Water Quality Monitoring Plan
For the Russian River Estuary Management Project

Russian River Estuary at Goat Rock State Beach

Prepared by

Sonoma County Water Agency

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1.0 INTRODUCTION

The purpose of the Sonoma County Water Agency's (Water Agency) Russian River Estuary Management Project is to enhance fish habitat and provide flood protection. The proposed project is located at the Russian River Estuary within Goat Rock State Beach near the town of Jenner, Sonoma County. The proposed project has three main components: 1) form and maintain an outlet channel at the river mouth and provide freshwater lagoon habitat for fish from May 15 to October 15; 2) breach the sandbar at the river when necessary to minimize flooding; and 3) conduct a geotechnical and groundwater evaluation at the existing Russian River mouth jetty.

2.0 BACKGROUND

Under the federal Endangered Species Act (ESA), steelhead, coho salmon and Chinook salmon in the Russian River watershed are listed as threatened or endangered species. Coho salmon is also listed as endangered under the California Endangered Species Act (CESA). In September 2008, National Marine Fisheries Service (NMFS) issued the *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation District in the Russian River Watershed* (Russian River Biological Opinion, NMFS 2008), a culmination of more than a decade of consultation under Section 7 of the ESA among the Water Agency, U.S. Army Corps of Engineers (Corps), and NMFS regarding the impacts of the Water Agency's and Corps' water supply and flood control operations in the Russian River watershed on the survival of these listed fish species. The California Department of Fish and Wildlife (CDFW) issued a consistency determination on November 9, 2009, finding that the Russian River Biological Opinion was consistent with the requirements of the CESA and adopting the measures identified in the Biological Opinion.

Studies conducted during the consultation period that ultimately led to this Biological Opinion concluded that artificially elevated inflows to the Estuary and the historical practice of breaching the sandbar that builds up and frequently closes the mouth of the Russian River during the summer and fall have adverse effects on estuarine rearing habitat for juvenile salmonids, particularly steelhead, and that current flood control operations in the Russian River Estuary may adversely affect the listed species and adversely modify their critical habitat. NMFS also concluded in the Biological Opinion that it might be better for juvenile steelhead and salmon if the sandbar is managed during these times, to allow for the formation of a seasonal freshwater lagoon with a low velocity outlet channel in the Russian River Estuary.

The Water Agency prepared an Environmental Impact Report (EIR) to disclose potential impacts and identify mitigation measures associated with changing the operation of the Estuary to a seasonal freshwater lagoon to satisfy California Environmental Quality Act (CEQA) requirements. Litigation against the project was initiated and a stipulated judgment (Stipulated Judgment) was rendered that included sediment chemistry and benthic invertebrate sampling in the Estuary.

3.0 OBJECTIVES

The objectives of this water quality sampling and analysis plan are to: Integrate existing data being collected under the Russian River Biological Opinion, Temporary Urgency Change (TUC) orders issued by the State Water Resources Control Board (SWRCB), and the Stipulated Judgment pertaining to the Russian River Estuary Management Project EIR, as well as meeting conditions of permits issued by the California Coastal Commission (Coastal Commission) and North Coast Regional Water Quality Control Board (NCRWQCB). Another objective of this sampling and analysis plan is to provide a more complete basis for analyzing spatial and temporal water quality trends that may be due to changes in Estuary management. The data collected under this plan will also be utilized in the analysis of potential changes to water quality and aquatic habitat availability that may be due to changes in minimum instream flows in the Russian River, as required in the TUC orders.

4.0 PURPOSE AND NEED

One of the conditions in the Coastal Commission Coastal Development Permit (CDP) is to prepare a Water Quality Monitoring Plan (Monitoring Plan) for the Russian River Estuary. The objectives of the Monitoring Plan are to provide information to evaluate potential changes to water quality and availability of habitat for aquatic resources resulting from the proposed changes to management of the Estuary as a seasonal freshwater lagoon from May 15 to October 15 (lagoon management period) with a low-velocity outlet channel as required by the Biological Opinion. Furthermore, the Monitoring Plan will build upon previous water quality studies that have been conducted in the Estuary as required by the Russian River Biological Opinion, TUC Petitions, and the Stipulated Judgment.

Requirements of the TUC Orders from the SWRCB include monitoring and reporting to evaluate potential changes to water quality and availability of habitat for aquatic resources in the freshwater and estuary portions of the Russian River resulting from the proposed changes to minimum instream flows that are also required by the Biological Opinion. As part of that effort, the Water Agency will conduct nutrient and cyanobacteria-related monitoring and sampling in coordination with the NCRWQCB and as detailed in Appendix G.

In addition, the NCRWQCB issued Clean Water Act (CWA) section 401 water quality certification (Certification) permit number WDID 1B10122WNSO for the Estuary Project on May 14, 2014. The conditions of the permit require a monitoring and reporting plan as well as additional focused water quality sampling related to contact recreation in the Russian River Estuary and maximum backwater area between Jenner and Vacation Beach.

Monitoring will generally be conducted during the spring, summer, and fall to track potential changes to water quality and the availability of aquatic habitat that may be associated with reduced flows in the mainstem Russian River and freshwater lagoon conditions in the Estuary. This will include an assessment of whether a low velocity lagoon outlet channel is successful in contributing to sustained elevated water levels and an increase in the availability of suitable aquatic habitat for juvenile steelhead rearing and potential impacts to contact recreation opportunities.

Estuary monitoring will include continuous hourly monitoring of temperature, dissolved oxygen, pH, and specific conductance at several stations stretching from Monte Rio to Jenner. In addition, the Estuary will be monitored hourly to observe salinity concentration and stratification in the water column; as well as up and downstream migration of the salt water layer associated with tidal exchange, periods of lower instream flows, and periods of barrier beach closure, partial or full lagoon formation, lagoon outlet channel implementation, and sandbar breaching. Vertical and cross-sectional profiles for temperature, dissolved oxygen, pH, specific conductance, and salinity will also be collected at mainstem monitoring stations and the adjacent shallow zones to characterize lagoon backwater areas when the river mouth is closed and a lagoon outlet channel is in place and functioning.

Water samples (grab) will be collected by Water Agency staff and analyzed for several constituents by Alpha Labs in Ukiah and the Sonoma County Department of Health Services (DHS) Public Health Division Lab in Santa Rosa. Sediment and benthic invertebrate samples will also be collected by Water Agency staff and analyzed for sediment chemistry by ALS Environmental Labs in Kelso, Washington and benthic invertebrate composition (community indices) by the Wetland Ecosystem Team School of Aquatic and Fishery Sciences at the University of Washington.

Regarding water quality monitoring to support the Russian River Biological Opinion, Stipulated Judgment, CDP, and Water Quality Certification for Estuary management, the following questions help to explain the objective of the monitoring plan:

- What are the background levels of nutrients and pathogens in the Estuary under open, tidally-influenced conditions? How do these background levels respond to changes in managing the Estuary as a seasonal freshwater lagoon, considering other contributing factors?
- Do water temperature, dissolved oxygen, and salinity respond to changes managing the Estuary as a seasonal freshwater lagoon?
- Are there secondary biological effects related to changes in water quality from managing the Estuary as a seasonal freshwater lagoon (e.g. stress to fish, plants, invertebrates) and if so, what are they?
- Are there affects to public health/recreation?

In addition, the following questions help to explain the objective of the water quality monitoring requirement in the TUC Orders:

- Are the reduced minimum instream flows authorized by the TUC Order impacting water quality in the Russian River from Ukiah to Jenner, including water quality impacts affecting recreation or the availability of aquatic habitat for salmonids?
- Do biostimulatory conditions exist within the Russian River?

5.0 SAMPLING AND ANALYSIS PLAN

5.1 Russian River Estuary Study

5.1.1 Datasonde Deployment

Water quality monitoring will occur at eight (8) stations in the lower, middle, and upper reaches of the Russian River Estuary, including tributaries and areas upstream from the Estuary that become inundated during lagoon conditions (maximum backwater area). Six stations will be located in the mainstem between Jenner and Monte Rio and two stations will be located in Willow and Austin creeks, in areas that are subject to tidal and/or lagoon inundation. Refer to Figure 1 for a map of Estuary water quality station locations. Locations of water quality monitoring stations within a given reach have changed over the years as more information and a better understanding of the Estuary has been gained and has been done in coordination with resource and regulatory agencies including NMFS, CDFW, SWRCB, DHS, and NCRWQCB. Although it was anticipated that the water quality stations monitored during the 2013 season would continue to be monitored for the duration of the CDP, the identification of cyanobacteria and presence of cyanotoxins in the mainstem water column during the 2015 season by the NCRWQCB and DHS has resulted in the NCRWQCB coordinating with the Water Agency and inquiring if there was an opportunity for the Water Agency to assist the NCRWQCB and DHS in gaining a better understanding of cyanobacteria in the mainstem Russian River. In order to accomplish this, the Water Agency requested that they be allowed to modify this Monitoring Plan to shift additional focus to cyanobacteria to support the NCRWQCB's request. In the event that future coordination with resource and regulatory agencies continues to identify alternative monitoring locations and constituents in subsequent years, the Water Agency will notify the Coastal Commission and NCRWQCB of the station location and constituent monitoring changes. The breadth and scale of the overall monitoring effort will essentially remain the same and provide the same degree of monitoring coverage.

Water Agency staff will use several Yellow Springs Incorporated (YSI) 6600 series multi-parameter datasondes (sondes) equipped with a YSI 6560 combination conductivity/temperature sensor, a YSI 6561 or YSI 6589Fr hydrogen ion (pH) sensor, and either a YSI 6562 dissolved oxygen sensor or YSI 6150 optical dissolved oxygen sensor to collect water quality parameters at all sites. Sondes will be programmed to record hourly measurements of water temperature (Celsius), dissolved oxygen (milligrams per liter, mg/L), dissolved oxygen (percent saturation, % Sat), specific conductance (microsiemens), salinity (parts per thousand, ppt), and hydrogen ion (pH). Monitoring sites will be accessed by boat or by foot.

All sondes will be recalibrated following the manufacturer's 6-Series User Manual and data downloaded every two weeks by Water Agency staff. The YSI temperature sensor utilizes a thermistor that does not require calibration or maintenance. However, thermistor accuracy will be checked against a National Institute of Standards and Technology (NIST) thermometer during initial deployment, and periodically throughout the monitoring season, to ensure the sensor is functioning properly. The YSI 6560 conductivity sensor will be calibrated using a 10,000 microsiemen (µS/cm) standard. The YSI 6561 pH sensor will be calibrated to two points using buffer solutions of pH 7 and 10. The YSI 6562 dissolved oxygen sensor will be calibrated using the dissolved-oxygen-calibration chamber-in-air method where

the calibration chamber is set-up with water and allowed to reach 100-percent saturation prior to calibration. The YSI 6150 optical dissolved oxygen sensor will be calibrated using a one-point dissolved-oxygen-calibration chamber-in-air method where the calibration chamber is set-up with water and allowed to reach 100-percent saturation prior to calibration.

Field calibration and data collection will be conducted using the YSI 650 Multiparameter Display System (MDS) datalogger designed to work with the 6-Series datasondes. Data will be downloaded onto the YSI 650 MDS and then transferred to a PC, where data will undergo analysis by Water Agency staff.

