacienda were generally in the suitable and tolerable zones (Figure 4-15). Hopland, Cloverdale, and Diggers Bend are several miles upstream of the Water Agency's Mirabel trap site. Based on water temperatures it is likely that steelhead would emigrate from these sites earlier in the year. It is likely that many of the steelhead smolts detected in the Water Agency's trap at Mirabel had emigrated from Dry Creek where the water temperatures are much cooler. It is important to note that the Water Agency installs their downstream migrant traps as early as possible to monitor salmonid smolt outmigration, however because of high spring flows which limit trap installation and the early run timing of steelhead smolts it is likely that the majority of steelhead smolts emigrate from the Russian River before the Water Agency can install their fish traps.

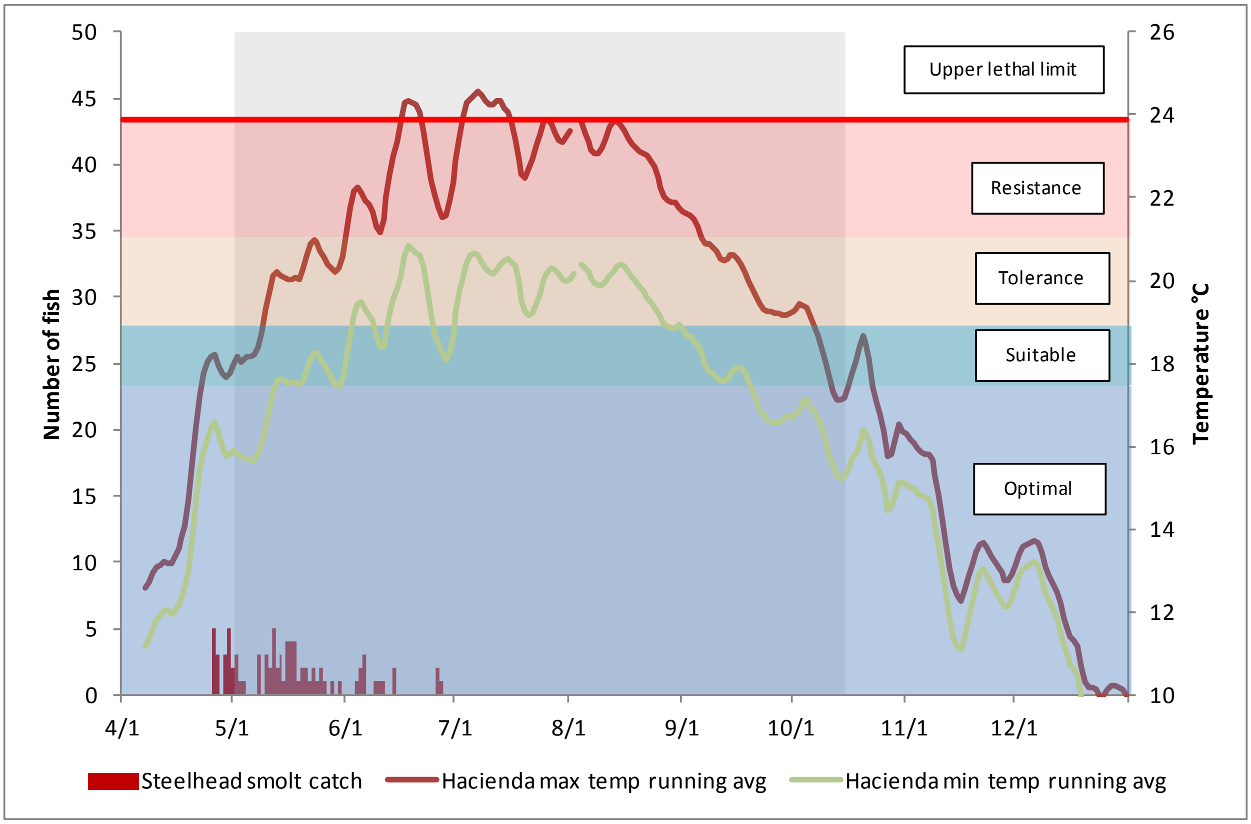

Figure 4-15. The number of steelhead smolts captured at Mirabel shown with the maximum and minimum daily water temperature 7-day running averages collected at Hacienda. Also shown are the temperature zones of optimal (<17 °C), suitable (17.5-18.9 °C), tolerance 18.9-21.1 °C), resistance (21.1-23.8 °C), and the upper critical lethal limit (>23.9 °C) for steelhead smolts. The period of the Order is shaded in grey.

Chinook

Chinook adults were present in the Russian River during the latter portion of the time span regulated by the Order. The first Chinook adult of 2012 was observed on September 7. By October 15, a total of 253 Chinook were estimated to have passed the dam, or 3.8 % of the Chinook adults detected at the inflatable dam. During this time period daily water temperatures at Hacienda were generally in the zone of resistance for the portion of the Chinook run that took place during the Order (Figure 4-16). Dry Creek is an important spawning area and many Chinook salmon migrating upstream during this time period may have been destined for by Dry Creek and the colder water the creek offers.

