

SURFACE WATER MONITORING AND REPORTING PLAN
(State Water Resources Control Board Agreement No. 03-240-55-0)
TUOLUMNE COUNTY
(September 21, 2005)

I. INTRODUCTION

Tuolumne County (County) has prepared this Surface Water Monitoring and Reporting Plan (MRP) to establish a consistent monitoring and reporting protocol for the acquisition of water quality data for local surface waterways. The MRP is intended to set standards and provide guidance for ensuring that the acquisition, use, and interpretation of water quality data are consistent with the State Water Resources Control Board's (SWRCB) protocols. The MRP describes all aspects of the monitoring program including sampling locations, field procedures, water quality sampling parameters, quality control practices, and reporting protocols. County staff will oversee the phased implementation of the MRP, which will include a first phase of baseline water quality monitoring, followed by a second phase tracking. The second phase will be implemented by a combination of County staff and trained-citizen monitoring.

II. BACKGROUND

The County, located along the western slope of the central Sierra Nevada Mountains, has a population of 54,500 individuals. Over the past decade, the growth rate has averaged about 12 percent. The County comprises some 1,418,781-acres and includes the City of Sonora, several unincorporated communities, the Stanislaus National Forest, and Yosemite National Park. The developed sections of the County occur within the lower sections of the Upper Tuolumne River and Upper Stanislaus River, both designated by the California Unified Watershed Assessment (CUWA) as Category I (Impaired) watersheds.

Category I watersheds are rated as such according to examined values, risks, and opportunities. Value(s) of the two watersheds include domestic water supplies, biodiversity, recreational opportunities, power generation, and so on. Risks to the two watersheds include threat of wildfire from high fuels loading; water bodies with impaired beneficial use (e.g. drinking water, recreation, fisheries); and impaired aquatic and/or wetland habitat according to the professional judgment assessment (PJA). No integrated management structure or local working group exists within the County to evaluate where issues exist and, more importantly, apply corrective actions, where appropriate

All urban and rural runoff generated within the County flows into the lower reaches of each watershed (e.g. New Melones or Don Pedro Reservoirs), and therefore, carries the potential to affect the water quality within each watershed. Comments received by local agencies and the community have suggested that Sullivan Creek, Woods Creek, Turnback Creek, Curtis Creek, all tributaries of the Tuolumne River, as well as Mormon Creeks, a tributary of the Stanislaus River, may be the most affected by various land uses within the County. High sediment levels within local creeks and documented reductions in local reservoir storage capacity have prompted the need for investigation. Based on local drainage patterns and available funding, five watershed planning units (Calwater 2.2)

were delineated for assessment at a greater level of detail. The four watersheds (or: hydrological areas) identified for monitoring include the Sullivan Creek, Woods Creek, North Don Pedro, and Groveland-Big Oak Flat (Garrotte Creek) within the Upper Tuolumne River Hydrologic Unit; and the Copperopolis unit (Mormon Creek) within the Upper Stanislaus River Hydrologic Unit.

III. OVERVIEW

Environmental Science Associates (ESA) has prepared this monitoring plan to be executed by staff with ESA, County personnel and, eventually, volunteer monitors. ESA, working on behalf of County personnel, will be responsible for coordinating and performing the first phase of the MRP, including providing sampling equipment, obtaining sample bottles from the lab, taking field notes, and ensuring delivery of the samples to the analytical laboratories. The following sections provide details of the monitoring plan, including constituents, sampling locations, frequency, and the sampling team. In a separate document, the QAPP will discuss the details of how the samples are collected to provide data that are representative and scientifically defensible.

IV. WATER QUALITY SAMPLING

This section outlines procedures for monitoring the water quality of foothill creeks at specific points within the County. By virtue of the expansive area involved and range in parameters covered by the MRP, its design consists of a two-phased approach. The first will involve the establishment of a water quality baseline. This phase will be completed by staff with ESA. Following preparation of the WQP, the second phase of the MRP will consist of tracking general field parameters and those constituents identified as a potential concern during the first phase in consultation with RWQCB staff. A volunteer monitoring group under County oversight will conduct the second phase of monitoring. The MRP is intended to be dynamic through its implementation and therefore, will be subject to future amendment based on data interpretation as it is collected. The first phase of monitoring will include two components:

Grab samples will be collected and analyzed from three runoff events. Specific criteria for the selection of storm events are provided below. The following parameters will be sampled and analyzed at targeted locations: flow, pH, total suspended solids (TSS), hardness, specific conductance, oil and grease, temperature, Priority Pollutant Metals¹, turbidity, and nitrate/nitrite as N. Other, more site-specific tests may include EPA 8151A Herbicides, EPA 8260B Volatile Organics, and Total and Fecal Coliform bacteria.

Concurrent with collection of the above grab samples visual observations for the presence of floating and suspended materials, films or sheens, discoloration, turbidity, potential nuisance conditions (e.g. odor) and aquatic life will also be taken and recorded.

No acute or chronic toxicity monitoring is proposed under the MRP. However, information yielded from this data collection effort may compel RWQCB staff to direct such monitoring in the future.

¹ Priority Pollutant Metals include arsenic (As), antimony (Sb), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), and zinc (Zn).

