# Russian River Water Quality Summary for the 2015 Temporary Urgency Change

SONOMA COUNTY WATER AGENCY

**March 2016**

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# 1.0 Introduction

On April 22, 2015, the Sonoma County Water Agency (Water Agency) filed a Temporary Urgency Change Petition (TUCP) with the State Water Resources Control Board (SWRCB) to temporarily reduce minimum instream flows in the upper Russian River to prevent significant depletion of storage in Lake Mendocino and the potential elimination of water supplies for 2015, and in the lower Russian River to protect fishery resources in Dry Creek.

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

(1) From May 1, 2015, through October 27, 2015, reduce instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) from 185 cubic feet per second (cfs) to 75 cfs.

(2) From May 1, 2015, through October 27, 2015, reduce instream flow requirements for the lower Russian River (downstream of its confluence with Dry Creek) from 125 cfs to 85 cfs.

The TUCP also requested that compliance with these minimum instream flow requirements be measured based on a 5-day running average of average daily stream flow measurements, provided that instantaneous flows on the upper Russian River shall be no less than 65 cfs and on the lower Russian River shall be no less than 75 cfs. These 5-day running average provisions allowed the Water Agency to reduce the operational buffers needed to manage these stream flows, thereby allowing the Water Agency to conserve more water in Lake Mendocino. The SWRCB issued an Order (Order) approving the Water Agency's TUCP on May 1, 2015.

On May 27, 2015, the Water Agency provided new information to the SWRCB regarding anticipated inflow into Lake Mendocino and requested additional changes to instream flow requirements (May 27 Request):

(1) From June 16, 2015, through October 27, 2015, reduce instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) to a minimum of 25 cfs.

(2) From June 16, 2015, through October 27, 2015, reduce instream flow requirements for the lower Russian River (downstream of its confluence with Dry Creek) to a minimum of 50 cfs.

The May 27 Request also requested that compliance with these reduced minimum instream flow requirements be measured based on a 24-hour mean instream flow criterion. The 24-hour instream flow criterion is intended to ensure a conservative operational buffer with respect to flow management, thereby allowing the Water Agency to conserve more water in Lake Mendocino.

The May 27 Request was intended to address the significant reductions in inflow from the Potter Valley Project (PVP) resulting from a Federal Energy Regulatory Commission (FERC) order approving Pacific Gas and Electric's (PG&E's) temporary variance request. The additional flow reduction in the upper Russian River intended to prevent significant depletion of storage in Lake Mendocino and potential elimination

of water supplies for 2015. Such depletion in storage and reduction to or elimination of water supplies could cause serious impacts to human health and welfare and reduce water supplies needed for fishery protection and stable flows in the upper Russian River. The request for the lower Russian River was intended to protect fishery resources in Dry Creek.

The SWRCB issued an Order (Order) on June 17, 2015, approving the May 27 Request and modifying the May 1, 2015 Order. The Order included several terms and conditions, including requirements for monitoring water quality to assess possible effects from the TUCP on the availability of aquatic habitat for salmonids or recreation (Terms 10 and 11). Data collected under Terms 10a and 11 were provided in weekly Hydrologic Status Reports as they became available. This report provides and summarizes all data collected during the 2015 water quality monitoring program as required by Term 14 of the Order.

## 2.0 2015 Russian River Flow Summary

In 2015, water storage in Lake Mendocino was below conditions experienced in 2013 and dropped below conditions observed in 2009 by early June. However, 2015 Lake Mendocino water storage conditions remained above conditions experienced in 2014 until late November. In December 2014, storms increased storage to over 56,000 acre-feet by 31 December (Figure 2-1). Whereas, milder storms in December 2015 only increased storage to just under 40,000 acre-feet by 31 December (Figure 2-1).

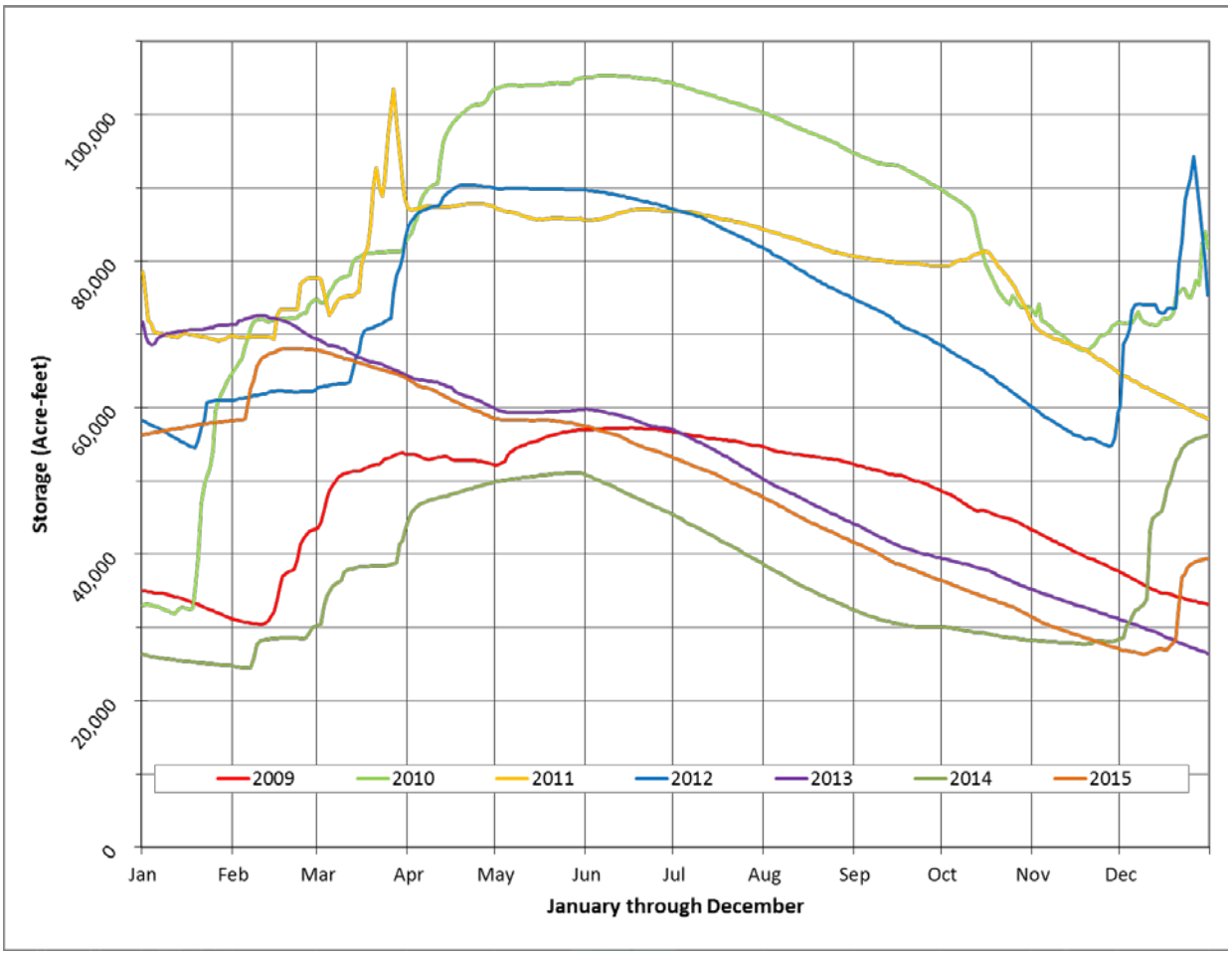


**Figure 2-1. Lake Mendocino water storage levels, in acre-feet, from 2009 through 2015.**

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

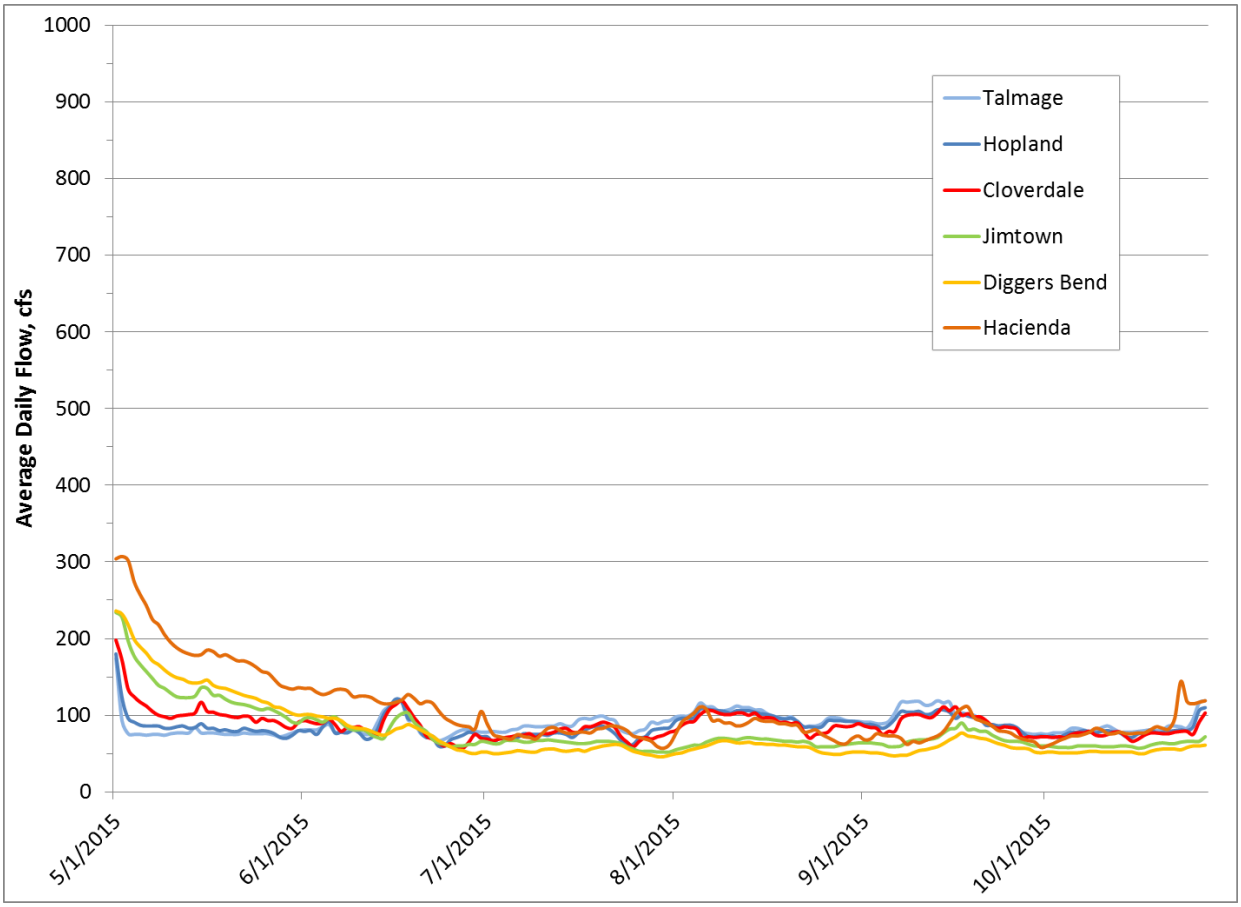


**Figure 2-2. 2015 average daily flows in the Russian River as measured at U.S. Geological Survey (USGS) gages in cubic feet per second (cfs).**

While the original Order was in effect through June 15, upper Russian River flows did drop below the 75 cfs five-day running average TUC flow twice at Talmage in early and late May, and once at Hopland in late May. Five-day running average flows during those periods were approximately 74 cfs, just under the 75 cfs minimum. However, upper Russian River flows did not drop below the instantaneous flow of 65 cfs authorized by the Order. While the modified Order was in effect from June 16 through October 27, upper Russian River flows did not drop below the 24-hour mean instream flow criterion of 25 cfs (Figure 2-3).

While the original Order was in effect through June 15, lower Russian River flows at Hacienda (downstream of the confluence with Dry Creek) did not drop below the five-day running average of 85 cfs or the instantaneous minimum flow of 75 cfs. While the modified Order was in effect from June 16 through October 27, lower Russian River flows at Hacienda did not drop below the 24-hour mean instream flow criterion of 50 cfs (Figure 2-4).

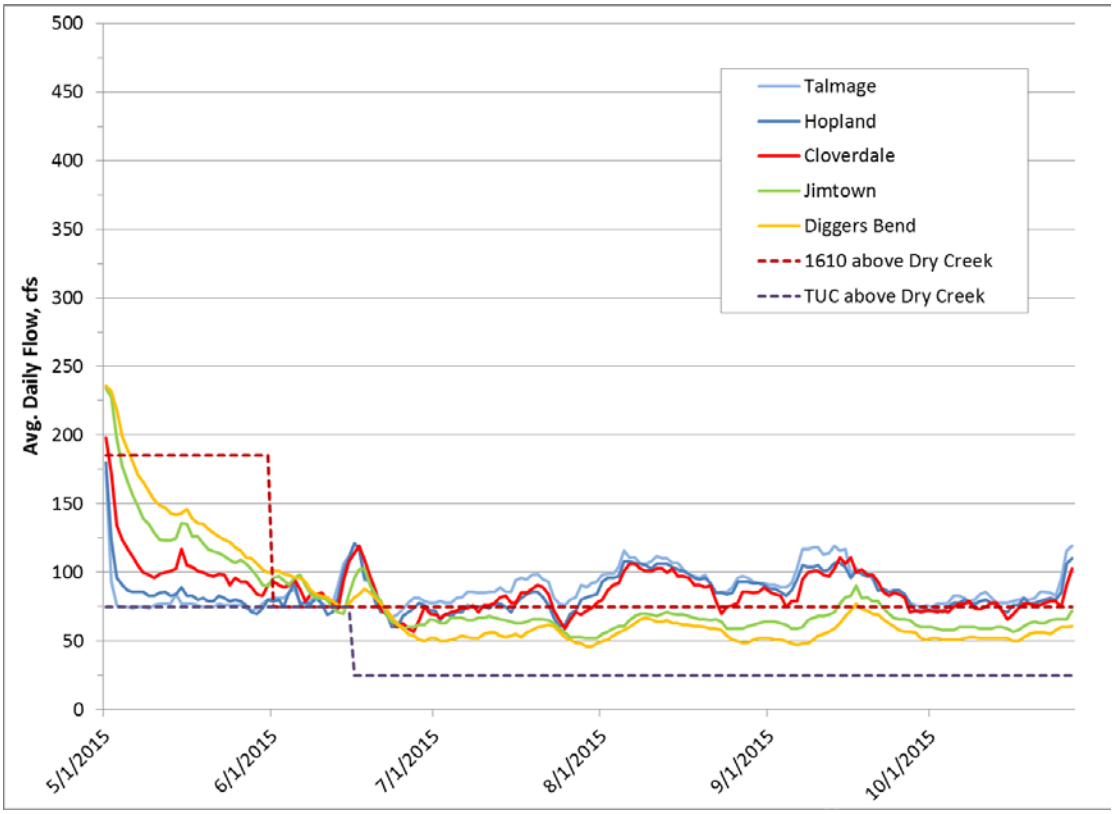


**Figure 2-3. 2015 average daily flows in the Russian River as measured at USGS gages above the Dry Creek confluence in cubic feet per second.**

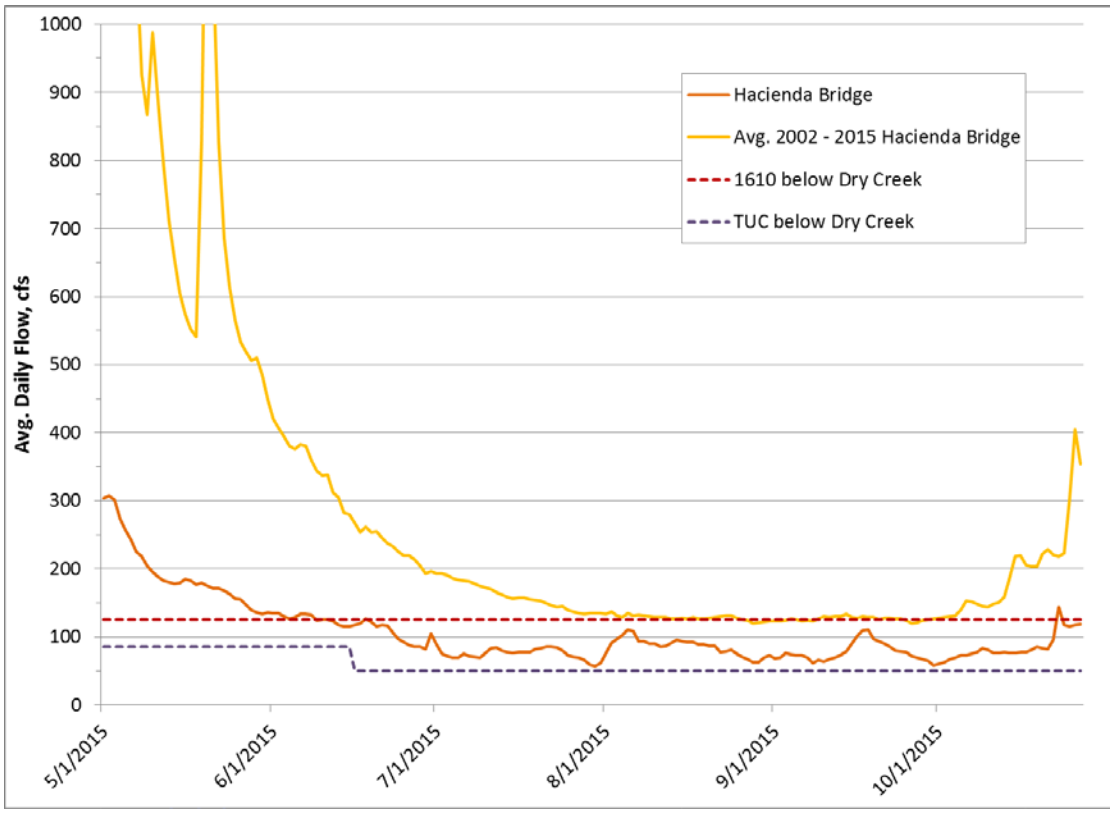


**Figure 2-4. 2015 average daily flows in the Russian River as measured at USGS gages below the Dry Creek confluence in cubic feet per second.**

# 3.0 Water Quality Monitoring

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

## 3.1 Seasonal Mainstem Bacterial Sampling (Beach Sampling)

The Sonoma County Department of Health Services (DHS) conducts seasonal bacteriological sampling to monitor levels of pathogens at ten (10) Russian River beaches with recreational activities involving the greatest body contact. Results are used by the Sonoma County DHS to determine whether or not bacteria levels fall within State guidelines. The 2015 Sonoma County DHS seasonal beach sampling locations consisted of: Cloverdale River Park; Del Rio Woods Beach; Camp Rose Beach; Healdsburg Veterans Memorial Beach; Steelhead Beach; Forestville Access Beach; Sunset Beach; Johnson's Beach; Monte Rio Beach; and Patterson Point. Bacteriological samples were collected weekly beginning May 26 and continued until October 5. The samples were analyzed using the Colilert quantitray MPN method for total coliform and *E. coli*. Results from the sampling program were reported by the Sonoma County DHS at their website and on the Sonoma County DHS Beach Sampling Hotline. The 2015 seasonal results are shown in Table 3-1 and in Figures 3-1 and 3-2.