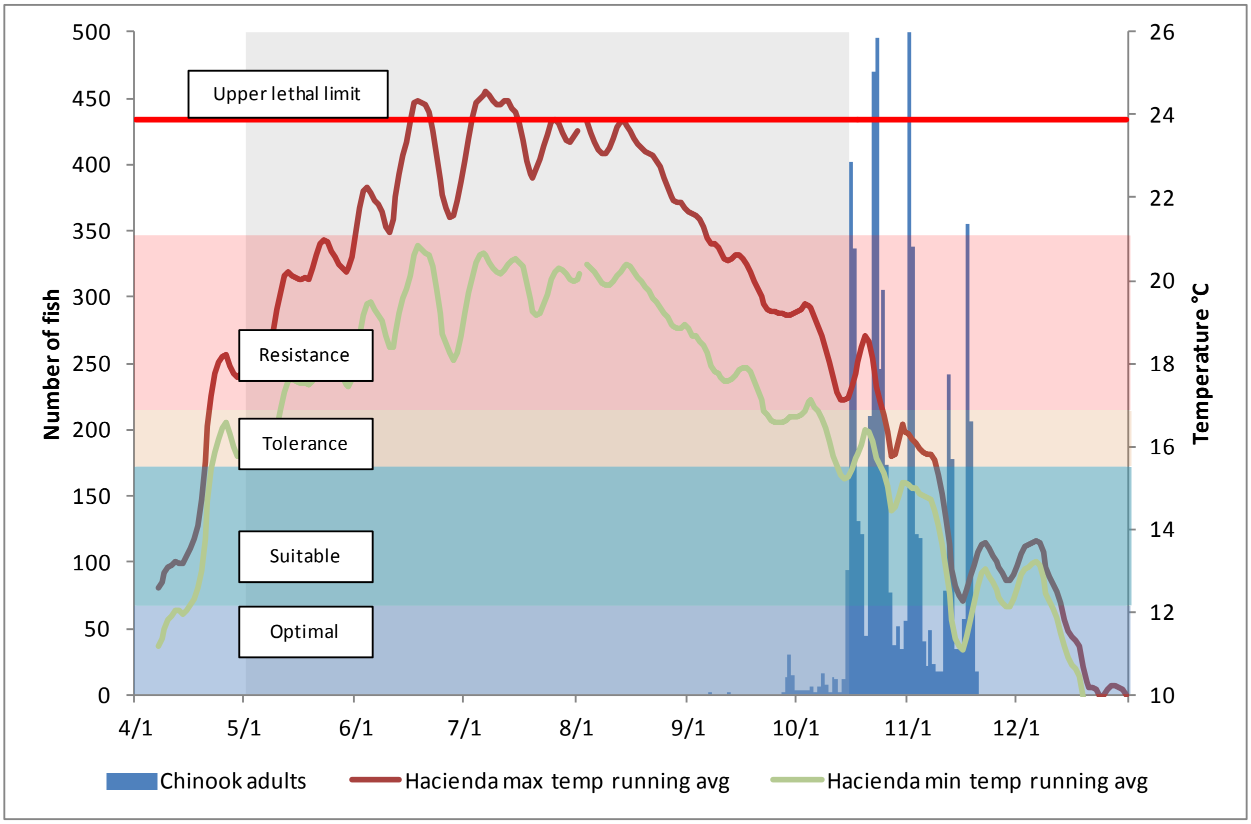

Figure 4-16. The number of Chinook adults detected at Mirabel shown with the maximum daily water temperature 7-day running average collected at Hacienda. Also shown are the temperature zones of optimal (<12.2 °C), suitable (12.2-15.5 °C), tolerance (15. 5-16.9 °C), resistance (16.9-21.1 °C), and the upper critical lethal limit (>23.9) for Chinook adults. The period of the Order is shaded in grey.

Between May 2, 2012 and when the traps were removed on July 3, 2012, a total of 2,082 Chinook smolts were captured at Mirabel. During the period of the Order daily maximum water temperatures at Hacienda were in the zones of optimal, suitable, tolerance, and resistance temperature conditions, with the tolerance, and resistance temperature conditions occurring during the tail of the Chinook smolt run (Figure 4-17). While water temperatures entered the zones of tolerance and resistance Russian River Chinook adapted under historic conditions that were likely naturally warm. Smolts from the Russian River Chinook population may be able to cope with warmer water than the populations of Chinook used in the literature to construct these temperature zones.

