

## **GROUP A: PROJECT MANAGEMENT**

### **1. TITLE AND APPROVAL SHEETS**

# Quality Assurance Project Plan FINAL

## San Gregorio Creek Watershed: Planning for Restoration

Proposal Identification Number: 9369

August 6th, 2008

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**APPROVAL SIGNATURES**

GRANT ORGANIZATION:

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date*:</u>
<u>Project Manager</u>	<u>Carson Cox</u>	_____	_____
<u>Project Coordinator</u>	<u>Neil Panton</u>	_____	_____
<u>QA Officer</u>	<u>Karl Lusebrink</u>	_____	_____

REGIONAL BOARD (RWQCB Region 2):

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date*:</u>
<u>Contract Manager</u>	<u>Jill Marshall</u>	_____	_____
<u>QA Officer</u>	<u>Wil Bruhns</u>	_____	_____

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### 3. DISTRIBUTION LIST

All watershed coordinators and group leaders will receive copies of this Quality Assurance Project Plan (QAPP), and any approved revisions of this plan. Once approved, this QAPP will be posted on the SGERC website in PDF Acrobat format and thus be available to any interested party.

<u>Title:</u>	<u>Name (Affiliation):</u>	<u>Email Address</u>	<u>QAPP No*:</u>
Contractor Project Manager	Carson Cox (NHI)	<a href="mailto:ccox@n-h-i.org">ccox@n-h-i.org</a>	
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Laboratory	Mike Galloway (Soil Control Lab)	mike@controllabs.com	

#### 4. PROJECT/TASK ORGANIZATION

##### 4.1 Involved parties and roles.

Natural Heritage Institute (NHI), a nonprofit environmental organization, is the lead agency for the San Gregorio Creek Watershed: Planning for Restoration. Carson Cox of NHI is the Project Manager and will oversee all aspects of the project.

San Gregorio Environmental Resource Center (SGERC) is a community based, non-profit organization founded in 1988 that is interested in the protection and improvement of the San Gregorio Watershed. As the Project Coordinator, Neil Panton of SGERC will organize the monitoring efforts working closely with the project partners.

Karl Lusebrink, a member of SGERC who works independently from the monitoring team, will help develop field assessment protocol, assist in data analysis and help establish quality assurance and quality control procedures.

**Table 1. (Element 4) Personnel responsibilities.**

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Carson Cox	NHI	Project Manager	ccox@n-h-i.org (650) 726-2499
Neil Panton	SGERC	Project Coordinator	sgerc@sanmateo.org
Karl Lusebrink	SGERC	QA Officer	24karl@gmail.com

##### 4.2 Quality Assurance Officer role

Karl Lusebrink is the project's Quality Assurance Officer. Karl's role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling, field analysis and in-house analytic procedures.

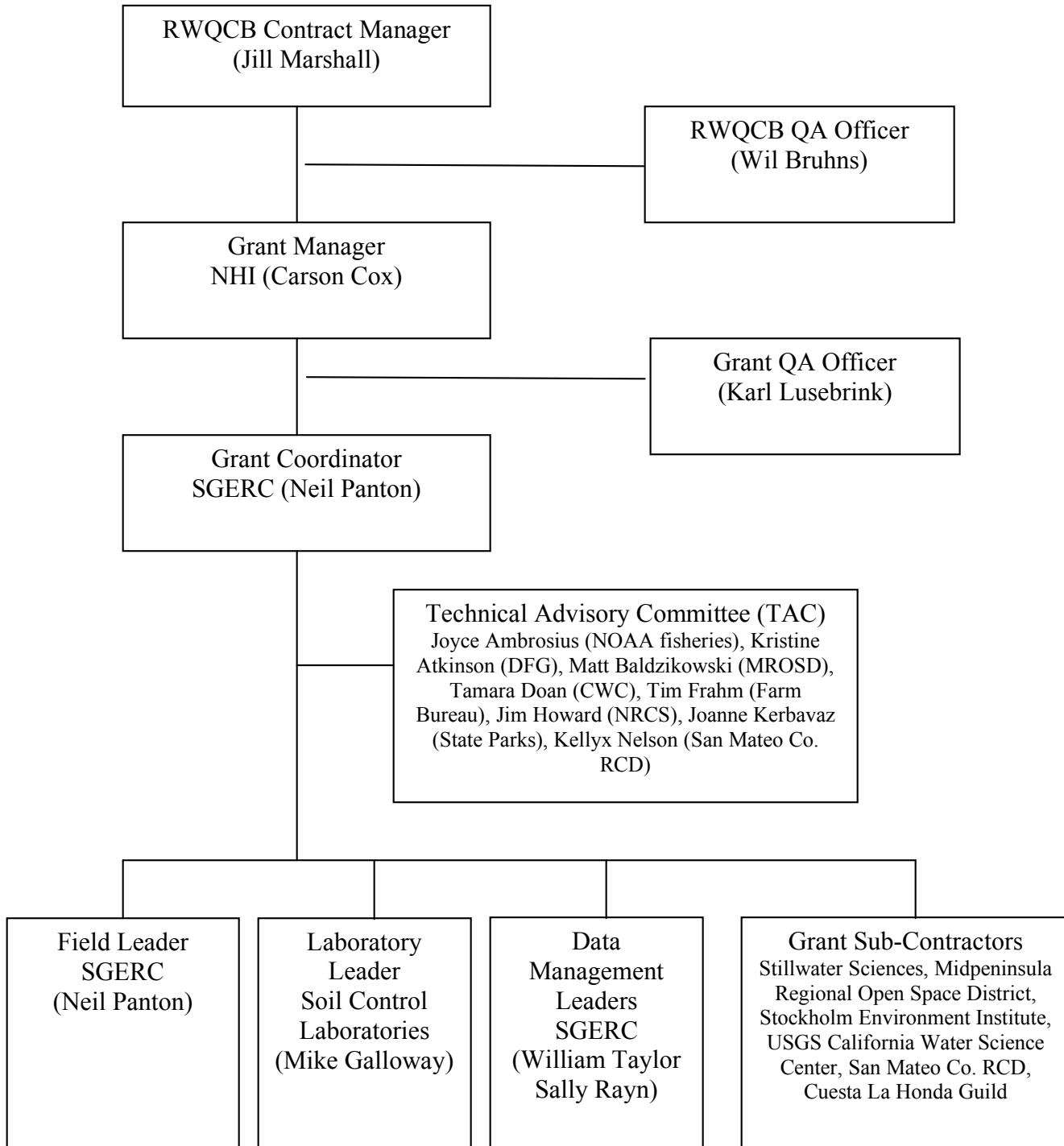
Karl Lusebrink will also review and assess all procedures during the life of the contract against QAPP requirements. Karl will report all findings to Neil Panton, including all requests for corrective action. Karl may stop all actions if there are significant deviations from required practices or if there is evidence of systematic failure.

##### 4.3 Persons responsible for QAPP update and maintenance.

Changes and updates to this QAPP may be made after a review of the evidence for change by NHI's Project Manager, SGERC's Quality Assurance Officer and the project Technical Advisory Committee, and with the concurrence of both the Regional Board's Contract Manager and Quality Assurance Officer. SGERC's Quality Assurance Officer will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

#### 4.4 Organizational chart and responsibilities

Figure 1. Organizational chart.



## **5. PROBLEM DEFINITION/BACKGROUND**

### **5.1 Problem statement.**

California salmon populations have declined by an estimated 90 percent during the last 50 years. The San Gregorio Creek Watershed is no exception; CDFG estimated that as recently as the early 60s, Pescadero and San Gregorio creeks supported a combined average coho run of about 1,000 adults (CDFG 2002). At present, few, if any, coho spawn in these creeks. Although not properly assessed, historic and current land and water uses are suspected to cause increased sedimentation in the stream, resulting in a loss of pool habitat, increased temperature, and reduced spawning and rearing opportunities (CDFG 1998). Farming operations rely heavily on riparian rights to irrigate croplands reducing summer low flows, and non-native invasive species are prevalent in the riparian corridor. These impacts are reflected in San Gregorio Creek being listed under the Clean Water Act 303(d) List as impaired by sediment .

Although there have been several studies in the watershed including a sediment source survey and creek sedimentation study in several of the upper tributaries (Balance Hydrologics Inc. 2006), an inventory of the roads and trails in the ECDM Preserve (Best 2002), there has not been a comprehensive assessment and planning effort associated with this critical watershed. Of the 101 coastal areas identified by the CCA Program, San Gregorio Creek is one of the ten highest priority watersheds in the state based on a range of criteria, including existing water quality conditions, value and sensitivity of coastal resources, new or expanding threats to beneficial uses, and degree of local support for watershed-based planning efforts. In addition, this watershed is one of nine watersheds identified by CDFG as a priority watershed (1998 Draft Strategic Plan for Restoration of Endangered Coho Salmon South of San Francisco Bay).