Monitoring Locations

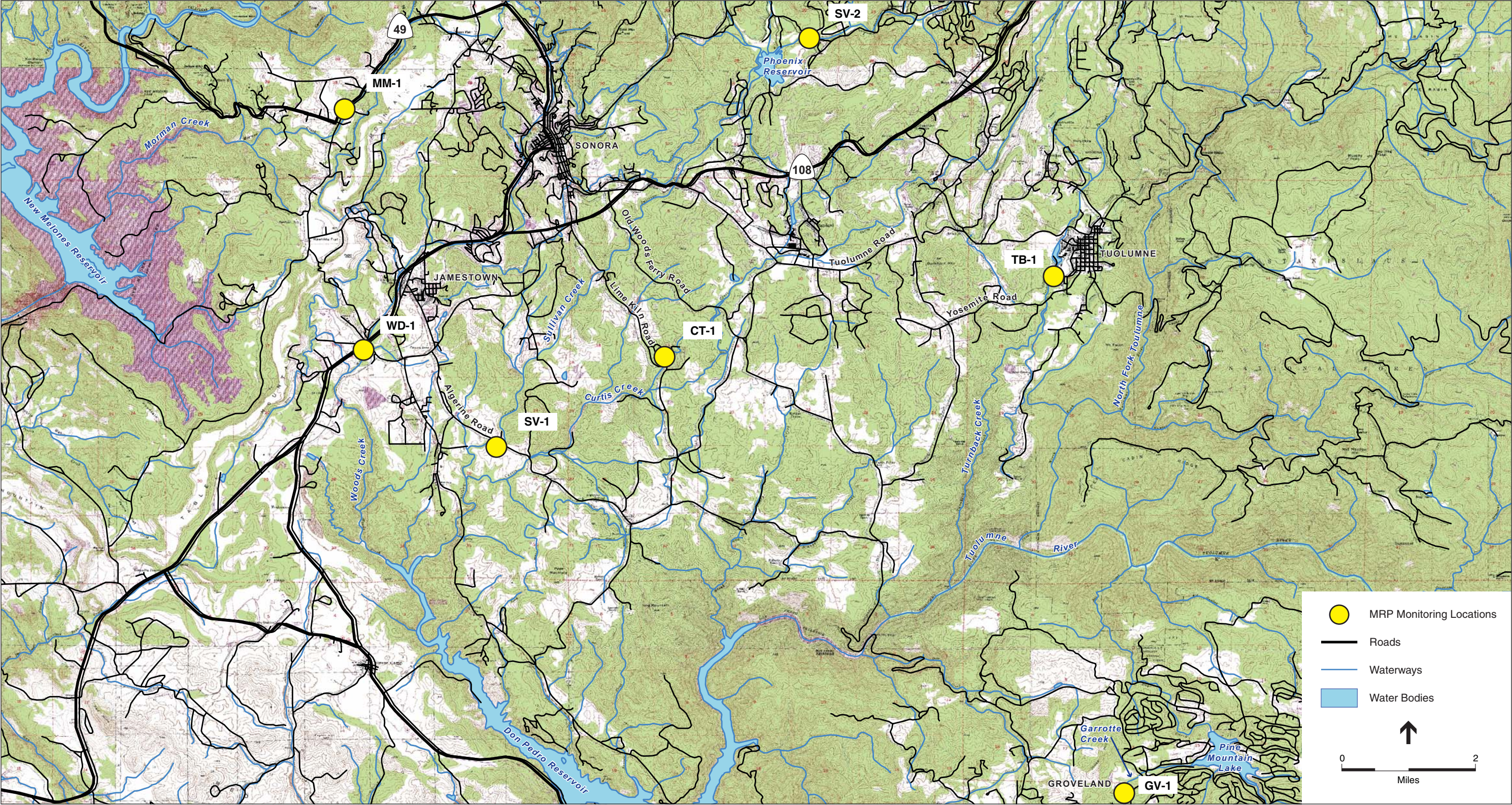
The locations of the seven monitoring sites were chosen to characterize the quality of surface water draining from existing urban and rural centers and areas currently experiencing increased growth pressures (e.g., construction). In addition, the identified waterways may or may not receive runoff from other uses such as grazing, small vineyards, rural roadways, and private timber operations. In this context, the selection of the seven sites is primarily based on localized hydrology within each of the selected hydrologic areas and land use considerations upstream of the selected monitoring points based on field investigation, aerial photograph interpretation, and review of the County General Plan Land Use Map. Land use considerations were particularly important in developing the MRP to account for factors that could influence surface water quality within each hydrologic area. In addition, the selection process favored those locations where access is readily available, such as where a public road crosses or intersects the waterbody.

The two phases of the MRP initially utilize a mass (or cumulative) loading approach to determine surface water quality at the seven monitoring locations. This approach is designed to monitor large drainage areas with mixed land use characteristics. ESA, in conjunction with the Tuolumne County Water Quality Committee and consultation with the CVRWQCB, selected the mass loading monitoring site locations. The primary site selection factors included:

- Suitability of the site drainage area to monitor area-wide contributions of storm water pollutant loading;
- Suitability of the site's hydrological characteristics to enable practical measurement of flow and collection of representative storm water samples;
- Safety from traffic and other hazards;
- Potential for development under County jurisdiction within the HA (hence corresponding potential to implement BMPs and increased likelihood of for water quality benefits); and
- Access for retrieving samples and maintaining equipment during storm conditions.

The mass loading sites were selected to directly measure pollutant loads being discharged into water supply sources, namely New Melones and Don Pedro Reservoirs, within the five hydrologic areas under consideration. Monitoring sites are included where flow from up-gradient catchments pass through a single hydrologically ratable point, suitable for measurement and sampling. In most instances, these sites were located upstream of the drainage area discharge point for accessibility and/or to avoid reservoir water level influences.

Six of the monitoring locations are located within the Upper Tuolumne River Watershed; with the fifth located in the Upper Stanislaus River. These surface water features receive a majority of the runoff generated from urban and rural centers within the County's jurisdiction. The monitoring locations along each reach were chosen to provide an indication of cumulative runoff within each sub-watershed unit. These monitoring locations are shown in **Figure 1** and in photographs contained in **Appendix A**.



SOURCE: Tuolumne County, 2004; and ESA, 2005

Tuolumne County WQP Project . 204254
Figure 1
Surface Water Monitoring Locations

Monitoring points within the Tuolumne River Watershed will be limited to specific reaches of Sullivan Creek, Woods Creek, Curtis Creek, Turnback Creek, and Garrotte Creek. These creeks drain directly into Don Pedro Reservoir, with the exception of Garrote Creek, which drains into Big Creek, via Pine Mountain Lake, and then onto the mainstem of the Tuolumne River. Two monitoring locations are proposed along Sullivan Creek with one situated just above Phoenix Lake and the second situated just above the confluence of Curtis Creek on Algerine Road. Monitoring along Garrotte Creek will occur downstream of the town of Groveland. Woods Creek will be monitored downstream of Jamestown. Monitoring along Turnback Creek will occur below Tuolumne City. Photographs and descriptions of the monitoring locations are provided in **Table 1** and **Appendix A**.