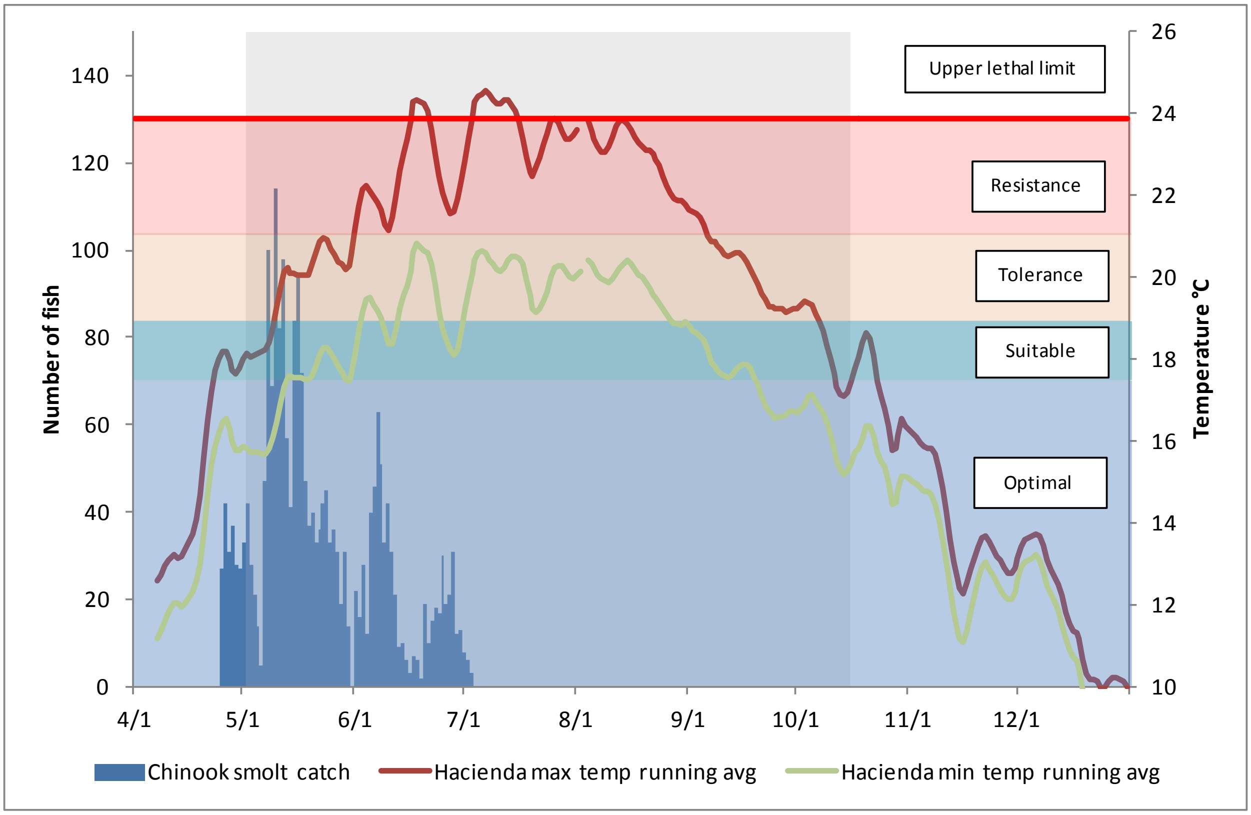

Figure 4-17. The number of Chinook smolts detected at Mirabel shown with the maximum daily water temperature 7-day running average collected at Hacienda. Also shown are the zones of optimal (<17 °C), suitable (17.5-18.9 °C), tolerance 18.9-21.1 °C), resistance (21.1-23.8 °C), and the upper critical lethal limit (>23.9 °C) for Chinook smolts. The period of the Order is shaded in grey.

Dissolved Oxygen

The data for the DO section of this report has been summarized for the time period when the Order overlaps the presence of each salmonid life stage found in the upper mainstem of the Russian River. Unlike temperature Dissolved oxygen requirements are fairly similar between species.

Adult Salmonids

Adult steelhead and Chinook were present in the Russian River during a portion of the Order. The first adult salmonid observed in 2012 at the Inflatable dam was a Chinook on September 7. A total of 253 adult Chinook were observed passing the Inflatable dam before October 15, 2012. The first steelhead was observed on the camera system was on September 13 and by October 15, 2012 a total of 26 steelhead were counted as they passed the Inflatable dam (SCWA unpublished data). The first adult coho was observed on September 28, 2012. During the Order 4 adult coho were observed on the Mirabel camera system. From September 7 to October 15, 2012, the lowest minimum DO readings at Hopland, Cloverdale, and Hacienda were 8.9, 8.2, and 8.2, mg/L, respectively. Both daily minimum and maximum levels of DO were typically within the suitable zone for adult salmonids at Hacienda (Figure 4-18).