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

**Table 3-1. Russian River Seasonal Recreational Beach Bacteria Sampling Results collected by the Sonoma County Department of Health Services in 2015. Highlighted values indicate those values exceeding the Total Coliform (TC) and E. coli (EC) California Department of Public Health Draft Guidance for Fresh Water Beaches (CDPH 2011).**

| Date Sampled | Cloverdale River Park | | Del Rio Woods Beach | | Camp Rose Beach | | Healdsburg Veterans | | Steelhead Beach | | Forestville Access Beach | | Sunset Beach | | Johnson's Beach | | Monte Rio Beach | | Monte Rio Beach (upstream) | | Monte Rio Beach (downstream) | | Patterson Point | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC | TC | EC |
| 26-May-15 | 7,701 | 31 | 733 | <10 | 1,162 | <10 | 833 | 41 | 697 | 30 | 1,162 | 52 | 794 | 20 | 1,789 | 41 | 857 | 41 | | | | | 624 | 3 |
| 2-Jun-15 | 6,488 | 10 | 2,247 | 31 | 1,935 | 31 | 1,119 | 41 | 1,017 | 20 | 727 | 31 | 650 | 20 | 1,541 | 30 | 2,247 | 41 | | | | | 1,086 | <10 |
| 9-Jun-15 | **12,003** | 20 | 1,086 | 10 | 1,658 | 10 | 3,076 | 10 | 1,145 | 31 | 1,298 | 31 | 1,162 | 10 | 2,142 | <10 | 1,333 | 109 | | | | | 1,553 | 62 |
| 10-Jun-15 | 4,106 | 41 | | | | | | | | | | | | | | | | | | | | | | |
| 16-Jun-15 | **10,462** | 10 | 2,481 | 10 | 2,909 | 20 | 2,143 | 97 | 1,050 | 41 | 1,153 | 41 | 2,382 | 31 | 3,076 | 201 | 3,873 | 20 | | | | | 3,255 | 20 |
| 18-Jun-15 | **17,329** | 31 | | | | | | | | | | | | | | | | | | | | | | |
| 23-Jun-15 | 8,164 | 20 | 1,956 | <10 | 2,909 | 10 | 2,282 | 84 | 1,224 | <10 | 1,658 | 30 | 1,904 | 30 | **15,531** | 63 | 3,076 | 63 | | | | | 1,607 | 10 |
| 24-Jun-15 | | | | | | | | | | | | | | | 3,654 | 107 | | | | | | | | |
| 30-Jun-15 | **12,033** | <10 | 3,255 | 10 | 4,352 | <10 | 2,143 | 135 | 6,488 | 86 | 2,098 | 31 | 2,046 | 31 | 3,654 | 63 | 2,382 | <10 | | | | | 2,310 | 31 |
| 1-Jul-15 | 7,701 | 31 | | | | | | | | | | | | | | | | | | | | | | |
| 7-Jul-15 | **24,196** | 10 | 1,333 | <10 | 2,909 | <10 | 2,098 | 161 | 1,191 | 20 | 1,650 | 31 | 1,296 | 10 | 3,448 | 20 | 1,314 | 10 | | | | | 1,935 | 10 |
| 8-Jul-15 | 5,794 | 10 | | | | | | | | | | | | | | | | | | | | | | |
| 14-Jul-15 | 7,270 | 20 | 2,755 | 31 | 3,255 | 20 | 1,850 | 74 | 1,935 | 20 | 1,396 | <10 | 1,497 | 41 | 2,728 | 31 | 1,658 | <10 | | | | | 1,850 | 20 |
| 21-Jul-15 | 5,172 | <10 | 1,789 | <10 | 2,909 | <10 | 2,187 | 199 | 1,439 | 10 | 1,607 | 10 | 1,664 | 31 | 3,255 | <10 | 1,130 | 10 | | | | | 1,918 | 20 |
| 28-Jul-15 | 8,664 | 20 | 1,722 | 41 | 4,611 | 10 | 2,224 | 223 | 1,050 | 20 | 1,376 | 20 | * | * | 2,481 | 10 | 933 | 20 | | | | | 1,450 | 10 |
| 29-Jul-15 | | | | | | | | | | | | | 1,553 | 31 | | | | | | | | | | |
| 4-Aug-15 | 7,720 | 20 | 3,448 | 41 | 3,255 | 10 | 2,247 | 175 | 1,112 | <10 | 1,314 | <10 | 1,334 | <10 | 3,873 | 63 | 839 | 31 | | | | | 1,067 | <10 |
| 11-Aug-15 | **>24,196** | 10 | 4,106 | 30 | 3,654 | 10 | 2,143 | 10 | 880 | 10 | 1,017 | <10 | 987 | <10 | 2,046 | 41 | 1,046 | 10 | | | | | 1,515 | <10 |
| 13-Aug-15 | 6,488 | 20 | | | | | | | | | | | | | | | | | | | | | | |
| 18-Aug-15 | 8,164 | 31 | 3,076 | 10 | 3,654 | 20 | 2,613 | 41 | 1,106 | 31 | 2,481 | 31 | 1,607 | 31 | 1,396 | 20 | 1,726 | 20 | | | | | 1,296 | 10 |
| 25-Aug-15 | 9,208 | 20 | 2,755 | 20 | 2,046 | 20 | 2,098 | 75 | 1,236 | 31 | 1,112 | 10 | 1,720 | >10 | 987 | 10 | 1,187 | >10 | | | | | 932 | 63 |
| 31-Aug-15 | 5,172 | 52 | 1,333 | 20 | 1,145 | 31 | 1,529 | 41 | 464 | <10 | 813 | <10 | 771 | <10 | ** | ** | ** | ** | | | | | ** | ** |
| 1-Sep-15 | | | | | | | | | | | | | | | 1,439 | 10 | 1,119 | 41 | | | | | 1,119 | 31 |
| 8-Sep-15 | 2,755 | 10 | 1,086 | <10 | 1,860 | <10 | 1,467 | 52 | 602 | <10 | 1,043 | <10 | 1,935 | 20 | 1,597 | 10 | 1,137 | 20 | | | | | 1,211 | <10 |
| 14-Sep-15 | 2,613 | 31 | 2,359 | 31 | 1,664 | 10 | 2,755 | 10 | 1,565 | <10 | 1,500 | <10 | 1,274 | 63 | 1,291 | 75 | 933 | <10 | | | | | 1,515 | 144 |
| 21-Sep-15 | 4,106 | 41 | 2,359 | 20 | 1,421 | 20 | 1,515 | 41 | 631 | 20 | 906 | 20 | 712 | 20 | 1,250 | 161 | 3,654 | 213 | | | | | 1,274 | 63 |
| 28-Sep-15 | 2,359 | 20 | 1,935 | 20 | 1,162 | 41 | 738 | 98 | 450 | 41 | 384 | <10 | 1,274 | 63 | 813 | 63 | **>24,196** | **9,804** | | | | | 1,935 | 41 |
| 30-Sep-15 | | | | | | | | | | | | | | | | | 2,382 | **336** | 3,078 | 233 | 2,755 | **259** | | |
| 5-Oct-15 | 4,611 | 31 | 1,722 | 41 | 862 | <10 | 959 | 86 | 816 | 10 | 798 | 20 | 763 | <10 | 771 | 41 | 776 | 63 | | | | | 546 | 20 |

*Sunset Beach was not sampled until July 29, 2015, due to inaccessibility during the Sheriff's Office investigation on July 28, 2015.

** Due to time constraints Johnson's Beach, Monte Rio Beach and Patterson Point were not able to be sampled on 8/31/15, but were sampled the next day on 9/1/15.

**Recommended EPA Recreational Water Quality Criteria - Statistical Threshold Values (STV):**

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

Total Coliforms (STV): 10,000 per 100ml

*E. coli* (STV): 235 per 100 ml

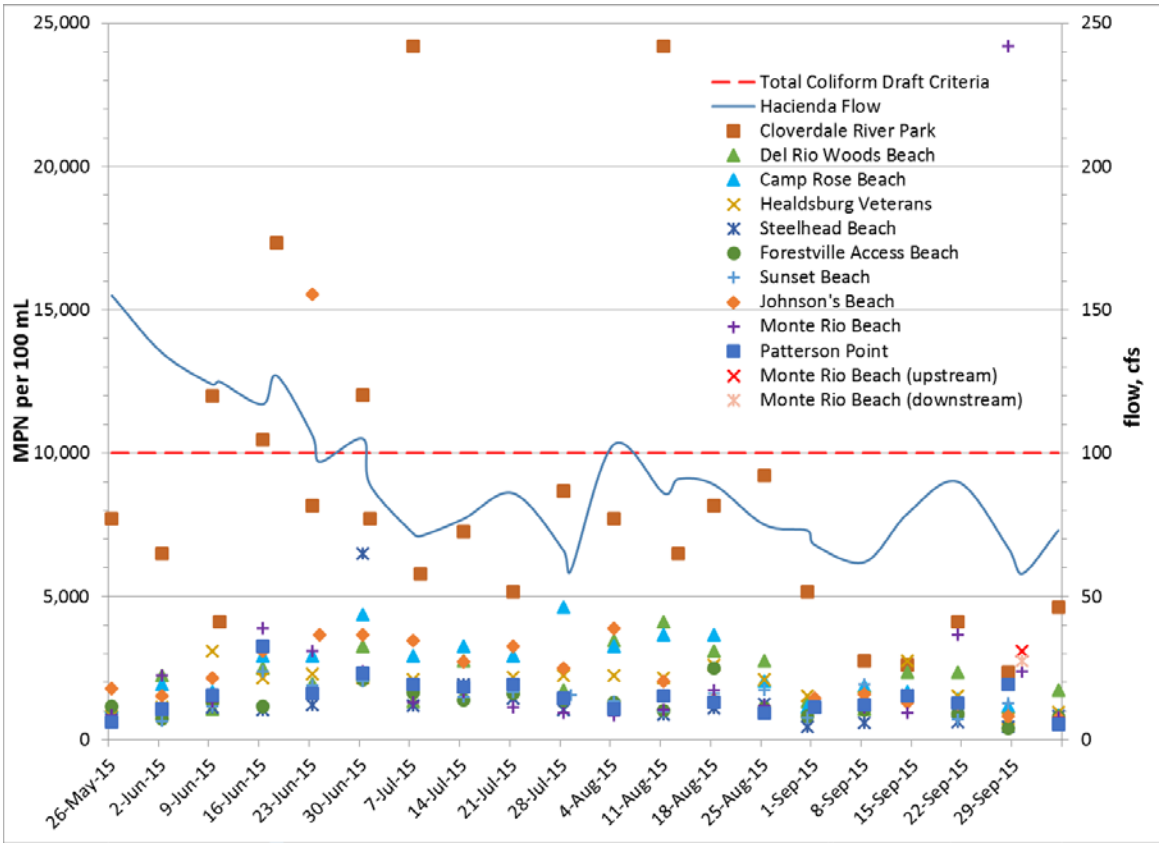


**Figure 3-1. Russian River Beach Recreational Beach Bacteria Sample Results for Total Coliform in 2015.**

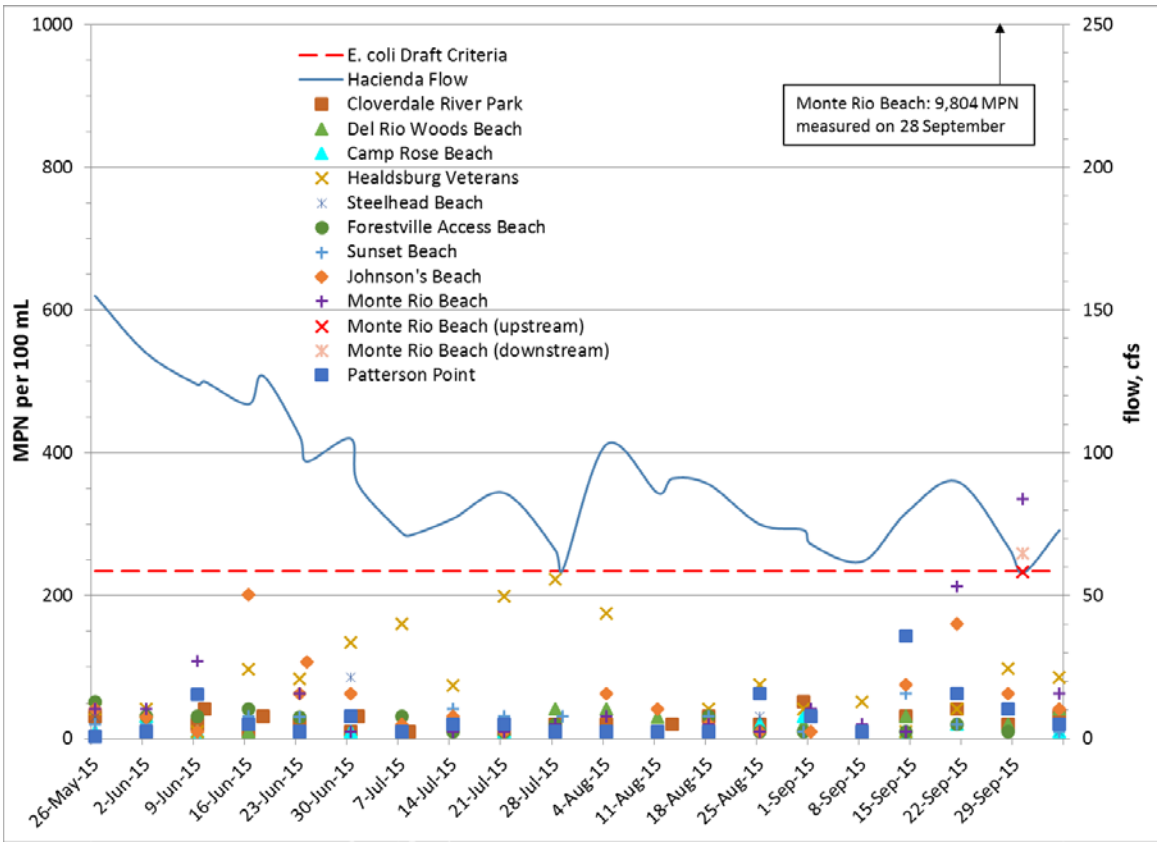


**Figure 3-2. Russian River Recreational Beach Bacteria Sample Results for E. coli in 2015.**

## 3.2 Water Agency Estuary Water Quality Sampling and Monitoring

Flows in the lower Russian River at Hacienda (downstream of the confluence with Dry Creek) continued to be affected by drought conditions during the term of the Order in 2015, but did not drop below the five-day running average of 85 cfs or the instantaneous minimum flow of 75 cfs while the original Order was in effect from May 1 through June 15. While the modified Order was in effect from June 16 through October 27, lower Russian River flows at Hacienda did not drop below the 24-hour mean instream flow criterion of 50 cfs. Long-term water quality monitoring and grab sampling was conducted in the lower, middle, and upper reaches of the Russian River Estuary and the upper extent of inundation and backwatering during lagoon formation, between the mouth of the river at Jenner and Vacation Beach, including in two tributaries.

Water Agency staff conducted weekly grab sampling from May 12 to October 13 at five stations in the mainstem of the lower river including: Jenner; Casini Ranch; Patterson Point, Monte Rio, and Vacation Beach (Figure 3-3). All samples were analyzed for nutrients, *chlorophyll a*, standard bacterial indicators (Total coliforms, *E. coli*, and *Enterococcus*), total and dissolved organic carbon, total dissolved solids, and turbidity. Samples were collected during the monitoring season for diluted and undiluted analysis of *E. coli* and total coliforms for comparative purposes and the results are included in Tables 3-2 through 3-6 and Figures 3-4 and 3-5. Samples collected for *Enterococcus* were undiluted only and results are included in Tables 3-2 through 3-6 and Figure 3-6. The Water Agency submitted samples to the Sonoma County DHS Public Health Division Lab in Santa Rosa for bacteria analysis. *E. coli* and total coliform were analyzed using the Colilert method and Enterococcus was analyzed using the Enterolert method. Samples for all other constituents were submitted to Alpha Labs in Ukiah for analysis.

Following the 2015 monitoring season, Water Agency staff discovered issues with the reliability of bacteria data that has been collected in the presence of brackish water in the Estuary. In 2014, the Jenner station had a couple of anomalous results for undiluted samples of *E. coli* compared to diluted samples collected at the same time. In 2015 it was more significant and frequent, with undiluted *E. coli* results often being >2419.6 MPN, compared to a value of less than 100 MPN in the diluted sample.

Water Agency staff contacted Sonoma County Department of Health Services (DHS) to see if the high *E. coli* results for the undiluted samples at Jenner were errors. DHS staff responded and explained that marine waters can create false positives when relying on the Colilert analysis if the samples are not diluted (Ferris, 2015). DHS staff also stated that any samples collected in marine waters should be diluted at a one to ten ratio (1:10). Water Agency staff conducted additional literature research and discovered that other non-coliform bacteria commonly found in marine waters (as well as plant and algal material) can produce false positives for total coliforms and *E. coli* if not diluted when using the IDEXX Colilert analytical methodology (Pisciotta, 2002). In addition, the IDEXX Colilert SOP states to dilute samples 1:10 if specific conductance is between 3,000 and 10,000 microsiemens (µs) and to not use the IDEXX Colilert at all if the samples are greater than 10,000 microsiemens (IDEXX, 2015).

In the last three years, Water Agency staff have only collected two (2) samples at Jenner when the water was less than 3,000 µs, out of 81 samples. The majority were over 10,000 µs. In 2015, 15 of 26 sample events at Jenner were in water with specific conductance values over 10,000 µs. In 2013 it was 15 of 29, and 2014 was 19 of 26.

DHS staff also stated that the Enterolert analysis could produce false positives in marine waters and Water Agency staff found a study conducted in Georgia that observed saltwater interference with the Enterolert system and recommended that samples collected in marine waters should be diluted 1:10 to reduce the number of false positive results (McDonald, 2003). Water Agency staff have been relying on Colilert and Enterolert since 2012, but only started having samples diluted for *E. coli* and total coliform in 2014 for part of the season, and in 2015 for all of the season. *Enterococcus* samples have not been diluted.

Essentially, the bacteria data collected at the Jenner station is predominantly unreliable due to the saline conditions at the site, although the diluted results for *E. coli* and total coliform did include some results that were collected in water with specific conductance values below 10,000 µs and should be considered reliable. For this reason, specific conductance values measured during the time of grab sample collection are included in the Jenner table. However, only the diluted *E. coli* and total coliform data collected in water with specific conductance values below 10,000 µs are included in Figures 3-4 and 3-5. Because the *Enterococcus* samples at Jenner were undiluted, results will not be included in Figure 3-6, but are included in Table 3-6. Finally, *E. coli* and total coliform data presented in Figures 3-4 and 3-5 utilize undiluted sample results unless the reporting limit has been exceeded, at which point the diluted results are utilized.

In 2014, staff at the NCRWQCB indicated that *Enterococcus* was not being utilized as a fecal indicator bacteria due to uncertainty in the validity of the lab analysis to produce accurate results, as well as evidence that *Enterococcus* colonies can be persistent in the water column and therefore its presence at a given site may not always be associated with a fecal source. However, Water Agency staff will continue to collect *Enterococcus* samples and record and report the data. NCRWQCB staff also indicated during the 2014 monitoring season that they were uncertain of the validity of the laboratory analysis for *Bacteroides* and would not be conducting lab analysis of the samples until the question of validity had been resolved. As a result, Water Agency staff did not collect surface-water samples to test for *Bacteroides* during the 2015 monitoring season.

Water Agency staff continued to collect long-term monitoring data to: establish baseline information on water quality in the Estuary and assess the availability of aquatic habitat in the Estuary; gain a better understanding of the longitudinal and vertical water quality profile during the ebb and flow of the tide; and track changes to the water quality profile that may occur during periods of low flow conditions, barrier beach closure, lagoon outlet channel implementation, and reopening. Long-term monitoring datasondes were deployed at nine stations in the Russian River estuary, including two tributary stations during the 2015 monitoring season (Figure 3-3).

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

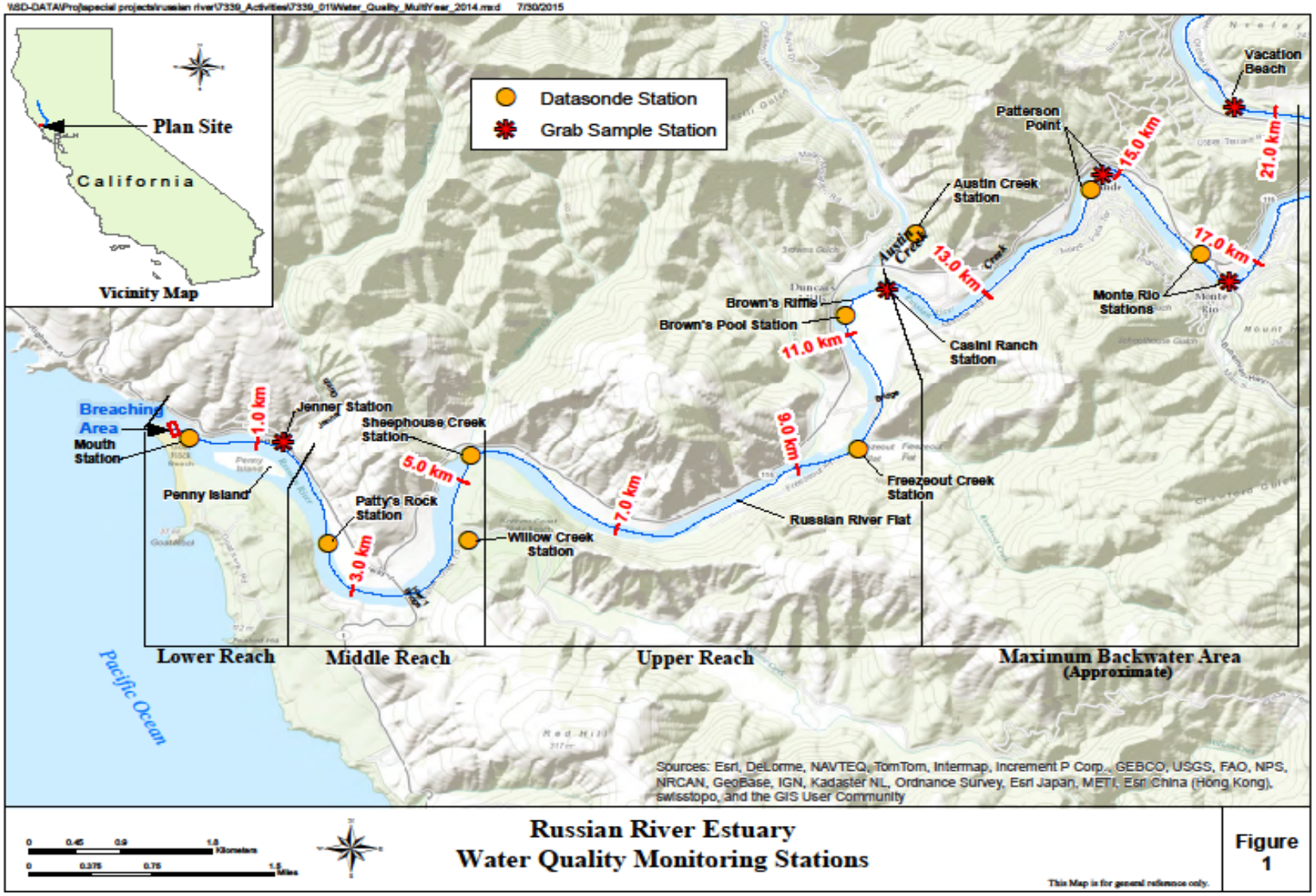


**Figure 3-3. 2015 Russian River Estuary water quality monitoring stations sampled by the Sonoma County Water Agency.**

The Water Agency submits an annual report to the National Marine Fisheries Service and California Department of Fish and Wildlife documenting the status updates of the Water Agency's efforts in implementing the Biological Opinion. The water quality monitoring data for 2015 is currently being compiled and will be discussed in the "Russian River Biological Opinion Status and Data Report Year 2015-16" due to be released in June 2016. The annual report will be available on the Water Agency's website: http://www.scwa.ca.gov/bo-annual-report/.