TABLE 1 - SAMPLING LOCATIONS

Sample Site Designation (A)	Sample Site Location (Latitude/ Longitude)	Land Uses Assessed	Other Site Information
TB-1	-120 deg 15' 0.0" 37 deg 57' 0.0"	Rural, Estate, and Low-Density Residential; General Commercial; Timber Production; Light Industrial	The TB-1 monitoring location is accessed by parking near the end of Box Factory Road at the Turnback Creek Bridge. The creek can be accessed at the upstream side of the bridge using caution while descending the bank..
SV-1	-120 deg 24' 0.0" 37 deg 55' 12.0"	Rural, Estate and High and Low-Density Residential; General and Heavy Commercial; Grazing; Heavy and Light Industrial; Business Park	This monitoring location is accessed by parking on the shoulder of Algerine Road at either end of the bridge over Sullivan Creek and proceeding to the downstream side on either end of the bridge. Use caution descending the stream bank below Algerine Road. If necessary, tie a piece of static rope or webbing of sufficient length to the bridge to aid in carrying equipment and supplies down-slope. Use a square knot to avoid knot failure.
SV-2	-120 deg 19' 12.0" 38 deg 0' 36.0"	Rural, Estate and High and Low-Density Residential; General Commercial; Grazing; Timber Production	The SV-2 monitoring location is located just east of Phoenix Lake on Potato Ranch Road. SV-2 can be accessed by parking on the shoulder of Potato Ranch Road, approximately 200 feet north of the bridge. Use caution descending the stream bank above Potato Ranch Road.
MM-1	-120 deg 26' 24.0" 37 deg 59' 24.0"	Rural, Estate and High and Low-Density Residential; General and Heavy Commercial; Light Industrial ; Airport (Mixed Use)	This monitoring location will be accessed by taking State Route 49 north towards New Melones Reservoir. Take a left onto Mormon Creek Road. Proceed to the first bridge and park on the shoulder. Sampling will take place upstream of the bridge along Mormon Creek. This location is readily assessable; however, use caution when descending down to the creek channel.
GV-1	-120 deg 13' 12.0" 37 deg 51' 0.0"	Rural, Estate and High and Low-Density Residential; General and Heavy Commercial; Mixed Use	GV-1 can be accessed by taking State Route 120 east past the town of Groveland. Just past the Groveland Wayside Park, proceed to the left on Ferretti Road. Proceed on Ferretti Road for about 1 mile before, taking a left at the Groveland CSD access road. The access road crosses Garrotte Creek, via a two-lane bridge. Park at either end of the bridge and proceed to the upstream side at either end of the bridge.
WD-1	-120 deg 25' 48.0" 37 deg 56' 24.0"	Rural, Estate and High and Low-Density Residential; General and Heavy Commercial; Grazing; Light Industrial;	The WD-1 monitoring location is accessed just south of Sonora Pass Road (Highway 108). At the intersection of Bell Money Road, proceed to the south approximately 700 feet to the Woods Creek Bridge and park on either side of the bridge. Sampling will take

TABLE 1 - SAMPLING LOCATIONS

Sample Site Designation (A)	Sample Site Location (Latitude/ Longitude)	Land Uses Assessed	Other Site Information
CT-1	-120 deg 20' 24.0" 37 deg 57' 0.0"	Business Park	place upstream of the bridge along Woods Creek. This location is readily assessable; however, use caution when descending down to the creek channel.
		Rural, Estate and High and Low-Density Residential; General and Heavy Commercial; Grazing; Heavy and Light Industrial; Business Park	The CT-1 monitoring location will be accessed from Lime Kiln Road. This location is approximately 1.0 miles south-southeast of Sonora. Sampling at this monitoring location will occur up-stream of the bridge. This location is readily assessable; however, use caution when descending down to the creek channel.
(A) - Ambient Surface Water Sampling Sites – Water samples will be collected and analyzed for constituents list in Table 1.			

Monitoring within the Stanislaus River Watershed will be limited to the Copperopolis HA with monitoring focused on the lower reach of Mormon Creek. As illustrated in Figure 1, the monitoring location is situated just upstream of New Melones Reservoir and below the Town of Columbia. Photographs and descriptions of the monitoring locations are provided in **Table 1** and **Appendix A**.

Sampling Constituents

After determining the locations to be sampled, it is necessary to define the constituents that are potentially present in the water column, especially those that could occur at sufficient concentrations to impair the beneficial uses. In this context, the MRP includes monitoring for a wide range of parameters that could be present in local creeks, based on those land uses present upstream within each hydrologic area, to characterize baseline mass loading conditions.

Table 2 lists water quality parameters important to the applied beneficial uses that may be affected by the variety of the land uses present with the each hydrologic unit. Chemical constituents to be analyzed at each monitoring location are summarized in **Table 2**. Sample containers, preservatives, laboratory methods, and detection limits for each constituent are provided in **Appendix B**. This list may be modified to add and/or remove constituents as data is collected.

The constituents included in the MRP for sampling analysis were selected due to their association with land uses encountered in the hydrologic study areas and importance in assessing the monitored waterbody's potential affect on downstream beneficial uses. Below is brief description of why each of the sampling constituents is included:

- Flow.** Creeks flows will be recorded with a field meter to provide a correlation between creek velocity and concentrations of other water quality constituents (e.g. turbidity).
- pH.** Water dissolves mineral substances it contacts, picks up aerosols and dust from the air, receives man-made wastes, and supports photosynthetic organisms, all of which affect pH. The buffering capacity of water, or its ability to resist pH change, is critical to aquatic life,

as it determines the range of pH. Generally, the ability of aquatic organisms to complete a life cycle greatly diminishes as pH becomes >9.0 or <5.0.

TABLE 2 - SURFACE WATER SAMPLING PARAMETERS

Analysis	Method	Units	RL / IAL	Monitoring Location(s)						
				SV-1	SV-2	GV-1	MM-1	TB-1	CT-1	WD-1
Flow	Field	ft. ³ /second	--	x	x	x	x	x	x	x
pH	Field	pH Units	pH Unit	x	x	x	x	x	x	x
Specific Conductance	Field	•S/cm	+/- 0.5%	x	x	x	x	x	x	x
Temperature	Field	deg. C	+/- 0.5 ° C	x	x	x	x	x	x	x
Dissolved Oxygen	Field	mg/L	+/- 2%	x	x	x	x	x	x	x
Turbidity	Field	NTU	+/- 2%	x	x	x	x	x	x	x
Hardness	SM-2340B	mg. eq. CaCO ₃ /L	1.0	x	x	x	x	x	x	x
Oil and Grease	EPA 1664	mg/L	5.0	x		x	x	x	x	x
Total Suspended Solids	EPA 160.2	mg/L	5.0	x	x	x	x	x	x	x
Priority Pollutant Metals	EPA 200.8 ^(A)	•g/L	variable	x	x	x	x	x	x	x
Low-Level Mercury	EPA 1631	ng/L	0.5	x	x	x	x	x	x	x
Total & Fecal Coliform	STDM 9221	MPN/100 mL	2	x	x	x	x	x	x	x
Nitrate/Nitrite as N	EPA 300.0	mg/L	0.500	x		x	x	x	x	x
Volatile Organics	EPA 8260B	ug/L	variable	x			x	x	x	x
Herbicides	EPA 8151A	ug/L	variable	x			x	x	x	x

Note: SV-1 (Sullivan Creek at Algerine Road); SV-2 (Sullivan Creek at Potato Ranch Road); GV-1 (Groveland Creek at Tannahill Road); MM-1 (Morman Creek at Morman Creek Road); TB-1 (Turnback Creek at Box Factory); CT-1 (Curtis Creek at Lime Kiln Road); WD-1 (Woods Creek at Bell Mooney Road).

(A) EPA Method 200.8 is designed to obtain analytical results for numerous metals with differing detection limits.

RL / IAL – Reporting Limit / Instrument Accuracy Level

Specific Conductance. Electrical conductivity is a measure of a water's ability to conduct electricity, and therefore a measure of the water's ionic activity and content. The higher the concentration of ionic (dissolved) constituents, the higher the conductivity. Specific conductance (SC) is simply the conductivity normalized to temperature of 25 °C. SC is generally found to be a good measure of the concentration of total dissolved solids (TDS) and salinity. Elements whose ionic forms contribute the most to these measures include: calcium (Ca²⁺), magnesium (Mg²⁺), sodium (Na⁺), potassium (K⁺), bicarbonate (HCO₃⁻), sulfate (SO₄²⁻), and chloride (Cl⁻).