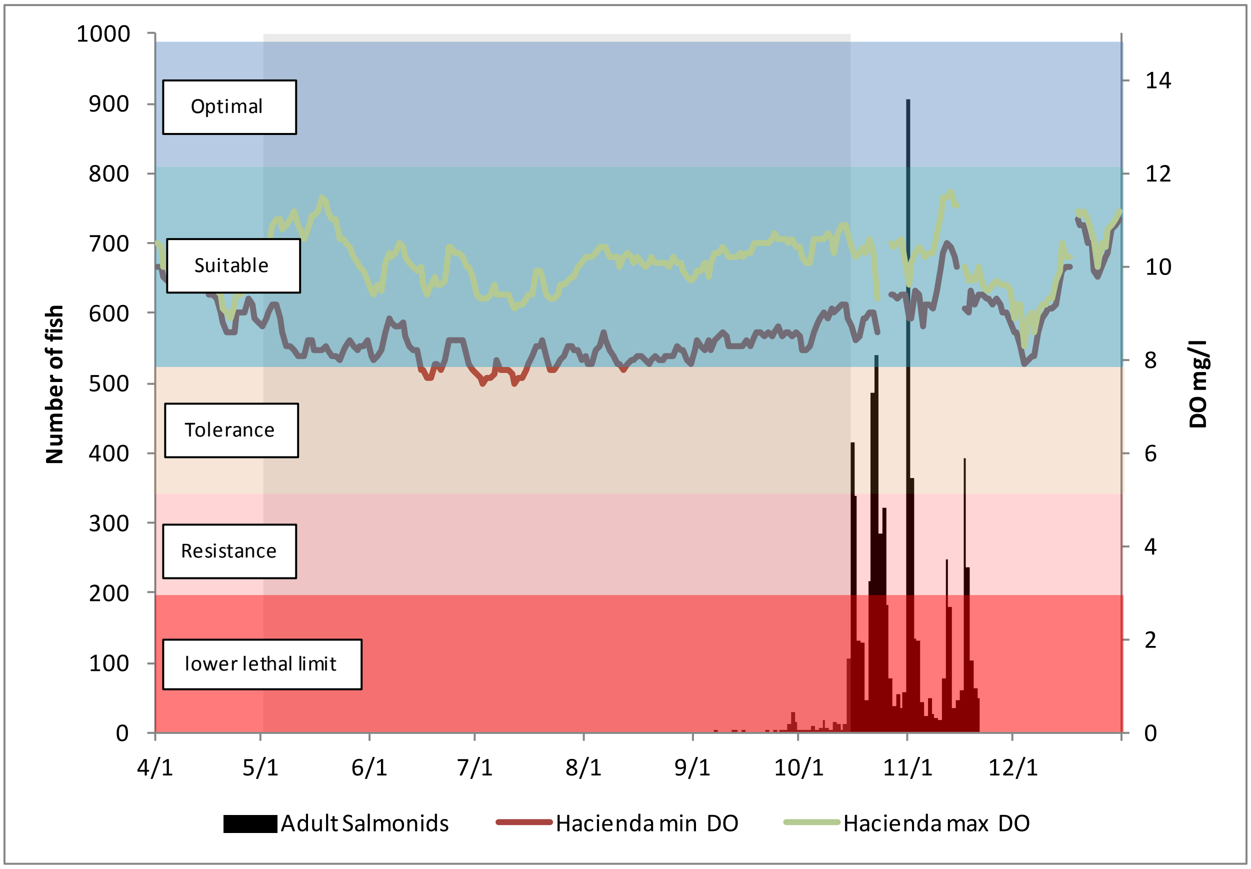

Figure 4-18. The number of adult salmonids observed at Mirabel shown with the daily minimum and daily maximum levels of DO at Hacienda. Also show are the DO zones of optimal (≥ 12 mg/L), suitable (8 to <12 mg/l), tolerance (5 to <8 mg/L), resistance (3.1 to <5 mg/L), and the lower lethal limit (≤3 mg/L) of DO for adult salmonids.

Juvenile freshwater rearing

Steelhead parr rear in the upper mainstem of the Russian River above Cloverdale year around (NMFS 2008). During the order the lowest daily minimum DO readings at Hopland and Cloverdale was 6.9 mg/L. Dissolved oxygen levels remained in the suitable zone for steelhead parr rearing at Hopland throughout the duration of the Order (Figure 4-19). At Cloverdale daily minimum DO levels occasionally entered the zone of tolerance, but were typically in the suitable zone (Figure 4-20). Daily maximum DO levels at Cloverdale remained in the suitable zone throughout the duration of the Order.