The grab sample sites are shown in Figure 3-3, and the results are summarized in Tables 3-2 through 3-11 and Figures 3-4 through 3-10. Highlighted values indicate those values exceeding California Department of Public Health Draft Guidance for Fresh Water Beaches for Indicator Bacteria (CDPH 2011), EPA Recreational Water Quality Criteria (EPA 2012), and EPA recommended criteria for Nutrients, Chlorophyll a, and Turbidity in Rivers and Streams in Aggregate Ecoregion III (EPA 2000). However, it must be emphasized that the draft CDPH guidelines and EPA criteria are not adopted standards, and are therefore both subject to change (if it is determined that the guidelines or criteria are not accurate indicators) and are not currently enforceable. In addition, these draft guidelines and criteria were established for and are only applicable to fresh water beaches and freshwater portions of the estuary. Currently, there are no numeric guidelines or criteria that have been established specifically for estuaries. However, Jenner will be included in the discussion for comparative purposes.

Based upon the recommended RWQC for fresh water beaches, several exceedances of the *Enterococcus* RWQC were observed in the latter half of the season at the freshwater stations, with flows varying from 62 cfs to 86 cfs. External factors likely had an effect on increasing *Enterococcus* concentrations including the removal of two summer dams in Guerneville at the end of September during a period of extended estuary closures that occurred between early September and early November (Figure 3-6). The Monte Rio and Vacation Beach stations were also observed to have one exceedance each of the RWQC for *E. coli* following summer dam removal (Figure 3-5). Jenner had one exceedance of the RWQC for *E. coli* during the term of the Order on May 12 during open conditions with a flow of 183 cfs (Table 3-6). There were also a few exceedances of the RWQC for total coliform including three exceedances at Vacation Beach, two exceedances at Jenner and one exceedance at Casini Ranch (Figure 3-4). Total coliform exceedances at these stations occurred during open and closed estuary conditions with flows that ranged from 59 cfs to 106 cfs.

All five stations predominantly exceeded the EPA criteria for Total Phosphorous during the term of the Order and under flows that ranged from 65 cfs to 183 cfs, continuing a trend of consistent exceedances observed in previous years (Figure 3-7). Interestingly, none of the stations exceeded the criteria for Total Phosphorus on September 8 when flows were only 62 cfs and the estuary had just closed the day before. See Tables 3-7 through 3-11. The EPA criteria for Total Nitrogen was not exceeded at the Monte Rio and Casini Ranch stations and was only exceeded once at Vacation Beach and Patterson Point (Figure 3-8). The Jenner station was observed to have several exceedances of the Total Nitrogen criteria throughout the season, under open and closed conditions and a variety of flows. Similarly, there were no exceedances of the Turbidity EPA criteria at the Monte Rio and Casini Ranch stations and there were only two exceedances each at the Vacation Beach and Patterson Point stations (Figure 3-9). There were also several exceedances of the Turbidity criteria at Jenner under open and closed conditions in flows that ranged from 68 cfs to 183 cfs. Most exceedances were slightly higher than the EPA criteria of 2.34

NTU. Algal (chlorophyll *a*) results exceeded the criteria at all of the stations periodically throughout the season, under open and closed conditions and flows that ranged from 62 cfs to 179 cfs (Figure 3-10). Algal concentrations were more pronounced at the Jenner station, but again, this is an estuarine station and the EPA criteria only apply to freshwater conditions.

**Table 3-2. 2015 Vacation Beach bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.**

| Vacation Beach | Time | Temperature | pH | Total Coliforms (Colilert) | Total Coliforms Diluted 1:10 (Colilert) | E. coli (Colilert) | E. coli Diluted 1:10 (Colilert) | Enterococcus (Enterolert) | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 20 | | 20 | | 2 | Flow Rate**** |
| Date | | °C | | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | (cfs) |
| 5/12/2015 | 9:50:00 | 19.5 | 8.2 | 722 | 789 | 12.1 | 10 | <1.0 | 183 |
| 5/19/2015 | 10:30:00 | 20.2 | 8.2 | 727.0 | 697 | 7.5 | 10 | 13.0 | 179 |
| 5/26/2015 | 11:00:00 | 21.1 | 8.1 | 613.1 | 1019 | 10.9 | 10 | 8.6 | 155 |
| 6/2/2015 | 9:50:00 | 20.8 | 8.2 | 920.8 | 1314 | 21.8 | 10 | 16.1 | 135 |
| 6/4/2015 | 10:00:00 | 21.2 | 8.2 | 866.4 | 1935 | 27.2 | 10 | 21.3 | 127 |
| 6/9/2015 | 12:20:00 | 23.7 | 8.1 | 1208.3 | 1565 | 10.9 | 10 | 30.8 | 124 |
| 6/16/2015 | 10:30:00 | 22.9 | 8.9 | 2419.6 | 5475 | 45.0 | 41 | **73.3** | 117 |
| 6/23/2015 | 11:50:00 | 23.1 | 7.9 | >2419.6 | **19863** | 41.4 | <10 | 54.6 | 106 |
| 6/30/2015 | 11:40:00 | 24.6 | 7.9 | >2419.6 | **11199** | 21.8 | 41 | 22.6 | 105 |
| 7/7/2015 | 9:20:00 | 24.0 | 8.0 | >2419.6 | 5475 | 14.6 | 30 | 52.1 | 72 |
| 7/14/2015 | 10:10:00 | 23.7 | 7.8 | 2419.6 | 2481 | 24.6 | 10 | 14.6 | 77 |
| 7/21/2015 | 9:30:00 | 25.2 | 7.8 | >2419.6 | 3448 | 63.7 | 98 | 47.1 | 86 |
| 7/28/2015 | 9:10:00 | 24.5 | 8.0 | >2419.6 | 2481 | 17.3 | 20 | **204.6** | 66 |
| 8/4/2015 | 9:40:00 | 24.1 | 7.9 | >2419.6 | 4106 | 9.6 | 10 | 38.9 | 103 |
| 8/11/2015 | 9:30:00 | 23.7 | 7.9 | 2419.6 | 1860 | 2.0 | <10 | 16.0 | 86 |
| 8/18/2015 | 9:20:00 | 23.9 | 7.9 | 1732.9 | 2755 | 23.1 | <10 | 45 | 89 |
| 8/25/2015 | 9:15:00 | 22.3 | 7.9 | 1413.6 | 1624 | 8.3 | <10 | 9.5 | 75 |
| 9/1/2015 | 11:00:00 | 23.9 | 7.9 | 1986.3 | 1872 | 4.1 | 10 | 6.3 | 68 |
| 9/8/2015 | 10:40:00 | 21.9 | 7.9 | 1986.3 | 1723 | 1.0 | 10 | **63.0** | 62 |
| 9/10/2015 | 10:40:00 | 22.0 | 7.9 | 1732.9 | 2755 | 10.9 | 10 | 8.6 | 64 |
| 9/15/2015 | 10:40:00 | 20.8 | 7.7 | 2419.6 | 1785 | 48.7 | 41 | 20.1 | 90 |
| 9/22/2015 | 11:10:00 | 21.0 | 7.6 | 1203.3 | 1081 | 30.5 | 52 | 16.0 | 86 |
| 9/24/2015 | 8:50:00 | 20.1 | 7.5 | 960.6 | 1187 | 51.2 | 73 | **76.7** | 79 |
| 9/29/2015 | 11:00:00 | 19.9 | 7.6 | 1299.7 | 1670 | 114.5 | 146 | **228.2** | 65 |
| 10/1/2015 | 10:50:00 | ---- | ---- | >2419.6 | **>24196** | **>2419.6** | **7270** | **>2419.6** | 59 |
| 10/6/2015 | 9:30:00 | 19.5 | 7.6 | 980.4 | 1198 | 44.1 | 108 | 42.2 | 73 |
| 10/13/2015 | 10:20:00 | 19.6 | 7.8 | 980.4 | 1211 | 45.9 | 109 | **85.5** | 78 |

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

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

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

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

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

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

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

**Table 3-3. 2015 Monte Rio bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.**

| Monte Rio | Time | Temperature | pH | Total Coliforms (Colilert) | Total Coliforms Diluted 1:10 (Colilert) | E. coli (Colilert) | E. coli Diluted 1:10 (Colilert) | Enterococcus (Enterolert) | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 20 | | 20 | | 2 | Flow Rate**** |
| Date | | °C | | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | (cfs) |
| 5/12/2015 | 9:50:00 | 19.5 | 8.1 | 727 | 880 | 8.5 | 20 | 5.2 | 183 |
| 5/19/2015 | 10:30:00 | 20.1 | 8.2 | 920.8 | 697 | 14.6 | <10 | 1.0 | 179 |
| 5/26/2015 | 11:00:00 | 20.8 | 8.0 | 686.7 | 1145 | 13.4 | 10 | 3.0 | 155 |
| 6/2/2015 | 9:50:00 | 20.4 | 8.1 | 866.4 | 1274 | 22.8 | 10 | 6.3 | 135 |
| 6/4/2015 | 10:00:00 | 21.3 | 8.2 | 913.9 | 2181 | 67.6 | 110 | 45.7 | 127 |
| 6/9/2015 | 12:20:00 | 23.7 | 8.1 | >2419.6 | 2613 | 76.7 | 121 | 48.7 | 124 |
| 6/16/2015 | 10:30:00 | 22.4 | 7.8 | >2419.6 | 5172 | 43.5 | 20 | 37.3 | 117 |
| 6/23/2015 | 11:50:00 | 23.2 | 7.9 | 1732.9 | 3448 | 31.3 | 20 | 13.1 | 106 |
| 6/30/2015 | 11:40:00 | 24.5 | 7.9 | 1046.2 | 1607 | 20.1 | 10 | 4.1 | 105 |
| 7/7/2015 | 9:20:00 | 23.6 | 8.0 | 1553.1 | 2909 | 18.1 | 98 | 17.4 | 72 |
| 7/14/2015 | 10:10:00 | 23.6 | 7.7 | 1732.9 | 2909 | 13.1 | <10 | 36.8 | 77 |
| 7/21/2015 | 9:30:00 | 25.0 | 7.8 | 1413.6 | 2187 | 6.3 | 41 | 3.0 | 86 |
| 7/28/2015 | 9:10:00 | 23.7 | 7.8 | 1553.1 | 1597 | 12.0 | 20 | 22.8 | 66 |
| 8/4/2015 | 9:40:00 | 23.9 | 7.8 | 1986.3 | 1670 | 9.8 | 10 | 20.6 | 103 |
| 8/11/2015 | 9:30:00 | 23.5 | 7.9 | 1299.7 | 1223 | 2.1 | <10 | 6.2 | 86 |
| 8/18/2015 | 9:20:00 | 23.8 | 7.9 | 1986.3 | 1421 | 14.6 | 20 | 5.2 | 89 |
| 8/25/2015 | 9:15:00 | 22.0 | 7.8 | 1119.9 | 1119 | 5.2 | <10 | 5.2 | 75 |
| 9/1/2015 | 11:00:00 | 23.5 | 7.7 | 980.4 | 882 | 3.1 | <10 | 2.0 | 68 |
| 9/8/2015 | 10:40:00 | 21.8 | 7.8 | 920.8 | 959 | 7.3 | 20 | 41.0 | 62 |
| 9/10/2015 | 10:40:00 | 21.6 | 7.8 | 727.0 | 1198 | 7.5 | <10 | 3.0 | 64 |
| 9/15/2015 | 10:40:00 | 20.2 | 7.5 | 1046.2 | 1450 | 6.2 | <10 | 7.4 | 90 |
| 9/22/2015 | 11:10:00 | 21.4 | 7.8 | 1986.3 | 1374 | 58.3 | 62 | **98.7** | 86 |
| 9/24/2015 | 8:50:00 | 20.3 | 7.6 | 1986.3 | 1515 | 70.6 | 63 | **93.3** | 79 |
| 9/29/2015 | 11:00:00 | 20.4 | 7.9 | 2419.6 | 1439 | **307.6** | 110 | **98.8** | 65 |
| 10/1/2015 | 12:40:00 | ---- | ---- | 913.9 | 1932 | 97.7 | 41 | **80.5** | 59 |
| 10/6/2015 | 9:30:00 | 19.6 | 7.6 | 1203.3 | 1376 | 15.8 | <10 | 27.5 | 73 |
| 10/13/2015 | 10:20:00 | 19.4 | 7.8 | 980.4 | 624 | 12.1 | <10 | 11.0 | 78 |

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

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

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

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

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

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

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

**Table 3-4. 2015 Patterson Point bacteria concentrations for samples collected by the Sonoma County Water Agency. This site experiences freshwater conditions.**

| Patterson Point | Time | Temperature | pH | Total Coliforms (Colilert) | Total Coliforms Diluted 1:10 (Colilert) | E. coli (Colilert) | E. coli Diluted 1:10 (Colilert) | Enterococcus (Enterolert) | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 20 | | 20 | | 2 | Flow Rate**** |
| Date | | °C | | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | (cfs) |
| 5/12/2015 | 9:50:00 | 19.5 | 8.2 | 770.1 | 521 | 4.1 | 10 | 3.1 | 183 |
| 5/19/2015 | 10:30:00 | 20.0 | 8.2 | 547.5 | 512 | 14.8 | 20 | 6.3 | 179 |
| 5/26/2015 | 11:00:00 | 20.6 | 8.0 | 770.1 | 1050 | 14.6 | 10 | 7.3 | 155 |
| 6/2/2015 | 9:50:00 | 20.3 | 8.0 | 1046.2 | 906 | 26.2 | 10 | 32.7 | 135 |
| 6/4/2015 | 10:00:00 | 21.0 | 8.2 | 1299.7 | 1674 | 32.7 | 10 | 49.6 | 127 |
| 6/9/2015 | 12:20:00 | 23.6 | 8.2 | 1732.9 | 2481 | 36.9 | 41 | 22.8 | 124 |
| 6/16/2015 | 10:30:00 | 22.5 | 7.9 | >2419.6 | 4352 | 20.1 | 30 | 20.0 | 117 |
| 6/23/2015 | 11:50:00 | 22.7 | 7.9 | 2419.6 | 1722 | 5.2 | <10 | 18.7 | 106 |
| 6/30/2015 | 11:40:00 | 23.5 | 7.8 | 1553.1 | 2603 | 39.9 | 20 | 16.9 | 105 |
| 7/7/2015 | 9:20:00 | 23.7 | 8.1 | >2419.6 | 2909 | 12.2 | 41 | 14.1 | 72 |
| 7/14/2015 | 10:10:00 | 23.8 | 7.7 | 1986.3 | 1904 | 37.3 | 31 | 42.5 | 77 |
| 7/21/2015 | 9:30:00 | 24.8 | 7.9 | 1986.3 | 2143 | 6.3 | 10 | 4.1 | 86 |
| 7/28/2015 | 9:10:00 | 24.1 | 7.8 | 1046.2 | 1872 | 52.0 | 52 | 6.3 | 66 |
| 8/4/2015 | 9:40:00 | 23.5 | 7.9 | 1553.1 | 2187 | 5.2 | 10 | 12.8 | 103 |
| 8/11/2015 | 9:30:00 | 23.2 | 7.8 | 1553.1 | 2143 | 6.3 | <10 | 3.1 | 86 |
| 8/18/2015 | 9:20:00 | 23.2 | 7.8 | 1553.1 | 2046 | 4.1 | 10 | 7.4 | 89 |
| 8/25/2015 | 9:15:00 | 22.1 | 7.9 | 920.8 | 1145 | 17.5 | <10 | 19.9 | 75 |
| 9/1/2015 | 11:00:00 | 23.5 | 7.9 | 472.1 | 1081 | 8.6 | 20 | | 68 |
| 9/8/2015 | 10:40:00 | 21.9 | 8.0 | 770.1 | 749 | 5.2 | 31 | 10.0 | 62 |
| 9/10/2015 | 10:40:00 | 22.1 | 8.0 | 866.4 | 1198 | 9.0 | <10 | 8.4 | 64 |
| 9/15/2015 | 10:40:00 | 20.8 | 7.8 | 2419.6 | 2046 | 69.1 | 74 | 26.5 | 90 |
| 9/22/2015 | 11:10:00 | 21.0 | 7.8 | 1299.7 | 1333 | 96.0 | 98 | **95.9** | 86 |
| 9/24/2015 | 8:50:00 | 20.4 | 7.9 | 1553.1 | 1860 | 63.7 | 85 | **93.3** | 79 |
| 9/29/2015 | 11:00:00 | 19.8 | 7.7 | 613.1 | 1236 | 42.0 | 20 | **62.0** | 65 |
| 10/6/2015 | 9:30:00 | 20.0 | 7.7 | 816.4 | 813 | 14.5 | 20 | 27.5 | 73 |
| 10/13/2015 | 10:20:00 | 19.3 | 7.8 | 1203.3 | 1291 | 68.3 | **331** | 59.4 | 78 |

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

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

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

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

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

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

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

**Table 3-5. 2015 Casini Ranch bacteria concentrations for samples collected by the Sonoma County Water Agency. This site may experience estuarine conditions.**

| Casini Ranch | Time | Temperature | pH | Total Coliforms (Colilert) | Total Coliforms Diluted 1:10 (Colilert) | E. coli (Colilert) | E. coli Diluted 1:10 (Colilert) | Enterococcus (Enterolert) | USGS 11467000 RR near Guerneville (Hacienda)** |
|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 2 | 20 | 2 | 20 | 2 | Flow Rate*** |
| Date | | °C | | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | (cfs) |
| 5/12/2015 | 9:50:00 | 20.1 | 8.25 | 547.5 | 677 | 5.2 | <10 | 2.0 | 183 |
| 5/19/2015 | 10:30:00 | 20.4 | 8.3 | 816.4 | 749 | 22.8 | 10 | 5.2 | 179 |
| 5/26/2015 | 11:00:00 | 20.6 | 8.1 | 686.7 | 932 | 6.3 | <10 | 8.5 | 155 |
| 6/2/2015 | 9:50:00 | 21.51 | 8.07 | 1299.7 | 1607 | 27.9 | 75 | 47.4 | 135 |
| 6/4/2015 | 10:00:00 | 21.16 | 8.37 | 1553.1 | 1720 | 47.1 | 98 | 35.5 | 127 |
| 6/9/2015 | 12:20:00 | 22.8 | 8.29 | 1732.9 | 1354 | 43.5 | 31 | 25.6 | 124 |
| 6/16/2015 | 10:30:00 | 22.3 | 7.9 | >2419.6 | 2489 | 8.4 | <10 | 2.0 | 117 |
| 6/23/2015 | 11:50:00 | 22.23 | 7.94 | 2419.6 | 2014 | 6.3 | 10 | 7.3 | 106 |
| 6/30/2015 | 11:40:00 | 23.6 | 8.0 | >2419.6 | 7270 | 15.8 | 31 | 7.4 | 105 |
| 7/7/2015 | 9:20:00 | 23.07 | 8.53 | >2419.6 | **11199** | 7.4 | 10 | 2.0 | 72 |
| 7/14/2015 | 10:10:00 | 24.0 | 7.93 | 2419.6 | 1860 | 8.4 | <10 | 16.0 | 77 |
| 7/21/2015 | 9:30:00 | 24.8 | 8.21 | 2419.6 | 1421 | 4.1 | 20 | 3.1 | 86 |
| 7/28/2015 | 9:10:00 | 23.4 | 8.2 | 1119.9 | 960 | 5.1 | 20 | 9.6 | 66 |
| 8/4/2015 | 9:40:00 | 22.71 | 7.74 | 770.1 | 809 | 4.1 | 10 | 1.0 | 103 |
| 8/11/2015 | 9:30:00 | 23.1 | 7.93 | 1299.7 | 1100 | 6.2 | <10 | 4.1 | 86 |
| 8/18/2015 | 9:20:00 | 22.3 | 8.0 | 1119.9 | 767 | 5.2 | <10 | 2.0 | 89 |
| 8/25/2015 | 9:15:00 | 21.3 | 8.1 | 816.4 | 851 | 14.6 | 10 | 3.1 | 75 |
| 9/1/2015 | 11:00:00 | 23.5 | 7.9 | 816.4 | 689 | 8.6 | <10 | 2.0 | 68 |
| 9/8/2015 | 10:40:00 | 21.5 | 8.1 | 920.8 | 884 | 7.4 | 10 | 41.0 | 62 |
| 9/10/2015 | 10:40:00 | 21.7 | 8.1 | 980.4 | 620 | 13.4 | 20 | 3.1 | 64 |
| 9/15/2015 | 10:40:00 | 21.2 | 8.0 | 1413.6 | 1664 | 38.4 | 75 | 60.2 | 90 |
| 9/22/2015 | 11:10:00 | 21.7 | 8.0 | 1413.6 | 1354 | 42.2 | 63 | 45.0 | 86 |
| 9/24/2015 | 8:50:00 | 20.0 | 8.0 | 1986.3 | 1956 | 60.2 | 63 | **79.4** | 79 |
| 9/29/2015 | 11:00:00 | 20.1 | 8.1 | 1119.9 | 1314 | 42.0 | 75 | **82.0** | 65 |
| 10/6/2015 | 9:30:00 | 19.4 | 7.8 | 547.5 | 512 | 14.5 | 20 | 6.3 | 73 |
| 10/13/2015 | 10:20:00 | 20.0 | 7.9 | 1986.3 | 2143 | 28.1 | 74 | 58.1 | 78 |