Temperature. The temperature of water has extremely important ecological consequences. Temperature exerts a major influence on aquatic organisms with respect to selection/occurrence and level of activity of the organisms. In general, increasing water temperature results in greater biological activity and more rapid growth. Temperature is also an important influence on water chemistry. Rates of chemical reactions also generally

increase with increasing temperature. Temperature is a regulator of the solubility of gases and minerals (solids) – or how much of these materials can be dissolved in water. The solubility of important gases, such as oxygen and carbon dioxide increases as temperature decreases. For example warm water contains less dissolved oxygen (DO) than cold water. Inversely the solubility of most minerals increases with increasing temperature.

Dissolved Oxygen. The concentration of dissolved oxygen [DO, units of milligram per liter (mg L⁻¹)] is an important regulator of chemical processes and biological activity. Most forms of aquatic life require Oxygen (DO). For example, certain combinations of low temperature and high DO concentrations are required for the maintenance of a cold water sport fishery (such as trout and salmon).

Oxygen is moderately soluble in water. The solubility limit, or saturation concentration of DO is largely regulated by temperature. Concentrations that exceed the saturation value are described as supersaturated. Such conditions reflect high photosynthetic activity (i.e. during an algal bloom). Undersaturated conditions prevail when the DO concentration is less than the saturation value, indicating oxygen-demanding processes exceed the sources of DO.

Turbidity (NTU) and Total Suspended Solids (TSS). These two parameters are included in the MRP to provide an indication of level of sedimentation within the monitored waterways. NTU is a nephelometric turbidity unit. The TSS and NTU are related parameters, in that the measurement of total suspended solids in a sample is somewhat related to the light scattering as reported in NTU. As a rough approximation, 1 mg/L of TSS in the form of finely divided silica of a certain type is equivalent to about 1 NTU. There are large variations in this relationship, depending on the characteristics of the suspended solids and how the NTU measurements are made. NTU is a standardized parameter for measuring light scattering that does not necessarily measure a definitive property.

Oil and Grease. Oil and grease measurement are included in the MRP to provide an indication of the level of petroleum and associated by-products entering local waterways from roadways, fueling stations, etc.

Priority Pollutant Metals. Sources of trace metals in local creeks vary greatly and may include industrial processes, corroding metal surfaces, combustions processes, natural deposits (e.g. mining), and others. Heavy metals (especially copper, lead and zinc) are by far the most prevalent priority pollutant constituents found in urban runoff. Metals in urban storm water have the potential to impact water supply and cause acute or chronic toxic impacts for aquatic life. A significant flux of metals (e.g. arsenic, mercury, copper, etc.) from abandoned and inactive mines is also thought to be a threat to local surface waters.

Total & Fecal Coliform. Increasing attention is being paid to the sanitary quality of the State's waters, particularly with regard to the use of the State's waters for contact recreation. While this issue has been largely ignored in the past, this situation is changing, primarily as a result of the US EPA's efforts to require that states update and enforce the sanitary quality indicator organism water quality standards. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Nitrate/Nitrite as N. Nitrate and Nitrite are forms of nitrogen, which is found in several different forms in terrestrial and aquatic ecosystems. Nitrates are very soluble (therefore, mobile) in water, unlike phosphorous. The nitrate level in freshwater is usually found in the range of 0.1 to 4 mg/l NO₃-N. Unpolluted waters generally have nitrate-nitrogen levels below 1 mg/l.

Nitrate is the most oxidized form of nitrogen, and is the primary form of biologically available nitrogen. Concentrations >10mg/L can cause Methemoglobinemia (Blue Baby Syndrome) in infants. Toxicity is the result of reduction of NO₃ to Nitrite (NO₂), which reacts with hemoglobin and prevents the blood cells from transporting oxygen to tissues. Excessive nitrate and resulting nitrite concentrations have been shown to be toxic to aquatic life such as frogs and marine invertebrates. Excessive concentrations stimulate growth of algae and aquatic plants which can negatively affect creek health. Extensive growth of algae increases decaying vegetative material, resulting in low or fluctuating dissolved oxygen levels. Low dissolved oxygen can be lethal to fish and other aquatic species.

Volatile Organics. These are chemicals of an organic nature (containing hydrogen, oxygen, and carbon) which readily volatilize, or travel from the water into the air. Most of these substances are industrial chemicals and solvents. They include light alcohols, acetone, trichloroethylene, dichloroethylene, benzene, vinyl chloride, xylenes, and methyl-tert-butyl ether (MTBE). These potentially toxic chemicals are used as solvents, degreasers, paints, thinners, and fuels. Because of their volatile nature, they readily evaporate into the air, increasing the potential exposure to humans. Due to their low water solubility, environmental persistence, and widespread industrial use, they are commonly found in soil and water.

Chlorinated Herbicides. Chlorinated herbicides have been used wide-spread in the past decades for landscaping, agriculture, forestry, and vegetation control applications. These compounds have high to very high acidity, low to high water solubility, and very low to moderate volatility. Both water solubility and soil retention are dependent on soil pH, with maximum soil adsorption occurring under acid conditions. Soil retention ranges from very low to low. Organic matter is the major component that binds this class of herbicides to soil. The major means of breakdown is microbial decomposition.

Other constituents that are not covered under the current version of the MRP, but may be included in future monitoring efforts, include:

Polycyclic Aromatic Hydrocarbons [PAHs] (EPA 610).
Organochlorine Pesticides (EPA 8081A).
Organophosphorus Pesticides (EPA 8141B).
Semi-Volatile Organic Compounds (EPA 8316, EPA 8270C).
PCBs (EPA 8082).

Sampling Frequency and Schedule

Sampling events under Phase One will be conducted on a quarterly basis through the first quarter of 2006 for a total of three events. Following this phase, volunteer monitoring will continue on a quarterly basis through the first quarter of 2007. Under phase one, each sampling event requires a full ten-hour

day to pre-calibrate field equipment, collect and record water column samples, measure field parameters, prepare samples for transport, and deliver samples to the respective laboratories. Sampling under phase two will be less comprehensive and take on the order to two to four hours depending of driving distances. County personnel will determine specific dates on which the sampling events will occur within each quarter. The aim will generally be to characterize water quality shortly, thereafter light to moderate rainfall events. In addition, it is encouraged that one dry-weather flow event be captured during the course of first phase and better capture variability in surface waters. Both non-storm (dry-weather) and storm conditions will be targeted over the long term.

The expected sampling dates are listed below in **Table 3**; however, unexpected circumstances may require that a sampling date be rescheduled. The monitoring plan will be updated with any changes.