Russian River Estuary Management Project Water Quality Monitoring sites (Figure 1) include:

- Russian River at Patty's Rock upstream from Penny Island (2 YSI 6600 Datasondes)
- Willow Creek at the 1st Bridge (1 YSI 6600 Datasonde)
- Russian River at Sheephouse Creek downstream of Sheephouse Creek (1 or 2 YSI 6600 Datasondes)
- Russian River at Freezeout Creek downstream of Freezeout Creek (2 YSI 6600 Datasondes)
- Russian River at Brown's Pool downstream of Austin Creek (2 YSI 6600 Datasondes)
- Austin Creek downstream of 1st Steel Bridge (1 YSI 6600 Datasonde)
- Russian River at Patterson Point in Villa Grande (2 YSI 6600 Datasondes)
- Russian River at Monte Rio downstream of Dutch Bill Creek (1 YSI 6600 Datasonde)

The three mainstem stations located in the lower, middle, and upper reaches of the Estuary between Jenner and Freezeout Creek will have a vertical array of two datasondes, with the exception of Sheephouse Creek which may only have one sonde in the mid-depth portion of the water column. Monitoring stations will be comprised of a concrete anchor attached to a steel cable suspended from the surface by a large buoy with sondes attached at varying depths along the cable. The rationale for choosing these sites was to locate the deepest pools at various points throughout the Estuary to obtain the fullest vertical profiles possible and to monitor hypoxic or anoxic events and temperature or salinity stratification. The two stations in the lower and middle Estuary that are predominantly saline will have sondes placed at the surface (approximately 1-meter depth) and mid-depth portions of the water column. The Freezeout Creek station in the upper Estuary, where water is predominantly fresh, will have sondes located at the mid-depth and bottom of the water column.

Three additional mainstem stations were established in the maximum backwater area in 2014, upstream from the Estuary in freshwater habitat that becomes inundated during sandbar closure events. The station at Brown's Pool will have a vertical array of two datasondes placed at the mid-depth and bottom of the pool or thalweg, which is the deepest part of the water column, to track the potential migration of saline water upstream of Freezeout Creek. The Villa Grande area has not previously been observed to become saline when monitored in 2011 and 2012 and the Patterson Point station was not observed to become saline when monitored in 2014 and 2105; however the Patterson Point station will have a vertical array of two datasondes placed at the mid-depth and bottom of the pool to track the potential for temperature stratification or the migration of saline water upstream of Brown's Pool. The Monte Rio station has not previously been observed to become saline and will have one sonde suspended at approximately mid-depth (during open river mouth conditions) in the thalweg. The two tributary

stations in Willow and Austin creeks will each have one sonde that will be suspended at approximately mid-depth (during open river mouth conditions) in their respective thalwegs near the confluences with the Russian River.

Sondes will be located in this manner to track changes to water quality in the water column, vertically and longitudinally, within the Estuary and Maximum Backwater Area during reduced instream flows, tidal fluctuation and partial or full closure events. The placement of sondes in this manner will also allow Water Agency staff to track changes to water quality that may be associated with the migration and stratification of the salt water layer within the Estuary, as well as the enhancement of habitat conditions for juvenile salmonids.

When the river mouth closes and a lagoon outlet channel is in place and functioning, vertical and cross-sectional profiles will be collected at the mainstem Russian River monitoring stations and their adjacent shallow zones to further characterize lagoon backwater areas. Measurements of water temperature, dissolved oxygen, specific conductance, pH, and turbidity will be collected using a YSI 6600 datasonde and YSI 650MDS datalogger. Monitoring sites will be accessed by boat.

5.1.2 River Stage Measurements at Monte Rio

Repairs will be made to the existing staff gage located on the northern abutment of the Bohemian Highway Bridge in Monte Rio to monitor water surface levels during barrier beach closure and inundation of the Maximum Backwater Area between Casini Ranch and Vacation Beach. Water surface levels will be recorded weekly during grab sample collection when the barrier beach is closed. Water surface level data will assist in an evaluation of the potential effect that backwatering may have on water quality conditions in this reach of the Russian River.

5.1.3 Nutrient/Bacterial/Algal Sampling

Water grab samples will be collected from 3 surface-water sites in the Russian River Estuary (Figure 1). All samples will be analyzed for nutrients, *chlorophyll a*, standard bacterial indicators (Total coliforms, *E. coli*, and *Enterococcus*), and dissolved organic carbon (see Table 1). NCRWQCB staff indicated during the 2014 monitoring season that there was uncertainty with the validity of the laboratory analysis for Bacteroides and staff 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. However, Regional Board staff has recently communicated that the issues with Bacteroides analysis have been resolved, therefore sample collection will resume for the 2016 monitoring season. Sampling will be conducted for *Bacteroides* bacteria at the 3 surface-water sites that occur in the maximum backwater area including Patterson Point, Monte Rio, and Vacation Beach (Figure 1).

Sampling methodology and quality assurance protocols including: chain-of-custody procedures, sample labeling, storage and transport protocols, sample containers and sample collection methods, and decontamination will follow the *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, chapters A1-A9*, available online at http://pubs.water.usgs.gov/twri9A (USGS various) and included as Appendix A, in conjunction

with protocols and procedures established by the contract laboratories (Alpha Labs and DHS Lab) and the Sonoma County Water Agency *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013* (SCWA 2013), included as Appendix B. As identified in Table 1, Alpha Labs will be reporting the results at the Method Detection Limit (MDL). However, the data will be subject to their reporting protocols, which will require that they record the results as "Detected but below Reporting Limit; therefore, the result is an estimated concentration, detected but not quantified (DNQ)". The DHS Lab will be reporting the *E. coli* and *Enterococcus* results at the Laboratory Reporting Limit/Practical Quantitation Limit LRL/PQL (Table 1). The DHS lab will also be reporting the *Bacteroides* bacteria results.

Beginning in mid-May of each year, grab samples will be collected weekly for the duration of the lagoon management period (May 15 to October 15). See Figure 1 for a map of surface-water sampling locations. Measurements of water temperature, dissolved oxygen, specific conductance, pH, and turbidity will be collected using a YSI 6600 datasonde and YSI 650MDS datalogger during water sample collection. The sonde will be calibrated before and after the collection of water samples and is outfitted with a YSI 6136 turbidity sensor that will be calibrated to two points using 0.0 Nephelometric turbidity units (NTU) distilled water, and 126 NTU turbidity standard (YSI 6073G).

Russian River Estuary Management Project Nutrient/Bacterial/*Chlorophyll a* monitoring sites (Figure 1) include:

- Russian River at Patterson Point in Villa Grande
- Russian River at Monte Rio below Dutch Bill Creek
- Russian River at Vacation Beach below summer dam

Additional focused sampling will also occur under certain conditions and following specific river management and operational events, noted below, at the sites listed above.

- Removal of Johnson's Beach and/or Vacation Beach Dam – 3 samples within 10 days after dam removal
- Sandbar Closure at the river mouth – 3 samples within first 10 days (weekly thereafter)
- Sandbar Breach at the river mouth – 3 samples within 10 days after breach
- Lagoon Outlet Channel implementation – 3 samples within 10 days after implementation (weekly thereafter).

Water Agency staff will also increase sampling frequency to daily at freshwater beach sites including: Patterson Point, Monte Rio and Vacation Beach, if bacteria indicators exceed NCRWQCB operative standards during the weekly sampling effort and shall continue daily until measurements are below operational standards. After consultation with NCRWQCB staff, it was decided that measurements for *E. coli* (235 MPN/100mL) would be used for a comparison to operational standards (pers. comm. Fitzgerald, 2013).

NCRWQCB staff has indicated, based on guidance from Sonoma County DHS, that *Enterococcus* is not currently being utilized as a fecal indicator bacteria in freshwater conditions 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. Water Agency staff will continue to collect *Enterococcus* samples and record and report the data, however, *Enterococcus* results will not be relied upon when coordinating with the NCRWQCB and Sonoma County DHS about potentially posting warning signs at freshwater beach sites or to discuss potential adaptive management actions including mechanical breaching of the sandbar to address potential threats to public health.

At the conclusion of any focused grab sampling event, regular weekly sampling will resume, as described above.

Sampling for human-host *Bacteroides* bacteria will be conducted at public freshwater beaches when other bacteria samples are collected. Samples will be filtered, frozen and archived for possible future analyses of human-host *Bacteroides* bacteria. Lab analysis of *Bacteroides* bacteria will be conducted only for those sample dates and locations when operational standards for *E. coli* bacteria are exceeded. The analysis of human-host *Bacteroides* bacteria will help determine whether the source of the high level of *E. coli* bacteria is from human or other sources.

Russian River Estuary *Bacteroides* sites (Figure 1) include:

- Russian River at Patterson Point in Villa Grande
- Russian River at Monte Rio below Dutch Bill Creek
- Russian River at Vacation Beach below summer dam

These analyses will continue the Water Agency's effort to establish a water-quality baseline for the Russian River Estuary (including the maximum backwater area) from Vacation Beach to the river mouth near Jenner. The baseline established with these analyses will inform the assessment of aquatic habitat availability and public recreational opportunities in the Russian River Estuary and maximum backwater area under open and closed river mouth conditions and during the implementation of a lagoon outlet channel across the river mouth sandbar.

Table 1. List of nutrient, bacterial, and algal indicators to be analyzed in water samples collected for the Russian River Estuary Management Project.

Compound	Test Method	Method Detection Limit (MDL)	Laboratory Reporting Limit (LRL/PQL[1])	Units
Nitrogen, Total	SM4500-N	0.2	0.5	mg/L
Nitrogen, Total Organic	SM4500-N	0.2	0.2	mg/L
Nitrogen, ammonia as N	SM4500NH3C	0.1	0.2	mg/L
Ammonia Unionized	SFBRWQCP	0.00010	0.00050	mg/L
Nitrogen, nitrate as N	EPA300.0	0.050	0.20	mg/L
Organic carbon, dissolved	SM5310C	0.0400	0.300	mg/L
Phosphorus, orthophosphate	SM4500-P E	0.020	0.020	mg/L
Phosphorus, total	SM4500-P E	0.020	0.10	mg/L
Chlorophyll (a)	SM10200H	0.000050	0.010	mg/L
Enterococcus	SM9223 (entro)[3]	2.0	2.0	MPN[2]
E. coli	SM9223 (clert)[4]	2.0	2.0	MPN

- Alpha Labs will be reporting the results at the MDL, however the data will be subject to their reporting protocols which will require that they record the results as "Detected but below Reporting Limit; therefore, result is an estimated concentration, detected but not quantified (DNQ)". The Sonoma County DHS Public Health Division Lab will be conducting the analysis for *E. coli* and *Enterococcus* and will be reporting the results at the LRL/PQL.
- [1] PQL – Practical Quantitation Limit
- [2] MPN – most probable number
- [3]entro – Enterolert Method
- [4]clert – Colilert Method
- [5]NTU – Nephelometric turbidity units

5.1.4 Periphytic and Planktonic Algae and Cyanobacteria

Monitoring of periphytic and planktonic algae will be conducted to document algal response following estuary closure and to establish baseline ecological data for algal populations that are representative of habitats available in the Russian River. Monitoring will be conducted as soon as flows allow a systematic investigation of abundance, cover, and successional processes. Timing of surveys would follow spring draw down and continue from approximately June to October. Photographs will be taken at the transects to document site conditions during each sampling event in each major algal habitat area (including underwater photographs of the condition of periphyton and floating mats of reproductive benthic algae).

Algal Response to Estuary Closure

The sample locations at Patterson Point will be conducted along shallow over-bank habitat in newly flooded shoreline areas that forms after water depths increase during river mouth closure from May 15 to October 15 (Figure 1). Transects will be established to monitor and assess periphytic algal growth, including the potential presence of cyanobacteria, from shoreline to below the photic zone. Transects will be located to sample the range of algae habitat available in these locations. Ambient algae conditions at Patterson Point will be monitored as described further in Appendix G.

Microalgae/Macroalgae Sampling (Collecting Cover Data)

Sampling methodology to monitor the algal response in newly flooded shoreline areas has been developed based on modification of *Standard Operation Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Assessments in California* (Fetscher, et al. 2009), the *California Watershed Assessment Manual: Volume II, Chapter 4* (Shilling et al., 2005), and the *Rapid Bioassessment Protocols for Use in Wadeable Stream and River: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition* (Barbour, 1999), included as Appendices C, E, and F.