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

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

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

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

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

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

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

**Table 3-6. 2015 Jenner bacteria concentrations for samples collected by the Sonoma County Water Agency. Estuarine conditions exist at this site. EPA criteria do not apply but exceedances are highlighted for comparison.**

| Jenner Boat Ramp | Time | Temperature | pH | Specific Conductance | Total Coliforms (Colilert) | Total Coliforms Diluted 1:10 (Colilert) | E. coli (Colilert) | E. coli Diluted 1:10 (Colilert) | Enterococcus (Enterolert) | USGS 11467000 RR near Guerneville (Hacienda)** |
|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | | 2 | 20 | 2 | 20 | 2 | Flow Rate*** |
| Unit of Measure | | °C | | µs | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | MPN/100mL | (cfs) |
| 5/12/2015 | 9:50:00 | 16.7 | 8.4 | 7735 | >2419.6 | 2481.0 | **1732.9** | **1956** | **435.2** | 183 |
| 5/19/2015 | 10:30:00 | 17.7 | 8.0 | 8433 | >2419.6 | 583.0 | 12.1 | 31 | 6.3 | 179 |
| 5/26/2015 | 11:00:00 | 17.1 | 8.0 | 9919 | >2419.6 | 2142.0 | 9.7 | 10 | 3.0 | 155 |
| 6/2/2015 | 9:50:00 | 18.0 | 8.3 | 3658 | >2419.6 | 3876.0 | 24.3 | 50 | 58.3 | 135 |
| 6/4/2015 | 10:00:00 | 18.1 | 8.3 | 4259 | >2419.6 | 1789 | **290.9** | 183 | **98.5** | 127 |
| 6/9/2015 | 12:20:00 | 20.0 | 8.2 | 3001 | 1299.7 | 1539 | 93.3 | 121 | 24.3 | 124 |
| 6/16/2015 | 10:30:00 | 20.2 | 7.7 | 11382 | >2419.6 | **>24196** | 2.0 | 10 | **816.4** | 117 |
| 6/23/2015 | 11:50:00 | 17.7 | 7.7 | 20054 | >2419.6 | 3076 | 3.0 | <10 | 35.5 | 106 |
| 6/30/2015 | 11:40:00 | 19.2 | 8.1 | 25570 | >2419.6 | **>24196** | 45.9 | 122 | **290.9** | 105 |
| 7/7/2015 | 9:20:00 | 19.4 | 7.9 | 33913 | >2419.6 | **>24196** | 98.3 | <10 | 31.3 | 72 |
| 7/14/2015 | 10:10:00 | 20.0 | 8.1 | 24413 | >2419.6 | **12033** | 31.8 | <10 | **261.3** | 77 |
| 7/21/2015 | 9:30:00 | 20.3 | 8.0 | 26643 | >2419.6 | **17329** | 32.7 | 10 | 33.7 | 86 |
| 7/28/2015 | 9:10:00 | 18.9 | 8.0 | 25570 | >2419.6 | **>24196** | **>2419.6** | 20 | **1046.2** | 66 |
| 8/4/2015 | 9:40:00 | 19.5 | 7.9 | 28952 | >2419.6 | **24196** | **1203.3** | 109 | **1299.7** | 103 |
| 8/11/2015 | 9:30:00 | 19.8 | 8.0 | 25559 | >2419.6 | **12033** | 85.1 | 62 | **1413.6** | 86 |
| 8/18/2015 | 9:20:00 | 18.8 | 8.0 | 25693 | >2419.6 | **19863** | **>2419.6** | 86 | **2419.6** | 89 |
| 8/25/2015 | 9:15:00 | 18.2 | 7.8 | 26237 | >2419.6 | **11199** | **>2419.6** | 86 | **920.8** | 75 |
| 9/1/2015 | 11:00:00 | 19.3 | 8.0 | 31760 | >2419.6 | 6488.0 | **866.4** | 86 | **410.6** | 68 |
| 9/8/2015 | 10:40:00 | 17.4 | 8.2 | 25683 | >2419.6 | 2723.0 | **387.3** | 121 | **1725.0** | 62 |
| 9/10/2015 | 10:40:00 | 17.8 | 8.3 | 16108 | 1732.9 | 402.0 | **290.9** | 10 | **88.6** | 64 |
| 9/15/2015 | 10:40:00 | 16.6 | 8.1 | 4160 | >2419.6 | **12033.0** | **281.2** | 20 | **178.5** | 90 |
| 9/22/2015 | 11:10:00 | 19.1 | 8.2 | 6443 | >2419.6 | 583.0 | 26.6 | 41 | 28.8 | 86 |
| 9/24/2015 | 8:50:00 | 18.0 | 8.1 | 6178 | >2419.6 | 1597.0 | 65.7 | 63 | **150.0** | 79 |
| 9/29/2015 | 11:00:00 | 18.5 | 8.2 | 5353 | 648.8 | 285.0 | 6.3 | <10 | 8.5 | 65 |
| 10/6/2015 | 9:30:00 | 19.4 | 7.8 | 7984 | >2419.6 | **19863.0** | 11.0 | <10 | 48.5 | 73 |
| 10/13/2015 | 10:20:00 | 17.6 | 8.5 | 19044 | >2419.6 | **>24196** | **325.5** | **256** | **>2419.6** | 78 |

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

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

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

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

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

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

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

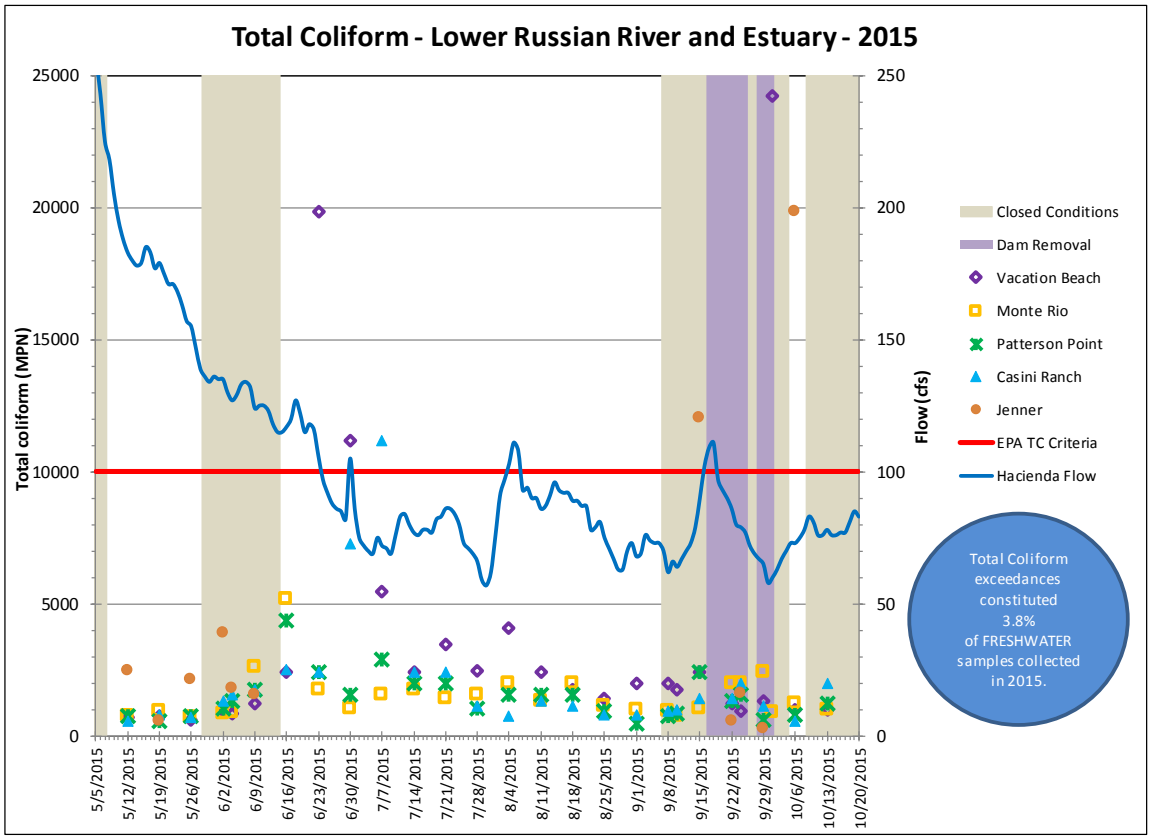


**Figure 3-4. Total coliform results for the Russian River from Vacation Beach to Jenner in 2015.**

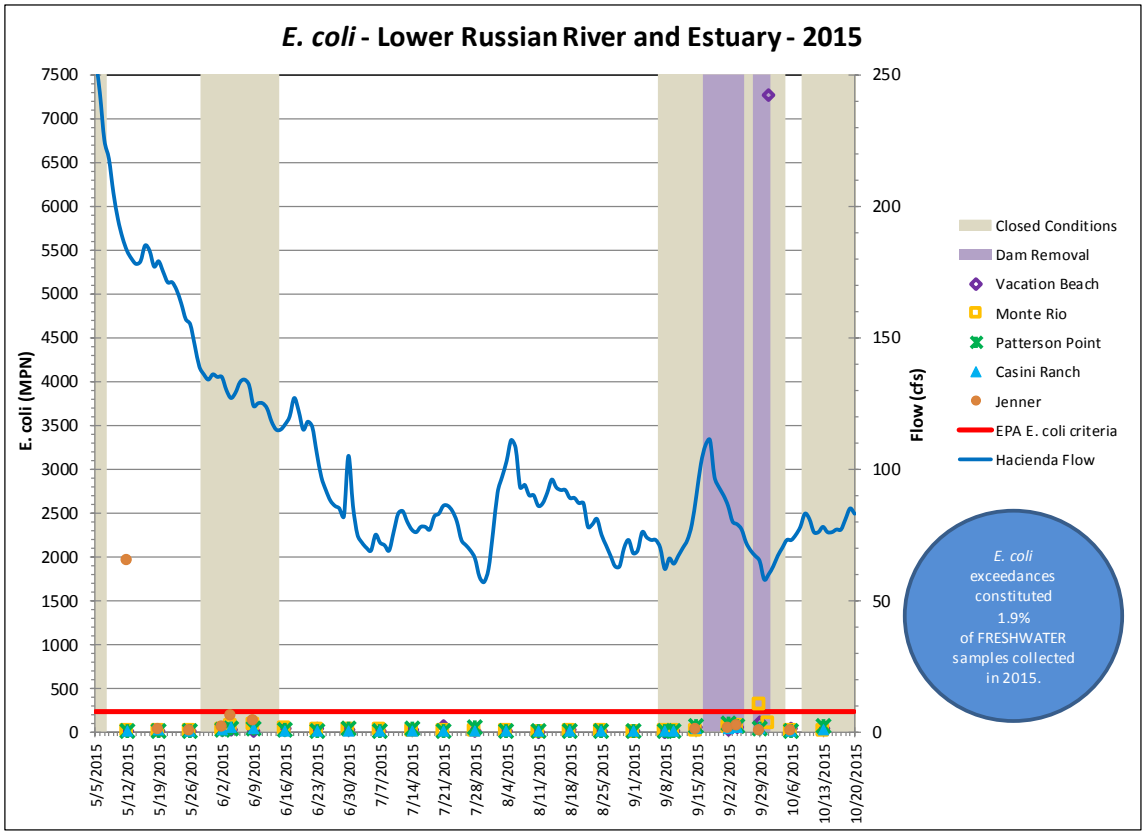


**Figure 3-5. E. coli results for the Russian River from Vacation Beach to Jenner in 2015.**

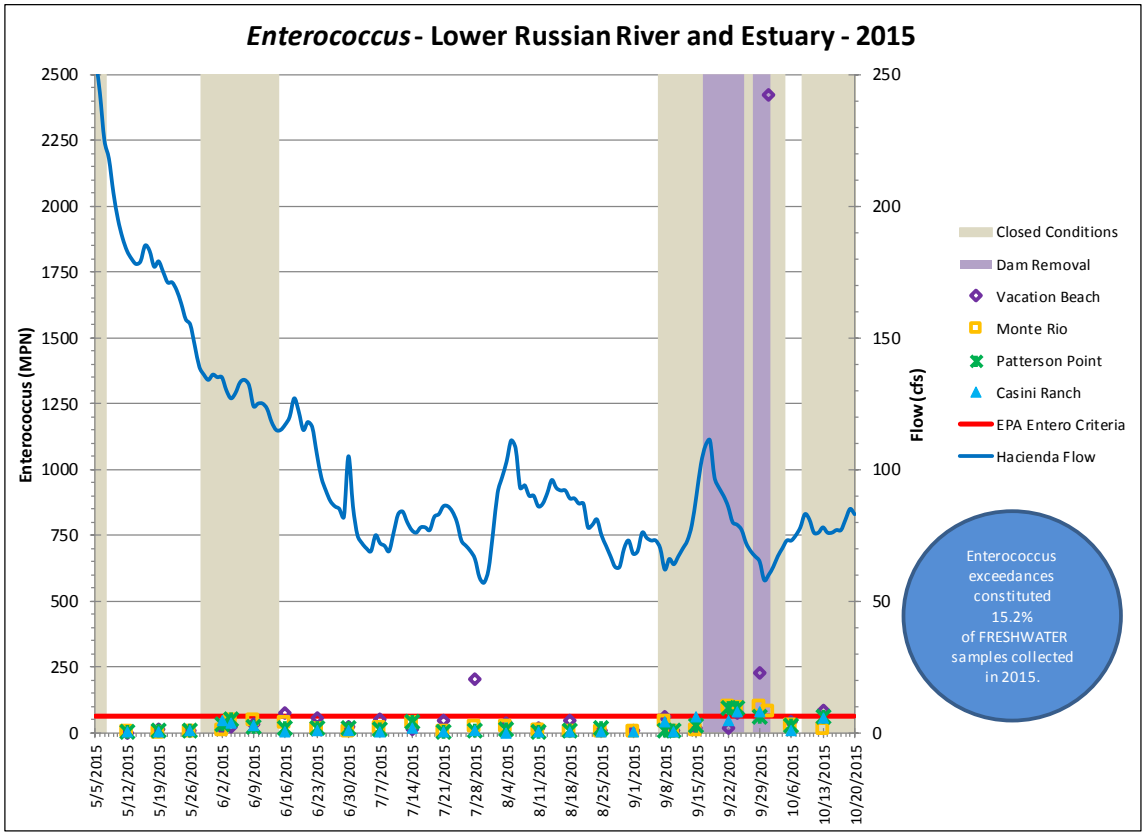


**Figure 3-6. Enterococcus results for the Russian River from Vacation Beach to Casini Ranch in 2015.**

**Table 3-7. 2015 Vacation Beach nutrient grab sample results. This site experiences freshwater conditions.**

| Vacation Beach | Time | Temperature | pH | Total Organic Nitrogen | Ammonia as N | Ammonia as N Unionized | Nitrate as N | Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen** | Phosphorus, Total | Total Orthophosphate | Dissolved Organic Carbon | Total Organic Carbon | Total Dissolved Solids | Turbidity | Chlorophyll-a | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 0.200 | 0.10 | 0.00010 | 0.030 | 0.030 | 0.10 | | 0.020 | 0.020 | 0.0400 | 0.0400 | 4.2 | 0.020 | 0.000050 | Flow Rate**** |
| Date | | °C | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | NTU | mg/L | (cfs) |
| 5/12/2015 | 11:20 | 19.5 | 8.2 | 0.21 | ND | ND | 0.076 | ND | 0.21 | 0.29 | **0.033** | 0.062 | 1.84 | 2.23 | 220 | 1.8 | 0.0015 | 183 |
| 5/19/2015 | 12:00 | 20.2 | 8.2 | ND | ND | ND | 0.053 | ND | ND | 0.23 | **0.028** | 0.062 | 1.65 | 1.91 | 170 | 0.96 | **0.0018** | 179 |
| 5/26/2015 | 12:50 | 21.1 | 8.1 | 0.21 | ND | ND | 0.052 | ND | 0.21 | 0.26 | **0.032** | 0.078 | 1.65 | 2.01 | 160 | 1.0 | 0.0017 | 155 |
| 6/2/2015 | 11:20 | 20.8 | 8.2 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.029** | 0.080 | 1.63 | 2.10 | 170 | 1.3 | 0.0010 | 135 |
| 6/4/2015 | 11:30 | 21.2 | 8.2 | 0.24 | ND | ND | 0.051 | ND | 0.24 | 0.30 | **0.036** | 0.084 | 1.61 | 2.18 | 170 | 2.0 | 0.0013 | 127 |
| 6/9/2015 | 12:20 | 23.7 | 8.1 | ND | ND | ND | 0.14 | 0.047 | ND | 0.36 | **0.036** | 0.087 | 1.53 | 2.07 | 160 | 1.2 | 0.00082 | 124 |
| 6/16/2015 | 10:30 | 22.9 | 8.9 | 0.42 | ND | ND | 0.052 | ND | 0.42 | **0.47** | **0.041** | 0.11 | 1.81 | 2.43 | 170 | 1.8 | 0.0015 | 117 |
| 6/23/2015 | 11:50 | 23.1 | 7.9 | 0.21 | ND | ND | 0.040 | ND | 0.21 | 0.25 | **0.034** | 0.075 | 1.80 | 2.28 | 160 | 1.7 | **0.0031** | 106 |
| 6/30/2015 | 11:40 | 24.6 | 7.9 | ND | ND | ND | 0.043 | ND | ND | 0.22 | **0.032** | 0.064 | 1.70 | 2.18 | 160 | 1.2 | **0.0019** | 105 |
| 7/7/2015 | 10:40 | 24.0 | 8.0 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.042** | 0.050 | 1.86 | 2.43 | 140 | 1.7 | **0.0034** | 72 |
| 7/14/2015 | 11:40 | 23.7 | 7.8 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.037** | ND | 1.45 | 1.91 | 160 | 1.9 | **0.0024** | 77 |
| 7/21/2015 | 11:00 | 25.2 | 7.8 | ND | ND | ND | ND | ND | ND | 0.14 | **0.037** | 0.060 | 1.47 | 1.88 | 140 | 1.3 | **0.0028** | 86 |
| 7/28/2015 | 10:30 | 24.5 | 8.0 | 0.24 | ND | ND | 0.049 | ND | 0.24 | 0.29 | **0.029** | 0.040 | 1.49 | 1.88 | 140 | 1.7 | 0.0016 | 66 |
| 8/4/2015 | 11:00 | 24.1 | 7.9 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.023** | 0.053 | 1.58 | 2.01 | 140 | 1.7 | 0.0016 | 103 |
| 8/11/2015 | 11:10 | 23.7 | 7.9 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | 0.020 | 0.024 | 1.59 | 2.06 | 120 | 1.1 | 0.0010 | 86 |
| 8/18/2015 | 10:50 | 23.9 | 7.9 | ND | ND | ND | 0.074 | ND | ND | 0.25 | **0.026** | 0.033 | 1.60 | 2.02 | 130 | 1.0 | **0.0020** | 89 |
| 8/25/2015 | 10:40 | 22.3 | 7.9 | 0.21 | ND | ND | ND | ND | 0.21 | 0.25 | **0.023** | 0.039 | 1.55 | 2.11 | 140 | 1.1 | **0.0023** | 75 |
| 9/1/2015 | 12:40 | 23.9 | 7.9 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | ND | 0.040 | 1.61 | 2.16 | 140 | 1.0 | **0.0020** | 68 |
| 9/8/2015 | 12:10 | 21.9 | 7.9 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | ND | 0.031 | 1.60 | 2.23 | 110 | 1.1 | 0.0015 | 62 |
| 9/10/2015 | 12:10 | 22.0 | 7.9 | ND | ND | ND | ND | ND | ND | ND | 0.021 | 0.029 | 1.54 | 1.77 | 140 | 1.1 | **0.0019** | 64 |
| 9/15/2015 | 12:00 | 20.8 | 7.7 | ND | ND | ND | ND | ND | ND | 0.18 | **0.024** | 0.027 | 1.67 | 2.25 | 150 | 0.99 | 0.0015 | 90 |
| 9/22/2015 | 12:40 | 21.0 | 7.6 | ND | ND | ND | ND | ND | ND | 0.18 | **0.024** | 0.049 | 1.47 | 2.03 | 140 | **2.4** | 0.00080 | 86 |
| 9/24/2015 | 10:20 | 20.1 | 7.5 | ND | ND | ND | ND | ND | ND | 0.14 | **0.028** | 0.050 | 1.35 | 1.82 | 140 | 1.4 | 0.00080 | 79 |
| 9/29/2015 | 12:10 | 19.9 | 7.6 | ND | ND | ND | ND | ND | ND | 0.10 | **0.024** | 0.052 | 1.42 | 2.04 | 150 | 2.3 | 0.0016 | 65 |
| 10/6/2015 | 11:00 | 19.5 | 7.6 | ND | ND | ND | 0.041 | ND | ND | 0.15 | 0.021 | 0.031 | 1.43 | 2.07 | 140 | **2.4** | 0.0016 | 73 |
| 10/13/2015 | 11:40 | 19.6 | 7.8 | ND | ND | ND | ND | ND | ND | 0.10 | **0.023** | 0.035 | 1.29 | 1.84 | 140 | 1.7 | 0.0013 | 78 |