### **5.2 Decisions or outcomes.**

The overall goal of this project is to improve ecosystem function and water quality in the San Gregorio Watershed for multiple benefits, including native species protection and restoration. Specific objectives in support of this goal include:

- To scientifically assess watershed conditions and determine limiting factors;
- To identify and prioritize restoration and management measures and strategies; and
- To develop and promote a robust watershed plan that will directly lead to strategic and coordinated restoration actions.

### **5.3 Water quality or regulatory criteria.**

The data collected in this project will be compared to the San Francisco Bay Water Quality Control Board's Basin Plan.

## 6. PROJECT/TASK DESCRIPTION

### 6.1 Work statement and produced products.

The study described in this QAPP will use the same model as the successful Clean Streams program implemented by the Coastal Watershed Council (CWC) in Santa Cruz County and the San Gregorio Environmental Resource Center (SGERC). Teams of volunteers will be recruited, trained and supervised as they monitor specific sites once a month in the San Gregorio Watershed. At each site on the creek, parameters that will be measured in-situ include temperature, dissolved oxygen, turbidity, pH and conductivity.

### 6.2. Constituents to be monitored and measurement techniques.

The suite of water quality parameters to be monitored and in-situ measuring devices for this project include:

- ❖ Water temperature
  - YSI-556 Handheld Multimeter
  - Onset Technologies TidbiTs
- ❖ Dissolved Oxygen
  - YSI 556 Handheld Multimeter
  - Winkler Titration
- ❖ pH
  - YSI 556 Handheld Multimeter
- ❖ Conductivity
  - YSI 556 Handheld Multimeter
- ❖ Turbidity
  - Hach 2100P Turbidimeter
  - OBS3+ Sediment Probe
  - Isokinetic Depth-Integrated Sampler
- ❖ Flow
  - USGS Gaging Station
  - Water Depth Probe & Data Logger
  - Price AA Pygmy Flow Meter

Analytical methods for the following parameters are listed below. Any samples for these parameters will be taken by volunteers and staff, and sent to Control Laboratories for analysis.

- ❖ Suspended Sediment Concentration

### 6.3 Project schedule

**Table 2. (Element 6) Project schedule timeline.**

<b>Activity</b>	<b>Completion Date</b>
Identify monitoring leaders	November 2007
Obtain training for monitoring leaders	December 2007
Recruit monitors	December 2007
Obtain and check operation of instruments	December 2007
Train monitors	January 2008
Initiate monitoring	Sept. 2008 – Aug. 2009
Initiate data entry	Oct. 2008 – Sept. 2009
Review data with technical advisors	Oct, Jan, Apr, July
Share data with community	Oct. 2008 – Sept. 2009

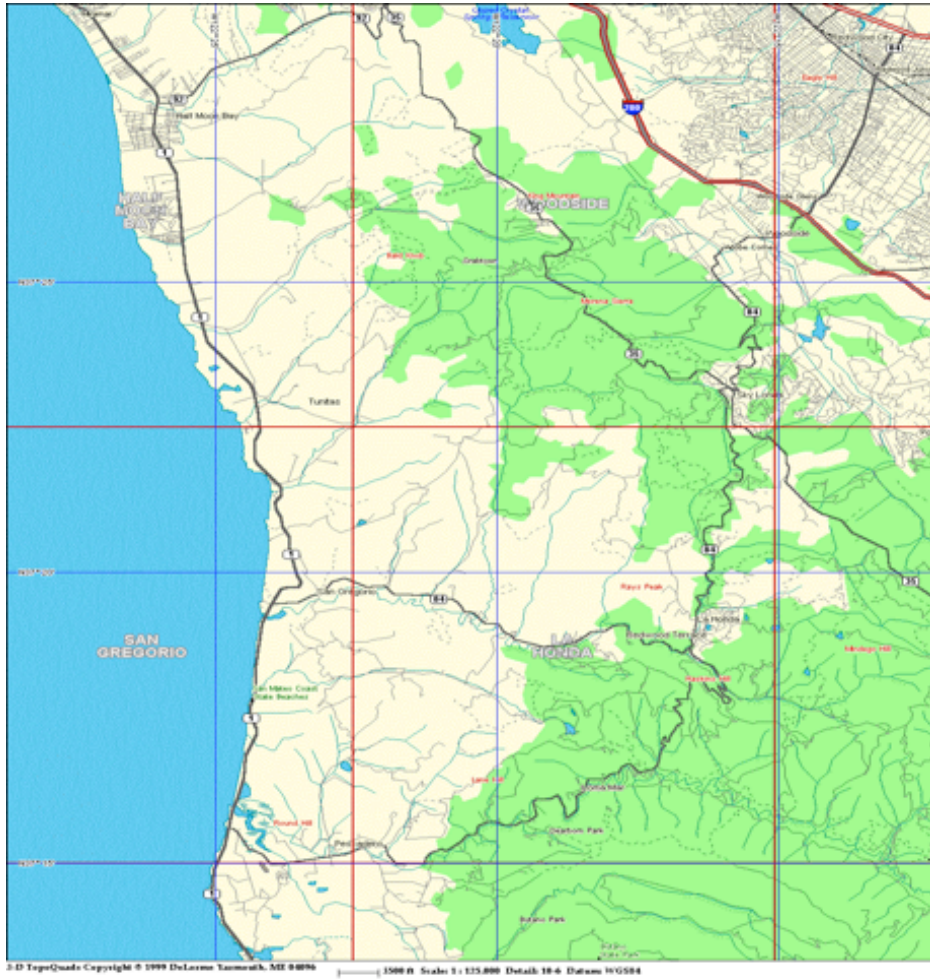
## 6.4 Geographical setting

The 52 square-mile San Gregorio Watershed is the second largest drainage in coastal San Mateo County. The watershed abuts the Tunitas watershed to the North, the Pescadero/Butano watershed to the South and drains into San Gregorio Creek, which empties into the Pacific Ocean. Three small, unincorporated communities of La Honda, San Gregorio, and Skylonda are contained in the San Gregorio watershed. Parts of the San Gregorio State Beach and Sam Mc Donald County Park and numerous Open Space Preserves are located in the watershed. California State Highway 84 courses through the watershed from the eastern boundary at the western margin of the San Francisco Bay Area to the Pacific Ocean at California State Highway 1. With approximately 45 miles of blue line streams, San Gregorio is one of nine priority creeks slated by CDFG for coho reintroduction.

**Figure 2. San Gregorio Watershed**



**Figure 3. San Mateo County**



## 6.5 Constraints

Sampling may not occur at every site every time. Safety of our monitors is our primary concern. At times the weather or high stream flows make sampling unsafe. Monitors will determine at each site if the conditions are safe for collecting and analyzing samples.

## 7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

This section identifies data quality objectives describing the precision, accuracy, representativeness, completeness, comparability and sensitivity of the data collected. These data quality objectives were derived based on the ability to measure water quality parameters relative to basin plan criteria and CCAMP objectives, by reviewing the QA plans and performance of other citizen monitoring organizations (e.g. Coastal Watershed Council, Contra Costa County Citizen Monitoring Program, Monterey Bay Sanctuary Citizen Monitoring Network, Yuba Watershed Monitoring Committee) and by considering the specifications of the instruments and methods we will employ. For purposes of this QAPP the data quality is considered adequate for the determination of general water quality conditions, with a potential application of the data to Section 305(b) reporting purposes.

Data quality objectives are summarized in Tables 7-1 to 7-4. Whenever possible the methods with the greatest sensitivity and lowest detection limit will be employed as the primary methods. Methods with lesser sensitivity and higher detection limits will be used for field confirmations or as back-up methods in the case that the primary methods are not available or functioning properly for a particular sampling event.