TABLE 3. QUARTERLY SAMPLING SCHEDULE

	Sampling Dates*	Targeted Conditions
Phase One		
Fall 2005	9/30/05 thru 10/30/05	Storm/Dry-Weather Event
Late Fall-Winter 2005	11/1/05 thru 12/31/05	Storm Event
Winter 2006	1/1/06 thru 2/28/06	Storm/Dry-Weather** Event
Phase Two		
Remainder of 2006-beginning of 2007	Quarterly After 3/1/06 thru 2/28/07	Non-Storm/Storm
*Specific sampling dates will be determined by County personnel.		
**If necessary		

Monitoring Criteria

The storm events that are sampled should meet several criteria. One event should be representative of the fall rainy season, and another should be representative of the spring rainy season. In the case of the fall event, the sampling team should attempt to capture the “first flush” storm event of the season. Each event should produce “significant stormwater discharge,” which is defined by the Regional Board as a continuous discharge of storm water for approximately one hour or more. Third, each event should be preceded by at least three days of dry weather. Finally, grab samples should be taken during the first few hours of storm water discharge (not precipitation), or as soon as practicable thereafter.

Sampling of significant storm events should be considered optional if they fall outside of regular business hours. However, sampling during the evening and/or weekend may be necessary if it is close to the end of the wet season and no samples have been taken. In no event should the sampler be required to sample during anything other than daylight hours.

The project schedule allows for limited dry weather monitoring. One dry-weather event may be included during the first phase on monitoring; depending weather conditions during the season. Dry-weather sampling will be continued on an annual basis during phase two of the MRP and is anticipated for the summer of 2006.

Sampling Methods

Below describes the sampling procedures to be implemented during both phases of the MRP; recognizing that phase two will entail reduced monitoring, largely driven by available funding. All field equipment will be stored at ESA's Sacramento Office during phase one and the UC Cooperative Extension main office, on 52 North Washington Street, during phase two. Prior to departure, all necessary equipment will be gathered. A complete list of suggested equipment is provided in **Appendix C**; monitoring worksheets are provided in **Appendix D**. All field equipment shall be calibrated according to manufacturers' specifications prior to sampling. To protect sampling personnel and prevent sample contamination, sampling personnel will wear rubber gloves at all times while sampling. Quality control is of utmost importance, and will be followed fastidiously to ensure the quality of the data.

Field meters will be used to measure in-stream flow, dissolved oxygen (DO), specific conductance, turbidity, pH, and temperature at locations illustrated in **Appendix A**. To the extent feasible, try to grab samples from the center of the creek verses the sides; while ensuring that you are standing downstream of the sensors. Allow approximately one minute for readings to stabilize. Log the field data electronically and on the hardcopy field worksheet to avoid accidental loss of data.

Flows velocity data shall be taken at a depth of 2/3 of the actual water depth. If flows are less than 1 foot per second, obtain an accurate DO reading by moving the sensor rapidly through the water. Rinse sensors with deionized water (or as prescribed by manufacturer) and dry with Kimwipes between samples. If flows are too turbulent to permit physical entry, use the sampling pole to acquire grab samples from the middle of the creek. Immediately immerse the probes within the sample container and follow procedures above.

Grab samples may be obtained using a sampling pole or by hand, depending on the flow present. Attach the first sample container to the sampling pole, and remove the container lid. Dip the container into the surface flow making sure that the container draws flows from the suspended load near the center of the creek and beneath the surface. Do not bring the sample container in contact with other objects. Pre-rinse the sample container and lid three times by collecting one grab sample and emptying the sample back into the surface flow (except for oil and grease samples, which do not receive a pre-rinse). Be sure to empty the rinse downstream of the collection site. Collect a second grab sample, replace lid, and remove from pole. Repeat until all samples have been collected. For samples placed in pre-preserved sample containers, attach a 1-liter polyethylene container to the sample pole, and follow the protocol above to grab the sample. Once the sample has been grabbed, transfer it to the pre-preserved container. Do not pre-rinse the pre-preserved container. Make sure that the two containers do not touch during the transfer. Place collected samples in ice chest, containing ice. **Appendix B** provides the bottle and preservation requirements for each parameter to be collected. Sampling parameters for each monitoring location are provided in **Table 2**.

Be sure to record visual observations downstream of the monitoring location. Observe any signs of water quality degradation including, but not necessary limited to: floating or suspended matter; discoloration; bottom deposits; aquatic life; visible films, sheen, or coatings; fungi, slimes, or objectionable growths; and potential nuisance conditions. Each sampling location will be photo-

documented at the time of each event. Photo-documentation will include taking a sufficient number of photographs of the waterway and surrounding site conditions, to the extent necessary, in order to characterize site conditions at the time of sampling.

Complete chain of custody forms.

Sample Delivery

Many of the constituents to be sampled can not be kept in prolonged storage. Therefore, it is important that samples are delivered to the laboratory on the same day that sampling occurs. Samples will be transported under chain-of-custody documentation. Sampling personnel will have the sample receiving clerk at the laboratory sign the chain of custody with date and time of receipt. A copy will be kept to complete the chain of custody in project files. Sample results will be requested with a 10-day turnaround. All samples, except bacteriological samples, requiring analytical analysis will be delivered to California Laboratory Services, Inc. (CLS), a California-certified facility. CLS's sample receiving address and phone is provided below:

CLS Labs
3249 Fitzgerald Road
Rancho Cordova, CA 95742
Contact: Mark Smith
(916) 638-7301,
fax (916) 638-4510

To ensure bacteria samples are delivered within the six-hour holding time, bacteriological analysis will be performed by AquaLab, located in the town of Twain Hare. AquaLab's sample receiving address and telephone and fax numbers are provided below:

AquaLab
1843 Fir Drive
Twain Harte, CA 95383
Contact: Catherine Behee
Telephone: (209) 586-3400

It should also be noted that other analytical laboratories may be used throughout Phase 2 of the MRP. These laboratories will be required to satisfy the target reporting limits identified in Table 2 and Table B-3 of the QAPP.

Return from Field

Upon return from the field, the following tasks shall be completed:

- Quality control measures for the field meters will be performed (post-calibration check).

- Following quality control, the meters will be disassembled and stored as described in the equipment manual.
- Meter data will be downloaded using applicable software.

Sampling Team

The sampling team is composed of one or two personnel that collect samples, measure field parameters, and take flow measurements. There may be times when the conditions are safe enough to necessitate only one sampler for an event. This decision will be made by County personnel based on flows, antecedent precipitation, and sampling site characteristics. However, having only one sampler may significantly slow the sampling process. The County's Project Manager will provide project oversight. ESA's Project Manager will lead of the sampling team under phase one. Staff with the County Farm Bureau and UC Cooperative Extension will provide leadership under phase two. If a Resource Conservation District (RCD) is formed, monitoring duties may be delegated to staff with the RCD.

Safety

Based on field conditions, the program may be modified by the project team during the sampling event to provide for field safety and make the collection accurate and thorough. Any changes made to the plan will be documented within field notebooks.