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

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

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

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

**Recommended EPA Criteria based on Aggregate Ecoregion III**

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

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

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

**Table 3-8. 2015 Monte Rio nutrient grab sample results. This site experiences freshwater conditions.**

| Monte Rio | Time | Temperature | pH | Total Organic Nitrogen | Ammonia as N | Ammonia as N Unionized | Nitrate as N | Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen** | Phosphorus, Total | Total Orthophosphate | Dissolved Organic Carbon | Total Organic Carbon | Total Dissolved Solids | Turbidity | Chlorophyll-a | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 0.200 | 0.10 | 0.00010 | 0.030 | 0.030 | 0.10 | | 0.020 | 0.020 | 0.0400 | 0.0400 | 4.2 | 0.020 | 0.000050 | Flow Rate**** |
| Date | | °C | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | NTU | mg/L | (cfs) |
| 5/12/2015 | 11:10 | 19.5 | 8.1 | 0.21 | ND | ND | 0.071 | ND | 0.21 | 0.28 | **0.040** | 0.089 | 1.82 | 2.35 | 170 | 1.8 | 0.0014 | 183 |
| 5/19/2015 | 11:40 | 20.1 | 8.2 | ND | ND | ND | 0.053 | ND | ND | 0.23 | **0.028** | 0.062 | 1.59 | 1.93 | 180 | 1.0 | 0.0012 | 179 |
| 5/26/2015 | 12:30 | 20.8 | 8.0 | 0.24 | ND | ND | 0.051 | ND | 0.24 | 0.30 | **0.035** | 0.086 | 1.64 | 2.00 | 160 | 1.2 | **0.0019** | 155 |
| 6/2/2015 | 11:00 | 20.4 | 8.1 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.035** | 0.080 | 1.60 | 2.07 | 180 | 1.6 | 0.0010 | 135 |
| 6/4/2015 | 11:10 | 21.3 | 8.2 | ND | ND | ND | 0.050 | ND | ND | 0.19 | **0.041** | 0.080 | 1.62 | 2.18 | 170 | 1.9 | 0.00028 | 127 |
| 6/9/2015 | 11:50 | 23.7 | 8.1 | ND | ND | ND | 0.14 | 0.048 | ND | 0.36 | **0.038** | 0.091 | 1.55 | 2.08 | 160 | 0.77 | 0.0011 | 124 |
| 6/16/2015 | 10:20 | 22.4 | 7.8 | 0.32 | ND | ND | 0.054 | ND | 0.32 | 0.37 | **0.050** | 0.150 | 1.73 | 2.41 | 180 | 1.5 | 0.00070 | 117 |
| 6/23/2015 | 11:30 | 23.2 | 7.9 | 0.28 | ND | ND | 0.040 | ND | 0.28 | 0.32 | **0.036** | 0.110 | 1.75 | 2.28 | 160 | 2.2 | **0.0023** | 106 |
| 6/30/2015 | 11:20 | 24.5 | 7.9 | ND | ND | ND | 0.043 | ND | ND | 0.22 | **0.032** | 0.064 | 1.68 | 2.20 | 160 | 1.2 | 0.0012 | 105 |
| 7/7/2015 | 10:30 | 23.6 | 8.0 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.038** | 0.080 | 1.87 | 2.32 | 150 | 1.3 | **0.0025** | 72 |
| 7/14/2015 | 11:30 | 23.6 | 7.7 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | **0.034** | ND | 1.41 | 1.91 | 140 | 2.2 | 0.0015 | 77 |
| 7/21/2015 | 10:50 | 25.0 | 7.8 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.040** | 0.064 | 1.42 | 1.89 | 130 | 1.3 | **0.0019** | 86 |
| 7/28/2015 | 10:10 | 23.7 | 7.8 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.032** | 0.048 | 1.44 | 1.89 | 140 | 2.2 | 0.0014 | 66 |
| 8/4/2015 | 10:50 | 23.9 | 7.8 | ND | ND | ND | ND | ND | ND | 0.18 | **0.030** | 0.083 | 1.49 | 2.01 | 150 | 1.9 | 0.0011 | 103 |
| 8/11/2015 | 10:50 | 23.5 | 7.9 | ND | ND | ND | ND | ND | ND | 0.18 | **0.026** | 0.036 | 1.54 | 2.00 | 120 | 0.88 | 0.0010 | 86 |
| 8/18/2015 | 10:30 | 23.8 | 7.9 | ND | ND | ND | 0.072 | ND | ND | 0.25 | **0.028** | 0.049 | 1.58 | 1.97 | 150 | 1.6 | 0.00074 | 89 |
| 8/25/2015 | 10:25 | 22.0 | 7.8 | ND | ND | ND | ND | ND | ND | 0.17 | **0.024** | 0.047 | 1.49 | 1.97 | 140 | 1.1 | **0.0020** | 75 |
| 9/1/2015 | 12:20 | 23.5 | 7.7 | ND | ND | ND | ND | ND | ND | 0.18 | **0.022** | 0.048 | 1.54 | 2.13 | 130 | 0.70 | 0.0011 | 68 |
| 9/8/2015 | 11:50 | 21.8 | 7.8 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | ND | 0.031 | 1.59 | 2.18 | 120 | 1.7 | 0.0014 | 62 |
| 9/10/2015 | 12:00 | 21.6 | 7.8 | ND | ND | ND | ND | ND | ND | 0.18 | **0.025** | 0.045 | 1.53 | 1.93 | 150 | 0.77 | 0.0011 | 64 |
| 9/15/2015 | 11:50 | 20.2 | 7.5 | ND | ND | ND | ND | ND | ND | 0.18 | **0.022** | 0.043 | 1.64 | 2.26 | 140 | 1.4 | 0.0014 | 90 |
| 9/22/2015 | 12:30 | 21.4 | 7.8 | ND | ND | ND | ND | ND | ND | 0.18 | ND | 0.049 | 1.84 | 2.02 | 140 | 0.79 | 0.00080 | 86 |
| 9/24/2015 | 10:10 | 20.3 | 7.6 | ND | ND | ND | ND | ND | ND | 0.14 | 0.020 | 0.037 | 1.46 | 1.99 | 140 | 0.73 | 0.00053 | 79 |
| 9/29/2015 | 12:00 | 20.4 | 7.9 | ND | ND | ND | ND | ND | ND | 0.10 | 0.020 | 0.040 | 1.43 | 1.99 | 140 | 1.3 | 0.0011 | 65 |
| 10/6/2015 | 10:40 | 19.6 | 7.6 | ND | ND | ND | 0.050 | ND | ND | 0.12 | **0.037** | 0.089 | 1.45 | 1.98 | 140 | 1.2 | 0.00087 | 73 |
| 10/13/2015 | 11:20 | 19.4 | 7.8 | ND | ND | ND | ND | ND | ND | 0.14 | **0.042** | 0.090 | 1.40 | 1.94 | 130 | 1.9 | 0.0014 | 78 |

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

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

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

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

**Recommended EPA Criteria based on Aggregate Ecoregion III**

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

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

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

**Table 3-9. 2015 Patterson Point nutrient grab sample results. This site experiences freshwater conditions.**

| Patterson Point | Time | Temperature | pH | Total Organic Nitrogen | Ammonia as N | Ammonia as N Unionized | Nitrate as N | Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen** | Phosphorus, Total | Total Orthophosphate | Dissolved Organic Carbon | Total Organic Carbon | Total Dissolved Solids | Turbidity | Chlorophyll-a | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 0.200 | 0.10 | 0.00010 | 0.030 | 0.030 | 0.10 | | 0.020 | 0.020 | 0.0400 | 0.0400 | 4.2 | 0.020 | 0.000050 | Flow Rate**** |
| Date | | °C | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | NTU | mg/L | (cfs) |
| 5/12/2015 | 10:40 | 19.5 | 8.2 | 0.28 | ND | ND | 0.075 | ND | 0.28 | 0.36 | **0.040** | 0.085 | 1.82 | 2.50 | 170 | 2.3 | 0.0011 | 183 |
| 5/19/2015 | 11:20 | 20.0 | 8.2 | 0.21 | ND | ND | 0.054 | ND | 0.21 | 0.26 | **0.031** | 0.066 | 1.71 | 1.82 | 170 | 0.82 | 0.00083 | 179 |
| 5/26/2015 | 12:00 | 20.6 | 8.0 | 0.21 | ND | ND | 0.051 | ND | 0.21 | 0.26 | **0.034** | 0.078 | 1.67 | 2.04 | 160 | 1.5 | **0.0019** | 155 |
| 6/2/2015 | 10:40 | 20.3 | 8.0 | ND | ND | ND | ND | ND | ND | 0.18 | **0.035** | 0.084 | 1.68 | 2.13 | 170 | 1.5 | 0.0016 | 135 |
| 6/4/2015 | 10:50 | 21.0 | 8.2 | ND | ND | ND | 0.051 | ND | ND | 0.23 | **0.043** | 0.11 | 1.63 | 2.19 | 170 | 1.6 | 0.0010 | 127 |
| 6/9/2015 | 11:30 | 23.6 | 8.2 | 0.21 | ND | ND | 0.14 | 0.048 | 0.21 | **0.40** | **0.036** | 0.091 | 1.60 | 2.08 | 160 | 1.3 | 0.00082 | 124 |
| 6/16/2015 | 10:00 | 22.5 | 7.9 | 0.24 | ND | ND | 0.058 | ND | 0.24 | 0.30 | **0.064** | 0.15 | 1.78 | 2.49 | 160 | 1.2 | 0.00082 | 117 |
| 6/23/2015 | 11:10 | 22.7 | 7.9 | 0.35 | ND | ND | ND | ND | 0.35 | 0.35 | **0.038** | 0.099 | 1.75 | 2.25 | 160 | 1.6 | **0.0021** | 106 |
| 6/30/2015 | 10:50 | 23.5 | 7.8 | ND | ND | ND | 0.045 | ND | ND | 0.22 | **0.041** | 0.081 | 1.66 | 2.20 | 160 | 1.2 | **0.0018** | 105 |
| 7/7/2015 | 10:10 | 23.7 | 8.1 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.045** | 0.085 | 1.73 | 2.31 | 160 | 1.2 | **0.0022** | 72 |
| 7/14/2015 | 11:00 | 23.8 | 7.7 | 0.21 | ND | ND | 0.049 | ND | 0.21 | 0.26 | **0.039** | 0.031 | 1.39 | 1.92 | 150 | **3.6** | 0.0014 | 77 |
| 7/21/2015 | 10:30 | 24.8 | 7.9 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | **0.041** | 0.092 | 1.40 | 1.94 | 140 | 1.6 | 0.00094 | 86 |
| 7/28/2015 | 9:50 | 24.1 | 7.8 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.036** | 0.053 | 1.49 | 1.91 | 140 | 1.8 | 0.0016 | 66 |
| 8/4/2015 | 10:30 | 23.5 | 7.9 | ND | ND | ND | ND | ND | ND | 0.18 | **0.031** | 0.088 | 1.42 | 1.99 | 150 | **2.9** | 0.00091 | 103 |
| 8/11/2015 | 10:30 | 23.2 | 7.8 | ND | ND | ND | ND | ND | ND | 0.14 | **0.023** | 0.048 | 1.52 | 1.98 | 130 | 0.88 | 0.0013 | 86 |
| 8/18/2015 | 10:10 | 23.2 | 7.8 | ND | ND | ND | 0.071 | ND | ND | 0.25 | **0.030** | 0.057 | 1.55 | 1.98 | 140 | 1.5 | 0.00050 | 89 |
| 8/25/2015 | 10:05 | 22.1 | 7.9 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.029** | 0.047 | 1.51 | 2.01 | 150 | 1.3 | 0.00094 | 75 |
| 9/1/2015 | 12:00 | 23.5 | 7.9 | ND | ND | ND | ND | ND | ND | 0.070 | **0.025** | 0.060 | 1.56 | 2.14 | 150 | 1.5 | 0.0011 | 68 |
| 9/8/2015 | 11:30 | 21.9 | 8.0 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | ND | 0.039 | 1.62 | 2.13 | 120 | 1.4 | 0.00068 | 62 |
| 9/10/2015 | 11:30 | 22.1 | 8.0 | ND | ND | ND | ND | ND | ND | 0.18 | **0.029** | 0.037 | 1.54 | 2.12 | 130 | 1.2 | 0.0016 | 64 |
| 9/15/2015 | 11:30 | 20.8 | 7.8 | ND | ND | ND | ND | ND | ND | 0.14 | **0.028** | 0.055 | 1.74 | 2.29 | 150 | 1.3 | **0.0019** | 90 |
| 9/22/2015 | 12:05 | 21.0 | 7.8 | ND | ND | ND | ND | ND | ND | 0.18 | **0.023** | 0.06 | 1.74 | 2.00 | 140 | 1.2 | 0.0013 | 86 |
| 9/24/2015 | 9:50 | 20.4 | 7.9 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.022** | 0.037 | 1.53 | 2.07 | 150 | 0.58 | 0.00093 | 79 |
| 9/29/2015 | 11:40 | 19.8 | 7.7 | ND | ND | ND | ND | ND | ND | 0.14 | **0.022** | 0.048 | 1.49 | 2.03 | 140 | 0.99 | 0.0015 | 65 |
| 10/6/2015 | 10:20 | 20.0 | 7.7 | ND | ND | ND | 0.046 | ND | ND | 0.15 | **0.036** | 0.082 | 1.46 | 2.00 | 150 | 1.0 | 0.00087 | 73 |
| 10/13/2015 | 11:00 | 19.3 | 7.8 | ND | ND | ND | ND | ND | ND | 0.10 | **0.036** | 0.082 | 1.38 | 2.01 | 130 | 1.4 | 0.0011 | 78 |

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

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

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

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

**Recommended EPA Criteria based on Aggregate Ecoregion III**

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

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

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

**Table 3-10. 2015 Casini Ranch nutrient grab sample results. This site may experience estuarine conditions.**

| Casini Ranch | Time | Temperature | pH | Total Organic Nitrogen | Ammonia as N | Ammonia as N Unionized | Nitrate as N | Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen** | Phosphorus, Total | Total Orthophosphate | Dissolved Organic Carbon | Total Organic Carbon | Total Dissolved Solids | Turbidity | Chlorophyll-a | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 0.200 | 0.10 | 0.00010 | 0.030 | 0.030 | 0.10 | | 0.020 | 0.020 | 0.0400 | 0.0400 | 4.2 | 0.020 | 0.000050 | Flow Rate**** |
| Date | | °C | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | NTU | mg/L | (cfs) |
| 5/12/2015 | 10:20 | 20.1 | 8.3 | ND | ND | ND | 0.066 | ND | ND | 0.24 | **0.044** | 0.18 | 1.87 | 2.57 | 180 | 1.6 | 0.0015 | 183 |
| 5/19/2015 | 10:50 | 20.4 | 8.3 | 0.24 | ND | ND | 0.21 | ND | 0.24 | 0.30 | **0.035** | 0.074 | 1.67 | 1.98 | 170 | 2.1 | 0.0013 | 179 |
| 5/26/2015 | 11:30 | 20.6 | 8.1 | ND | ND | ND | 0.051 | ND | ND | 0.23 | **0.036** | 0.082 | 1.64 | 1.97 | 160 | 2.2 | **0.0027** | 155 |
| 6/2/2015 | 10:10 | 21.5 | 8.1 | ND | ND | ND | 0.14 | ND | ND | 0.32 | **0.040** | 0.099 | 1.67 | 2.18 | 170 | 2.0 | **0.0028** | 135 |
| 6/4/2015 | 10:30 | 21.2 | 8.4 | 0.21 | ND | ND | 0.053 | ND | 0.21 | 0.26 | **0.044** | 0.095 | 1.42 | 1.93 | 170 | 2.1 | **0.0024** | 127 |
| 6/9/2015 | 11:10 | 22.8 | 8.3 | ND | ND | ND | ND | 0.051 | ND | 0.19 | **0.036** | 0.091 | 1.57 | 2.04 | 160 | 1.1 | 0.0016 | 124 |
| 6/16/2015 | 9:30 | 22.3 | 7.9 | 0.28 | ND | ND | 0.053 | ND | 0.28 | 0.33 | **0.047** | 0.14 | 1.76 | 2.28 | 170 | 1.3 | 0.00082 | 117 |
| 6/23/2015 | 10:50 | 22.2 | 7.9 | 0.21 | ND | ND | 0.040 | ND | 0.21 | 0.25 | **0.042** | 0.10 | 1.78 | 2.30 | 160 | 0.85 | **0.0021** | 106 |
| 6/30/2015 | 10:20 | 23.6 | 8.0 | 0.28 | ND | ND | 0.044 | ND | 0.28 | 0.32 | **0.038** | 0.085 | 1.72 | 2.20 | 160 | 1.4 | 0.0012 | 105 |
| 7/7/2015 | 9:50 | 23.1 | 8.5 | ND | ND | ND | ND | ND | ND | 0.18 | **0.040** | 0.093 | 1.77 | 2.28 | 150 | 0.66 | 0.0014 | 72 |
| 7/14/2015 | 10:30 | 24.0 | 7.9 | ND | ND | ND | ND | ND | ND | 0.18 | **0.035** | ND | 1.50 | 2.00 | 140 | 0.65 | 0.0013 | 77 |
| 7/21/2015 | 10:10 | 24.8 | 8.2 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | **0.046** | 0.10 | 1.48 | 2.06 | 140 | 0.66 | 0.0012 | 86 |
| 7/28/2015 | 9:30 | 23.4 | 8.2 | ND | ND | ND | 0.049 | ND | ND | 0.19 | **0.038** | 0.070 | 1.53 | 2.07 | 120 | 1.0 | 0.0009 | 66 |
| 8/4/2015 | 10:00 | 22.7 | 7.7 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.029** | 0.083 | 1.58 | 2.06 | 140 | 1.0 | 0.0014 | 103 |
| 8/11/2015 | 10:00 | 23.1 | 7.9 | ND | ND | ND | ND | ND | ND | 0.18 | **0.028** | 0.052 | 1.59 | 2.08 | 92 | 0.75 | 0.00064 | 86 |
| 8/18/2015 | 9:50 | 22.3 | 8.0 | 0.21 | ND | ND | 0.076 | ND | 0.21 | 0.29 | **0.031** | 0.049 | 1.62 | 2.06 | 140 | 1.4 | 0.00074 | 89 |
| 8/25/2015 | 9:45 | 21.3 | 8.1 | 0.21 | ND | ND | ND | ND | 0.21 | 0.25 | **0.036** | 0.051 | 1.58 | 2.33 | 140 | 0.67 | 0.00094 | 75 |
| 9/1/2015 | 11:30 | 23.5 | 7.9 | ND | ND | ND | ND | ND | ND | 0.21 | **0.027** | 0.078 | 1.67 | 2.27 | 140 | 0.78 | 0.0012 | 68 |
| 9/8/2015 | 11:00 | 21.5 | 8.1 | ND | ND | ND | ND | ND | ND | 0.18 | ND | 0.043 | 1.65 | 2.23 | 79 | 0.98 | 0.00096 | 62 |
| 9/10/2015 | 11:00 | 21.7 | 8.1 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | 0.021 | 0.049 | 1.69 | 1.68 | 130 | 0.92 | 0.0011 | 64 |
| 9/15/2015 | 11:00 | 21.2 | 8.0 | ND | ND | ND | ND | ND | ND | 0.18 | **0.028** | 0.047 | 2.11 | 2.30 | 150 | 1.0 | **0.0019** | 90 |
| 9/22/2015 | 11:40 | 21.7 | 8.0 | ND | ND | ND | ND | ND | ND | 0.18 | 0.021 | 0.049 | 1.51 | 2.07 | 140 | 1.0 | **0.0019** | 86 |
| 9/24/2015 | 9:20 | 20.0 | 8.0 | ND | ND | ND | ND | ND | ND | 0.14 | **0.024** | 0.046 | 1.74 | 2.02 | 140 | 1.1 | 0.0015 | 79 |
| 9/29/2015 | 11:20 | 20.1 | 8.1 | ND | ND | ND | ND | ND | ND | 0.18 | ND | 0.048 | 1.86 | 2.23 | 140 | 1.2 | **0.0021** | 65 |
| 10/6/2015 | 10:00 | 19.4 | 7.8 | ND | ND | ND | 0.041 | ND | ND | 0.15 | **0.032** | 0.070 | 1.84 | 2.13 | 150 | 0.84 | 0.0013 | 73 |
| 10/13/2015 | 10:40 | 20.0 | 7.9 | ND | ND | ND | ND | ND | ND | ND | **0.031** | 0.090 | 1.73 | 1.99 | 140 | 1.5 | 0.00071 | 78 |