Cover data on algal populations will be conducted to estimate both micro- and macro-algal taxa cover. Point intercept sampling provides an effective method to quickly estimate cover and abundance of microalgae, but since it is a dimensionless sampling method, does not provide clear data on where mats of algae form in relation to different conditions in the littoral zone. Line intercept sampling can be completed quickly and provides additional cover information (size and location of algal mats).

Percent algal cover will be calculated using a point-intercept methodology. Algal cover will be the amount of microalgae coating and macroalgae taken at 2 foot intervals (60 cm) along the transects. The percentage of the points across the transects at each monitoring site will provide an estimate of percent algal cover. Beginning with the downstream transect at each site, water depth and the presence of algae will be recorded at 2 foot (60 cm) intervals along the transect, and identified as microalgae or macroalgae. Microalgae is defined as a “film-like coating” of algae. Measurement of microalgae thickness will follow the method identified in Fetscher, et al. 2009 and an estimate of film-like coating will follow descriptions in Table 2. Thicker microalgae layers will be measured using a ruler or rod with demarcations at 1, 5, and 20 mm. Photographs will be taken to document the periphyton at 10-foot intervals along each transect during point sampling. These photographs will include images taken with underwater cameras and utilizing a 7 X 7 grid marked “viewing bucket”.

Additionally, the presence/absence (distance occupied along transect) of attached macroalgae or unattached, floating macroalgae, emergent vegetation, dried and floating algal mats, and riparian canopy will also be recorded along each transect using the line intercept method. Distance occupied by algal mats divided by total distance of the transect provides an effective measure of instantaneous absolute cover. Cover data on emergent and riparian canopy will be collected along each transect (if present).

Table 2. Microalgal thickness codes and descriptions.

Microalgal thickness codes and descriptions (from Fetscher, et al. 2009 and adapted from Stevenson and Rollins 2006)		
Code	**Thickness**	**Diagnostics**
0	No microalgae present	The surface of the substrate feels rough, not slimy.
1	Present, but not visible	The surface of the substrate feels slimy, but the microalgal layers is too thin to be visible.
2	<1mm	Rubbing fingers on the substrate surface produces a brownish tint on them, and scraping the substrate leaves a visible trail, but the microalgal layers is too thin to measure.
3	1-5mm	
4	5-20mm	
5	>20mm	
UD	Cannot determine if a microalgal layer is present	

Prior to collection of percent algae cover, algae samples will be collected 1 m downstream and adjacent to each point (to avoid trampling on samples during collection of percent algal cover data), beginning at the downstream transect. A multi-habitat sample will be collected at 10 foot (3 meters) intervals along each transect. Each sample will be collected from the substrate that is uppermost within the stream and has highest possibility of sun exposure (i.e. if a thick layer of macroalgae covers the substrate, collection will include the layer). Samples will be placed in a cooler to protect the algae from heat and desiccation and to preserve specimen integrity. Algal species present will be identified to the lowest taxa, preferably species but at least genera. Successional changes in genera over the season should provide a metric to assess species (genera) richness as well as document the stages in development of the periphyton layer.

Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyta (Golden Brown Algae (diatoms)), and Cyanobacteria (Blue Green Algae). In addition, along each transect one sample will be collected at a 1 foot depth in the flowing (in active flowing channel) water column using a plankton net (deployed for five minutes) to assess the presence and abundance of phytoplankton. If cyanobacteria target species are identified (including species of *Anabaena*, *Microcystis*, *Planktothrix*, *Oscillatoria, and Phormidium*), they will be evaluated for changes in cover successionally and the possibility of the presence of cyanotoxins will also be evaluated.

The samples will be combined, homogenized and plated on microscopic slides. The number of cells per volume by genera will be used to evaluate relative abundance of each genera present. Keenan Foster, a taxonomic botanist and Principal Environmental Specialist with the Water Agency, will be conducting the algae identification and evaluation for the presence of cyanobacteria.

Water chemistry measurements will be recorded near the substrate at each transect point using a YSI 6600 datasonde and YSI 650MDS datalogger. Conditions to be measured include water temperature, dissolved oxygen, specific conductance, pH, and turbidity. Water depth will be taken using a stadia rod or similar device.

Monitoring and sample collection will occur under certain conditions and following specific river management and operational events, noted below, at Patterson Point.

- Transects will be established during open river mouth conditions beginning in June, or at least one month after storm events with sufficient power to mobilize gravels and sand/silt. Monitoring of percent algae cover and collection of samples will be completed with establishment of the transects.
- The next monitoring and sampling event will occur when the river mouth is closed, in an extended perched condition, or with an outlet channel in place and the water surface elevation at the Jenner gage is at or approaching 4.5 feet. Monitoring and sample events will then be repeated with each 2 foot stage change (e.g. 6.5 feet and 8.5 feet) until the river mouth returns to an open condition or at the end of the monitoring period (October 15).

5.1.5 Sediment Chemistry and Benthic Community Indices (Stipulated Judgment)

The Water Agency has conducted sediment chemistry and benthic invertebrate sampling to collect baseline data on sediment chemistry and benthic community indices in the Russian River Estuary, including the maximum backwater area, during open Estuary conditions. The Water Agency will also collect samples during closed freshwater lagoon conditions with a low-velocity overflow channel in place to understand the effects of mouth closures on the sediment chemistry and benthic community indices within the Estuary and maximum backwater area.

The Stipulated Judgment requires that an initial round of baseline sampling be conducted during the lagoon management period (May 15 to October 15) when the mouth has been open for at least 30 days to provide baseline information. This baseline event was completed in August 2013. The Judgment also requires that up to three (3) rounds of sampling be conducted during the five (5) year term of the Judgment (ending September 2017) when the Estuary has been in a lagoon condition, with a functioning low velocity outlet channel, for at least 21 consecutive days during the lagoon management period. No more than one round of this lagoon condition sampling would occur per year.

Samples will be taken at five stations in the Russian River Estuary, including the maximum backwater area, to coincide with ongoing invertebrate sampling locations. At each station, a cross-sectional transect was established and sampled for sediment chemistry and benthic community indices. The

sampling transect stations are located on the mainstem at the River Mouth, Penny Island, Willow Creek, Freezeout Creek, and Monte Rio (Figure 2).

The Stipulated Judgment requires that the sediment chemistry and benthic community indices analysis be conducted in compliance with the protocols set forth in Sections V.D through V.J of the SWRCB *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (Water Quality Plan) http://www.swrcb.ca.gov/water_issues/programs/bptcp/docs/sediment/sed_qlty_part1.pdf (SWRCB, 2009), included as Appendix D. With the exception of using a benthic corer to collect samples rather than a grab sampler as described in Section D.1 of the Water Quality Plan.

Additional sampling methodology and quality assurance protocols including: chain-of-custody procedures, sample labeling, storage and transport protocols, sample containers and sample collection methods, and decontamination will follow the *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9*, available online at http://pubs.water.usgs.gov/twri9A (USGS various), in conjunction with protocols and procedures established by the contract laboratories (Alpha Labs and DHS Lab) and the Sonoma County Water Agency *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013* (SCWA 2013).

Benthic Community Indices - In order to sample the benthic infauna, three core samples will be collected (using a 2" diameter PVC corer inserted 10cm into the sediment) at each transect, with one sample on each river side and in the center. After each core is collected, the sample will be placed into a labeled sample jar, and the depth of the sample and the sample number will be recorded on the data sheet. The corer will be rinsed thoroughly between each core sample collected.

Following sample collection, each sample jar lid will be sealed with a triple wrap of electrical tape, and then shipped in containment bags with packing. Core samples will be shipped to the Wetland Ecosystem Team School of Aquatic and Fishery Sciences at the University of Washington for analysis and identification. Analysis of the samples and evaluation of the benthic community indices as outlined in the SWRCB Water Quality Plan will be under the direction of Charles Simenstad, Research Professor at the University of Washington.

Sediment Chemistry – Three core samples will be collected (using a 2" diameter PVC corer in the top 5 cm of sediment) at each transect, with one sample on each river side and in the center. The three core samples will then be composited into one sample representing the station. The composite samples will be mixed in glass bowls with stainless steel spoons, and then deposited into two glass sample jars for each station. All equipment including glass mixing bowl, stainless steel spoon, and sediment coring sampler will be rinsed thoroughly between each core sample collected. A composite sample for determining cobble size will also collected at each station. These cores will be collected and mixed in the same manner as the sediment chemistry cores and will be deposited and sealed in a *Ziploc* bag. Each bag will be filled with approximately 16 oz. of composited sediment from each station transect.

The chain-of-custody forms and labels will be filled out for each site and sample jar. A security seal will be affixed on each sediment chemistry sample jar and labeled with site name, date, and sampler. The chain-of-custody will accompany the samples during collection and will be labeled appropriately with

site information, collection date and time, and sampler information. All samples will be stored in a cooler with bagged ice during collection and transport to Water Agency facilities. Samples will then be transferred to a refrigerator and stored at 4 degrees Celsius (4°C) until shipment. Samples will be packed with bagged ice in a cooler that will be sealed with duct tape for shipment. Samples will be shipped overnight to ALS Environmental Labs in Kelso, Washington for analysis.

5.2 Reporting

An annual report describing the results of the Water Agency Russian River Estuary water quality monitoring and sampling effort will be prepared. The report will provide summaries of data observations recorded for each constituent sampled or monitored (not including the grab sample constituents previously mentioned as not undergoing analysis) and the impacts if any to aquatic habitat availability. Data will be compared to previous years and special attention will be given to the potential for the outlet channel to successfully maintain elevated water levels and improve water quality and the availability of suitable aquatic habitat for salmonid rearing. The report will also address the objectives of the monitoring plan described in Section 3.0, as well as address the purpose and need of the plan described in Section 4.0, including the following questions:

- What are the background levels of nutrients and pathogens in the Estuary under open, tidally-influenced conditions? How do these background levels respond to changes in managing the Estuary as a seasonal freshwater lagoon, considering other contributing factors?
- Do water temperature, dissolved oxygen, and salinity respond to changes managing the Estuary as a seasonal freshwater lagoon?
- Are there secondary biological effects related to changes in water quality from managing the Estuary as a seasonal freshwater lagoon (e.g. stress to fish, plants, invertebrates) and if so, what are they?
- Are there affects to public health/recreation?

Monitoring data is shared with Water Agency partners, including the University of California at Davis Bodega Marine Laboratory (BML). BML conducts hydrological analyses of both University-collected and Water Agency-collected data on currents, temperature, salinity, dissolved oxygen, biological oxygen demand (BOD), and water levels in the context of changes in river flow, tide range, wave conditions, and river mouth state, with specific attention to:

- Circulation patterns and statistical description of current speeds associated with tidal flows when mouth open, and wind-driven seiche when mouth closed.
- Salinity intrusion (i.e., landward extent of saline waters).
- Stratification strength and resistance to vertical mixing (i.e., stability) and how stability evolves during long-closure periods.
- Residence times for both low-salinity surface waters and high-salinity bottom waters in the estuary.
- Water budget for the estuary when closed, with a view to better quantifying the loss term due to seepage through the sand barrier at the mouth when closed.

- Salt budget for the estuary when closed, with a view to better quantifying the export of saline waters due to seepage through the sand barrier at the mouth when closed, but also recognizing the role of wave over-wash of seawater into the estuary.
- Quantification of dissolved oxygen levels, BOD levels and de-oxygenation rates in estuary waters during periods of closure, barrier overflow, and immediately after breaching of the mouth.