**Table 7.1 Data Quality Objectives for Conventional Water Quality Parameters**

Parameter	Method/range	Units	Detection Limit	Resolution	Precision	Accuracy	Completeness
Temperature	Electronic meter/probe -5 to 45° C	° C	-5	0.01 ° C	± 0.15 ° C	± 0.15 ° C	80%
Dissolved Oxygen	Electronic meter/probe 0 to 50 mg/L	mg/l	0.0 mg/l	0.01 mg/l	± 2%	± 2%	80%
	Winkler Titration	mg/L	0.2 mg/L	0.2 mg/L	± 25%	± 20%	80%
pH	Electronic meter/probe 0 – 14 units	pH units	0.0 units	0.01 unit	± 0.2 units	± 0.2 units	80%
Conductivity	Electronic meter/probe 0 – 200 mS/cm	mS/cm	0.0 mS/cm	0.001 mS/cm	± 5%	± 5%	80%
Turbidity	Turbidimeter 0 to 1000 NTU	NTUs	0.0 NTU	0.01 NTUs	± 2%	± 2%	80%
	OBS 3+ Probe	NTUs	0.0 NTU			0.25 NTU	80%

**Table 7.3 Data Quality Objectives for Laboratory Parameters**

Parameter	Method/range	Units	Detection Limit	Resolution	Precision	Accuracy	Completeness
Suspended Sediment	ASTM D3977-97C	mg/L	0.5	0.5	± 20% RPD	± 85%	80%

**Table 7.4 Data Quality Objectives for Physical Parameters**

Parameter	Method/Range	Measurement Range	Precision	Accuracy	Completeness
Turbidity	OBS probe	0-4000 ntu	Continuous	Turbidity 0–100 0.5 NTU 100–500 2 NTU 500–4,000 10 NTU	80%
Current Velocity	Capacitance Probe	1 meter	Continuous	± 1% of full scale reading	80%
Current Velocity	Flow meter	0.05-15 m/sec	Est. ±10%	Est. ±10%	60%

**Table 7.5 San Francisco Bay Water Quality Control Board Basin Plan Objectives for Measured Parameters**

Parameter	Basin Plan Objective
Temperature	Protect COLD beneficial use Shall not be altered from natural receiving water temperature unless it can be demonstrated that it does not adversely affect beneficial uses Temp. shall not be increased by more than 5° above natural receiving water temperature
Dissolved oxygen	7.0 mg/l minimum
pH	Not below 6.5 units nor above 8.5 units
Conductivity	Shall not increase the total dissolved solids or salinity of waters of the state so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.
Turbidity	Protect beneficial uses and not increase turbidity more than 10 percent in areas where natural turbidity is greater than 50 NTU.
Suspended Sediment Concentration	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses. Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life.
Current Velocity	NA

## **8. SPECIAL TRAINING NEEDS/CERTIFICATION**

### **8.1 Specialized training or certifications.**

No specialized training or certifications are required for this project. The Department of Health Services has certified Control Laboratories for the analytes described in this plan (see attached). Control Laboratories will conduct the total suspended solids test and has been certified in that method.

Although no specialized training or certifications are required for this project, all Watershed Coordinators will participate in an intensive, comprehensive “Train the Trainers” session specific to the protocols used in the watershed they will be working in. All citizen monitoring teams will have a team leader. Team leaders must participate in a 4-hour training on water quality monitoring conducted by the Coordinators and the Water Quality Program and Project Manager. Team participants will be encouraged to participate in hands-on training and will also be trained by team leaders. Individual trainees are evaluated by their performance of analytical and sampling techniques, by comparing their results to known values, and to results obtained by trainers and other trainees.

In addition to completion of the above described training course, the Watershed Coordinator will be in the field with each of the volunteer groups for the first two months and then as necessary after that.

Citizen monitoring team leaders must also participate in an annual Quality Control Session. These Quality Control Sessions will be supervised by the Water Quality Program QA Officer and will provide an opportunity for citizen monitors to check the accuracy and precision of their equipment and techniques. Team leaders will bring his/her equipment to the Quality Control Session.

### **8.2 Training and certification documentation.**

Field staff training is documented and filed with the Contract Manager. Documentation consists of a record of the training date, attendees and agenda.

Control Laboratories maintains records of their training. Those records can be obtained if needed from the lab through the Quality Assurance Officer.

### **8.3 Training personnel.**

The Project Quality Assurance Officer and the San Gregorio Environmental Resource Center Project Manager provide the training.

**Table 3. (Element 8) Specialized Personnel, Training or Certification.**

<b>Specialized Training Course Title or Description</b>	<b>Training Provider</b>	<b>Personnel Receiving Training/ Organizational Affiliation</b>	<b>Location of Records &amp; Certificates *</b>
CWT Train the Trainer	Eric Burres	Neil Panton (SGERC)	SGERC Office (no certificate) May 11 <sup>th</sup> , 2006

OBS3A	Jill Marshall		Date TBD
Isokinetic Depth Integrated Sediment Sampler	Jill Marshall		Nov. 1 <sup>st</sup> 2008
YSI-556 & Hach 2100P Calibration and Use	Stillwater Science Noah Hume	Neil Panton (SGERC) and 14 SGERC Monitors	SGERC Office (no certificate) Dec. 8 <sup>th</sup> , 2007

## **9. DOCUMENTS AND RECORDS**

All field results will be recorded at the time of collection, using the field data sheets. Data sheets will be reviewed by the team leader for outliers and omissions before leaving the sample site. Data sheets will be signed after review by the citizen monitoring team leader. Data sheets will be stored in hard copy form at SGERC's office. Field data sheets are archived for three years from the time they are collected. If data entry is ever performed at another location, duplicate data sheets will be used, with the originals remaining at SGERC's site. Hard copies of all data as well as computer back-up disks are maintained by SGERC's Director.

All completed data quality control forms and maintenance logs will also be kept at SGERC's office. The Excel database details the dates of equipment inspection, battery replacement and calibrations, as well as the dates that reagents and standards are replaced.

Distribution of any revised and approved versions of this QA Project Plan will be the responsibility of the Project Manager, Neil Panton.

## **GROUP B: DATA GENERATION AND ACQUISITION**

### **10. SAMPLING PROCESS DESIGN**

Samples to characterize water quality will be collected at numerous points within the San Gregorio Watershed drainage system. Sampling locations represent the different characteristic reaches of San Gregorio Creek Watershed including sites in the headwater reaches down to the confluence, above and below tributary inputs and on major tributaries. As the project progresses, this monitoring will be updated as needed to add or remove sampling sites and to adjust the timing of the sampling events. Selection of sampling sites is also based on the following criteria:

- Access is safe;
- Permission to cross private property is granted;
- Sample is representative of the part of the water body of interest; and
- Location complements or supplements historical data.

Project partners and local volunteers will be instructed to work in teams of at least two people. If a scheduled team cannot conduct the sampling together, the team captain will be instructed to contact the monitoring leader so that arrangements can be made for a substitute trained volunteer.

Prior to final site selection, the SGERC monitoring leader will obtain permission to access the stream from all property owners. If access to the site is a problem, the monitoring leader will select a new site following the site selection criteria identified above.

Safety measures will be discussed with all project partners and volunteers. No instream sampling will be conducted if there are small creek flood warnings or advisories, or if stream flow is high enough to be unsafe. It is the responsibility of the citizen monitoring organization to ensure the safety of their volunteer monitors. Safety issues are included in the 'U.S. EPA Volunteer Stream Monitoring Manual' (1997).

### **11. SAMPLING METHODS**

Chemistry parameters will be monitored according to manufactures specifications and using protocols outlined in the U.S. EPA 'Volunteer Stream Monitoring Manual' (1997). Current velocity will be monitored with a flow meter according to manufacturers specifications or determined by using the protocol described in the U.S. EPA Volunteer Stream Monitoring Manual (1997). Sediment grab samples will be taken using methods described in the U.S. EPA Volunteer Stream Monitoring Manual (1997).

Whenever possible, the collector will sample from a bridge so that the water body is not disturbed from wading. All samples are taken approximately in mid-stream, at least one inch below the surface. If it is necessary to wade into the water, the sample collector will stand downstream of the sample, taking a sample upstream. If the collector disturbs sediment when wading, the collector will wait until the effect of disturbance is no longer present before taking the sample.

Table 4a. describes the sampling location, sample holding container, sample preservation method and maximum holding time for each parameter.