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

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

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

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

**Recommended EPA Criteria based on Aggregate Ecoregion III**

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

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

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

**Table 3-11. 2015 Jenner nutrient grab sample results. Estuarine conditions exist at this site. EPA criteria do not apply but exceedances are highlighted for comparison.**

| Jenner Boat Ramp | Time | Temperature | pH | Total Organic Nitrogen | Ammonia as N | Ammonia as N Unionized | Nitrate as N | Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen** | Phosphorus, Total | Total Orthophosphate | Dissolved Organic Carbon | Total Organic Carbon | Total Dissolved Solids | Turbidity | Chlorophyll-a | USGS 11467000 RR near Guerneville (Hacienda)*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL* | | | | 0.200 | 0.10 | 0.00010 | 0.030 | 0.030 | 0.10 | | 0.020 | 0.020 | 0.0400 | 0.0400 | 4.2 | 0.020 | 0.000050 | Flow Rate**** |
| Date | | °C | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | NTU | mg/L | (cfs) |
| 5/12/2015 | 9:50 | 16.7 | 8.4 | 0.32 | ND | ND | 0.063 | ND | 0.32 | **0.38** | **0.065** | 0.13 | 1.74 | 2.24 | 4200 | **12** | 0.0015 | 183 |
| 5/19/2015 | 10:30 | 17.7 | 8.0 | 0.35 | ND | ND | 0.26 | ND | 0.35 | **0.62** | **0.044** | 0.086 | 1.09 | 1.23 | 7400 | **2.6** | **0.0059** | 179 |
| 5/26/2015 | 11:00 | 17.1 | 8.0 | 0.24 | ND | ND | 0.27 | ND | 0.24 | **0.52** | **0.050** | 0.086 | 1.32 | 1.20 | 6600 | **2.8** | **0.0074** | 155 |
| 6/2/2015 | 9:50 | 18.0 | 8.3 | 0.21 | ND | ND | 0.28 | ND | 0.21 | **0.49** | **0.033** | 0.072 | 2.07 | 2.05 | 2100 | 1.8 | **0.0027** | 135 |
| 6/4/2015 | 10:00 | 18.1 | 8.3 | ND | ND | ND | 0.053 | ND | ND | 0.23 | **0.039** | 0.072 | 2.00 | 1.94 | 2400 | 1.5 | **0.0023** | 127 |
| 6/9/2015 | 10:40 | 20.0 | 8.2 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | **0.035** | 0.052 | 2.09 | 2.24 | 1600 | 1.3 | **0.011** | 124 |
| 6/16/2015 | 9:10 | 20.2 | 7.7 | 0.32 | ND | ND | 0.029 | ND | 0.32 | **0.60** | **0.052** | 0.15 | 1.45 | 1.59 | 7000 | 1.8 | 0.00047 | 117 |
| 6/23/2015 | 10:30 | 17.7 | 7.7 | 0.21 | ND | ND | 0.59 | ND | 0.21 | **0.80** | **0.042** | 0.11 | 0.931 | 0.950 | 14000 | 1.3 | 0.0014 | 106 |
| 6/30/2015 | 9:50 | 19.2 | 8.1 | ND | ND | ND | 0.80 | ND | ND | **0.94** | **0.032** | 0.056 | 0.849 | 0.852 | 15000 | 1.6 | **0.0022** | 105 |
| 7/7/2015 | 9:20 | 19.4 | 7.9 | 0.32 | ND | ND | ND | ND | 0.32 | 0.32 | **0.036** | 0.059 | 0.623 | 0.731 | 22000 | 1.8 | **0.0044** | 72 |
| 7/14/2015 | 10:10 | 20.0 | 8.1 | 0.32 | ND | ND | 1.1 | ND | 0.32 | **1.4** | **0.045** | 0.023 | 0.748 | 0.807 | 19000 | **3.5** | **0.0031** | 77 |
| 7/21/2015 | 9:30 | 20.3 | 8.0 | 0.35 | ND | ND | ND | ND | 0.35 | 0.35 | **0.043** | 0.048 | 0.702 | 0.718 | 17000 | 1.8 | **0.0024** | 86 |
| 7/28/2015 | 9:10 | 18.9 | 8.0 | 0.21 | ND | ND | ND | ND | 0.21 | 0.21 | **0.033** | ND | 0.785 | 0.742 | 17000 | 1.3 | **0.0058** | 66 |
| 8/4/2015 | 9:40 | 19.5 | 7.9 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.025** | 0.048 | 0.684 | 0.600 | 18000 | 1.8 | **0.0029** | 103 |
| 8/11/2015 | 9:30 | 19.8 | 8.0 | 0.28 | ND | ND | 1.1 | ND | 0.28 | **1.4** | **0.027** | 0.044 | 0.851 | 0.901 | 17000 | 1.9 | **0.0033** | 86 |
| 8/18/2015 | 9:20 | 18.8 | 8.0 | ND | ND | ND | 1.1 | ND | ND | **1.2** | **0.027** | 0.033 | 0.746 | 0.670 | 19000 | 1.8 | **0.0021** | 89 |
| 8/25/2015 | 9:15 | 18.2 | 7.8 | 0.28 | ND | ND | 0.92 | ND | 0.38 | **1.3** | **0.032** | 0.047 | 0.88 | 0.970 | 19000 | 1.6 | **0.0039** | 75 |
| 9/1/2015 | 11:00 | 19.3 | 8.0 | 0.28 | ND | ND | ND | ND | 0.28 | **1.0** | **0.038** | 0.06 | 0.820 | 0.899 | 21000 | **3.3** | **0.0024** | 68 |
| 9/8/2015 | 10:40 | 17.4 | 8.2 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | ND | 0.020 | 0.833 | 0.851 | 17000 | 1.4 | **0.0060** | 62 |
| 9/10/2015 | 10:40 | 17.8 | 8.3 | 0.28 | ND | ND | ND | ND | 0.28 | 0.28 | **0.030** | 0.021 | 1.17 | 2.13 | 13000 | 1.4 | **0.0082** | 64 |
| 9/15/2015 | 10:40 | 16.6 | 8.1 | 0.32 | ND | ND | ND | ND | 0.32 | 0.32 | **0.037** | 0.035 | 2.15 | 2.20 | 3000 | **4.4** | **0.0049** | 90 |
| 9/22/2015 | 11:10 | 19.1 | 8.2 | 0.21 | ND | ND | 0.21 | ND | 0.21 | **0.42** | **0.027** | 0.033 | 2.00 | 1.97 | 3400 | 1.2 | **0.0042** | 86 |
| 9/24/2015 | 8:50 | 18.0 | 8.1 | ND | ND | ND | 0.22 | ND | ND | **0.40** | **0.024** | ND | 1.75 | 1.85 | 3500 | 1.4 | **0.0031** | 79 |
| 9/29/2015 | 11:00 | 18.5 | 8.2 | 0.24 | ND | ND | ND | ND | 0.24 | 0.24 | **0.026** | 0.060 | 1.75 | 2.13 | 3000 | 1.5 | **0.0051** | 65 |
| 10/6/2015 | 9:30 | 19.4 | 7.8 | 0.21 | ND | ND | 0.24 | ND | 0.21 | **0.45** | **0.045** | 0.089 | 1.73 | 1.78 | 4300 | 1.5 | 0.0015 | 73 |
| 10/13/2015 | 10:20 | 17.6 | 8.5 | ND | ND | ND | ND | ND | ND | 0.18 | **0.026** | 0.027 | 0.983 | 1.07 | 11000 | 1.4 | **0.0023** | 78 |

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

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

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

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

**Recommended EPA Criteria based on Aggregate Ecoregion III**

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

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

Total Nitrogen: 0.38 mg/L

Turbidity: 2.34 FTU/NTU

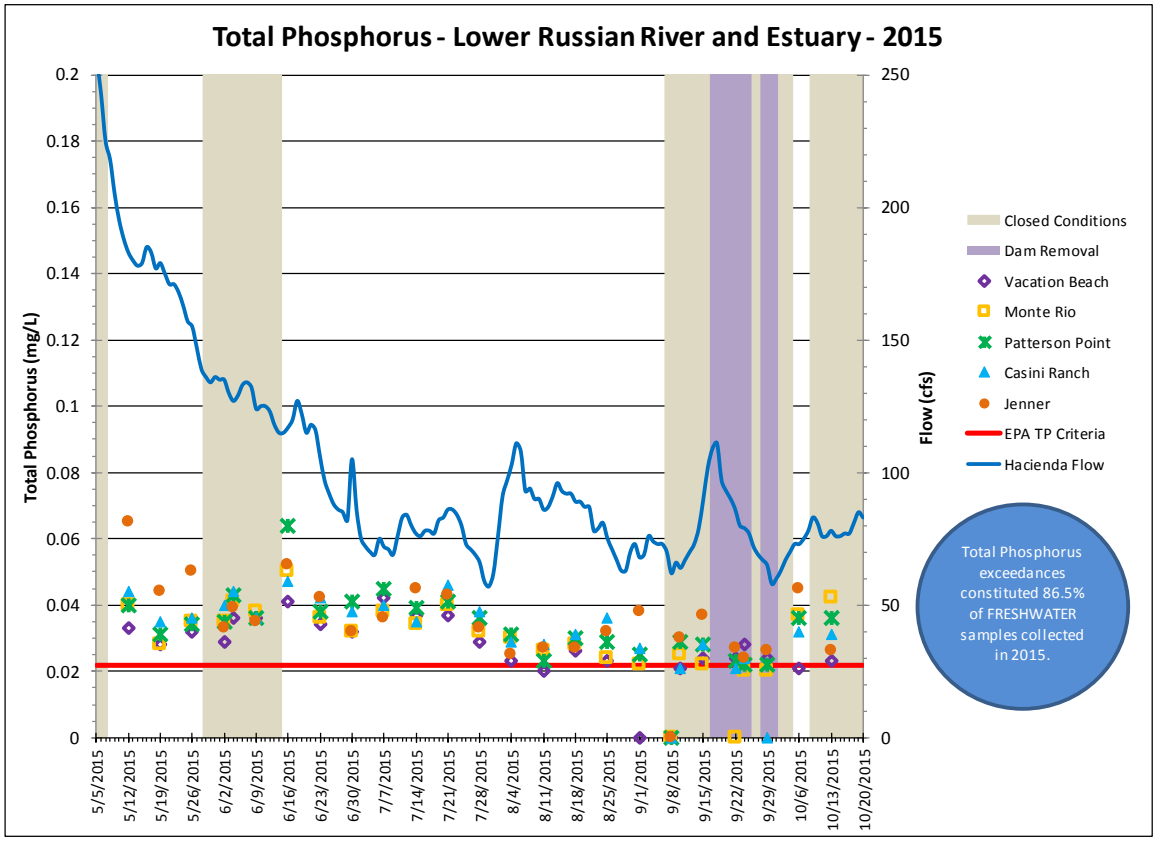


**Figure 3-7. Total Phosphorus results for the Russian River from Vacation Beach to Jenner in 2015.**

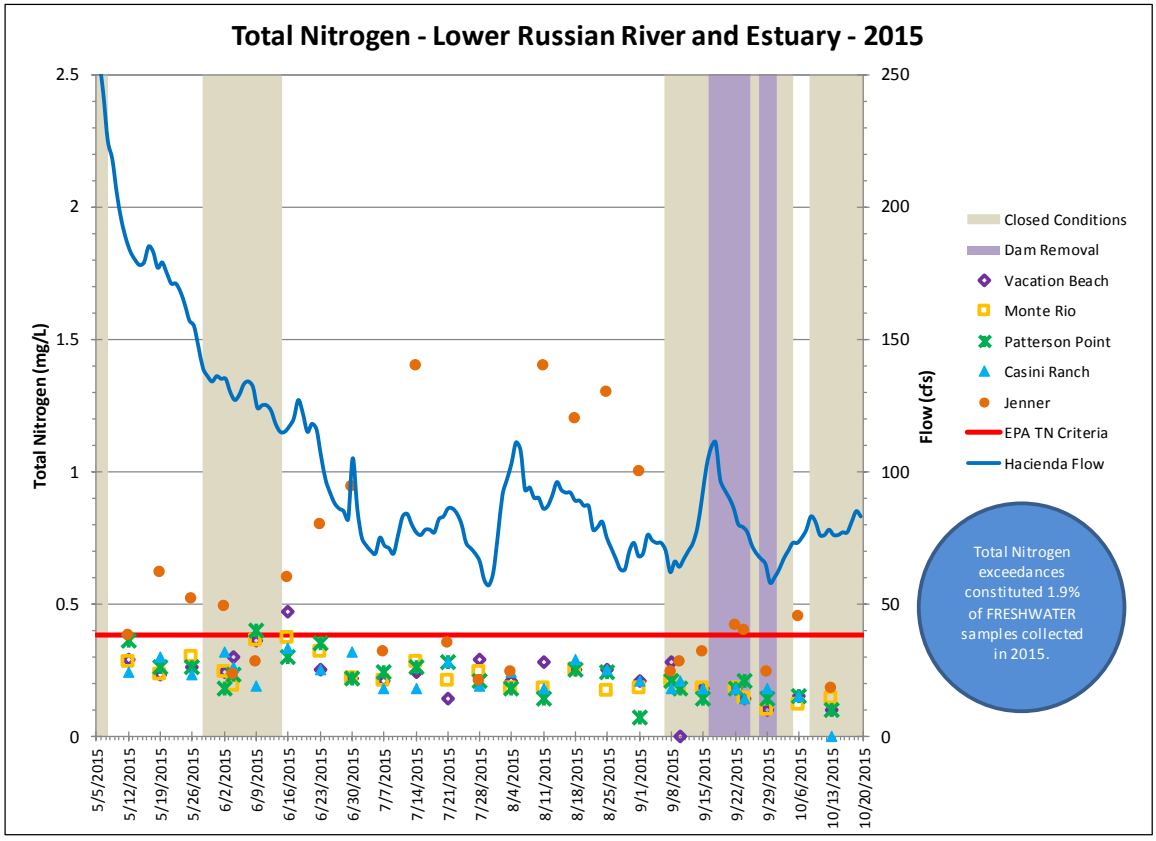


**Figure 3-8. Total Nitrogen results for the Russian River from Vacation Beach to Jenner in 2015.**

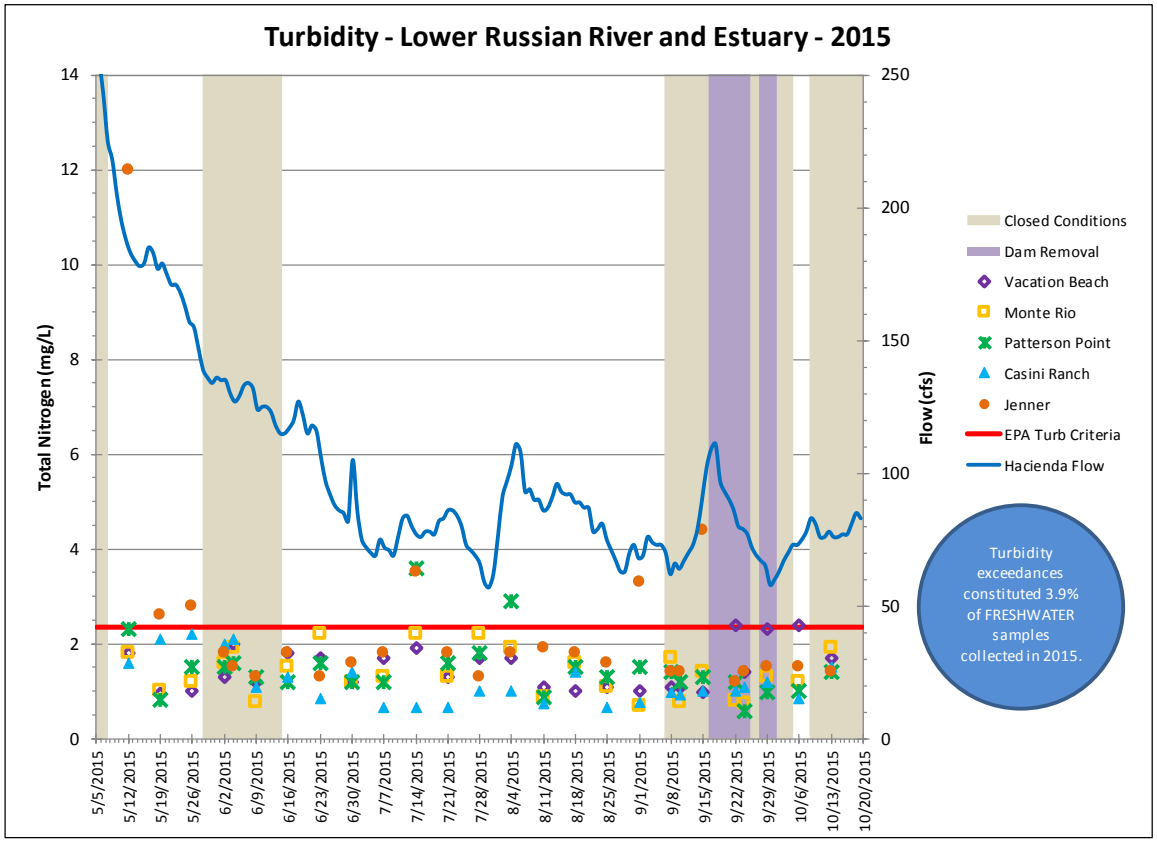


**Figure 3-9. Turbidity results for the Russian River from Vacation Beach to Jenner in 2015.**

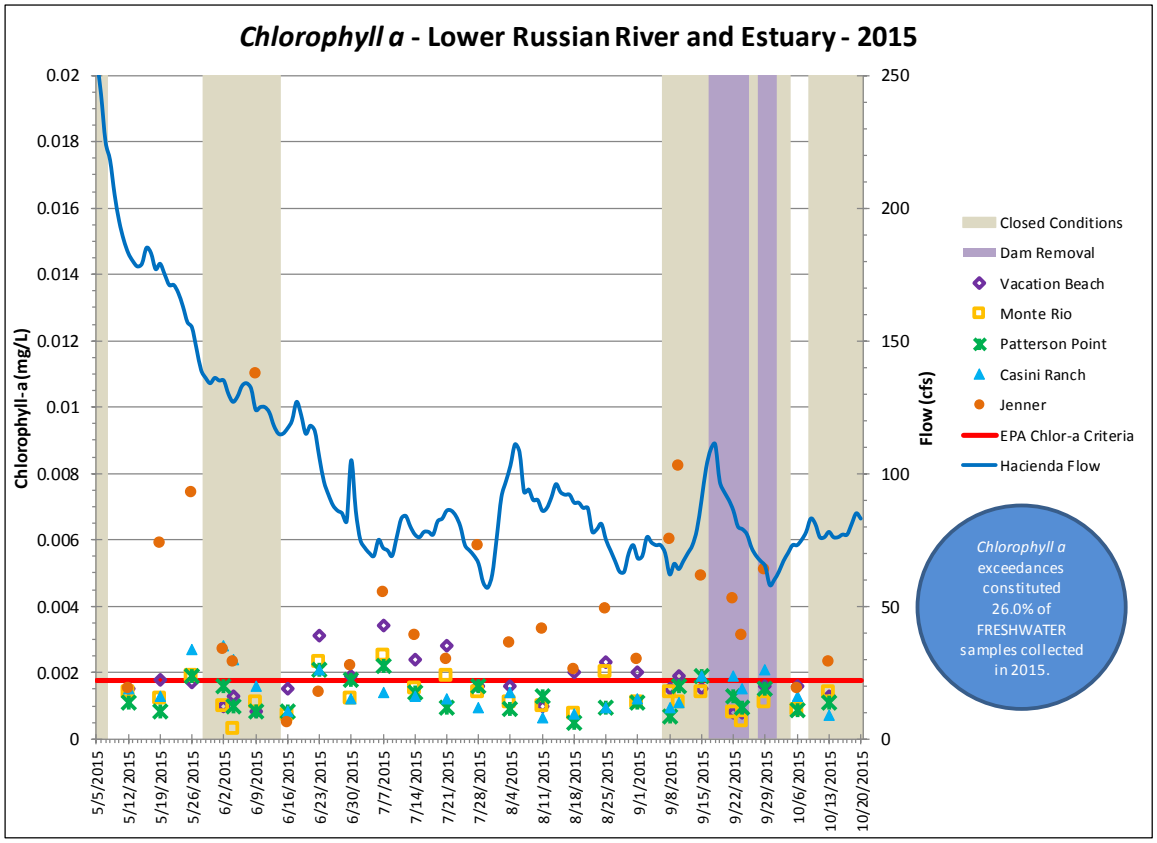


**Figure 3-10. Chlorophyll a results for the Russian River from Vacation Beach to Jenner in 2015.**

# 4.0 Additional Monitoring

## 4.1 Permanent Datasondes

In coordination with the USGS the Water Agency maintains three, multi-parameter water quality sondes on the Russian River located at Russian River near Hopland, Russian River at Diggers Bend near Healdsburg, and Russian River near Guerneville (aka Hacienda Bridge). These three sondes are referred to as "permanent" because the Water Agency maintains them as part of its early warning detection system for use year-round (Figure 4.1). The sondes take real time readings of water pH, temperature, dissolved oxygen content (DO), specific conductivity, turbidity, and depth, every 15 minutes.

In addition to the permanent sondes, the Water Agency, in cooperation with the USGS, installed three seasonal sondes with real-time telemetry at the USGS river gage station at Russian River near Cloverdale (north of Cloverdale at Comminsky Station Road), at the gage station at Russian River at Jimtown (Alexander Valley Road Bridge), and at Johnson's Beach in Guerneville (Figure 4.1). The two seasonal sondes at Cloverdale and Jimtown are included by the USGS on its "Real-time Data for California" website.

The data collected by the sondes described above are evaluated in Section 4.2 in response to the SWRCB request to evaluate whether and to what extent the reduced flows authorized by the Order caused any impacts to water quality or availability of aquatic habitat for salmonids. In addition, the 2015 data will help provide information to evaluate potential changes to water quality and availability of habitat for aquatic resources resulting from the proposed permanent changes to D1610 minimum instream flows that are mandated by the Biological Opinion.