BML's staff and Principal Investigator, Dr. John Largier, interacts with Water Agency staff and other collaborators in relating estuarine hydrology to water quality (specifically concurrent data on nutrient and fecal indicator bacteria levels), ecological productivity (specifically concurrent invertebrate surveys), human uses (specifically salinity intrusion into water sources) and ecosystem functions (specifically quantity and quality of juvenile salmon habitat) in the estuary. BML's data will be included in the annual report, to the extent that data is available.

The report and its evaluation will help guide the adaptive management process and may also provide recommendations for changes to monitoring and sampling efforts to be conducted in subsequent years. The information from this report will also be used in a synthesis report being prepared by the Water Agency that incorporates other Estuary studies and discusses trends and observations relating to the proposed permanent changes to minimum instream flows and Estuary management during the summer months. Additionally, the NCRWQB has requested that the data be submitted into their California Environmental Data Exchange Network (CEDEN) database for the 303d/305b Integrated Report process.

5.3 Quality Assurance Program

The following section describes applicable standard operating procedures and established monitoring and sampling protocols that Water Agency staff, under the guidance of Senior Environmental Specialist Jeff Church, will follow as part of their Quality Assurance (QA) and Quality Control (QC) efforts. Water Agency staff will conduct water quality data collection, management, analysis, and evaluation following the Sonoma County Water Agency's *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013* (Appendix B).

All YSI 6600 Datasondes deployed for long-term continuous monitoring will be recalibrated following the manufacturer's 6-Series User Manual and data downloaded every two weeks by Water Agency staff. YSI sondes used for the collection of water chemistry information during water and algal sample collection will be calibrated daily, before and after use in the field.

- The YSI temperature sensor utilizes a thermistor that does not require calibration or maintenance. However, thermistor accuracy will be checked against a National Institute of Standards and Technology (NIST) thermometer during initial deployment, and periodically throughout the monitoring season, to ensure the sensors are functioning properly.
- The YSI 6560 conductivity sensors will be calibrated using a 10,000 microsiemen (µS/cm) standard.
- The YSI 6561 pH sensors will be calibrated to two points using buffer solutions of pH 7 and 10.

- The YSI 6562 dissolved oxygen sensors will be calibrated using the dissolved-oxygen-calibration chamber-in-air method where the calibration chamber is set-up with water and allowed to reach 100-percent saturation prior to calibration.
- The YSI 6150 optical dissolved oxygen sensors will be calibrated using a one-point dissolved-oxygen-calibration chamber-in-air method where the calibration chamber is set-up with water and allowed to reach 100-percent saturation prior to calibration.
- The YSI 6136 turbidity sensor will be calibrated to two points using 0.0 Nephelometric turbidity units (NTU) distilled water, and 126 NTU turbidity standard (YSI 6073G).

Water grab sampling methodology and quality assurance protocols including: chain-of-custody procedures, sample labeling, storage and transport protocols, sample containers and sample collection methods, and decontamination will follow the USGS *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9* (Appendix A), in conjunction with protocols and procedures established by Alpha Analytical Laboratories and the Sonoma County Department of Health Services Public Health Division Lab (the Water Agency's contract laboratories) and the Sonoma County Water Agency *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013*. Water Agency staff will follow standard operating procedures while collecting water grab samples including:

- Water Agency staff will wear non-powdered nitrile gloves during the collection of all water grab samples. New gloves will be used at each sampling site.
- Sample bottles will be labeled with station name, sample date, sample time, sampler identification, constituents being sampled, and preservative used (if any).
- Water grab samples will be collected where the stream depth is approximately 12 to 18 inches.
- Water grab samples will be collected at an approximate depth of 8 inches below the water surface.
- Water Agency staff will position bottles at the upstream direction of flow in relation to their body when collecting samples to prevent potential sample bias caused by disturbance to the adjacent substrate when accessing the sample point.
- If substrate is disturbed and cannot be avoided during sampling due to a lack of positive flow, Water Agency staff will remain in place until the substrate settles.
- Water grab sample bottle lids will be removed subsurface to allow sample bottles to fill from within the water column and not collect surface detritus.
- Water grab sample bottles will be recapped subsurface to minimize potential sample bias from surface detritus.
- Water grab samples collected (e.g. nutrient, algal, and bacterial samples) have a maximum hold time of six (6) hours between sample collection and receipt by the respective lab.
- Water grab samples will be placed in an ice-filled cooler after collection to keep samples at a temperature below 6 degrees Celsius (>6°C).
- Water Agency staff will transport bacterial samples directly to the DHS lab in Santa Rosa.
- Water grab samples that will be analyzed by Alpha Analytical Labs in Ukiah will be returned to Water Agency facilities following completion of sample collection and coolers will be topped off

with ice to ensure samples remain >6°C and ready for pick-up and transport to Alpha Analytical Labs by the lab courier.

- Chain of custody forms are filled out and signed by Water Agency staff for release and transfer of water grab samples to their respective lab for analysis. Chain of custody forms are submitted to laboratory staff at the DHS lab and to the Alpha Analytical Labs courier.
- Paper copies of chain of custody forms are kept on file at the Water Agency along with lab results and the corresponding lab analysis quality control results (e.g. duplicates, spikes, and blanks). Electronic copies of the chain of custody forms and lab results are also kept on file.

Sampling methodology to address monitoring periphytic algae growth in newly flooded shoreline areas has been developed based on modification of *Standard Operation Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Assessments in California* and *California Watershed Assessment Manual: Volume II Chapter 4*, and the *Rapid Bioassessment Protocols for Use in Wadeable Stream and River: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition* (Barbour, 1999), (Appendices C, E, and F), as described above in Section 5.1.4.

- Monitoring of periphytic and planktonic algae will be conducted to document the algal response following estuary closure and to establish baseline ecological data for algal populations that are representative of habitats available in the Russian River Estuary.
- Monitoring will be conducted as soon as flows allow a systematic investigation of abundance, cover, and successional processes. Timing of surveys will follow spring draw down from May 15 to October 15.
- Transects to monitor and assess periphytic algal growth, including the potential presence of cyanobacteria, will be established at Patterson Point.
- Two transects will be established at the Patterson Point monitoring site.
- Transects will be subjectively placed to collect data from areas with different depths, velocities, substrates, insolation, emergent vegetation, etc. in the littoral zone.
- Photographs will be taken at each transect to document site conditions during each sampling event in each major algal habitat area (including underwater photographs of the condition of periphyton and floating mats of reproductive benthic algae).
- Transects will be located on gravel bars that become inundated during estuary closure on Patterson Point beach. Transect endpoint 0 will be established at a 1 m depth in the mainstem Russian River and extend 12.5 m landward or to a 9 foot elevation.
- Transect locations will avoid locations such as tributaries, outfalls, and man-made structures to minimize influence of algal growth from contributions in nutrients, temperature, or canopy cover from such sources.
- Keenan Foster, a taxonomic botanist and Principal Environmental Specialist with the Water Agency, will be conducting the algae identification and evaluation for the presence of cyanobacteria.
- Water chemistry measurements will be recorded near the substrate at each transect point using a YSI 6600 datasonde and YSI 650MDS datalogger. Conditions to be measured include water

temperature, dissolved oxygen, specific conductance, pH, and turbidity. Water depth will be taken using a stadia rod or similar device.

Collecting Cover Data

Identifying Taxa Present (Multi Habitat Algal Sampling)

- Prior to collection of percent algae cover, algae samples will be collected 1 m downstream and adjacent to each point (to avoid trampling on samples during collection of percent algal cover data).
- Multi-habitat sampling will follow the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999).
- A multi-habitat sample will be collected at various points along 10 foot (3 meters) intervals on the transect that are representative of the variety of habitats present (up to a maximum of 5 samples per transect).
- Each sample will be collected from the substrate that is uppermost within the stream and has highest possibility of sun exposure (i.e. if a thick layer of macroalgae covers the substrate, collection will include the layer, or if a thin film on gravel sample will include gravel and the film will be "scrubbed off" for analysis).
- Samples will include all the algae present at the sampling point in a 4 inch (10 cm) radius as collected using a 4.5 inch Pyrex culture dish. Each sample will include all the algae present in the defined area of substrate.
- Samples from each interval will be combined into a common container.
- Samples will be placed in a cooler to protect the algae from heat and desiccation and to preserve specimen integrity.
- Algal species present will be identified to the lowest taxa, preferably species but at least genera.
- Successional changes in genera over the season should provide a metric to assess species (genera) richness as well as document the stages in development of the periphyton layer.
- Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyceae (Golden Brown Algae (diatoms)), and Cyanobacteria (Blue Green Algae).
- Samples will be combined, homogenized, and plated on microscope slides.
- The number of cells per volume by genera can be used to sample relative abundance of each genera present.
- Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyta (Golden Brown Algae [diatoms]), and Cyanobacteria (Blue Green Algae).
- If cyanobacterial target species are identified (including species of *Anabaena*, *Microcystis*, *Planktothrix*, *Oscillatoria,* or *Phormidium*), they will be evaluated for seasonal changes in cover and the possibility of the presence of cyanotoxins will also be evaluated.
- Sampling will follow the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999) and incorporate the steps below:
    - Visual estimates or quantitative transect-based assessments can be used to determine the percent coverage of each substrate type and the estimated relative abundance of

macrophytes, macroscopic filamentous algae, diatoms and other microscopic algal accumulations (periphyton), and other biota.

- Collect algae from all available substrates and habitats. The objective is to collect a single composite sample that is representative of the periphyton assemblage present in the reach.
- Sample all substrates and habitats (riffles, runs, shallow pools, nearshore areas) roughly in proportion to their areal coverage in the reach. A composite sample will be collected randomly from 5 points selected from a table of random numbers along the transect. Each sample will include all the algae present in a 5X5 cm square area of substrate. Changes in species composition of algae among habitats are often evident as changes in color and texture of the periphyton. Small amounts (about 5 mL or less) of sample from each habitat are usually sufficient. Pick specimens of macroalgae by hand in proportion to their relative abundance in the reach. Combine all samples into a common container.
    - Collection methods include:
        - Removable substrates (hard): gravel, pebbles. Remove representative substrates from water; brush cobble and woody debris or scrape representative area of algae from surface and rinse into sample jar.
        - Removable substrates (soft): mosses, macroalgae. Place a portion of the plant in a sample container with some water. Shake it vigorously and rub it gently to remove algae. Remove plant from sample container.
        - Loose sediments: (sand, silt, fine particulate organic matter). Invert petri dish over sediments. Trap sediments in petri dish by inserting spatula under dish. Remove sediments from stream and rinse into sampling container. Algal samples from depositional habitats can also be collected with spoons, forceps, or pipette.
        - Place all samples into a single water-tight, unbreakable, wide-mouth container. A composite sample measuring four 4 ounces (ca. 125 ml) is sufficient. Add recommended amount of Lugol's (IKI) solution, "M3" fixative, buffered 4% formalin, 2% glutaraldehyde, or other preservative.
        - Label the outside of the sample container with the following information: waterbody name, sampling location, transect, date, name of collector, and type of preservative. Record this information and relevant ecological information in a field notebook. Place another label with the same information inside the sample container.
        - Transport samples back to the laboratory in a cooler with ice (keep them cold and dark) and store preserved samples in the dark until they are processed. Be sure to stow samples in a way so that transport and shifting does not allow samples to leak. When preserved, check preservative every few weeks and replenish as necessary until taxonomic evaluation is completed.

- Record sample identification code, date, stream name, sampling location, transect, collector's name, sampling method, and area sampled.