**Table 4a. (Element 11) Sampling locations and sampling methods.**

Sampling Locations	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time Preparation/analysis
Lagoon at San Gregorio State Beach	SGR-002	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> </ul>	12 12 12 12 12	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06	Instream Instream Instream Instream Instream	N/A N/A N/A N/A N/A	none none none none none	Immediately Immediately Immediately Immediately Immediately
San Gregorio Creek at Stage Rd.	SGR-010	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> <li>▪ SSC</li> </ul>	12 12 12 12 12 ?	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06 LAB SOP	Instream Instream Instream Instream Instream 1 liter	N/A N/A N/A N/A N/A 1 liter plastic	none none none none none Place in cooler	Immediately Immediately Immediately Immediately Immediately 28 days @ 4°
Alpine Creek at Heritage Grove	SGR-150	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> </ul>	12 12 12 12 12	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06	Instream Instream Instream Instream Instream	N/A N/A N/A N/A N/A	none none none none none	Immediately Immediately Immediately Immediately Immediately
La Honda Creek at Playbowl	SGR-100	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> </ul>	12 12 12 12 12	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06	Instream Instream Instream Instream Instream	N/A N/A N/A N/A N/A	none none none none none	Immediately Immediately Immediately Immediately Immediately
Woodham's Creek at Roquena	SGR-104	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> </ul>	12 12 12 12 12	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06	Instream Instream Instream Instream Instream	N/A N/A N/A N/A N/A	none none none none none	Immediately Immediately Immediately Immediately Immediately
La Honda Creek at Weeks Creek	SGR-110	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ dissolved oxygen</li> <li>▪ pH</li> <li>▪ conductivity</li> <li>▪ temperature</li> <li>▪ turbidity</li> </ul>	12 12 12 12 12	SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC07 SOP SGC06	Instream Instream Instream Instream Instream	N/A N/A N/A N/A N/A	none none none none none	Immediately Immediately Immediately Immediately Immediately
La Honda Creek at Entrada Bridge	SGR-102	water	>1 (in) Below the surface	<ul style="list-style-type: none"> <li>▪ SSC</li> </ul>		LAB SOP	1 liter	1 liter plastic	Place in cooler	28 days @ 4°

## 12. SAMPLE HANDLING AND CUSTODY

Once lab sample containers are filled they are labeled and placed in a cooler with ice for transport to Control Laboratories. All samples will be delivered to the lab immediately after sampling is completed.

Containers for all analysis will be sterile plastic containers provided by the lab.

The conventional water quality monitoring tests do not require specific custody procedures since they will, in most cases, be conducted immediately by the same person who performs the sampling. In certain circumstances (such as driving rain or extreme cold), samples will be taken to a nearby shelter for analysis.

When samples are transferred from the citizen monitoring group to an outside professional laboratory, then a Chain of Custody form will be used. This form identifies the waterbody name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. In cases where the sample remains in the custody of the monitoring organization, then the field data sheet may be allowed to double as the chain of custody form. It is recommended that when a sample leaves the custody of the monitoring group, then the Chain of Custody form used be the one provided by the outside professional laboratory. Similarly, when quality control checks are performed by a professional lab, their samples will be processed under their chain of custody procedures with their labels and documentation procedures.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

**Table 5. (Element 12). Sample Handling and Custody.**

<b>Parameter</b>	<b>Sample Bottle</b>	<b>Preferred / Maximum Holding Times</b>
<i>Conventional Parameters</i>		
Temperature	sample directly or clear plastic bottle	Immediately
Dissolved oxygen	sample directly or glass bottle	Immediately / for wet chemistry fix per protocol instructions, continue analysis within 8 hr.
pH	sample directly or plastic bottle	Immediately
Conductivity	sample directly or plastic bottle	Immediately / refrigerate up to 24 hours
Turbidity	sample directly or plastic bottle using D-84.	Immediately / store in dark for up to 24 hr.
<i>Laboratory Parameters</i>		
Suspended Sediment Concentration	Plastic 1 liter bottle	Immediately / 28 days at 4° C

### 13. ANALYTICAL METHODS

Water chemistry is monitored using protocols outlined in ‘U.S. EPA Volunteer Stream Monitoring Manual’ (1997). The methods were chosen based on the following criteria:

- Capability of volunteers to use methods;
- Provide data of known quality;
- Ease of use; and
- Methods can be compared to professional methods in *Standard Methods*.

Tables 6 and 7 outline the analytic methods for each parameter.

**Table 6. (Element 13) Field Analytical Methods.**

Analyte	Organization	Equipment/Kit	Project Action Limit	Units	Detection Limit	Analytical Method
Temperature	Field by SGERC volunteers	YSI-556	>18° for watch, >22° for action	°C	-5	SOP SGC07
	SGERC	Hobo TidbiT Continuous	>18° for watch, >22° for action	°C	- 4°C to +37°C	SOP SGC05
Dissolved oxygen	Field by SGERC volunteers	YSI-556	<7 or >12	mg/l	0.0 mg/l	SOP SGC07
	Field by SGERC volunteers	Winkler Titration	<7 or >12	mg/l		SOP SGC01
pH	Field by SGERC volunteers	YSI-556	<6.5 or >9.0	pH units	0.0	SOP SGC07
Conductivity	Field by SGERC volunteers	YSI-556	N/A	mS/cm	0.0	SOP SGC07
Turbidity	Field by SGERC volunteers	Hach 2100P	N/A	NTU	0.0 NTU	SOP SGC06
	SGERC	OBS 3+ Continuous		NTU	0.9 mg/L	

**Table 7. (Element 13) Laboratory Analytical Methods.**

Analyte	Organization	Project Action Limit	Units	Target Reporting Limit	Analytical Method
Suspended Sediment Concentration	Soil Control Lab		mg/l	0.5	ASTM D3977-97C

All chemicals used at each site by SGERC monitors will be collected in a waste bottle and disposed of properly.

## 14. QUALITY CONTROL

Quality control samples will be taken to ensure valid data are collected. Depending on the parameter, quality control samples will consist of blanks or replicate samples. In addition, quality control sessions (a.k.a. intercalibration exercises) will be held twice a year to verify the proper working order of equipment, refresh volunteers in monitoring techniques and determine whether the data quality objectives are being met.

### ***Blanks, Replicates, and Standardization***

Field Blanks: Approximately five percent of all samples collected will be field blanks. They will be turned into the lab with the regular samples for analysis.

*Instructions for Field Blanks*: Distilled water is taken into the field. When samples are collected in the field, a second container will be filled with distilled water to be analyzed exactly like the field sample. This procedure tests the cleanliness of the sample container and the procedures of the sampler to ensure that no contamination gets into the sample bottle.

Replicates: Replicate samples are two or more samples collected at the same time and place. When there are only two replicates then these are referred to as duplicates. Duplicate field samples will be taken for approximately 5% of the samples collected. Duplicate samples will be collected at the same time the initial sample is collected, and will be subjected to identical handling and analysis.

Standardization of Instruments and Procedures: At the Quality Assurance sessions the temperature measurements will be standardized by comparing thermometers to a NIST-certified or calibrated thermometer in ice water and ambient temperature water. Conductivity meters, pH and Turbidimeters will be evaluated at the Quality Assurance Session using standards provided with the assistance of a professional laboratory and/or the Water Quality Program Manager. For oxygen meters the standard will be distilled water saturated with oxygen and then compared to a Winkler Titration Method.

**Table 8. (Element 14) Sampling (Field) QC.**

Matrix: Water		
Sampling SOP: SGC-07		
Analytical Parameter(s): temperature, dissolved oxygen, turbidity, pH, and conductivity. No samples taken; all done instream.		
# Sample locations: 6		
Field QC	Frequency/Number per sampling event	Acceptance Limits
Equipment Blanks	0	N/A
Field Blanks	0	N/A
Trip Blanks	0	N/A
Cooler Temperature	N/A	N/A
Field Duplicate Pairs	0	N/A
Collocated Samples	0	N/A
Lab Duplicates	0	N/A
Field Matrix Spikes	0	N/A
Other:		

**Table 9. (Element 14) Analytical QC.**

Matrix: Water		
Sampling SOP: Soil Control Lab SOP		
Analytical Parameter: Suspended Sediment Concentration		
# Sample locations: 2		
Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	0	Nd
Reagent Blank	0	Nd
Storage Blank	0	
Instrument Blank	0	Nd
Lab. Duplicate Fine Fraction	Every 20 samples / 1	+/- 20% RPD
Lab. Matrix Spike	0	N/A
Matrix Spike Duplicate	0	N/A
Lab. Blank Fine Fraction	Every 20 samples / 1	+/- 20% RPD
Surrogates	0	
Internal Standards	0	
Others:		

## 15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Field measurement equipment will be checked by the Watershed Coordinator for operation in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of conductivity electrodes. All equipment will be inspected when first handed out and when returned from use for damage. Spare parts are available from the suppliers of the equipment as well as the manufacturers. Any deficiencies will be corrected by the Watershed Coordinator including re-calibration prior to the next deployment of the equipment.

Soil Control Laboratories maintains its equipment in accordance with its SOPs, which include those specified by the manufacturer and those specified by the method. \*\*These SOPs are in compliance with SWAMP criteria

**Table 10. (Element 15) Testing, inspection, maintenance of sampling equipment and analytical instruments. This table will not be used.**

## 16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

### *Calibration Records*

All calibration records and accuracy checks will be documented using the DQM Calibration and Accuracy Checks Data Sheet (DQM SOP Calib). Hard copies are stored at SGERC's office and the results are entered into an Excel database. The database will store all necessary equipment information including instrument ID, resolution, range, calibration events, etc.

### *Temperature*

YSI-556 Multiprobe: Accuracy will be verified by comparing with HOBO TidBiT thermometers installed at each field site. The TidBiT field thermometers will be verified by comparing with three NIST certified TidBiT thermometers prior to installation.