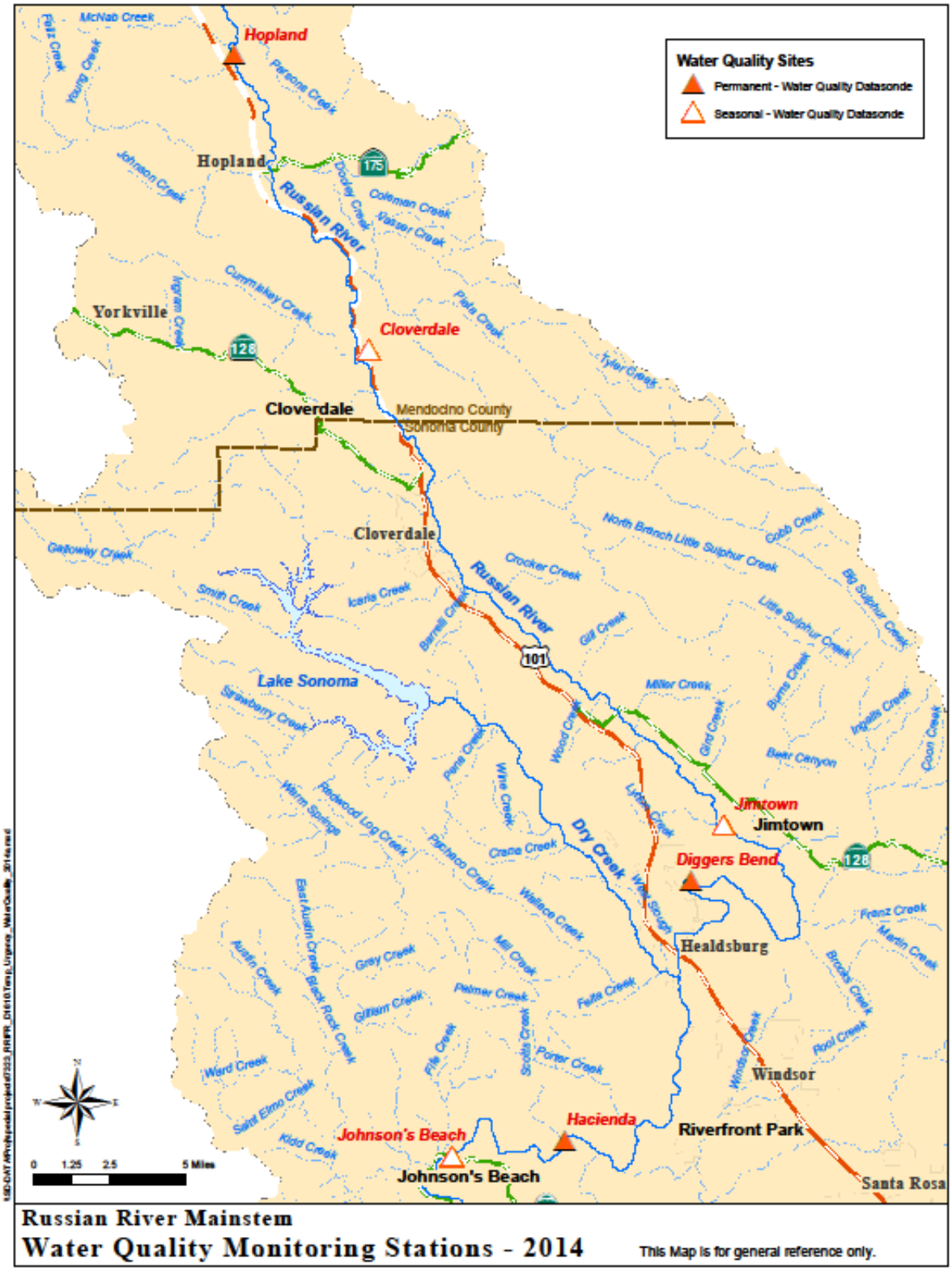


**Figure 4-6. 2015 Russian River mainstem water quality monitoring stations sampled by the Sonoma County Water Agency.**

## 4.2 Aquatic Habitat for Salmonids

### 4.2.1 Introduction

In Term 14 of the Temporary Urgency Change Order (Order) the State Water Resource Control Board (SWRCB) tasked the Water Agency with evaluating impacts associated with reductions in minimum instream flows authorized by the Order to water quality and the availability of aquatic habitat for Russian River salmonids. This section of the report summarizes temperature and dissolved oxygen conditions in the Russian River during the order and relates these conditions to fisheries monitoring data collected by the Water Agency.

### 4.2.2 Russian River Salmonid Life Stages

Salmonids in the Russian River can be affected by flow, temperature, and dissolved oxygen (DO) changes at multiple life stages. The Russian River supports three species of salmonids, coho salmon, steelhead, and Chinook salmon. These species follow a similar life history patterns. 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 and deposit eggs which remain in the redd for 8-10 weeks before hatching. After hatching, the larval fish remain in the gravel for another 4-10 weeks before emerging. After emerging from the gravel these young salmonids are identified first as fry and then later as parr once they have undergone some freshwater growth. Parr rear for a few months (Chinook) to 2 years (steelhead) in freshwater before undergoing a physiological change identified as smoltification. At this stage, fish are identified as smolts, 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 three species of Russian River salmonids spend a period of time in the Russian River, they must cope with the freshwater conditions they encounter including flow, temperature, and DO. While all three species follow a similar life history, each species tends to spawn and rear in different locations and are present in the Russian River watershed at slightly different times. These subtle but important differences may expose each species to a different set of freshwater conditions.

#### *Coho Timing and Distribution*

Wild coho have become scarce in the Russian River and monitoring data relies mainly on fish released from the hatchery as part of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP). Data collected on the Water Agency's Mirabel inflatable dam video camera system in 2011 through 2013 indicate that the adult coho salmon run may start in late October and continue through at least January. In 2013 97% of coho were observed after November 20 (Martini-Lamb and Manning 2014). 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, the temperature and DO data relating to the adult life and smolt stages will be analyzed for this report as these are the life stages likely to be present in the Russian River during the time period governed by the Order (May 1, 2015 through October 28, 2015).

### *Steelhead Timing and Distribution*

Based on video monitoring at the Water Agency's Mirabel inflatable dam and returns to the Warm Springs Hatchery, adult steelhead return to the Russian River later than Chinook. Deflation of the inflatable dam and removal of the underwater video camera system preclude a precise measure of adult return timing or numbers. However, continuous video monitoring at the inflatable dam during late fall through spring in 2006-2007, timing of returns to the hatchery, and data gathered from steelhead angler report cards (SCWA unpublished data, Jackson 2007) suggests that 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 mainstem of the Russian River were distributed in the highest concentrations between Hopland and Cloverdale (Canyon Reach). Steelhead were also found in relatively high numbers (when compared to habitats downstream of Cloverdale) in the section of river between the Coyote Valley Dam and Hopland. The Canyon Reach is the highest gradient section of the mainstem Russian River and contains fast water habitats that include riffles and cascades (Cook 2003). Both the Canyon and Ukiah reaches generally have cooler water temperatures when compared to other mainstem reaches due to releases made from Lake Mendocino.

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, parr (rearing) and smolt life stages are present in the mainstem during the time period covered by the Order. Therefore only the temperature and DO data relating to the juvenile rearing and smolt life stages will be analyzed for this report.

### *Chinook Timing and Distribution*

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

### 4.2.3 Methods

The Water Agency uses underwater video, dual frequency identification sonar (DIDSON), downstream migrant traps, and water quality data collected in the Russian River and Dry Creek to summarize Russian

River water quality conditions when salmonids where present. The Water Agency operates underwater video cameras and DIDSON to enumerate adult salmonids, and downstream migrant traps to enumerate salmonid smolts. USGS stream gages were used to provide water quality data in the mainstem Russian River.

Typically the Water Agency operates an underwater video camera system at Mirabel to estimate the number of adult Chinook that return to the Russian River. However, a large construction project to improve fish passage at Mirabel Dam in 2015 precluded us from operating an underwater camera system at this site. Instead the Water Agency relied on adult counts from a DIDSON paired with an underwater video camera at Dry Creek (a tributary to the Russian River near Healdsburg). The DIDSON collects sonar images of fish as they pass the sample site. This allows us to count fish across a larger area of the stream channel than can be captured by video images and collect images of fish during periods of high turbidity when an underwater camera would be ineffective. The resolution of DIDSON often precludes the accurate identification of species. When conditions permitted we operated an underwater video camera at this site in combination with the DIDSON in order to determine the species composition of fish passing the Dry Creek site. This allowed us to prorate DIDSON counts at Dry Creek. In addition to operating a DIDSON at Dry Creek the Water Agency experimented with an underwater video camera in a fish ladder at Memorial Beach near Healdsburg. This site is located on the mainstem Russian River upstream of Dry Creek. Data from these monitoring sites were used to determine when adult salmonids were present in the Russian River during 2015.

Physical habitat conditions (flow, water temperature, and DO) were collected at multiple sites in the Russian River. USGS stream gages located on the Russian River at Hacienda and Hopland provided flow, water temperature, and DO data. These water quality conditions were compared to findings in the literature and were used to construct temperature and DO criteria for Russian River salmonids (Table 4-1 through Table 4-3).

Adult salmonid counts are used to relate water quality conditions to the timing and magnitude of the adult salmonid run. We compared adult counts from counting stations with water quality information only where fish would either pass through a water quality station before being detected at a particular counting station. For instance since Hacienda is downstream of both Dry Creek and Healdsburg all adult salmonids observed at these sites must first pass through the Hacienda water quality station. Therefore displaying Dry Creek and Healdsburg adult salmonid counts with Hacienda water quality conditions allows us to relate the timing and magnitude of the adult salmonid run to water quality conditions they likely experienced at Hacienda. Because the majority of steelhead rearing habitat in the mainstem Russian River occurs upstream of Hopland this report presents the water quality data from the USGS Hopland gaging station when discussing juvenile steelhead. Smolts moving downstream out of Dry Creek first pass our Dry Creek downstream migrant trap then pass the Hacienda USGS stream gage before entering the ocean. Therefore we have paired Dry Creek salmonid smolt data with Hacienda water quality data to describe the conditions these fish likely experienced in the mainstem Russian River.

**Table 4-1. Adult salmonid temperature (°C) thresholds used for describing water quality conditions during the term of the May 2015 temporary urgency change order.**

| Description | Chinook | Coho | Steelhead |
|---|---|---|---|
| Optimal upper limit | 15.6 | 11.1 | 11.1 |
| suitable upper limit | 17.8 | 15.0 | 15.0 |
| stressful upper limit | 19.4 | 21.1 | 21.1 |
| acute stress upper limit | 23.3 | 23.8 | 23.8 |
| lethal | 23.9 | 23.9 | 23.9 |

**Table 4-2. Juvenile salmonid (parr and smolt) temperature (°C) thresholds used for describing water quality conditions during the term of the May 2015 temporary urgency change order.**

| Description | Chinook | Coho | Steelhead |
|---|---|---|---|
| Optimal upper limit | 16.9 | 13.9 | 16.9 |
| suitable upper limit | 17.8 | 16.9 | 18.9 |
| stressful upper limit | 20.0 | 18.9 | 21.9 |
| acute stress upper limit | 23.8 | 23.8 | 23.8 |
| lethal | 23.9 | 23.9 | 23.9 |

**Table 4-3. Dissolved oxygen (mg/L) thresholds used for describing water quality conditions during the term of the May 2015 temporary urgency change order.**

| Description | Dissolved Oxygen (mg/l) |
|---|---|
| Optimal | >12 |
| suitable | 8.0-11.9 |
| stressful | 5.0-7.9 |
| acute stress | 3.1-4.9 |
| lethal | <3.0 |

### 4.2.4 Results

#### *Flow*

From May 1, 2015 to October 28, 2015 flow in the Russian River at Hacienda ranged from approximately 305 cfs in May to 60 cfs in July. During the period of the Order, the Russian River was influenced by tributary in-flow until June, and was generally controlled by reservoir releases from July through the end of the Order.

During the period of the Order, 109 adult salmonids were observed at Dry Creek and Healdsburg. Based on video images from 2015 and run timing information from Mirabel in past years it is likely that these fish were mainly Chinook salmon. The first of these salmonids, a steelhead, was observed at the counting stations on September 22, 2015 (Figure 4-2). Flow at Hacienda during the time these fish were observed ranged from 58 cfs to 144 cfs. Although adult salmonids were observed migrating past the

adult counting stations at Dry Creek and the mainstem Russian River, a barrier beach at the river mouth limited fish entry for a portion of the season. The barrier beach formed at the mouth of the Russian River, precluding fish entry, three times between early September and mid-October. On October 28, 2015, 14 days after the River mouth breached 29 Chinook were observed at the counting station (Figure 4-2). The flow at Hacienda ranged from 70 to 83 cfs for the period of time from when the river mouth breached to when these 29 fish were observed at the counting stations.

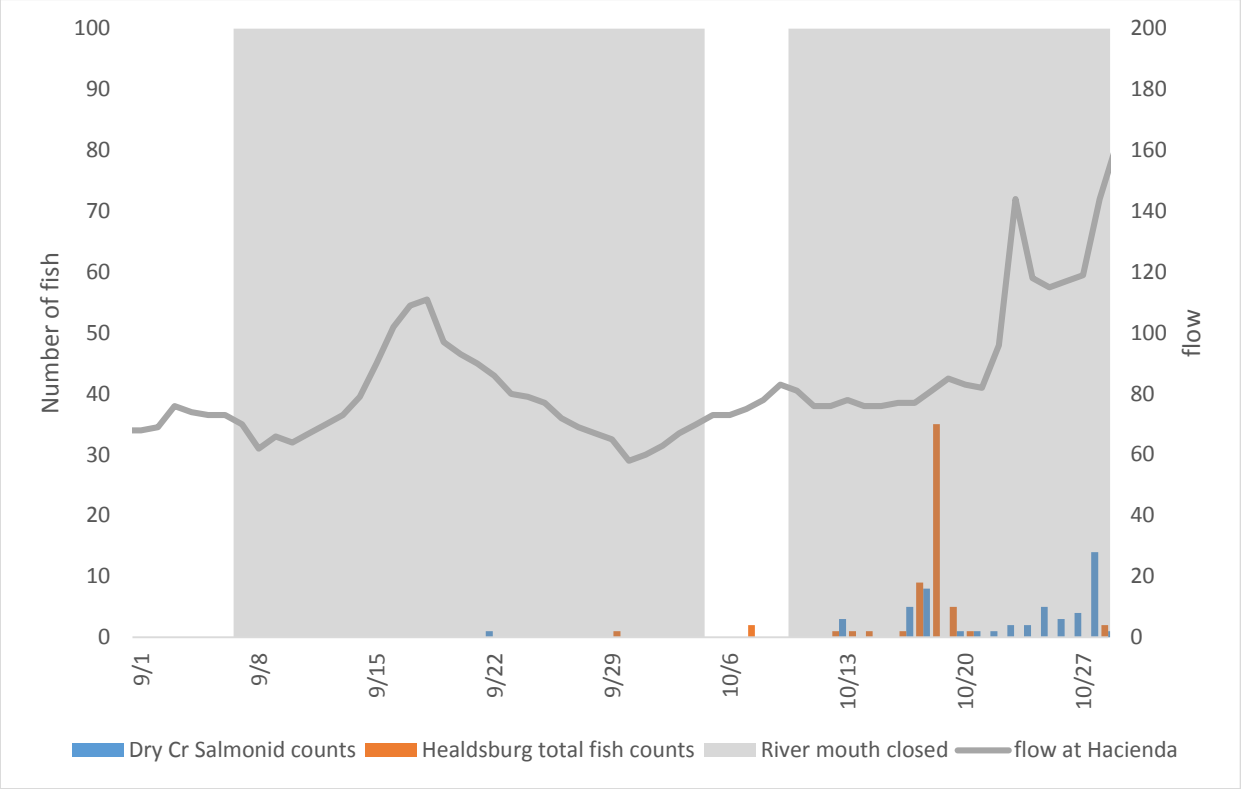


**Figure 4-2. Flow in the Russian River at the USGS Hacienda stream gage for the period of that the Order overlapped with the adult salmonid migration period (September 1 to October 28, 2015). Times when the mouth of the Russian River was closed due to the formation of a sand bar are shown as shaded areas. Also shown are the total salmonid counts from video collected at Healdsburg and DIDSON collected on Dry Creek.**

## *Temperature*

### Adult Salmonid Migration

At Hacienda gage, average daily water temperature ranged from 15.3 °C to 24.4 °C during the period of the Order. This temperature range is considered optimal to acutely stressful for adult salmonids based on our criteria (Table 4-1). However, on days when adult salmonids were observed at the counting station the maximum and minimum daily water temperature were declining and generally fell within the optimal to suitable range (Figure 4-3). During the Order we observed 61 salmonids that we were unable to identify to species, 45 Chinook, 0 coho, and 3 steelhead. It is important to note that the river mouth was closed for much of September and October and that the bulk of the adult salmonid run occurred after the end of the Order when water temperatures were suitable to optimal. Most of the unidentified adult salmonids observed on the Dry Creek DIDSON during the Order were likely Chinook based on run timing information from previous years of monitoring at Mirabel. After the Order expired many more adult salmonids were observed on the Dry Creek DIDSON. From October 29, 2015, to the end of January

2016, a total of 8,706 adult salmonids had been observed on the Dry Creek DIDSON alone. Using the weekly species ratios from Mirabel our preliminary estimate is that 3,253 of the 8,706 unidentified salmonids are Chinook and the reminder a mostly steelhead (Table 4-4). In addition to the 3,253 Chinook we estimate to have returned to Dry Creek 384 Chinook were observed on the Healdsburg fish ladder during this time. Additional adult salmonids have returned to the Russian River since January 31, 2016 and are not included in these preliminary counts.

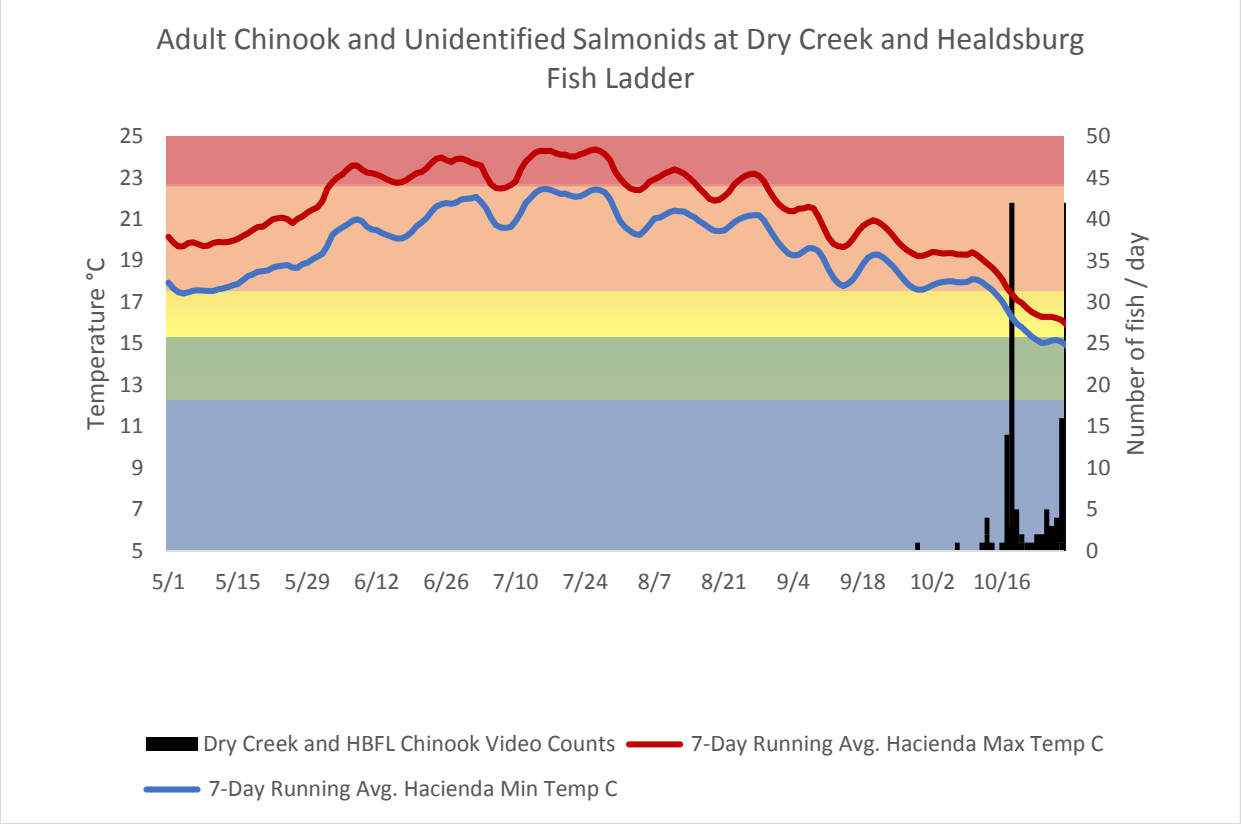


**Figure 4-3. The 7-day running average of the minimum and maximum water temperatures collected at Hacienda shown with the Chinook counts from the mainstem Russian River and Dry Creek. Also show are optimal, suitable, stressful, acutely stressful, and lethal water temperature thresholds for adult Chinook based on Table 4-1.**

**Table 4-4. The number of days of the adult salmonid run that occurred in each time period, the percentage of those days the river mouth was closed and blocked adult salmonids from entering the Russian River, the number of adult salmonids that could not be identified to species, the estimated number of unidentified salmonids that are adult Chinook, and the number of Chinook observed on the underwater video cameras. The time periods are separated into the period of the Order that overlaps with the adult salmonid run (September 1, 2015 through October 28, 2015) and the period of time from when the order expired (October 29, 2015) to January 31, 2016. Additional adult salmonids were observed after January 31, 2016, and are not included in this table.**

| Time period | # of days | % of time river mouth closed | Unidentified salmonids | Estimated Chinook | Observed Chinook |
|---|---|---|---|---|---|
| **During order** | 58 | 81 % | 61 | 47 | 45 |
| **After order expired** | 95 | 33 % | 8,706 | 3,253 | 384 |

## Salmonid Smolt Outmigration and Rearing

As salmonid smolts immigrate to the ocean they experience river temperatures that are often warmer than their natal tributary or mainstem river habitat. We operated a downstream migrant trap at Dry Creek from March 18, 2015, until July 30, 2015. During the Order we captured 2,834 Chinook salmon smolts, 109 coho salmon smolts and 2,033 wild and hatchery steelhead smolts at this trapping site. We relate these catch data to temperature collected at Hacienda. Hacienda is located approximately 20 km downstream of the trap site and represents temperatures experienced by smolts as they emigrate through the lower river. It is worth noting that temperatures at the trap site are significantly cooler than temperatures at Hacienda.