Sampling will occur along local roadways and within creeks with hazards including oncoming vehicles, steep embankments, etc. Sampling personnel shall use orange cones when sampling near roadways and place the cones at a sufficient distance from oncoming traffic to ensure sufficient notice for drivers. Treaded, water-proof boots shall be worn to aide in traction on embankments with static-ropes and/or webbing employed in steeper locations.

Samples will not be taken if hazardous flows are present. Hazardous flows include flood flows or bank-to-bank inundation coupled with wet/slippery levee conditions. Rubber gloves will be worn at all times to avoid physical contact with creek flows. Personal security will be checked. Sampling personnel should not sample if they feel threatened by an unknown individual(s). Sampling personal security will be a priority.

Certain sample containers will be pre-preserved with concentrated acids. When bottles are opened, hands shall be gloved. Special attention will be paid to wind direction when aqueous samples are placed into a pre-preserved sample container. Water to acid will create an acid aerosol that, if inhaled, can burn sinuses and throat.

V. REPORTING

Results obtained from both the field investigation parameters and laboratory data are to be validated for quality, accuracy, and completeness according to the guidelines set forth in the QAPP document.

The data are then to be tabulated in database format (i.e. Microsoft Access) compliant with the SWAMP program, saved, and maintained by County personnel. Results of these reports will be provided as described in the contractual agreement with the State (SWRCB No. 03-240-55-0). A template for reports is provided in **Appendix E**. The report will include copies of all field observation worksheets, quality control data, and laboratory results as an attachment.

Trend Analysis

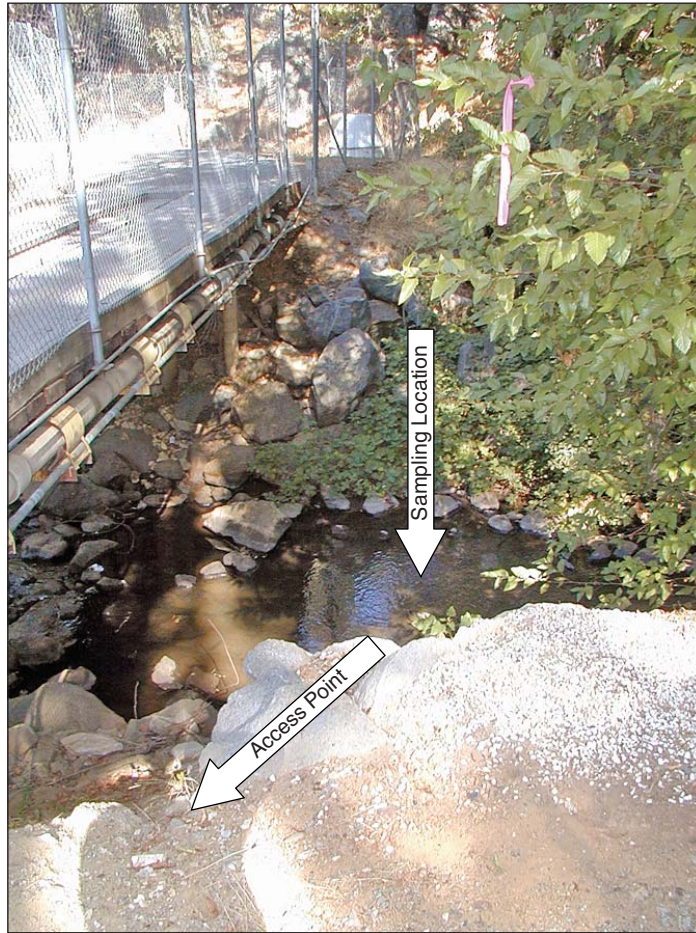
One of the objectives of water quality monitoring is an assessment of trends. While this terminology is often used as part of discussing a justification for a monitoring program, rarely are monitoring programs established that have any potential for reliably detecting trends in water quality data, especially associated with stormwater runoff from rural and/or urban areas. In order to reliably assess a trend in the data over time or as a function of the implementation of control technology for discharges, it is necessary to have a sufficient database at any one time to be able to reliably detect a change in concentration at another time. A sample collected once each quarter from local waterways, for almost all parameters will show high variability. This variability will need to be considered in determining how many samples are needed to detect a change in concentration with a certain degree of reliability.

V1. AMENDMENTS TO THE MRP

This MRP was developed for the County based on development and drainage patterns within the hydrologic study areas. The MRP anticipates changes to sampling parameters and locations based on actual monitoring results gathered over time. All amendments to the MRP will be integrated into the current September 2005 version accordingly. The revised MRP will be distributed to appropriate County, ESA, and RWQCB staff for review and approval.