### *Dissolved oxygen*

YSI-556 Multiprobe: Procedures based on manufacturer's instruction for the meter to self-calibrate each time it is turned on will be followed. Every 2 to 3 months the Dissolved Oxygen sensor will be compared to a Winkler Titration Method using distilled water saturated with oxygen.

### *Conductivity and pH*

YSI-556 Multiprobe: Procedures based on manufacturer's recommendations for calibration every 2 to 3 months. Conductivity standards and pH buffers are replaced based on manufacturer's expiration dates. Conductivity standards are stored with the cap firmly in place and in a dry location away from extreme heat.

### *Turbidity*

Hach 2100-P Turbidimeter: Units checked for cleanliness and proper operation. Calibration procedures and frequency are based on manufacturer's recommendation. StablCal Stabilized Formazin Standards will be used in 20, 100 and 800 NTU values.

**Table 11. (Element 16) Testing, Inspection, and Maintenance of sampling equipment and analytical instruments**

<b>Equipment / Instrument</b>	<b>SOP reference</b>	<b>Calibration Description and Criteria</b>	<b>Frequency of Calibration/Accuracy Check</b>	<b>Responsible Person</b>
Multiprobe Temperature	SOP SGC07	Compare to infield TidbiT thermometers	Quarterly	Project Manager
TidbiT Temperature	SOP SGC05	Compare to 3 NIST thermometers	Yearly	Project Manager
Multiprobe Dissolved Oxygen	SOP SGC07	Compare to the Winkler Titration Method	Quarterly	Project Manager
Winkler Dissolved Oxygen	SOP SGC01	All chemicals in kit checked for expiration date and replaced if necessary	Monthly	Project Manager
Multiprobe pH	SOP SGC07	Compare to known buffer solution	Quarterly	Project Manager
Multiprobe Conductivity	SOP SGC07	Calibrate with a known standard	Quarterly	Project Manager
Turbidimeter	SOP SGC06	Calibrate with a known standard	Twice a year	Project Manager
OBS 3+ Sediment Probe		Monitor data readout for unusual spikes. Use samples collected with an isokinetic to develop a sediment rating curve. Spot check rating curve values generated at known times against in-stream samples collected at the same known time	Twice a year	Project Manager
Lab Analysis Suspended Sediment Concentration	Soil Control Lab SOP	Analytical Balance Class A weights	Daily	Lab QA officer

## **17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES**

Upon receipt, buffer solutions, standards, and reagents used in the field kits will be inspected by the team leader for leaks or broken seals, and to compare the age of each reagent to the manufacturer's recommended shelf-life. All other sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation prior to each use. Any problems will be reported to the Watershed Coordinator.

Reagents are replaced before they exceed manufacturer's recommended shelf life. These shelf lives are typically one to two years. However, specific replacement dates can be determined by providing the reagent lot number to the manufacturer. Reagent replacement dates are noted in the maintenance log.

**Table 12. (Element 17) Inspection/acceptance testing requirements for consumables and supplies. This table will not be used.**

## **18. NON-DIRECT MEASUREMENTS (EXISTING DATA)**

Additional data may be used to supplement data collected in this study. This additional data was collected in the past year at the same sites monitored for this study by the same Watershed Coordinator for this program following the same protocols and using equipment maintained by SGERC. Other data may be incorporated from the Citizen Watershed Monitoring Network Snapshot Day events. All protocols are the same for both of these programs.

## **19. DATA MANAGEMENT**

Field data sheets are checked and signed in the field by the citizen monitoring team leader. The citizen monitoring team leader will identify any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate. Such data will be marked as unacceptable by the monitoring leader and will either be flagged or not be entered into the electronic database.

Independent laboratories will report their results to the Project Manager. The Project Manager, working with the team leader as appropriate, will verify sample identification information, review the chain-of-custody forms, and identify the data appropriately in the database.

The Watershed Coordinators will review the field sheets and enter the data deemed acceptable by the citizen monitoring team leader. Upon entering the data the data management coordinator will sign and archive the field data sheets. Data will be entered into an Excel database, which will allow export to the CCAMP database and subsequently to SWAMP. This database is backed up regularly. Following initial data entry the Watershed Coordinator will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

Raw data will be provided to the SWQCB and RWQCB in electronic form at least once every two years so that it can be included in the 305(b) report. Appropriate quality assurance information may be provided upon request.

## **GROUP C: ASSESSMENT AND OVERSIGHT**

### **20. ASSESSMENTS & RESPONSE ACTIONS**

Review of all field and data activities is the responsibility of the citizen monitoring leader, with the assistance of the technical advisory committee. Volunteers will be accompanied by the citizen monitoring leader, or a technical advisor on their first two sampling trips. If possible, volunteers in need of performance improvement will be retrained on-site. All volunteers must attend a refresher course offered by the citizen monitoring group or Coastal Watershed Council. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

State and EPA quality assurance officers may review all field and laboratory activities and records.

### **21. REPORTS TO MANAGEMENT**

The technical advisors will review draft reports to ensure the accuracy of data analysis and data interpretation. Raw data will be made available to data users per their request. The citizen monitoring organization will report its data to its constituents after quality assurance has been reviewed and approved by their technical advisors. Quarterly reports will be made to the State and/or Regional Board staff.

## **GROUP D: DATA VALIDATION AND USABILITY**

### **22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS**

Data sheets or data files are reviewed quarterly by the Quality Assurance officer to determine if the data meet the Quality Assurance Project Plan objectives. They will identify outliers, spurious results or omissions to the monitoring leader. They will also evaluate compliance with the data quality objectives. They will suggest corrective action that will be implemented by the monitoring leader. Problems with data quality and corrective action will be reported in final reports.

### **23. VERIFICATION AND VALIDATION METHODS**

Team Leaders will review field data sheets for completeness and any unusual results the day of the monitoring event. As part of standard field protocols, any sample readings out of the expected range will be reported to the citizen monitoring leader. A second sample will be taken as soon as possible to verify the condition. It is the responsibility of the citizen monitoring leader to re-train volunteers until performance is acceptable.

### **24. RECONCILIATION WITH USER REQUIREMENTS**

The Technical Advisory Committee will review data every six months to determine if the data quality objectives (DQOs) have been met. They will suggest corrective action. If data do not meet the project's specifications, the following actions will be taken. First, the technical advisors will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the technical advisors and the TAC will review the DQOs and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to DQOs will be appended to this QA plan with the revision date and the reason for modification. The appended QA plan will be sent to the quality assurance panel that approved this plan. When the appended QA plan is approved, the citizen monitoring leader will work with the data coordinator to ensure that all data meeting the new DQOs are entered into the database. Archived data can also be entered.

## APPENDIX A. Definitions

**Accuracy.** A data quality indicator, accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias.

**Analyte.** Within a medium, such as water, an analyte is a property or substance to be measured. Examples of analytes would include pH, dissolved oxygen, bacteria, and heavy metals.

**Bias.** Often used as a data quality indicator, bias is the degree of systematic error present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed.

**Blind sample.** A type of sample used for quality control purposes, a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the analyst's or laboratory's expertise in performing the sample analysis.

**Comparability.** A data quality indicator, comparability is the degree to which different methods, data sets, and/or decisions agree or are similar.

**Completeness.** A data quality indicator that is generally expressed as a percentage, completeness is the amount of valid data obtained compared to the amount of data planned.

**Data users.** The group(s) that will be applying the data results for some purpose. Data users can include the monitors themselves as well as government agencies, schools, universities, businesses, watershed organizations, and community groups.

**Data quality objectives (DQOs).** Data quality objectives are quantitative and qualitative statements describing the degree of the data's acceptability or utility to the data user(s). They include indicators such as accuracy, precision, representativeness, comparability, and completeness. DQOs specify the quality of the data needed in order to meet the monitoring project's goals. The planning process for ensuring environmental data are of the type, quality, and quantity needed for decision making is called the *DQO process*.

**Detection limit.** Applied to both methods and equipment, detection limits are the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain and report as greater than zero.

**Duplicate sample.** Used for quality control purposes, duplicate samples are two samples taken at the same time from, and representative of, the same site that are carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitor, and/or analyst. More than two duplicate samples are referred to as *replicate samples*.

**Environmental sample.** An environmental sample is a specimen of any material collected from an environmental source, such as water or macroinvertebrates collected from a stream, lake, or estuary.

**Equipment or rinsate blank.** Used for quality control purposes, equipment or rinsate blanks are types of field blanks used to check specifically for carryover contamination from reuse of the same sampling equipment (see *field blank*).