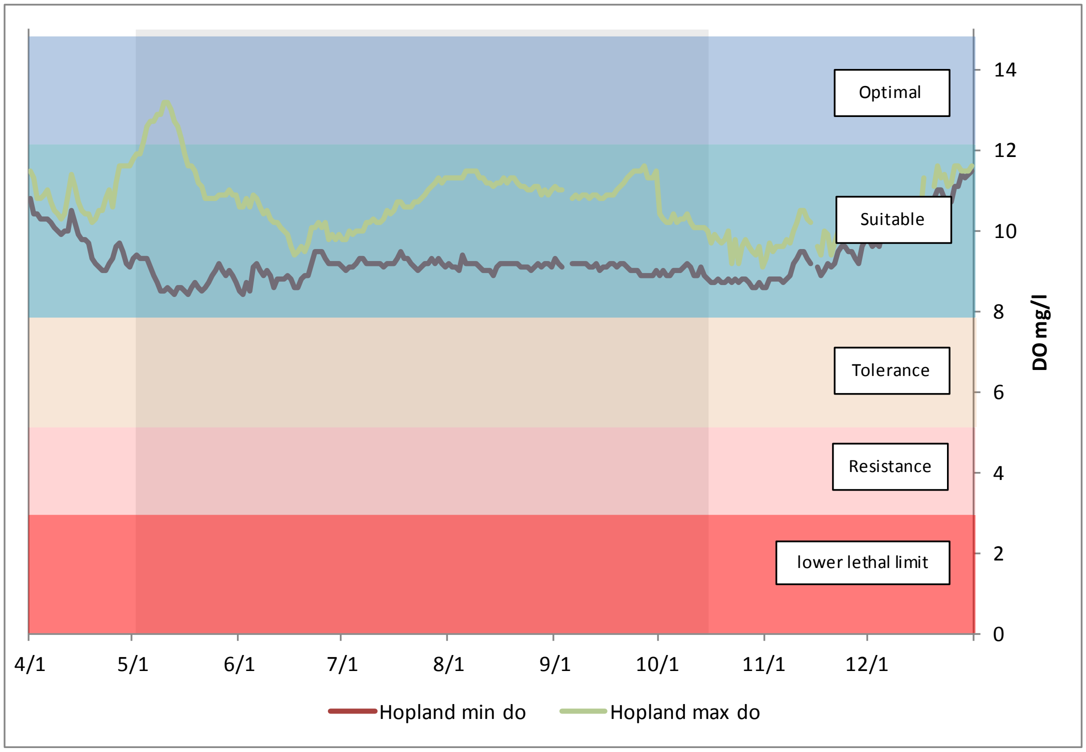

Figure 4-19. The daily minimum and daily maximum levels of DO at Hopland. Also show are the DO zones of optimal (≥ 12 mg/L), suitable (8 to <12 mg/l), tolerance (5 to <8 mg/L), resistance (3.1 to <5 mg/L), and the lower lethal limit (≤3 mg/L) of DO for salmonids.