APPENDIX A

PHOTOGRAPHIC DESCRIPTIONS OF MONITORING SITES



TB-1 Sampling Location



Sample Location Just Upstream of Bridge



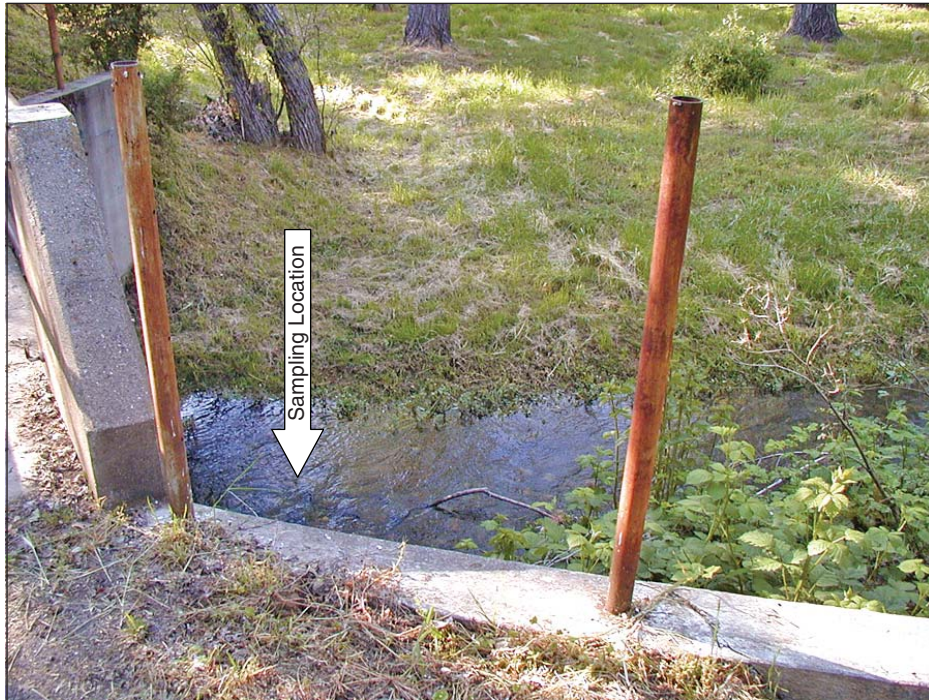
Sullivan Creek Bridge on Algerine Road



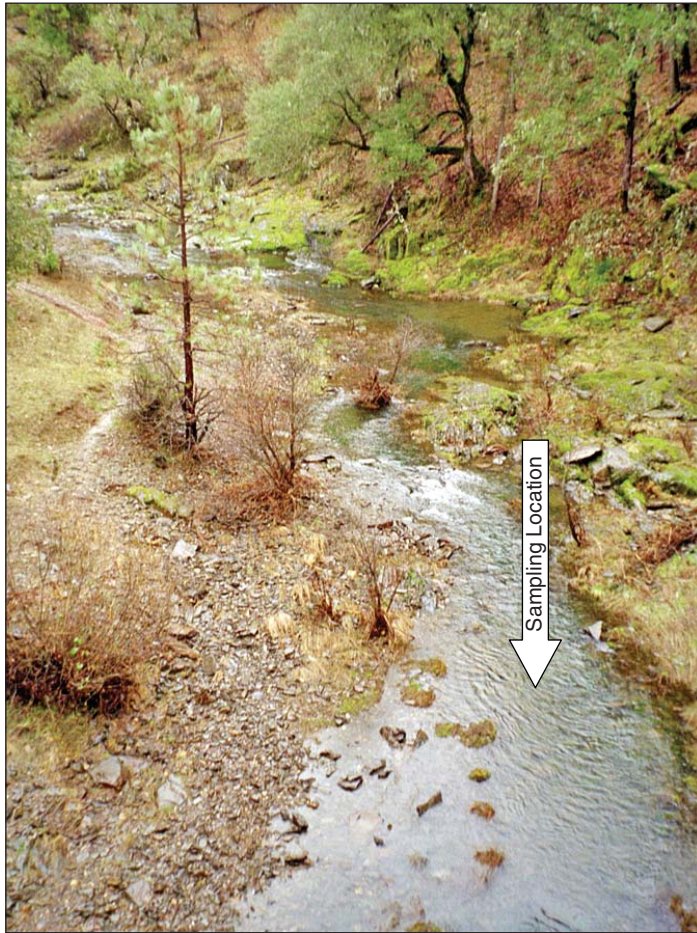
SV-1 Sampling Location



Mormon Creek Road Bridge



MM-1 Sample Location



Sample Location GV-1, upstream of the Groveland CSD access road.



Curtis Creek Bridge on Lime Kiln Road



CT-1 Sample Location



Bell Mooney Road Crossing on Woods Creek



WD-1 Sample Location

APPENDIX B

SAMPLE CONTAINERS, PRESERVATIVES, AND LABORATORY METHODS, AND DETECTION LIMITS

Sample Analysis	Bottle Size	Number of Bottles	Type	Preservative	Method
Total Suspended Solids (TSS)	500 mL	1	Poly	Cold	EPA 160.2
Oil and Grease	1 L	1	Amber	Cold	EPA 1664
Priority Pollutant Metals ^A	500 mL	2	Poly	HNO ₃	EPA 200.8
Hardness	500 mL	1	Poly		SM-2340B
Total and Fecal Coliform	125 mL		Coliform vessel	Na ₂ S ₂ O ₃	STDM 9221
Herbicides	1-L	1	Amber	Cold	EPA 8151A
Nitrate and Nitrite (as N)	250 mL	1	Poly	Cold	EPA 300.0
Volatile Organics	120 mL	3	VOA vials	Cold	EPA 8260A

A – Inorganic samples obtained for analysis under EPA Method 200.8 may be collected in two 500 mL polypropylene containers.

MRP Bottle Requirements

Updated: 3/5/2005

Analytical Method, Analytes	Bottle Type/Size	Number of Bottles	Preservative	Special Sampling Methods
Hardness, F, Cl, NO2 as N, NO3 as N, SO4, MBAS, pH, EC, TDS, Cr6 (EPA 7199)	1-L poly	1	None	Some methods call for preservatives. Also, many need to be analyzed w/in 24 hours. Should check with lab.
EPA 200.8 Metals	500-ml poly	1	HNO3	
Very-low-level Mercury	Frontier Science	1	Frontier Sci.	
EPA 8151A Herbicides (inc. Bentazon, Picloram)	1-L amber	2	None	No headspace. Sampler should not come in contact with sample.
EPA 8270C Semi-volatile Organics	1-L amber	2	None	No headspace. Sampler should not come in contact with sample.
EPA 8260B Volatile Organics	40-ml VOA	3	HCl	Volatile: no headspace, no bubbles. Also, keep samples in separate ziploc bags after collection.
EPA 8316 Acrolein & Acrylonitrile	40-ml VOA	2	None	Volatile: no headspace, no bubbles.

Note: Lab can supply (on loan) a video on low level mercury sampling procedures, please contact customer service.

APPENDIX C

SUGGESTED EQUIPMENT LIST

APPENDIX C

SUGGESTED EQUIPMENT

- Sampling pole and clamp.
- Nitrile/Rubber gloves.
- Rubber boots or waders.
- Protective eyewear, snake guards, static rope.
- Ice chest with ice. Include a sufficient number of ice packs to adequately chill samples for delivery to the laboratory.
- Field equipment, pre-calibrated, including:
 - Global Water FP201 Flow Meter
 - YSI Model 556 for pH, Temperature, dissolved oxygen, and specific conductance
 - Lamotte 2020 Potable Turbidity Meter
 - YSI Model 63 (pH, conductivity, specific conductance, and temperature)
 - Hach 2100P Turbidity meter;
 - Digital Camera
- Squeeze bottle filled with deionized (DI) water for field equipment rinsing between samples.
- Kimwipes.
- Certified clean sample containers. One additional bottle of each type should be included in case sampling containers become contaminated. Remember to bring additional sample containers when performing the field duplicate sampling. Bottles will be provided by Lab.
- An appropriate number of extra one-liter, wide-mouth polyethylene containers for grabbing samples from bridges and/or collecting meter readings.
- Chain-of-custody forms and labels for samples. Complete forms and labels to the extent feasible prior to departure.
- One-liter Graduated Cylinder.
- Large flat head (standard) screwdriver.
- Field observation worksheet (Appendix D)

APPENDIX D

FIELD DATA WORKSHEETS

COUNTY OF TUOLUMNE
SURFACE WATER MONITORING AND REPORTING PLAN – 2005/2007

Field Data Worksheet for Surface Water Monitoring Site (_____)

Date:

Time:

Sampler:

Weather/Flow Conditions: _____

Flow: _____ cfs at _____ feet (depth)

Turbidity:

(_____) _____ NTUs

10 NTU standard _____ NTUs

1 NTU standard _____ NTUs

Specific Conductance @ 25 deg. C

(_____) _____ uS/m

pH

(_____) _____ pH Units

Dissolved Oxygen

(_____) _____ mg/L

Temperature

(_____) _____ degree F

Conditions in Channel

Floating or suspended matter Y N

If yes, describe: _____

Visible films, sheens, or coatings Y N

If yes, describe: _____

Discoloration Y N

If yes, describe: _____

Algae, fungi, slimes, or objectionable growths Y N

If yes, describe: _____

Odor/Other nuisance conditions Y N

If yes, describe: _____

Aquatic life/Other Notes:

APPENDIX E

REPORT TEMPLATE

INSERT REPORT YEAR (2005)
ANNUAL SURFACE WATER MONITORING SUMMARY REPORT
TUOLUMNE COUNTY WQP

Sample ID: [Insert Site ID]
Sample Location: Yosemite Road Bridge
Sample Matrix: Water
Sampler(s):

Sampling Dates:
Lab Received Dates:
Report Date:

Sampling Results

Analysis	Method	Sample	Units	RI/IAL	Sampling Dates	Annual Min.	Annual Max.	Annual Average	Annual Median
Flow	Field	Grab	feet/second						
TSS	EPA 160.2	Grab	mg/L	5.0					
pH	Field	Grab	units	+/- 0.2					
Temperature	Field	Grab	Deg. F	+/- 0.27					
Dissolved Oxygen	Field	Grab	mg/L	+/- 2%					
Specific Conductance	Field	Grab	uS/cm	+/- 0.5%					
Turbidity	Field	Grab	NTU	+/- 2%					
Hardness	SM-2340B	Grab	mg/L	1.0					
Oil and Grease	EPA 1664	Grab	mg/L	5.0					
Nitrate and Nitrite (as N)	EPA 300.0	Grab	mg/L	0.500					
Microbiological									
Fecal Coliform	SM 9221B/E	Grab	MPN/100 mL	2.0					
Total Coliform	SM 9221B/E	Grab	MPN/100 mL	2.0					
Volatile Organics									
1,1-Dichloroethane	EPA 8260B		ug/L	1.0					
1,1-Dichloroethene	EPA 8260B		ug/L	0.5					
1,1,1-Trichloroethane	EPA 8260B		ug/L	2.0					
1,1,2-Trichloroethane	EPA 8260B		ug/L	0.5					
1,1,2,2-Tetrachloroethane	EPA 8260B		ug/L	0.5					
1,2-Dichlorobenzene	EPA 8260B		ug/L	2.0					
1,2-Dichloroethane	EPA 8260B		ug/L	0.5					
cis-1,2-Dichloroethene	EPA 8260B		ug/L	0.5					
1,2-Dichloropropane	EPA 8260B		ug/L	0.5					
1,2,4-Trichlorobenzene	EPA 8260B		ug/L	5.0					
1,3-Dichlorobenzene	EPA 8260B		ug/L	2.0					
1,3-Dichloropropene	EPA 8260B		ug/L	0.5					
1,4-Dichlorobenzene	EPA 8260B		ug/L	2.0					
Benzene	EPA 8260B		ug/L	0.5					
Bromoform	EPA 8260B		ug/L	2.0					
Bromomethane	EPA 8260B		ug/L	2.0					
Carbon tetrachloride	EPA 8260B		ug/L	0.5					
Chlorobenzene (mono chlorobenzene)	EPA 8260B		ug/L	2.0					
Chloroethane	EPA 8260B		ug/L	2.0					
Chloroform	EPA 8260B		ug/L	0.5					
Chloromethane	EPA 8260B		ug/L	0.5					
Dibromochloromethane	EPA 8260B		ug/L	0.5					
Dichlorobromomethane	EPA 8260B		ug/L	0.5					
Dichloromethane	EPA 8260B		ug/L	2.0					
Ethylbenzene	EPA 8260B		ug/L	2.0					
Hexachlorobutadiene	EPA 8260B		ug/L	1.0					

Report Approved By: _____
Page 1 of XX

Naphthalene	EPA 8260B	ug/L	10
Tetrachloroethene	EPA 8260B	ug/L	0.5
Toluene	EPA 8260B	ug/L	2.0
trans-1,2-Dichloroethylene	EPA 8260B	ug/L	1.0
Trichloroethene	EPA 8260B	ug/L	2.0
Vinyl chloride	EPA 8260B	ug/L	0.5
Inorganic Analysis (Metals)			
Arsenic	EPA 200.8	ug/L	1.0
Cadmium	EPA 200.8	ug/L	0.25
Mercury	EPA 200.8	ug/L	0.5
Antimony	EPA 200.8	ug/L	5.0
Beryllium	EPA 200.8	ug/L	1.0
Chromium (total)	EPA 200.8	ug/L	2.0
Copper	EPA 200.8	ug/L	0.5
Lead	EPA 200.8	ug/L	100.0
Nickel	EPA 200.8	ug/L	20.0
Selenium	EPA 200.8	ug/L	5.0
Silver	EPA 200.8	ug/L	5.0
Thallium	EPA 200.8	ug/L	1.0
Zinc	EPA 200.8	ug/L	1.0
Herbicides			
Bentazon	EPA 8151A	ug/L	2.0
2,4-D	EPA 8151A	ug/L	1.0
Dalapon	EPA 8151A	ug/L	2.0
Dinoseb	EPA 8151A	ug/L	1.0
Picloram	EPA 8151A	ug/L	1.0
2,4,5-TP (Silvex)	EPA 8151A	ug/L	1.0
Pentachlorophenol	EPA 8151A	ug/L	1.0

RL/IAL: Reporting Limit/Instrument Accuracy Level

nd: Not detected

Report Approved By: _____

INSERT REPORT YEAR (2005)
ANNUAL SURFACE WATER MONITORING SUMMARY REPORT
TUOLUMNE COUNTY WQP

Notes on Receiving Water Conditions

Floating or suspended matter Y ☐ N ☐

 If yes, describe:

Discoloration Y ☐ N ☐

 If yes, describe:

Bottom deposits Y ☐ N ☐

 If yes, describe:

Visible films, sheens, or coatings Y ☐ N ☐

 If yes, describe:

Algae, fungi, slimes, or objectionable growths Y ☐ N ☐

 If yes, describe:

Potential nuisance conditions Y ☐ N ☐

 If yes, describe:

Aquatic life:

INSERT REPORT YEAR (2005)
ANNUAL SURFACE WATER MONITORING SUMMARY REPORT
TUOLUMNE COUNTY WQP
Quality Control Data

Post-Field Calibration Check

pH (4)	Observed
	Actual
	<i>Difference</i>

pH (7)	Observed
	Actual
	<i>Difference</i>

pH (10)	Observed
	Actual
	<i>Difference</i>

Specific Conductance (uS/m)	Observed
	Actual
	<i>Difference</i>

Turbidity (NTU) - 1.0	Observed
	Actual
	<i>Difference</i>

Turbidity (NTU) - 10.0	Observed
	Actual
	<i>Difference</i>