**Field blank.** Used for quality control purposes, a field blank is a "clean" sample (e.g., distilled water) that is otherwise treated the same as other samples taken from the field. Field blanks are submitted to the analyst along with all other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis, and transport.

**Instrument detection limit.** The instrument detection limit is the lowest concentration of a given substance or analyte that can be reliably detected by analytical equipment or instruments (see *detection limit*).

**Matrix.** A matrix is a specific type of medium, such as surface water or sediment in which the analyte of interest may be contained.

**Measurement Range.** The measurement range is the extent of reliable readings of an instrument or measuring device, as specified by the manufacturer.

**Method detection limit (MDL).** The MDL is the lowest concentration of a given substance or analyte that can be reliably detected by an analytical procedure (see *detection limit*).

**Performance evaluation (PE) samples.** Used for quality control purposes, a PE sample is a type of *blind sample*. The composition of PE samples is unknown to the analyst. PE samples are provided to evaluate the ability of the analyst or laboratory to produce analytical results within specified limits.

**Precision.** A data quality indicator, precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions. Precision is usually expressed as a *standard deviation* in absolute or relative terms.

**Protocols.** Protocols are detailed, written, standardized procedures for field and/or laboratory operations.

**Quality assurance (QA).** QA is an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. QA activities involve planning quality control, quality assessment, reporting, and quality improvement.

**Quality assurance project plan (QAPP).** A QAPP is a formal written document describing the detailed *quality control* procedures that will be used to achieve a specific project's data quality requirements.

**Quality control (QC).** QC is the overall system of technical activities designed to measure quality and limit error in a product or service. A QC program manages quality so that data meets the needs of the user as expressed in a *quality assurance project plan*.

**Relative standard deviation (RSD).** RSD is the *standard deviation* of a parameter expressed as a percentage and is used in the evaluation of *precision*.

**Relative percent difference (RPD).** RPD is an alternative to *standard deviation*, expressed as a percentage and used to determine precision when only two measurement values are available.

**Replicate samples.** See duplicate samples.

**Representativeness.** A data quality indicator, representativeness is the degree to which data accurately and precisely portray the actual or true environmental condition measured.

**Sensitivity.** Related to *detection limits*, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The more sensitive a method is, the better able it is to detect lower concentrations of a variable.

**Spiked samples.** Used for quality control purposes, a spiked sample is a sample to which a known concentration of the target analyte has been added. When analyzed, the difference between an environmental sample and the analyte's concentration in a spiked sample should be equivalent to the amount added to the spiked sample.

***Split sample.*** Used for quality control purposes, a split sample is one that has been equally divided into two or more subsamples. Splits are submitted to different analysts or laboratories and are used to measure the precision of the analytical methods.

***Standard reference materials (SRM).*** An SRM is a certified material or substance with an established, known and accepted value for the analyte or property of interest. Employed in the determination of bias, SRMs are used as a gauge to correctly calibrate instruments or assess measurement methods. SRMs are produced by the U. S. National Institute of Standards and Technology (NIST) and characterized for absolute content independent of any analytical method.

***Standard deviation(s).*** Used in the determination of *precision*, standard deviation is the most common calculation used to measure the range of variation among repeated measurements. The standard deviation of a set of measurements is expressed by the positive square root of the *variance* of the measurements.

***Standard operating procedures (SOPs).*** An SOP is a written document detailing the prescribed and established methods used for performing project operations, analyses, or actions.

***True value.*** In the determination of accuracy, observed measurement values are often compared to true, or standard, values. A true value is one that has been sufficiently well established to be used for the calibration of instruments, evaluation of assessment methods or the assignment of values to materials.

***Variance.*** A statistical term used in the calculation of *standard deviation*, variance is the sum of the squares of the difference between the individual values of a set and the arithmetic mean of the set, divided by one less than the numbers in the set.

Appendix B SGERC Water Quality Data Form

**San Gregorio Environmental Resource Center**

**Field Data Sheet for Water Quality Monitoring**

Date: \_\_\_\_\_

Creek Name: \_\_\_\_\_

Station Name: \_\_\_\_\_

Project Name or ID: \_\_\_\_\_

Station ID: \_\_\_\_\_

Team Name: \_\_\_\_\_

Station Habitat: Pool: Run: Riffle:

Team Leader: _____	Date of last rain: _____
Team Members: _____	Photos: <input type="checkbox"/> Left/Right Bank (facing downstream)
_____	<input type="checkbox"/> Upstream
_____	<input type="checkbox"/> Downstream
	<input type="checkbox"/> In the Stream (looking down at water)

**Observations:** (circle one underlined option)

**Observations Time:** \_\_\_\_\_ am / pm

Cloud cover	No clouds: Partly cloudy: Cloudy sky:
Precipitation	None: Misty: Foggy: Drizzle: Rain:
Wind	Calm: Breezy: Windy:
Water murkiness	Clear water: Cloudy water (>4" visibility): Murky (<4" visibility): [pertains to the water itself, not scum]
Flow conditions	Dry creekbed: Isolated pools: Trickle (<0.25 gal/sec): <5 gal/sec: >5 gal/sec: full waterway no observed flow:
Embeddedness	(surface covered by fine sediment) <5% covered: 5-25% covered: 25-50% covered: 50-75% covered: >75% covered:
Sample color	None: Amber: Yellow: Green: Brown: Gray: Other:
Other (presence)	Algae or water plants: Oily sheen: Foam or suds: Litter: Other:
Fish Sighted	One: Two: Three: Four: >Four: >Eight: >Twelve: 1/2" 1/2" 1" 1 1/2" 2" 3" >3" <6" >6"

**Measurements:**

Instrument ID	Parameter	Unit	Result	Repeated Result	Bracket/Resolution	YSI-556 MU-SGC		Comments
Stage Rd only	Depth: Staff Gage	Ft				01	02	
	Water Temperature	°C						
	Specific Conductivity	µS/cm						
	DO % Saturation	%						
	DO (Dissolved Oxygen)	mg/l						
	pH	pH						
	Turbidity	NTU	1.	1.				
2.			2.					
3.			3.					
	Air Temperature	°C						

Measurement Depth: (select one) Surface: Mid-column: Near-bottom:

Sampling Device: (select one) None: Kemmerer: Bucket & rope: Pole & beaker: Other:

Sample ID: (for offsite analyses)	Collection Time:	Collection Depth:	Sample Containers:
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Team Leader signature: \_\_\_\_\_ Date: \_\_\_\_\_

QA Officer signature: \_\_\_\_\_ Date: \_\_\_\_\_

Appendix C Sediment Sample Collection Form

SGERC Field Data Sheet (Sediment Monitoring Program)						Entered in d-base (initial/date)		Pg. of Pgs.	
*StationID:			*Date (mm/dd/yyyy): / /		*Season:				
Arrival Time:			Departure Time:		*Sample Time (1st sample):				
Event Type: Field Description	Sample Type: FieldObs	SampleDepth/Collection: -88	WAGABILITY: YES / NO	REAL/FORT SCALE (see attachment):	WIND DIRECTION (from):	WIND SPEED	PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):		
DOMINANTSUBSTRATE: Concrete Cobble, Gravel, Sand, Mud, Other, unk			SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Hazy				1: (RB / LB / BB / US / DS / ##)		
SITE ODOOR: None, Sulfides, Sewage, Petroleum, Mixed, Other			PRECIPITATION: None, Foggy, Drizzle, Rain, Snow				2: (RB / LB / BB / US / DS / ##)		
OTHERPRESENCE: Vascular, Nonvascular, Oily Sheen, Foam, Trash, Other			PRECIPITATION (last 24 hrs): Unknown, <1", >1", None				3: (RB / LB / BB / US / DS / ##)		
WATERODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other			WATERCOLOR: Colorless, Green, Yellow, Brown						
WATERCLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)			OBSERVED FLOW: NA, Dry Waterbody Bed, No Observed Flow, Isolated Pool, 0.1 - 1cfs, 1 - 5 cfs, 5 - 20 cfs, 20 - 50 cfs, 50 - 200 cfs, >200cfs						
Comments:									
EVENT TYPE: WaterChem -- Suspended Sediment		SAMPLE TYPE: Grab / Integrated		*SAMPLING CREW:					
OCCUPATION METHOD: Walk in, Bridge, RV, Other			STARTING BANK: LB / RB / NA						
SAMPLING EQUIPMENT: Indiv bottle by hand, By pole, Pole & Beaker, Isokinetic sampler, other									
SAMPLE LOCATION: Bank, Thalweg, Midchannel, Cross Section, Open Water									
HYDROMODIFICATION: None, Bridge, Pipes, Concrete Channel, Grade Control, Culvert, Other									
<b>Samples Taken (ID # of containers filled)</b>				Field Blank? (SampleType = Field/Dup):		YES / NO DupID:			
Time									
Container ID									
<b>Field Measurements (SampleType = FieldMeasure)</b>									
Time									
Tube 1 (NTU)									
Tube 2 (NTU)									
Tube 3 (NTU)									
Duplicate									
Tube 1 (NTU)									
Tube 2 (NTU)									
Tube 3 (NTU)									
Instrument:									
COMMENTS:									