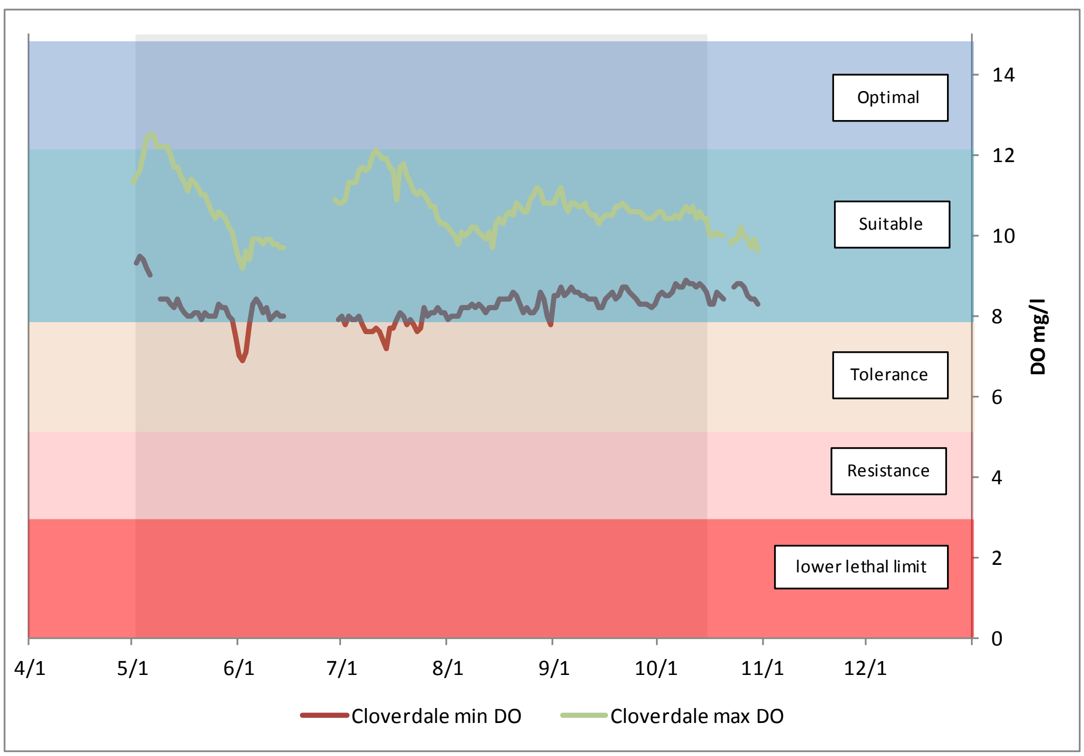

Figure 4-20. The daily minimum and daily maximum levels of DO at Cloverdale. Also show are the DO zones of optimal (≥ 12 mg/L), suitable (8 to <12 mg/l), tolerance (5 to <8 mg/L), resistance (3.1 to <5 mg/L), and the lower lethal limit (≤3 mg/L) of DO for salmonids.

Smolts

Salmonid smolts were observed in the mainstem Russian River during the June and July portion of the Order. Downstream migrant traps were installed at the Inflatable dam in 2012 before the Order went into effect and were operated until July 3, 2012. The traps were ultimately removed because the daily catch of salmonids was diminishing. In total 2,082 Chinook smolts, 201 hatchery and wild coho smolts, and 64 wild steelhead smolts were captured in the downstream migrant traps from May 2 to July 3, 2012. During the time period that salmonid smolts were captured at the inflatable dam daily minimum and maximum DO readings Hacienda were 7.5 mg/L and 11.5 mg/L, respectively. During this time the daily minimum DO at Hacienda was typically in the suitable DO zone and occasionally in the zone of tolerance while the daily maximum DO remained in the suitable DO zone (Figure 4-21).