Estimating Taxa Richness and Abundance

- An assessment of the relative abundances of algal taxa will be conducted for “soft" (non-diatom) algae and diatoms using a modified version of the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999).
- Five samples will be collected at each transect by collecting all the algae present at the sampling point in a 4 inch (10 cm) radius as collected using a 4.5 inch Pyrex culture dish.
- All the algae present will be removed from the substrate and all five samples will be combined into a common container.
- Algal samples will be homogenized in a blender and pipetted into a “Palmer” counting cell.
- Cell densities will be adjusted by diluting (with known volumes) with distilled water to optimize cell counts (20-40 cells per 400X microscope field).
- Relative abundances of "soft" algae will be determined by dividing the number of cells (cell units) counted for each taxon by the total number of cells counted.
- 300 algal cell units will be counted per site for each field event.
    - Homogenize algal samples with a tissue homogenizer or blender.
    - Thoroughly mix the homogenized sample and pipette into a Palmer counting cell. Algal suspensions that produce between 10 and 20 cells in a field provide good densities for counting and identifying cells. . Lower densities slow counting.
    - Dilute samples if cells overlap too much for counting.
    - Identify and count 300 algal "cell units" to the lowest possible taxonomic level at 400X magnification. Distinguishing cells of coenocytic algae and filaments of blue-green algae as 10 mm sections of the thallus or filament.
    - For diatoms, only count live diatoms and do not identify to lower taxonomic levels.
    - Record numbers of cells or cell units observed for each taxon.
    - Make taxonomic notes and drawings of important specimens.
- Palmer counting cells will be utilized to identify and count soft-algae.
- Relative abundances of "soft" algae are determined by dividing the number of cells (cell units) counted for each taxon by the total number of cells counted (e.g., 300).
- Estimate total taxa richness by adding the number of "soft" algal taxa and diatom taxa.

Data on algal populations will be collected using both point and line intercept sampling methods. Percent algal cover will be calculated as an algal indicator of productivity measured as algal abundance using a point-intercept collection methodology. Algal cover will be the amount of microalgae coating and macroalgae taken at 2 foot intervals (60 cm) along each transect. The percentage of the points across the transects will provide an estimate of percent algal cover. Line intercept methodology will be

used to further characterize macro-algal and riparian conditions. The presence/absence (distance occupied along transect) of attached macroalgae or unattached, floating macroalgae, emergent vegetation, dried and floating algal mats, and riparian canopy will also be recorded along each transect.

Point-Intercept Sampling

- Beginning with the downstream transect at each site, for each point along the transect, the presence of algae will be recorded and identified as microalgae or macroalgae. Microalgae is defined as a "film-like coating" of algae.
- Sample periphyton at 2 foot (60 cm intervals).
- Characterize microalgal cover. Measurement of microalgae thickness will follow the method identified in Fetscher, et al. 2009 and an estimate of film-like coating will follow descriptions in Table 2. Thicker microalgae layers will be measured using a ruler or rod with demarcations at 1, 5, and 20 mm.
- The presence/absence of attached macroalgae or unattached, floating macroalgae will also be recorded at each point.
- Photograph transect condition (from both endpoints).
- Photograph benthic conditions at 10 foot intervals using an underwater camera and viewing bucket marked with a 7 X 7 grid.
- Measure water depth at each sampling location.
- Characterize macroalgal biomass. Record the species and length of macroalgae. If two or more genera of macroalgae are present, measure and record information for each type of macroalgae separately.

Line-Intercept Sampling

- Cover along transects occupied by floating and attached algal mats will be recorded using the line-intercept method. Distance occupied by algal mats divided by total distance of the transect provides an effective measure of instantaneous absolute cover.
- Where individual cyanobacterial colonies can be visually differentiated in the periphyton, distances for these colonies will be recorded.
- Data on emergent and riparian canopy cover will be collected along each transect (if present)

Periphytic algal monitoring and sample collection will occur under certain conditions and following specific river management and operational events, noted below, at the sites described above.

- Transects will be established beginning in mid-May, or at least one month after storm events with sufficient power to mobilize gravels and sand/silt. Monitoring of percent algae cover and collection of samples will be completed with establishment of the transects.
- The next monitoring and sampling event will occur when the river mouth is closed, in an extended perched condition, or with an outlet channel in place and the water surface elevation at the Jenner gage is at or approaching 4.5 feet. Monitoring and sample events will be repeated as needed with each 2 foot stage change (e.g. 6.5 feet and 8.5 feet) until the river mouth returns to an open condition or at the end of the monitoring period (October 15).

Sediment chemistry and benthic invertebrate sampling will also be conducted in compliance with the testing protocols set forth in Sections V.D through V.J of the SWRCB *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality* (Appendix D), except as noted above in Section 5.1.5. Additional sampling methodology and quality assurance protocols including: chain-of-custody procedures, sample labeling, storage and transport protocols, sample containers and sample collection methods, and decontamination will follow the *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9*, available online at http://pubs.water.usgs.gov/twri9A (USGS various), in conjunction with protocols and procedures established by the contract laboratories (Alpha Labs and DHS Lab) and the Sonoma County Water Agency *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013* (SCWA 2013).

- In order to sample the benthic infauna, three core samples will be collected (using a 2" diameter PVC corer inserted 10cm into the sediment) at each transect, with one sample on each river side and in the center.
    - After each core is collected, the sample will be placed into a labeled sample jar, and the depth of the sample and the sample number will be recorded on the data sheet.
    - The corer will be rinsed thoroughly between each core sample collected.
    - Following sample collection, each sample jar lid will be sealed with a triple wrap of electrical tape, and then shipped in containment bags with packing.
    - Core samples will be shipped to the Wetland Ecosystem Team School of Aquatic and Fishery Sciences at the University of Washington for analysis and identification.
    - Analysis of the samples and evaluation of the benthic community indices as outlined in the SWRCB Water Quality Plan will be under the direction of Charles Simenstad, Research Professor at the University of Washington.
- In order to sample the sediment chemistry, three core samples will be collected (using a 2" diameter PVC corer in the top 5 cm of sediment) at each transect, with one sample on each river side and in the center.
    - The three core samples will then be composited into one sample representing the station.
    - The composite samples will be mixed in glass bowls with stainless steel spoons, and then deposited into two glass sample jars for each station.
    - All equipment including glass mixing bowl, stainless steel spoon, and sediment coring sampler will be rinsed thoroughly between each core sample collected.
    - A composite sample for determining cobble size will also collected at each station. These cores will be collected and mixed in the same manner as the sediment chemistry cores and will be deposited and sealed in a *Ziploc* bag. Each bag will be filled with approximately 16 oz. of composited sediment from each station transect.
    - The chain-of-custody forms and labels will be filled out for each site and sample jar.
    - A security seal will be affixed on each sediment chemistry sample jar and labeled with site name, date, and sampler.

- The chain-of-custody will accompany the samples during collection and will be labeled appropriately with site information, collection date and time, and sampler information.
- All samples will be stored in a cooler with bagged ice during collection and transport to Water Agency facilities.
- Samples will then be transferred to a refrigerator and stored at 4 degrees Celsius (4°C) until shipment.
- Samples will be packed with bagged ice in a cooler that will be sealed with duct tape for shipment.
- Samples will be shipped overnight to ALS Environmental Labs in Kelso, Washington for analysis.

Datasonde data management will include downloading datasets every two weeks from the YSI 6600 datasondes to YSI 650MDS hand units in the field.

- The datasets are downloaded from the 650 MDS to a Water Agency personal computer (PC) and are converted to excel files.
- Individual electronic files for each downloaded dataset are kept in project files on the Water Agency computer network in .dat and .xls format.
- The data is stored on a water quality database and maintained by Water Agency staff under the supervision of Jeff Church.
- Datasonde data is analyzed by Jeff Church for accuracy and to ensure datasondes were operating properly during data collection. Calibration logs are utilized in the process of identifying valid and invalid data.
- Invalid data is flagged and a separate electronic file of the QC'd dataset is created for analysis, evaluation and reporting purposes. The invalid data is removed from the QC'd dataset for the purposes of statistical analysis to generate seasonal minimum, mean, and maximum values for each dataset.

Grab sample data management will include receiving laboratory results from the two contract laboratories: the Sonoma County DPH lab and Alpha Labs in Ukiah.

- Grab sample laboratory results for bacteria are received from the Sonoma County DPH lab in electronic pdf format.
- Grab sample laboratory results for nutrients and *chlorophyll a* are received from Alpha Labs of Ukiah in electronic (pdf) and hard copy format.
- Hard copies of grab sample data are kept in project folders at the Water Agency offices.
- Electronic copies are stored in project files on the Water Agency computer network, and data is entered into the water quality database under the supervision of Jeff Church.

All data is analyzed for validity by Water Agency staff under the supervision of Jeff Church and all data undergoes a final QA/QC review by Jeff Church prior to analysis, evaluation, and reporting.

As described in Section 5.2, Reporting, data collected under this WQMP will be evaluated and provided in an annual report describing the results of the Water Agency Russian River Estuary water quality

monitoring and sampling effort. The report will provide summaries of data observations recorded for each constituent sampled or monitored (not including the grab sample constituents previously mentioned as not undergoing analysis) and the impacts if any to aquatic habitat availability. Lab results will be provided as appendices to the annual report, as well as shared with the NCRWQCB and DHS, as they are QA/QC'd by Water Agency Senior Environmental Specialist Jeff Church. The report will also address the objectives of the monitoring plan described in Section 3.0, as well as address the purpose and need of the plan described in Section 4. As described in Section 5.2, the report and its evaluation will help guide the adaptive management process and may also provide recommendations for changes to monitoring and sampling efforts to be conducted in subsequent years. The information from this report will also be used in a synthesis report being prepared by the Water Agency that incorporates other Estuary studies and discusses trends and observations relating to the proposed permanent changes to minimum instream flows and Estuary management during the summer months.

5.4 Adaptive Management Approach

The Russian River Biological Opinion provides for an adaptive management approach to changes in Estuary management. Each year in coordination with NMFS, CDFW, and the Corps, the Water Agency prepares an annual barrier beach outlet plan by April 1 for their review and input. Water quality results will be considered if any revisions to the adaptive management approach are considered for recommendation.

The Biological Opinion's Incidental Take Statement allows for artificially breaching the lagoon using methods that do not create a perched lagoon twice per year between May 15 and October 15 (the lagoon management period) during the first three years covered by the Biological Opinion, and once per year during years 4-15. NMFS assumes that experience gained during years 1-3 and remediative steps associated with modification of the jetty or flood management options will improve the proficiency of the Water Agency at maintaining a closed or perched lagoon. If the estuary is breached using methods that create a deep channel through the bar more than the number of times indicated above, or biological monitoring indicates periods of adverse water quality throughout the estuary longer than 3 to 4 weeks, then incidental take may be exceeded. As described in the Biological Opinion, NMFS anticipates 3 to 4 weeks of adverse water quality conditions after the sandbar closes the mouth of the estuary. A longer period of adverse water quality conditions may indicate that the formation of a closed lagoon or the creation of a perched lagoon by adaptive bar management has resulted in unanticipated water quality degradation (for example, dramatic reductions in invertebrate prey items, or temperatures over 23 degrees Celsius throughout the water column, or dissolved oxygen levels near zero throughout the water column) (NMFS 2008).