Appendix E Equipment Calibration Form

**DQM Calibration and Accuracy Checks Data Sheet V3**

Event \_\_\_\_\_

Project ID \_\_\_\_\_

Page \_\_\_\_ of \_\_\_\_

Record 1

Record 2

Record 3

A	Instrument ID			
B	Instrument Type (adjustable or non-adjustable)			
C	Characteristic (Parameter)			
D	Unit			
E	Date of Calibration or Accuracy Check			
F	Time of Calibration or Accuracy Check			
G	Reason for Calibration or Accuracy Check (Pre-event, Post-event, Routine, new instrument)			
H	Temperature (C) at Calibration or Accuracy Check (not applicable for temperature checks)			
I	Thermometer ID (not applicable for temperature checks)			
J	Standard Material (enter Standard ID, or NIST thermometer ID, or 'saturated water', or 'distilled water ice-bath', etc.)			
K	"True" value of Standard Material (see on the label) or natural point			
L	Reading in Standard Material (non-adjustable instruments) or Reading in Standard Material before Calibration (adjustable instruments)	first - second - third	first - second - third	first - second - third
M	Action taken (cal, none, or nap) (adjustable instruments only)			
N	Reading after calibration (adjustable instruments only)			
O	Cal/AccurCheck Operator (your name)			
P	Comments			

Note: If you are calibrating an oxygen electrode, write "humid air" or "saturated water" in the "Standard Material" box above.

If you calibrate in air and can measure the absolute barometric pressure, write the value and unit here \_\_\_\_\_; otherwise please indicate your elevation above sea level \_\_\_\_\_.

# San Gregorio Environmental Resource Center

## Water Sample Collection Instructions

### Using a Sampling Apparatus with Thermometer and D.O. Bottle

- 1) Remove the peg-shaped stopper from the gray sampler lid. Lift the wire lid retainer up and away from sampler. Carefully remove the lid with the inlet tube attached, sliding it up the rope bridle.
- 2) Insert the D.O. collection bottle, with the cap removed, into the inner chamber of the sampler.
- 3) Press the thermometer into the hole in the floor of the outer chamber and position the scale so it can be read through the clear sampler body.
- 4) Replace the sampler lid, inserting the inlet tube into the D.O. collection bottle. Snap the wire retainer into the grooves on the lid. Press the stopper into the center hole in the lid.
- 5) Attach the weight to the large snap ring at the bottom of the sampler. In the winter attach the hand-held winder to the top of the sampler.
- 6) Submerge the sampling apparatus in an upright position with the lid 6-10 inches below the water surface.
- 7) Use a quick jerk of the line to remove the stopper from the lid of the apparatus. Water will begin filling the D.O. collecting bottle, then overflow and fill the outer chamber, flushing about 5 volumes of the D.O. bottle without contact with air. As air is displaced from the small pore on the side of the outer chamber, bubbles will be observed rising to the surface. When the water sampler is filled, bubbles will no longer appear. Filling takes about one minute.
- 8) Retrieve the sampling apparatus steadily from the water. Decreasing water pressure prevents the exchange of air and water in the sample.
- 9) Proceed to read the water temperature and fix the D.O. sample.
- 10) Do not discard the remainder of the water in the sampler since it will be used for the remaining tests (pH, Conductivity and Turbidity).

# San Gregorio Environmental Resource Center

## LaMotte Dissolved Oxygen Measurement Instructions

### **Step 1: Fixing the Sample** (Must be done immediately after collecting sample)

1. Examine the Dissolved Oxygen collection bottle when **removing it from the Water Sampling bottle** to make sure that no air bubbles are trapped inside. (An air bubble can produce false, high readings. If there are air bubbles start over and take another sample from the creek.)
2. To fix the sample in the field as soon as it is collected do the following:  
**Add 8 drops of Manganous Sulfate Solution** and **8 drops of Alkaline Potassium Iodide Azide** (white capped bottles in the kit). Some of the sample may overflow as chemicals are added, but sufficient amounts of the oxygen-reacting chemicals will fall to the bottom of the bottle. The overflow assures that when the sample bottle is closed, no air bubbles will be trapped inside.
3. **Cap and invert the bottle several times.** A precipitate will form. Allow the precipitate to settle to the shoulder of the bottle before proceeding. **Patience** with this step is critical as impatience may result in an incomplete reaction and produce false readings.
4. Once the precipitate has settled below the shoulder of the bottle, **add 8 drops of Sulfuric Acid, 1:1. Cap the bottle and gently shake** until the reagent and precipitate have dissolved. This may take a few minutes. A clear-yellow to brown-orange color will develop, depending on the oxygen content of the sample.

### **Step 2: Test Procedure with Fixed Water Sample**

1. **Fill the titrator bottle** (with the cap with a hole in it) to the **20 ml line** with the fixed water sample.
2. **Add 8 drops of the Starch Indicator Solution.** The sample will turn blue. Recap the titrator bottle and swirl so starch indicator mixes with sample.
3. **Fill the direct reading titrator (syringe) with Sodium Thiosulfate 0.025N.** First, insert the titrator into the plastic fitting of the Sodium Thiosulfate bottle. Turn the bottle upside down and slowly withdraw the plunger until the bottom of the plunger is opposite the zero mark on the scale. If small bubbles are filling the syringe, pump the syringe until the bubbles disappear. Turn the Sodium Thiosulfate bottle right-side-up and remove the titrator.
4. **Insert the titrator into the center hole of the water sample titration bottle.** Slowly release one drop of the Sodium Thiosulfate into the water sample and gently swirl. **Continue to add one drop at a time until the blue color instantly turns colorless.** Make sure the solution remains colorless for at least 1 - 2 minutes.  
If the plunger tip reaches the bottom line of the titrator before the solution turns clear, refill the Sodium Thiosulfate and continue titration.

5. **Read the test results** off the titrator (syringe) and **record on data sheet**. The titrator holds a total of 10 parts per million (ppm) of the reagent. Each minor division on the scale is equal to 0.2 ppm. If the titrator was refilled, add the first 10 ppm to the last reading to reflect the total amount of reagent dispensed.
  
6. **Discard the water sample solution in the waste water bottle**. Rinse the fixed sample bottle and the titrator bottle with distilled water and discard in waste water bottle.

## SOP SGC-05 Hobo TidbiT Temperature Thermographs

# Thermograph (TidBiT) Standard Operating Procedures

## INTRODUCTION

Tidbit thermographs record the temperature of water at preset intervals. The SOPs that follow describe how to set up, deploy, and post-calibrate TidbiT thermographs. These SOPs assume some familiarity with Microsoft Excel, and the spreadsheet files “Raw\_thermograph\_example.xls” and “Adj\_thermograph\_template.xls” are needed to do the data analysis portion of the SOPs.

### Getting started

When you receive new thermographs (Tidbits) the first step is to test them. First, launch them as described in the “Thermograph Launching” SOP. Then, do the calibrations described in the “2-Point Post-Calibration Procedure” and “Data Correction” SOPs. If, at the end of the calibration procedure, any of your thermographs does not register a slope of 1 and an offset of 0 (see step 23 of the “Data Correction” SOP), then do not use that thermograph. Otherwise, repeat the launching process and deploy the thermographs as described in the “Thermograph Deployment” section.

## THERMOGRAPH LAUNCHING

1. Make sure your computer clock is set correctly.
2. Open BoxCarPro 4.3.
3. Attach the logger to the computer using the supplied connector.
4. Select “**Logger, Multiple launch**”.
5. Select “**Enter a description**” and name the sampling event. Then hit “**Start**”
6. The program will say “New logger type” and will download default parameters: select “**OK**” then hit “**Cancel**” and disconnect the thermograph from the computer before pressing “**OK**”.
7. Reconnect the first logger to the computer, then hit “**Start**”.
8. You should see a box labeled “Launch”. In the “Launch” box, add the serial number of the thermograph at the beginning of the “Description” line.
9. Change the interval duration to 15 minutes or your desired interval.
10. Choose the measurement units.
11. Select delayed start.
12. Click today in the date field (or fill in the date you want it to start logging).
13. Type in the military time you want the thermograph to start logging.
14. Leave multiple sampling off.
15. Click “**Start**” (NOTE: this will erase all previously recorded data on this logger. Until you re-launch a logger, the previous data is stored and available to be downloaded again).
16. Remove before clicking “**OK**”.
17. Once the logger has been launched (even if it is set for delayed launch) it will blink yellow. Check that it is blinking.
18. Attach the next logger and in the “Multiple launch” box click “**Start**” and all of the parameters you filled in for the first logger will automatically be generated.
19. All you have to do for each additional logger is add the thermograph serial number to the beginning of the description and click start.