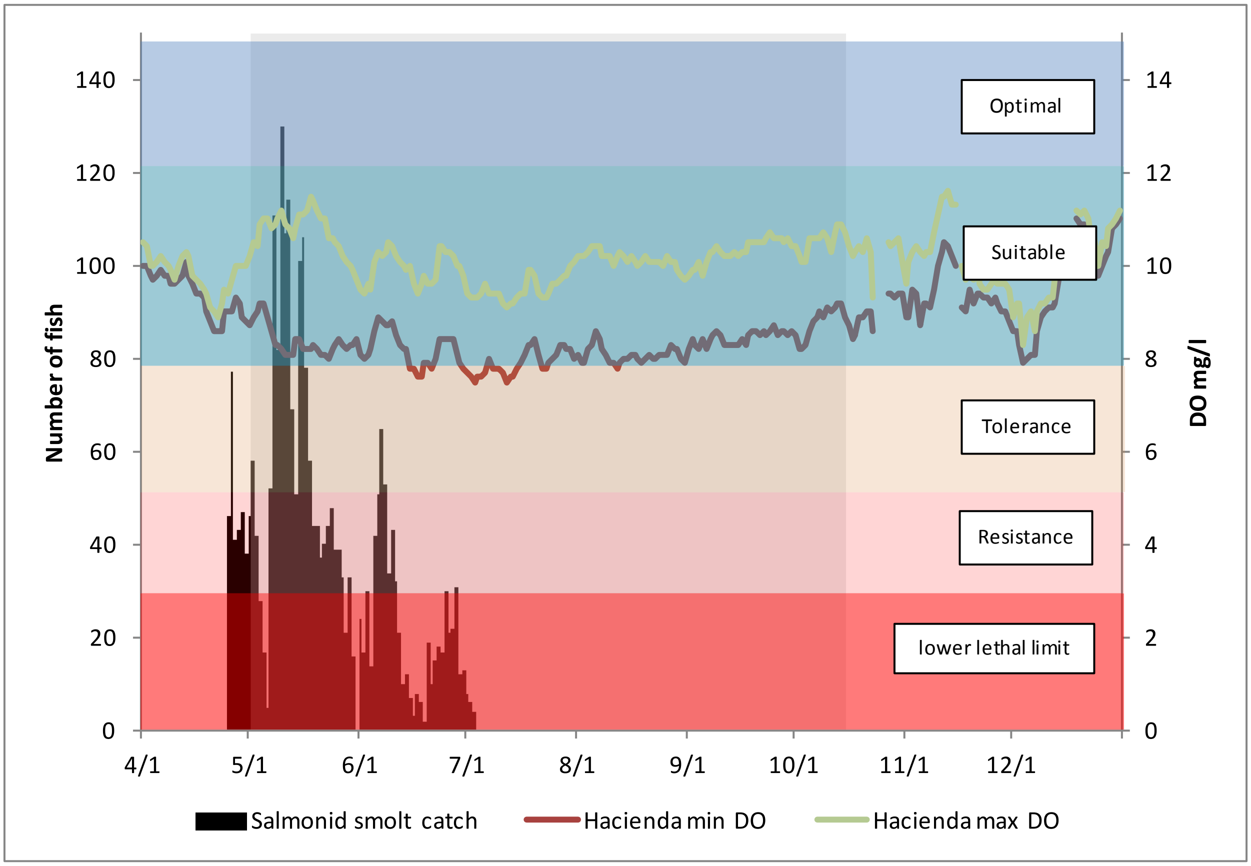

Figure 4-21. The number of salmonid smolts observed at Mirabel shown with the daily minimum and daily maximum levels of DO at Hacienda. Also show are the DO zones of optimal (≥ 12 mg/L), suitable (8 to <12 mg/l), tolerance (5 to <8 mg/L), resistance (3.1 to <5 mg/L), and the lower lethal limit (≤3 mg/L) of DO for salmonids.

4.2.5 Summary

The Water Agency was tasked with evaluating impacts to water quality and the availability of aquatic habitat for salmonids in the Russian River associated with flow reductions outlined in the Order. However due to a relatively small temperature and DO data set coupled with climate variability it is difficult to determine, in most cases, if changes in temperature or DO were due to flow changes related to the Order. Therefore the Water Agency summarized the environmental conditions experienced by salmonids during the Order and compared these conditions to standards outlined in the literature.

Flow

Flows were effectively reduced in summer steelhead rearing habitat in the upper Russian River during a portion of the time period covered by the Order. For much of the duration of the 2012 Order, flows in the upper Russian River were lower than D1610 flows and closer to the flows that are outlined in the Biological Opinion to improve salmonid habitat. For a 94 day period in 2012 flows in the lower Russian River were below D1610 minimum instream flows and closer to the flows outlined in the Biological Opinion (Figures 4-2 and 4-6).

Temperature

At Hopland water temperatures were cooler in 2012 when compared to historic normal water years where flows were above D1610 minimums (Figure 4-4). This is likely due to preserving the cold water pool (the cooler portion of the lake below the thermocline) in Lake Mendocino during the 2012 flow regime, but depleting the cold water pool during D1610 flows. This trend is not present at downstream gauge stations most likely because stream temperatures at downstream gauge sites are more dependent on air temperatures as there is a longer period of time for the water to warm once released from the dam (Figure 4-8). Water temperature at Hacienda seemed to track local air temperatures fairly closely during the smolt season (Figure 4-7).

Coho

Few adult coho where observed in the Russian River during the order, however coho smolts were regularly encountered at the fish trap during the early portion of the order. A total of 4 adult coho were observed on the Mirabel underwater video camera during the Order. Based on counts at the Mirabel inflatable dam most of the adult coho run took place well after the Order expired (SCWA unpublished data). Coho smolts migrate through the mainstem Russian River and were in the river during the beginning portion of the Order. During the Order, daily maximum water temperatures for coho at Hacienda were in the zone of suitability and the zone of tolerance with a few individuals emigrating during the tail of the run in the zone of tolerance. The elevated water temperatures during the coho smolt migration were likely related to rising air temperatures in June (Figure 4-7).

Steelhead

Adult steelhead were observed in the Russian River during the time period that the Order was in effect. However, it is important to note that only a few individual adult steelhead were detected during the Order and that the bulk of the adult steelhead migration occurs later in the year from December through April when water temperatures are cooler. The water temperatures during the portion of the order that steelhead adults were observed in the Russian River were in the zones of tolerance and resistance. While water temperatures at Hacienda were in the zone of tolerance and resistance water temperatures at Hacienda in 2012 were similar to water temperatures during normal water years (2002, 2003, 2005, 2006) when flows were above D1610 minimum flows (Figure 4-6). It is important to note that adult steelhead voluntarily leave the ocean and enter the Russian River.

Steelhead parr rear throughout the summer in a section of the upper Russian River near Ukiah and Hopland. During the Order the maximum water temperature at Hopland remained in the suitable temperature zone. The daily minimum water temperature remained in the optimal temperature zone for the duration of the order. Water temperatures in this section of the river are influenced by the temperature of water released from Coyote Valley Dam. The flow regime outlined by the Order may have preserved the cold water pool in Lake Mendocino later into the year than under D1610 releases (Figure 4-22). Juvenile steelhead that reared between Ukiah and Hopland may have benefited from the releases remaining cooler later into the year.