6.0 References

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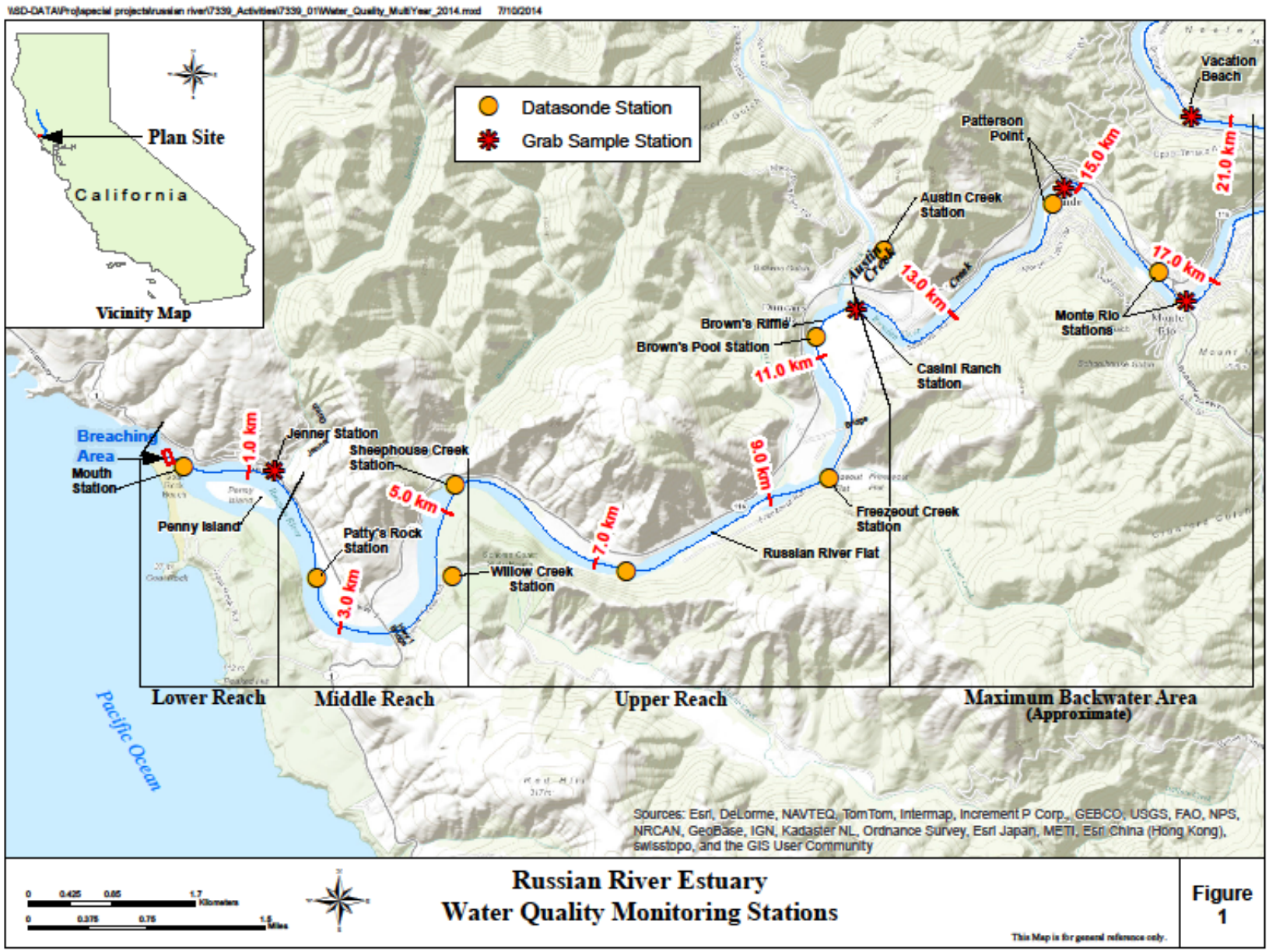
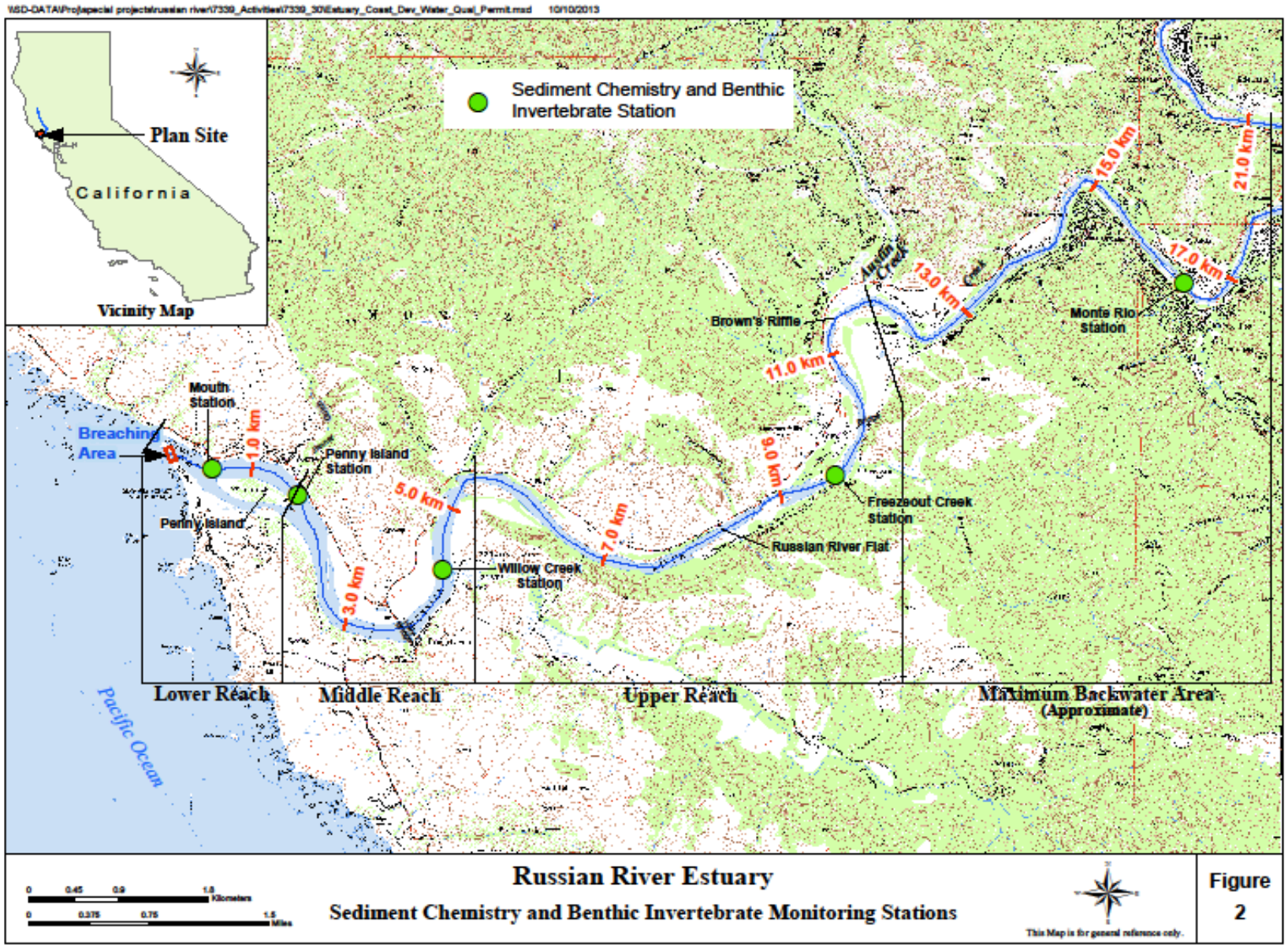

Datasonde Station
Grab Sample Station
Plan Site
California
Vicinity Map
Vacation Beach
Patterson Point
Austin Creek Station
Austin Creek
Brown's Riffle
Brown's Pool Station
Casini Ranch Station
Monte Rio Stations
Monte Rio
Breaching Area
Mouth Station
Jenner Station
Sheephouse Creek Station
Penny Island
Patty's Rock Station
Willow Creek Station
Freezeout Creek Station
Russian River Flat
1.0 km
3.0 km
5.0 km
7.0 km
9.0 km
11.0 km
13.0 km
15.0 km
17.0 km
21.0 km
Pacific Ocean
Lower Reach
Middle Reach
Upper Reach
Maximum Backwater Area
(Approximate)
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
Kilometers
Miles
Russian River Estuary
Water Quality Monitoring Stations
This Map is for general reference only.
Figure 1


Sediment Chemistry and Benthic Invertebrate Station
Plan Site
California
Vicinity Map
Mouth Station
Breaching Area
Penny Island Station
Penny Island
Willow Creek Station
Brown's Riffle
Austin Creek
Freezeout Creek Station
Russian River Flat
Monte Rio Station
1.0 km
3.0 km
5.0 km
7.0 km
9.0 km
11.0 km
13.0 km
15.0 km
17.0 km
21.0 km
Lower Reach
Middle Reach
Upper Reach
Maximum Backwater Area (Approximate)
Pacific Ocean
Russian River Estuary
Sediment Chemistry and Benthic Invertebrate Monitoring Stations
Figure 2

APPENDIX A. National Field Manual for the Collection of Water Quality Data: U.S. Geological Survey Techniques of Water Resources Investigations, Book 9, Chapters A1-A9

There are multiple documents associated with the National Field Manual that are available online at http://pubs.water.usgs.gov/twri9A

APPENDIX B. Sonoma County Water Agency Quality Assurance Manual, Water Quality Manual

APPENDIX C. Standard Operating Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California

APPENDIX D. Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality

APPENDIX E. California Watershed Assessment Manual: Volume II, Chapter 4

APPENDIX F. Rapid Bioassessment Protocols for Use in Wadeable Stream and River: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition

APPENDIX G. Addendum to the Water Quality Monitoring Plan for The Russian River Estuary Management Project to address Mainstem Russian River Ambient Algae Monitoring

APPENDIX G

Mainstem Russian River Ambient Algae Monitoring

Introduction

Monitoring of periphytic and planktonic algae will be conducted to gather ecological data for algal populations that are representative of habitats available in the Russian River under a variety of dry season flows. This effort is intended to identify the composition, abundance, cover and change over time of algal periphytic and planktonic taxa in the Russian River. Monitoring is also being conducted to gain a better understanding of how and what ecological conditions influence periphytic and planktonic algae populations in the Russian River. Green (Family Chlorophyta) taxa will be identified to the level of genus. Golden-Brown (Family Chrysophyceae) represented overwhelmingly by diatom taxa, will be grouped as Bacillariophyta. Blue-Green algae (Phylum Cyanophyta), or Cyanobacteria, will be identified to taxonomic level of genus where possible depending on visible diagnostic features present during sampling and monitoring.

Monitoring will be conducted as soon as stream flows allow a systematic investigation of abundance, cover, and successional processes. Timing of surveys will follow spring draw down, approximately from June to October, and target representative areas in the upper, middle, and lower Russian River. Transects to monitor and assess periphytic algal growth, including the potential presence of cyanobacteria, will be established at four surface water locations selected to represent the range of algal habitats available in the Russian River. Locations for sampling include establishing monitoring sites at Patterson Point, Syar Vineyards, Jimtown Bridge in Alexander Valley, and near Hopland (Figure 1)(need new figure for new location).

Methodology

Sampling methodology has been developed based on modification of *Standard Operation Procedures for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Assessments in California* (Fetscher, et al. 2009), the *California Watershed Assessment Manual: Volume II, Chapter 4* (Shilling et al., 2005), and the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999).

The monitoring approach is summarized in the sections below and the sampling and monitoring methodology are discussed in further detail in the QAPP.

Transect Establishment

Transects to monitor and assess periphytic algal growth, including the potential presence of cyanobacteria, will be established at the four surface water sites selected to represent the range of algal habitats available in the Russian River. Monitoring sites in the Russian River will be located at: Patterson Point, located in the lower river in Villa Grande; at Syar Vineyards, located south of Healdsburg; at Jimtown Bridge, located in Alexander Valley, and in Hopland at the USGS gauging station (Figure 1).

Transects will be subjectively placed to collect data from areas with different habitat features including but not limited to depths, velocities, substrates, insolation, and emergent vegetation in the littoral zone. Transects will be placed to capture algal habitat variation in the littoral zone (riffles, runs, backwaters, boulders, gravel, sand, mud, sun, shade, etc.). As a result, transects will vary in length based on the habitat composition, but will typically be between 100 and 150 feet in length.