## Chinook

The average daily water temperature at Hacienda ranged from 17.1 °C to 25.0 °C during the time we captured Chinook smolts. The maximum and minimum daily water temperature were generally stressful or acutely stressful for fish emigrating through the lower river in June and July (Figure 4-4).

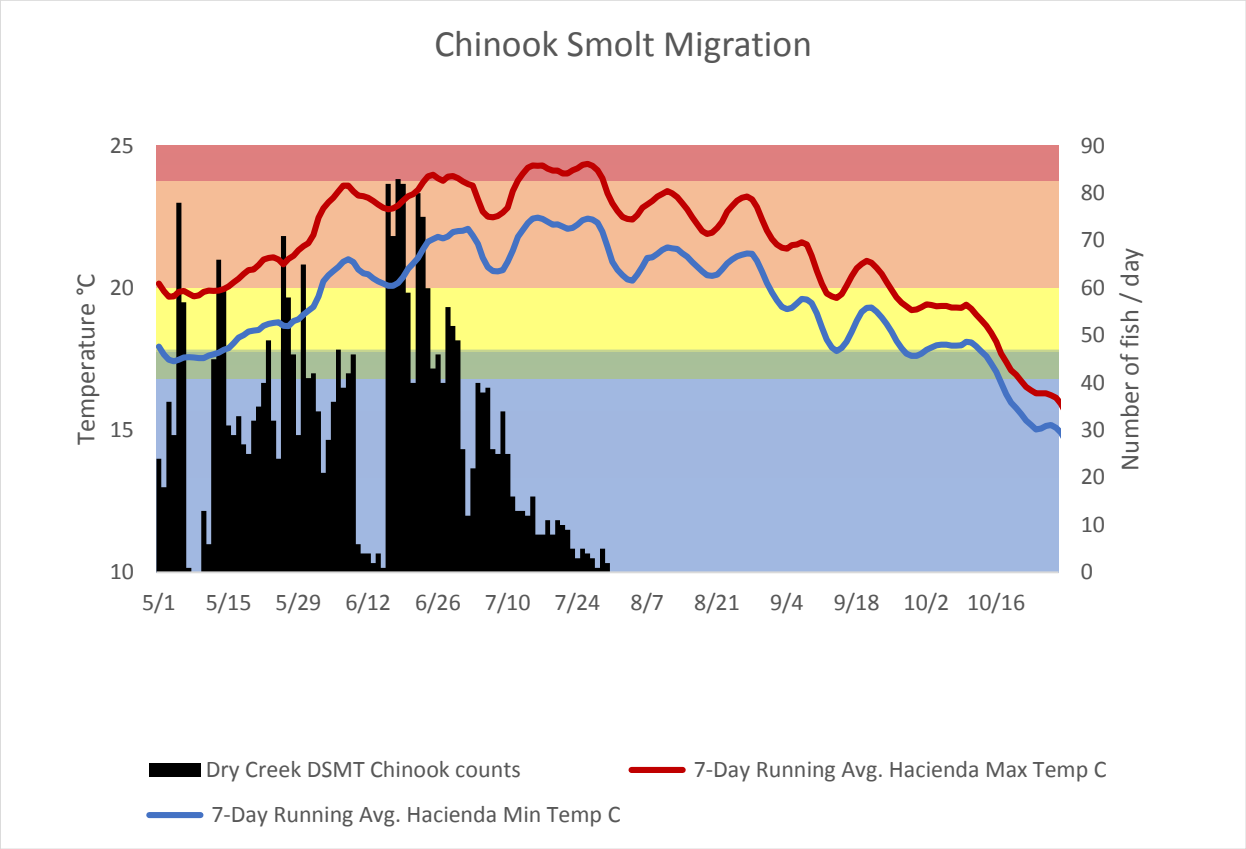


**Figure 4-4. The 7-day running average of the minimum and maximum water temperatures collected at Hacienda shown with the Chinook smolt catch from Dry Creek. Also show are the optimal, suitable, stressful, acutely stressful and lethal water temperature thresholds for Chinook rearing based on Table 4-2.**

## Coho

Coho were captured at the downstream migrant trap from the day the trap was installed until July 28, however only two individuals were captured after June 8, 2015. The water temperature at Hacienda ranged from 17.1 °C to 24.3 °C during the time we captured coho smolts. For coho smolts the observed water temperatures were in the suitable through lethal range. For the days that we captured coho smolts the maximum and minimum daily water temperature were generally in the stressful to acutely stressful range (Figure 4-5).

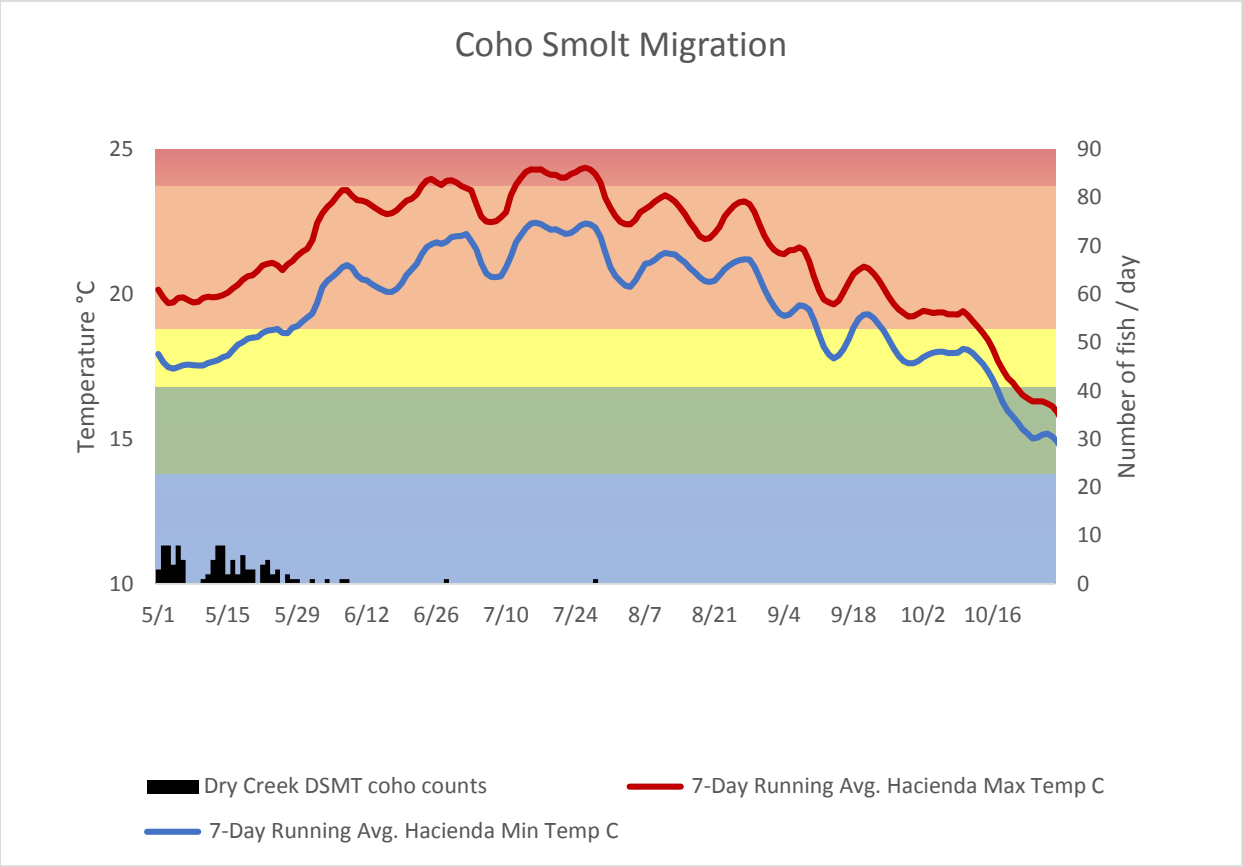


**Figure 4-5. The 7-day running average of the minimum and maximum water temperatures collected at Hacienda shown with the coho smolt catch from Dry Creek. Also show are the optimal, suitable, stressful, acutely stressful and lethal water temperature thresholds for coho smolts based on Table 4-2.**

## Steelhead

Steelhead were captured at the downstream migrant trap from the day the trap was installed on March 18, 2015, until July 29, 2015. The water temperature at Hacienda ranged from 17.1 °C to 25 °C during the time we captured steelhead smolts. For steelhead smolts the observed water temperatures were in the optimal to lethal range. For days that fish were captured the minimum and maximum daily water temperature was generally suitable to acutely stressful (Figure 4-6).

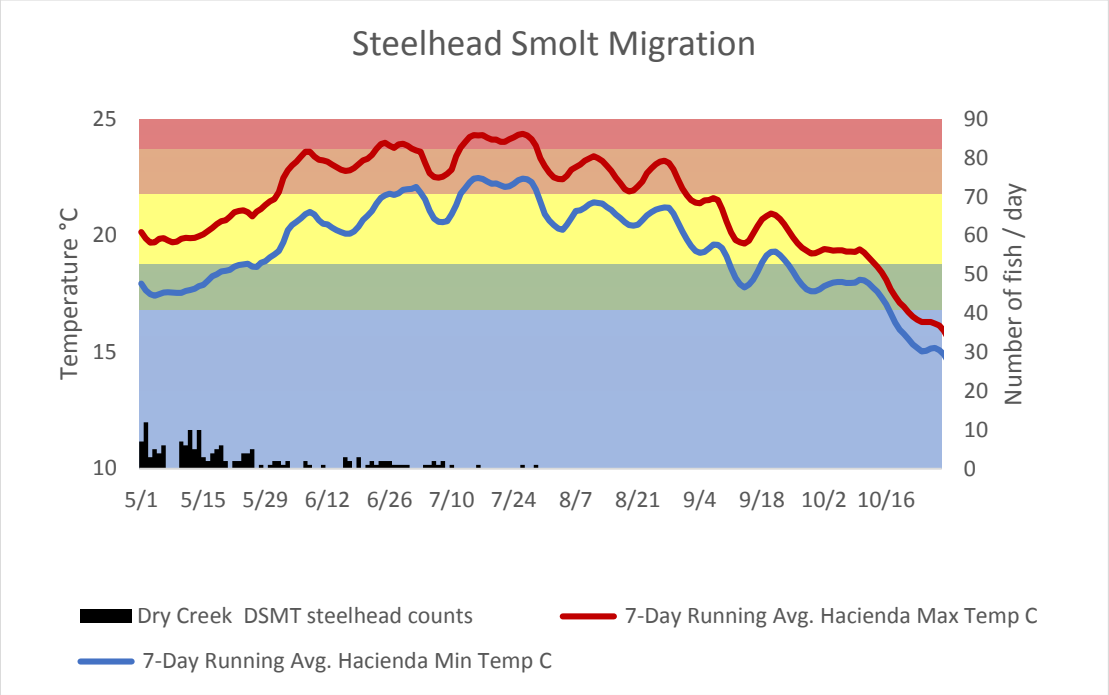


**Figure 4-6. The 7-day running average of the minimum and maximum water temperatures collected at Hacienda shown with the steelhead smolt catch from Dry Creek. Also show are the optimal, suitable, stressful, acutely stressful and lethal water temperature thresholds for steelhead smolts based on Table 4-2.**

Steelhead parr rear year round in the upper Russian River. During the Order water temperature at the USGS stream gage at Hopland ranged from a low of 13.7 °C to a high of 22 °C. For steelhead parr the water temperatures fell in the optimal to stressful range (Figure 4-7).

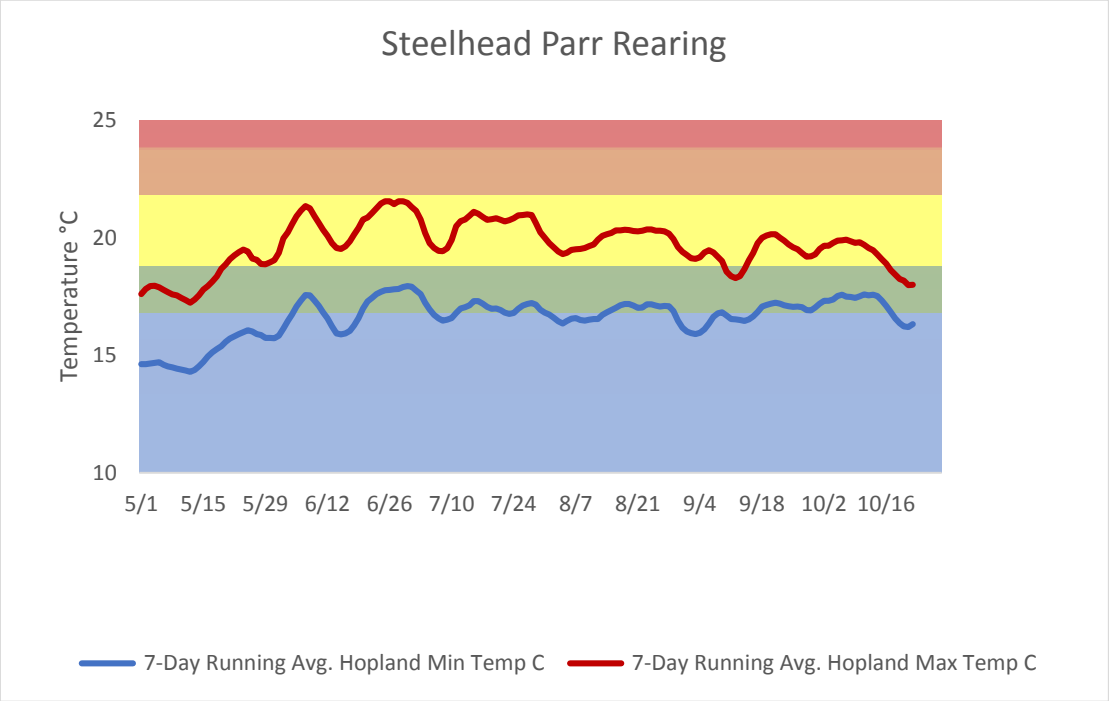


**Figure 4-7. The 7-day running average of the minimum and maximum water temperatures collected at Hopland. The optimal, suitable, stressful, acutely stressful and lethal water temperature thresholds for steelhead parr based on Table 4-2 are also shown.**

### *Dissolved Oxygen*

Dissolved oxygen was generally favorable for salmonids in the Russian River throughout the Order at both Hacienda and Hopland. At Hacienda, the average daily dissolved oxygen ranged from 7.1 mg/L to 11.2 mg/L. At Hopland dissolved oxygen ranged from 7.5 mg/L to 11 mg/L. According to our criteria dissolved oxygen levels in this range would generally be considered suitable for salmonids (Figure 4-8 and Figure 4-9).

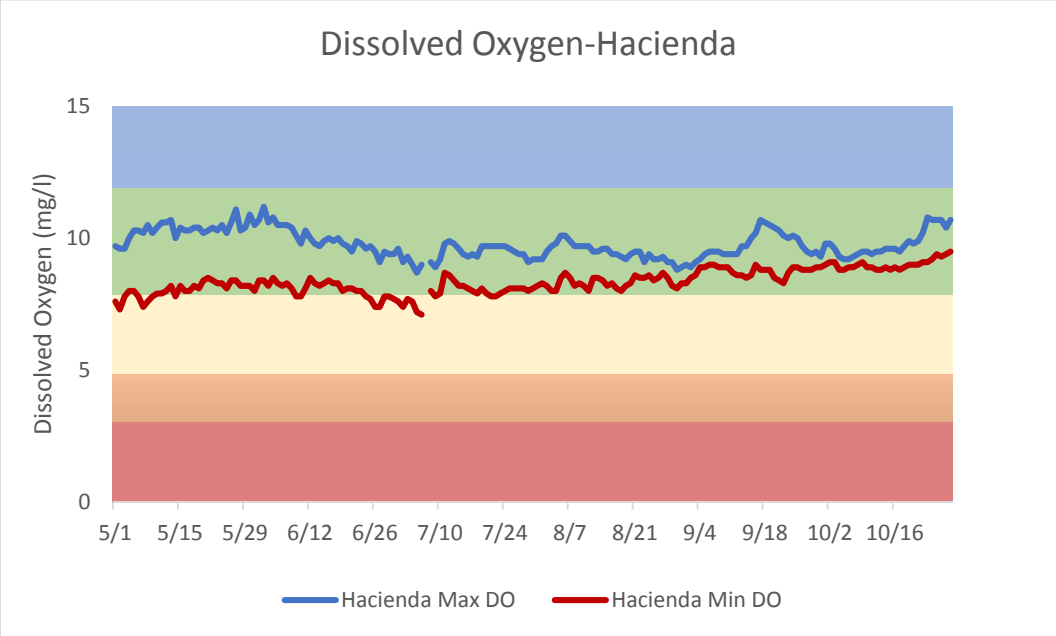


**Figure 4-8. The 7-day running average of the minimum and maximum dissolved oxygen collected at Hacienda. Also shown are the optimal, suitable, stressful, acutely stressful, lethal dissolved oxygen zones based on our criteria. See Table 4-3 for a description of water quality zones.**

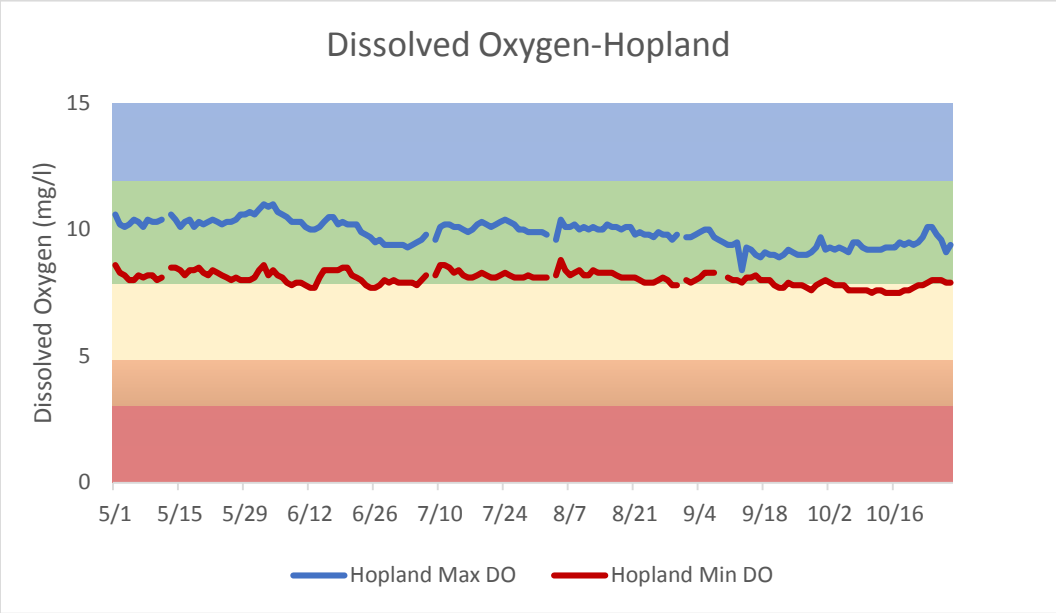


**Figure 4-9. The 7-day running average of the minimum and maximum dissolved oxygen collected at Hopland. Also shown are the optimal, suitable, stressful, acutely stressful, lethal dissolved oxygen zones based on our criteria. See Table 4-3 for a description of water quality zones.**

### 4.2.5 Summary

Due to a multi-year drought and the need to conserve an unusually low amount of water in Lake Mendocino, instream flow was lower in the Russian River than in normal water years. Despite low flows and a barrier beach that formed at the mouth of the Russian River in the fall, adult salmonids were observed at our counting stations during the Order, but in low numbers. After the Order expired, reservoir releases were increased to comply with flows prescribed by Decision 1610 and the Water Agency's water rights permits. However an increase in the number of salmonids was not immediately seen. This is likely due to the fact that the river mouth remained closed for much of the time between the end of the Order on October 28, 2015, and when the river mouth breached on December 12, 2015. From September 1 through December 12, 2015, the river mouth was closed for 76% of the days. During this time only 563 adult salmonids were observed at the counting stations. It was not until after December 12, 2015, when the river mouth remained opened for a long period of time that adult salmonids were seen in large numbers. From December 12, 2015, to the end of January 2016, a total of 8,232 adult salmonids were observed at Dry Creek. Using the species ratio from Mirabel our preliminary estimate is that 2,855 of these fish are Chinook and the remainder are mainly steelhead. Additional adult salmonids have returned to the Russian River since January 31, 2016 and are not included in this count. While temperature at Hacienda was at times stressful for adult salmonids during the Order most of the adult salmonid run occurred after the Order expired when water temperatures were more favorable. It is important to note that water temperatures in the lower Russian River are strongly influenced by atmospheric temperatures and less so by reservoir releases.

Water temperature in the upper river near Hopland was favorable for steelhead rearing through the entire order. This is because the cold water pool (the lower, colder section of the thermally stratified lake) in Lake Mendocino was preserved throughout the summer. During this multi-year drought the preservation of the cold water pool in Lake Mendocino was accomplished by lowering release rates from Coyote Valley Dam. Dissolved oxygen was generally suitable for salmonids at Hacienda and at the Hopland USGS stream gages.

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