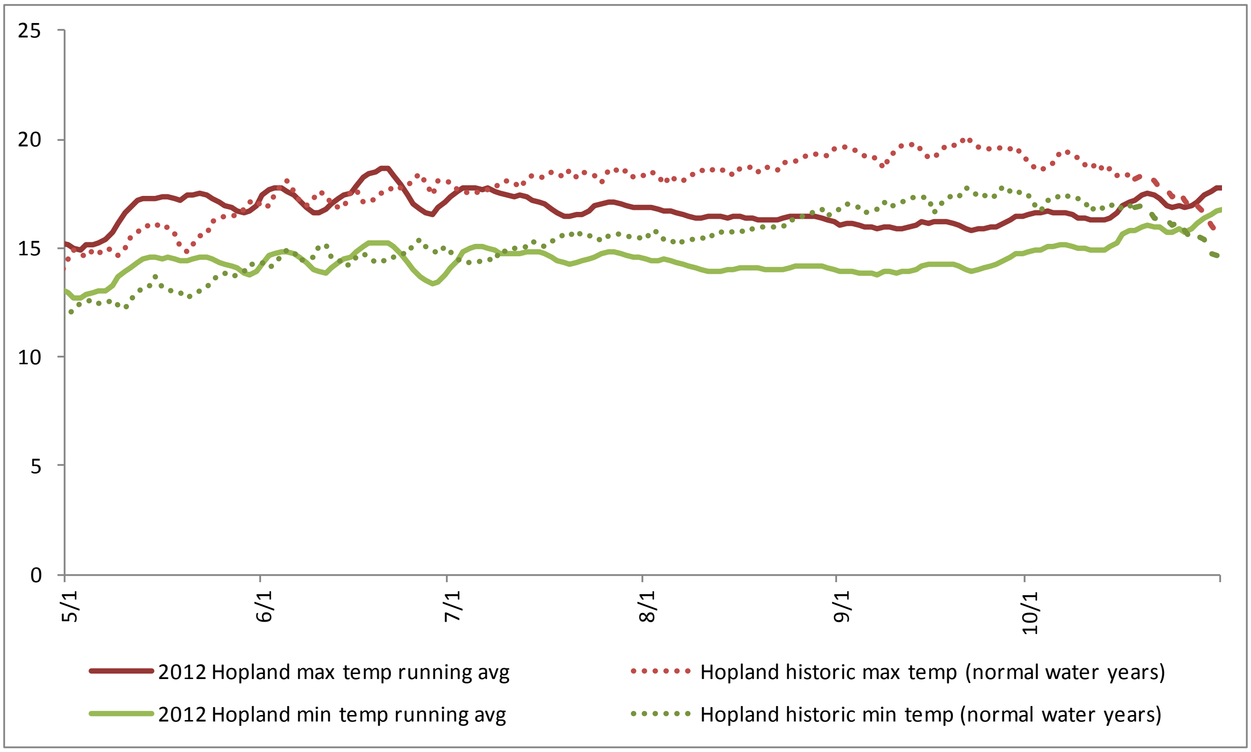

Figure 4-22. The daily maximum and minimum water temperature 7-day running average collected at Hopland shown with the daily maximum and minimum water temperature for normal water years (2002, 2003, 2005, 2006).

Steelhead smolts were in the mainstem Russian River during the beginning portion of the Order. During the Order daily maximum water temperatures for steelhead smolts at Hacienda were in the optimum zone, the zone of suitability, and the zone of tolerance with only a few individuals emigrating during the tail of the run in the zone of tolerance. The maximum daily water temperature reached the upper critical lethal limit at the tail end of the steelhead smolt emigration. The elevated water temperatures during the steelhead smolt migration were likely related to rising air temperatures in June (Figure 4-7).

Chinook

Chinook adult upstream migration in the Russian River begins during the latter portion of the time span regulated by the Order. At Hacienda, daily maximum water temperatures where generally in the zone of resistance for adult Chinook during the Order. The daily minimum water temperatures were in the zone of tolerance and zone of resistance during the period of the order that adult Chinook were observed at Hacienda. It is important to note that while water temperatures at Hacienda were in the zone of resistance water temperatures at Hacienda in 2012 were similar to water temperatures during normal water years (2002, 2003, 2005, 2006) when flows were above D1610 minimum flows (Figure 4-6).

Chinook smolts were captured in mainstem Russian River traps during portions of the Order when water temperatures were in the zones of suitability, tolerance, and resistance. However despite lower flow in

2012 the water temperatures were similar to water temperatures during normal water years (2002, 2003, 2005, 2006) when flows were above D1610 minimum flows. The water temperatures observed during the smolt migration were likely a result of the ambient air temperatures.

DO

Dissolved oxygen levels were generally favorable for salmonids in the Russian River. For the adult life stage, Hacienda daily minimum and maximum DO remained in the zone of suitability. For the parr life stage at Hopland, both the daily minimum and daily maximum DO remained in the zone of suitability for the duration of the order. At Cloverdale the daily minimum DO occasionally dipped into the zone of tolerance, but was generally in the zone of suitability while the daily maximum DO remained in the zone of suitability for the duration of the order. For the smolt life stage the daily minimum DO occasionally dipped into the zone of tolerance, but was generally in the zone of suitability while the daily maximum DO remained in the zone of suitability for the duration of the order. During the order DO levels were typically favorable for all salmonid species and life stages at the locations where water quality data was summarized.

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