Photographs will be taken at each transect to document site conditions during each sampling event in each major algal habitat area (including underwater photographs of the condition of periphyton and floating mats of reproductive benthic algae). Transect locations will avoid locations such as tributaries, outfalls, and man-made structures to minimize influence of algal growth from contributions in nutrients, temperature, or canopy cover from such sources.

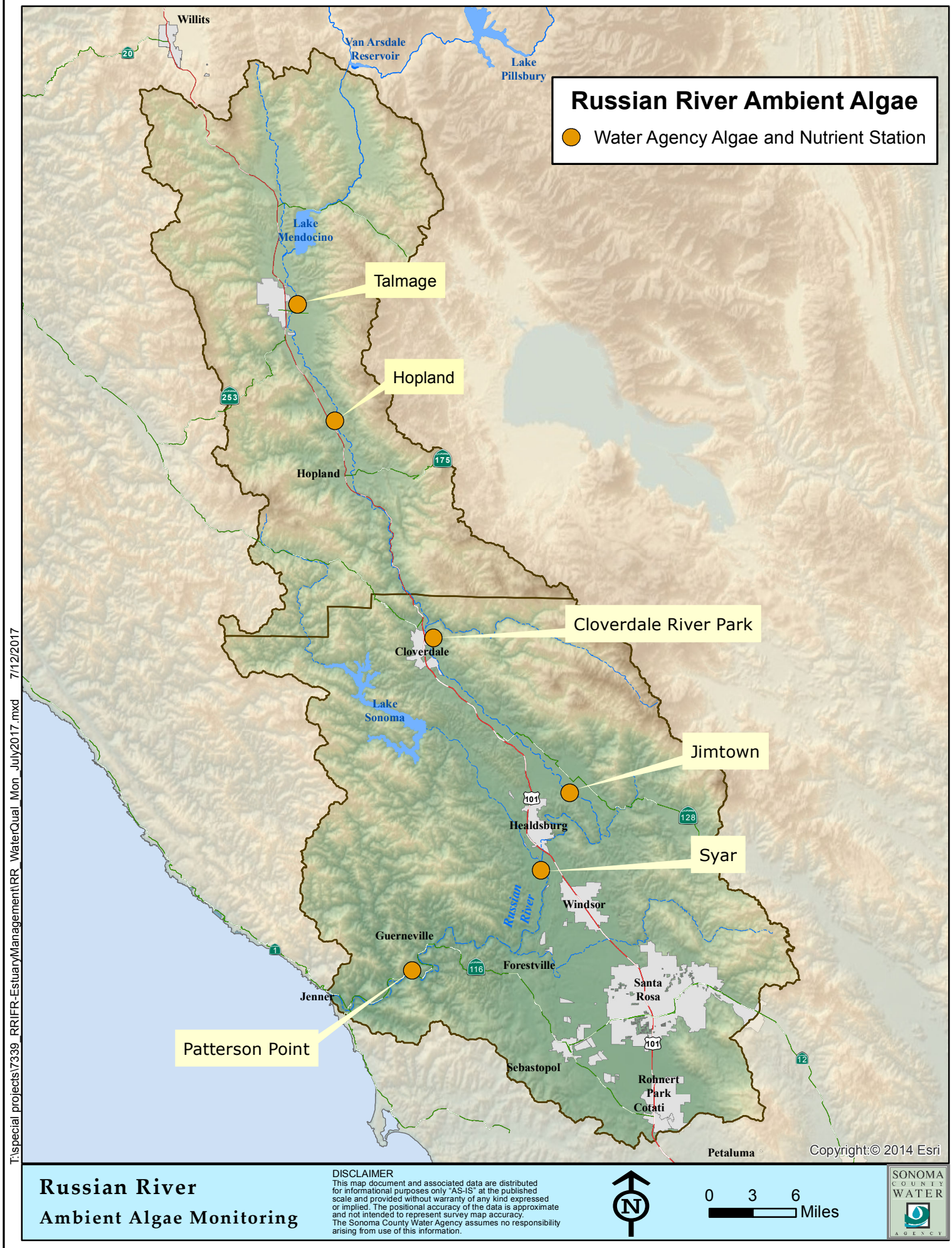
Collecting Cover Data

Identifying Taxa Present (Multi Habitat Algal Sampling)

Prior to collection of percent algae cover, algae samples will be collected 1 m downstream and adjacent to each point (to avoid trampling on samples during collection of percent algal cover data), beginning at the downstream transect. A multi-habitat sample will be collected at various points along 10 foot (3 meters) intervals on the transect that are representative of the variety of habitats present (up to a maximum of 5 samples per transect). Algal species present will be identified to the lowest taxa, preferably species but at least genera. Successional changes in genera over the season should provide a metric to assess species (genera) richness as well as document the stages in development of the periphyton layer. Each sample will be collected from the substrate that is uppermost within the stream and has highest possibility of sun exposure (i.e. if a thick layer of macroalgae covers the substrate, collection will include the layer). Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyta (Golden Brown Algae [diatoms]), and Cyanobacteria (Blue Green Algae). If cyanobacterial target species are identified (including species of *Anabaena*, *Microcystis*, *Planktothrix*, *Oscillatoria,* or *Phormidium*), they will be evaluated for seasonal changes in cover and the possibility of the presence of cyanotoxins will also be evaluated.

Estimating Taxa Richness and Abundance and Metrics Based on Species Composition

Estimates of species abundance will developed from 50 dot viewing bucket sampling, line intercept data, and the relative frequency of occurrence of each genera and species in the multi-habitat sample. Metrics will be calculated based on presence/absence data or on relative abundances of taxa. Percent community similarity will be calculated between sample locations. It will be calculated as the percent of species that are the same by making all relative abundances greater than 0 equal to 1. Metrics of biotic integrity evaluated will include species richness, total number of genera, and total number of taxonomic divisions (green, golden brown, red, blue-greens) present. The following metrics will also be calculated with presence/absence data (as feasible based on known algal indexes): % sensitive taxa, % motile taxa, % acidobiontic, % alkalibiontic, % halobiontic, % saprobiontic, % eutrophic, simple autecological indices, and change in inferred ecological conditions.


Russian River Ambient Algae
Water Agency Algae and Nutrient Station
Willits
Van Arsdale Reservoir
Lake Pillsbury
Lake Mendocino
Talmage
Hopland
Hopland
Cloverdale River Park
Cloverdale
Lake Sonoma
Jimtown
Healdsburg
Syar
Russian River
Windsor
Guerneville
Forestville
Jenner
Patterson Point
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Petaluma
Copyright:© 2014 Esri
T:\special projects\7339_RRIFR-EstuaryManagement\RR_WaterQual_Mon_July2017.mxd 7/12/2017
Russian River
Ambient Algae Monitoring
DISCLAIMER
This map document and associated data are distributed for informational purposes only "AS-IS" at the published scale and provided without warranty of any kind expressed or implied. The positional accuracy of the data is approximate and not intended to represent survey map accuracy. The Sonoma County Water Agency assumes no responsibility arising from use of this information.
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Cover data on algal populations will be conducted to estimate cover by both micro- and macro-algal taxa. Point intercept sampling provides an effective method to quickly estimate cover and abundance of micro-algae, but since it is a dimensionless sampling method, does not provide clear data on where mats of algae form in relation to different conditions in the littoral zone. Line intercept sampling can be completed quickly and provides additional cover information (size and location of algal mats).

Point Intercept Sampling

Percent algal cover will be calculated as an algal indicator of productivity measured as algal abundance using a point-intercept collection methodology. Algal cover will be the amount of microalgae coating and macroalgae taken at 2 foot intervals (60 cm) along each transect. The percentage of the points across the transects at each monitoring site will provide an estimate of percent algal cover.

Beginning with the downstream transect at each site, at every 2-foot (60 cm) interval along the transect, water depth and the presence of algae will be recorded and identified as microalgae or macroalgae. Microalgae is defined as a "film-like coating" of algae. Measurement of microalgae thickness will follow the method identified in SCWA, 2016 and an estimate of film-like coating will follow descriptions in Table 1. Thicker microalgae layers will be measured using a ruler or rod with demarcations at 1, 5, and 20 mm.

Line Intercept Sampling

Line intercept methodology will be used to further characterize macro-algal and riparian cover conditions. The presence and absence (distance occupied along transect) of attached macroalgae or unattached, floating macroalgae, emergent vegetation, dried and floating algal mats, and riparian canopy will also be recorded along each transect. Cover along transects occupied by floating and attached algal mats will be recorded using the line intercept method. Distance occupied by algal mats (or other cover category) divided by total distance of the transect provides an effective measure of instantaneous absolute cover. Where individual cyanobacterial colonies can be visually differentiated in the periphyton, relative distances along the transect for these colonies will be recorded. Data on emergent vegetation and riparian canopy cover will be collected along each transect. Cover data on emergent and riparian canopy will be collected along each transect (if present).

Viewing Bucket Sampling

Semi-quantitative assessments of benthic algal biomass and taxonomic composition will be made rapidly with a viewing bucket marked with a grid and a biomass scoring system. This technique enables rapid assessment of algal biomass over large spatial scales. Coarse-level taxonomic characterization of communities is also possible with this technique. This technique is a survey of the natural substrate and requires no laboratory processing beyond verifying identification.

A viewing bucket marked with a 50-dot grid will be utilized to characterize algae biomass. Three samples will be collected along each transect at approximately 10-30 foot intervals to represent the right bank littoral zone, river center littoral zone, and left bank littoral zone. Using the dots, observations are made to determine thickness of microalgae, length of macroalgae, as well as, occupied and unoccupied substrate.

Sampling Phytoplankton

One sample will be collected along each transect at a 1-foot depth in the flowing (in active flowing channel) water column using a plankton net (deployed for five minutes) to assess the presence and abundance of phytoplankton.

Water Chemistry and Nutrient Sampling

Water chemistry measurements will be recorded near the substrate at each transect point using a YSI 6600 datasonde and YSI 650MDS datalogger. Conditions to be measured include water temperature, dissolved oxygen, specific conductance, pH, and turbidity. Water depth will be taken using a stadia rod or similar device. Water grab samples will be collected from the four ambient algae monitoring sites during algal monitoring activities. Water chemistry and grab sampling will also be conducted at two additional sites including at Cloverdale River Park in Cloverdale and at Talmage Road in Ukiah. All samples will be analyzed for nutrients and *chlorophyll a* (Table 2).

Reporting

An annual report describing the results of the Water Agency Mainstem Russian River Ambient Algae Monitoring effort will be prepared. The report will provide summaries of data observations recorded for each constituent sampled or monitored and the impacts if any to aquatic habitat availability or public health associated with contact recreation. The report will also address the objectives of the monitoring plan described above and answer the following questions:

- What is the composition, abundance, cover and change over time of algal periphytic and planktonic taxa in the Russian River?
- What ecological conditions, including instream flows, influence periphytic and planktonic algae populations in the Russian River?

Quality Assurance Project Plan (QAPP)

Transect Establishment

- Transects to monitor and assess periphytic algal growth, including the potential presence of cyanobacteria, will be established at the four surface water sites selected to represent the range of algal habitats available in the Russian River.
- Monitoring sites in the Russian River will be located at: Patterson Point, located in the lower river in Villa Grande; the upstream end of Riverfront Park, located near Windsor; at Jimtown Bridge, located in Alexander Valley, and in Hopland at the USGS gauging station (Figure 1).
- Transects will be subjectively placed to collect data from areas with different habitat features including but not limited to depths, velocities, substrates, insolation, and emergent vegetation in the littoral zone Establish the reach for multihabitat sampling.
- Transect location will be subjectively placed to incorporate range of the substrate, flow, depth, and light exposure available in aquatic habitats in the Russian River.
- Transects will vary in length based on the habitat composition, but will typically be between 100 and 150 feet in length.

- Photographs will be taken at each transect to document site conditions during each sampling event in each major algal habitat area (including underwater photographs of the condition of periphyton and floating mats of reproductive benthic algae).
- Transect locations will avoid locations such as tributaries, outfalls, and man-made structures to minimize influence of algal growth from contributions in nutrients, temperature, or canopy cover from such sources.

Collecting Cover Data

Identifying Taxa Present (Multi Habitat Algal Sampling)

- Prior to collection of percent algae cover, algae samples will be collected 1 m downstream and adjacent to each point (to avoid trampling on samples during collection of percent algal cover data).
- Multi-habitat sampling will follow the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999).
- A multi-habitat sample will be collected at various points along 10 foot (3 meters) intervals on the transect that are representative of the variety of habitats present (up to a maximum of 5 samples per transect).
- Each sample will be collected from the substrate that is uppermost within the stream and has highest possibility of sun exposure (i.e. if a thick layer of macroalgae covers the substrate, collection will include the layer, or if a thin film on gravel sample will include gravel and the film will be “scrubbed off” for analysis).
- Samples will include all the algae present at the sampling point in a 4 inch (10 cm) radius as collected using a 4.5 inch Pyrex culture dish. Each sample will include all the algae present in the defined area of substrate.
- Samples from each interval will be combined into a common container.
- Samples will be placed in a cooler to protect the algae from heat and desiccation and to preserve specimen integrity.
- Algal species present will be identified to the lowest taxa, preferably species but at least genera.
- Successional changes in genera over the season should provide a metric to assess species (genera) richness as well as document the stages in development of the periphyton layer.
- Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyceae (Golden Brown Algae (diatoms)), and Cyanobacteria (Blue Green Algae).
- Samples will be evaluated for presence of Chlorophyta (Green Algae), Chrysophyta (Golden Brown Algae [diatoms]), and Cyanobacteria (Blue Green Algae).
- If cyanobacterial target species are identified (including species of *Anabaena*, *Microcystis*, *Planktothrix*, *Oscillatoria,* or *Phormidium*), they will be evaluated for seasonal changes in cover and the possibility of the presence of cyanotoxins will also be evaluated.
- Metrics of Biotic Integrity will be evaluated, including species richness, total number of genera, and total number of algal taxonomic divisions.

- Sampling will follow the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999) and incorporate the steps below:
    - Visual estimates or quantitative transect-based assessments will be used to determine the percent coverage of each substrate type and the estimated relative abundance of macrophytes, macroscopic filamentous algae, diatoms and other microscopic algal accumulations (periphyton), and other biota.
    - Collect algae from all available substrates and habitats. The objective is to collect a single composite sample that is representative of the periphyton assemblage present in the reach.
    - Sample all substrates and habitats (riffles, runs, shallow pools, nearshore areas) roughly in proportion to their areal coverage in the reach. A composite sample will be collected randomly from 5 points selected from a table of random numbers along the transect. Each sample will include all the algae present in a 5X5 cm square area of substrate. Changes in species composition of algae among habitats are often evident as changes in color and texture of the periphyton. Small amounts (about 5 mL or less) of sample from each habitat are usually sufficient. Pick specimens of macroalgae by hand in proportion to their relative abundance in the reach. Combine all samples into a common container.
        - Collection methods include:
            - Removable substrates (hard): gravel, pebbles. Remove representative substrates from water; brush cobble and woody debris or scrape representative area of algae from surface and rinse into sample jar.
            - Removable substrates (soft): mosses, macroalgae. Place a portion of the plant in a sample container with some water. Shake it vigorously and rub it gently to remove algae. Remove plant from sample container.
            - Loose sediments: (sand, silt, fine particulate organic matter). Invert petri dish over sediments. Trap sediments in petri dish by inserting spatula under dish. Remove sediments from stream and rinse into sampling container. Algal samples from depositional habitats can also be collected with spoons, forceps, or pipette.
            - Place all samples into a single water-tight, unbreakable, wide-mouth container. A composite sample measuring four 4 ounces (ca. 125 ml) is sufficient.
            - Label the outside of the sample container with the following information: waterbody name, sampling location, transect, date, name of collector, and type of preservative. Record this information and relevant ecological information in a field notebook. Place another label with the same information inside the sample container.
            - Transport samples back to the laboratory in a cooler with ice (keep them cold and dark) and store preserved samples in the dark until they

are processed. Be sure to stow samples in a way so that transport and shifting does not allow samples to leak.

- Record sample identification code, date, stream name, sampling location, transect, collector's name, sampling method, and area sampled.

Estimating Taxa Richness and Abundance

- An assessment of the relative abundances of algal taxa will be conducted for “soft" (non-diatom) algae and diatoms using a modified version of the *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour, 1999).
- Five samples will be collected at each transect by collecting all the algae present at the sampling point in a 4 inch (10 cm) radius as collected using a 4.5 inch Pyrex culture dish.
- All the algae present will be removed from the substrate and all five samples will be combined into a common container.
- All genera observed in the common container will be identified to division and genus using light microscopy.
- A minimum of ten “wet’” slides per multi-habitat sample will be prepared and evaluated.
- Samples will be evaluated until no new genera are found in the container
- Abundance and species richness will be estimated by taxa based on frequency of occurrence in algal samples

Cover data on algal populations will be conducted to estimate cover by both micro- and macro-algal taxa. Ambient data on algal populations will be collected along transects using both point and line intercept sampling methods. Point intercept sampling provides an effective method to quickly estimate cover and abundance of micro-algae, but since it is a dimensionless sampling method, does not provide clear data on where mats of algae form in relation to different conditions in the littoral zone. Line intercept sampling can be completed quickly and provides additional cover information (size and location of algal mats).

Viewing Bucket Sampling

- Percent algal cover will be calculated as an algal indicator of productivity measured as algal abundance using a 50 dot viewing bucket collection methodology.
- Beginning with the downstream transect at each site, for each sampling point along the transect, the presence of algae will be recorded and identified as microalgae or macroalgae. Microalgae is defined as a “film-like coating” of algae.
- Algal cover will be the amount of microalgae coating and macroalgae taken at three representative locations along each transect. The number of occupied versus un-occupied dots will provide an estimate of percent algal cover.
- Thickness ranks will be evaluated separately for diatoms and blue-green algae.

- Measurement of microalgae thickness will follow the method identified in Fetscher, et al. 2009 and an estimate of film-like coating will follow descriptions in Table 1. Thicker microalgae layers will be measured using a ruler or rod with demarcations at 1, 5, and 20 mm.
- The number of dots occupied by macroalgae will be recorded.
- The length of the macroalgae on occupied dots will be recorded.
- Dots where no microalgae or macroalgae occur will be recorded.
- The presence/absence of attached macroalgae or unattached, floating macroalgae will also be recorded at each point.
- Photographs will be taken to document the viewing bucket analysis and generally of the periphyton at 10 foot intervals along each transect during viewing bucket sampling. These photographs will include images taken with underwater cameras and utilizing a 7 X 7 grid marked "viewing bucket".
- Measure water depth at each sampling location.
- Specifically, data collected with the viewing bucket will be used to determine algal density by calculating:
    - Total number of grid points evaluated at site
    - number of grid points over macroalgae
    - Total number of grid points over suitable substrate for microalgae
    - number of grid points over microalgae of different thickness ranks by each type of microalgae (blue-green or diatoms)
    - average percent cover of the habitat by each type of macroalgae
    - maximum length of each macroalgae
    - mean density of each type of macroalgae on suitable substrate

Table 1. Microalgal thickness codes and descriptions.

Microalgal thickness codes and descriptions (from Fetscher, et al. 2009 and adapted from Stevenson and Rollins 2006)		
Code	**Thickness**	**Diagnostics**
0	No microalgae present	The surface of the substrate feels rough, not slimy.
1	Present, but not visible	The surface of the substrate feels slimy, but the microalgal layers is too thin to be visible.
2	<1mm	Rubbing fingers on the substrate surface produces a brownish tint on them, and scraping the substrate leaves a visible trail, but the microalgal layers is too thin to measure.
3	1-5mm	
4	5-20mm	
5	>20mm	
UD	Cannot determine if a microalgal layer is present	

Line Intercept Sampling-Cover

- Cover along transects occupied by attached macroalgae or unattached floating macroalgae, and dried and floating algal mats, will be recorded using line intercept method.
- Distance occupied by algal mats divided by total distance of the transect provides an effective measure of instantaneous absolute cover.
- Cover data on emergent and riparian canopy will be collected along each transect (if present).

Sampling Phytoplankton

- One sample will be collected along each transect at a 1-foot depth in the flowing (in active flowing channel) water column using a plankton net deployed for five minutes to assess the presence and abundance of phytoplankton.
- Samples will be placed in a cooler to protect the algae from heat and desiccation and to preserve specimen integrity.
- Species present will be identified to the lowest taxonomic level feasible given diagnostic characteristics available in the samples.
- Cell counts using the Palmer cells will also be conducted for plankton samples.
- Keenan Foster, a taxonomic botanist and Principal Environmental Specialist with the Water Agency, will be conducting the algae identification and evaluation for the presence of cyanobacteria.

Water Chemistry and Nutrient Sampling

- Water chemistry measurements will be recorded near the substrate at each transect point at the four algal monitoring sites and at two additional mainstem Russian River sites using a YSI 6600 datasonde and YSI 650MDS datalogger. Conditions to be measured include water temperature, dissolved oxygen, specific conductance, pH, and turbidity. Water depth will be taken using a stadia rod or similar device.
- The applicable standard operating procedures and established monitoring and sampling protocols that Water Agency staff, under the guidance of Senior Environmental Specialist Jeff Church, will follow as part of their Quality Assurance (QA) and Quality Control (QC) efforts are described in the Water Quality Monitoring Plan for the Russian River Estuary Management Project (SCWA, 2016).
- All YSI 6600 Datasondes used to collect real-time data during algal and nutrient sampling will be calibrated following the manufacturer's 6-Series User Manual by Water Agency staff.
- Water grab samples will be collected from the four algal monitoring sites and at two additional mainstem Russian River sites during algal monitoring activities. All samples will be analyzed for nutrients and *chlorophyll a* (Table 2).

Sampling methodology and quality assurance protocols including: chain-of-custody procedures, sample labeling, storage and transport protocols, sample containers and sample collection methods, and decontamination will follow the *National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, chapters A1-A9*, available online at http://pubs.water.usgs.gov/twri9A (USGS various) and included in the Water Quality

Monitoring Plan for the Russian River Estuary Management Project (SCWA, 2016), in conjunction with protocols and procedures established by the contract laboratories (Alpha Labs and DHS Lab) and the Sonoma County Water Agency *Quality Assurance Manual, Water Quality Manual*, *July 9, 2013* (SCWA 2013), also included in SCWA, 2016.

Table 2. List of nutrient and algal indicators to be analyzed in water samples collected for the Mainstem Russian River Ambient Algae Monitoring.

Compound	Test Method	Method Detection Limit (MDL)	Laboratory Reporting Limit (LRL/PQL[1])	Units
Nitrogen, Total	SM4500-N	0.2	0.5	mg/L
Nitrogen, Total Organic	SM4500-N	0.2	0.2	mg/L
Nitrogen, ammonia as N	SM4500NH3C	0.1	0.2	mg/L
Ammonia Unionized	SFBRWQCP	0.00010	0.00050	mg/L
Nitrogen, nitrate as N	EPA300.0	0.050	0.20	mg/L
Phosphorus, total	SM4500-P E	0.020	0.10	mg/L
Chlorophyll (a)	SM10200H	0.000050	0.010	mg/L

- Alpha Labs will be reporting the results at the MDL, however the data will be subject to their reporting protocols which will require that they record the results as "Detected but below Reporting Limit; therefore, result is an estimated concentration, detected but not quantified (DNQ)".
- [1] PQL – Practical Quantitation Limit.

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