Your thermographs are ready to be deployed in the field!

## **THERMOGRAPH DEPLOYMENT**

In general, all thermographs should be placed in the deepest part of the channel of riffle locations to ensure complete mixing of the water and to maintain sufficient water depth for the duration of the sampling window. Alternatively, if riffles are too shallow, place the sensor in a pool or glide that exhibits well-mixed conditions. Do not place the sensor in a deep pool that may stratify during the summer, unless this is the objective of your study. This ensures that sensors are not selectively placed in cooler areas such as stratified pools, springs, or seeps or in warm, stagnant locations (hot spots), that would misrepresent a stream reach's temperature signature. For more detailed information on placement of thermographs, see Dunham *et al.*, 2005.

### **Tributaries or other junctions**

At locations of tributary confluences or other point discharges, it would be ideal to provide three thermographs (upstream, tributary, or downstream), but often two will suffice. The length of reach required to reach equilibrium will depend on stream size (especially water depth) and morphology, but a good rule of thumb is to place a thermograph 7–10 stream widths downstream and 3–5 channel widths upstream of a tributary junction. A hand-held thermometer can be used to document sufficient mixing by making frequent measurements horizontally and vertically across a stream. If stream temperatures are relatively homogenous ( $\pm 1-2^{\circ}\text{C}$ ) throughout the cross section during summer low flow conditions, then sufficient mixing exists.

### **Installation specifics**

Thermographs should be installed so that they are completely submerged, but not in contact with the bottom. The preferred method is to pound a 2-ft steel foundation stake into the stream bed using a sledge hammer, leaving approximately 2–3 inches exposed above the channel bed. Secure the thermograph with two zip ties through an upper nail hole. Ideally, the stake would be mounted on the downstream side of a large boulder that could provide shelter from mobilized bedload and debris that could damage the thermograph. In all cases, use two zip-ties and orient the stake with the thermograph facing downstream. Use two more zip-ties to secure the top and bottom of an ABS pipe section to the stake, encompassing the stake and thermograph. Do not attach thermographs using weights. In some cases, such as bedrock locations, the tidbit can be mounted in a short section of perforated ABS or galvanized pipe using a zip tie with the pipe affixed to a swaged stainless steel braided cable. This is reserved for extreme circumstances because of the high visibility, potential for tampering, and potential to be swept out of place by stream flows. Observe the following steps:

1. Pound the foundation stake into stream bed until you are sure passing debris could not knock it out. If it feels loose, pull it out and try another location.
2. Record the serial number of the thermograph to be deployed after verifying that it is blinking.
3. Mount the thermograph underwater after the stake is set to within 3-inches of stream bed.
4. If the stake cannot be pounded into the stream bed, locate a boulder or tree to which you can secure a cable set-up.
  - a. Place the Thermograph in center of ABS or PVC pipe section and run cable through the middle hole in the pipe on one side, through the Thermograph, and then out the middle hole in the pipe on the other side. Secure the cable loop with two ferrules using swager tool.

- b. Measure out enough cable to lead from the desired stream bed location to the boulder/tree and loop cable around the boulder/tree; Cut cable and secure loop with two ferrules using swager tool
  - c. Place a dive weight on either side of the ABS pipe section. Run cable through one dive weight, through the upper hole in the pipe on that side, out the upper hole in the pipe on the other side, through the other dive weight, and form a loop, secured with two ferrules. Repeat this step at the bottom of the pipe section. The setup is now ready to go.
5. Record instream temperatures with hand-held thermometer (not mercury unless armored and tethered)
  6. Install flagging and at least one metal tag (two preferred) to a nearby tree for distance and bearing to the thermograph
  7. Mark site locations on a topographic map, aerial photo, or GIS map and provide a separate site sketch with details such as:
    - a. Thermograph location, distances and bearing from observable features
    - b. Riparian shade features
    - c. tributaries with summer flow
    - d. locations of roads and other disturbances to the channel or riparian vegetation
  8. Take a picture of the location facing upstream and downstream, and of any landmarks as seen from the location of the Thermograph.

Once a sensor/data logger combination has been deployed at a site, make notes of any relocation due to de-watering in the field notebook. If possible, provide a record of simultaneous temperatures at the original and redeployed locations

## References

Dunham, J., Chandler, G., Rieman, B., Martin, D. 2005. Measuring stream temperature with digital data loggers: a user's guide. Gen. Tech. Rep. RMRS-GTR-150WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 15 p.

## **THERMOGRAPH 2-POINT POST-CALIBRATION PROCEDURE**

The two-point post-calibration of thermographs involves exposing them to an ice bath for a long enough period to reach stable temperatures, and then exposing them to water with a constant, higher temperature for a similar length of time. These two processes can be done in either order. NIST certified thermographs should be exposed to the same baths, so that results from the field thermographs can be compared to the NIST certified loggers, and corrected if need be.

1. Collect all logging thermographs from field. The time of deployment and retrieval should be noted in field notebook.
2. Set up the ice bath.
  - Note the time implemented.
  - Place all thermographs in 1L Nalgene or similar container packed with ice and enough cold water to fill all the spaces. Avoid leaving bubbles in the container.
  - Fill a large cooler ½ way with ice.
  - Place the Nalgene in the cooler.
  - Fill the cooler full with ice.
  - Add cold water so all interstitial spaces between packed ice are filled, but the cooler is still mostly filled with ice.
  - Make sure the Nalgene is fully surrounded by ice (top, bottom, and ends).
  - Close the cooler, place it away from sun light, and let the thermographs log.
  - Leave overnight if possible. A full 24 hours of data is good to have for the ice bath. However, this test is very stable, so a few hours of good data is enough if you're in a hurry.
3. Set up the water bath.
  - Find a sink in a building where no water will be drawn elsewhere in the building overnight, and there will be no people or other air disturbances.
  - Place all thermographs in a similar orientation on the floor of a cooler small enough to fit in the sink. (The thermographs should be on their flat backs, facing up).
  - If the hot and cold water come out of the same spigot, turn off the hot water valve for the sink. (The valve usually located below the sink). Verify that the hot water is off by trying to get hot water from the tap.
  - Fill the cooler with water.
  - Allow water to flow (about the width of a pencil) to keep water temperature stable overnight.
  - Leave a note attached to the spigot explaining that there is an experiment in progress and please leave the water on until at least 6 am the following morning. (The calibration numbers are usually only good from about 10 pm to 6 am when there is no air movement).
  - Note the date/time the water was started and stopped.

## DOWNLOADING PROCEDURE

Once the two point calibration has been run, the thermographs and all their data are ready to be downloaded.

1. Open BoxcarPro 4.3.
2. Plug in the first logger.
3. Select **“Logger, Readout”** (The program should tell you what the serial number of the thermograph you are downloading).
4. When the data has been downloaded, unplug the logger from the serial cable then press **“OK”**.
5. Click **“Save”**. The first time you download a batch of thermographs, you may have to create appropriate folder (i.e. “thermograph download 2004-09-16”). Every time you have a logger from a different batch, it will send you back to the C drive, so ensure that you are saving to the appropriate folder. Although the loggers should each be appropriately and uniquely named at the time of launching, make sure each file is correctly and uniquely named (e.g. “serial#\_deploymentname\_datelaunched”).
6. Select your desired temperature units and click **“OK”**. (A graph of the data will appear).

While graph is selected:

7. Select **“File, Export, Microsoft Excel Spreadsheet”**. Select **“Include serial number”** and **“All series”**. Click **“Export”**, navigate to the appropriate folder, name the file, and click **“Save”**. (The computer will write the series information to excel).
8. Close the graphed data in BoxcarPro.
9. Repeat, starting at step 2, for the other thermographs.
10. When you are finished, make sure you have the same number of .dtf files as .xls files as downloaded thermographs.

## DATA CORRECTION

The thermograph data should be corrected using the data gathered from the NIST certified loggers. The thermographs can drift over time, so doing this correction ensures that that drift is corrected.

1. Open the example spreadsheet “Raw\_thermograph\_example.xls” and save a new Excel file as “raw\_thermograph\_data\_downloaddate”. The data in this spreadsheet is organized in the same way you will organize your data.
2. Name a blank worksheet (“**Insert, worksheet**”) tab in the new Excel file with the date the thermographs were launched.
3. Open all .xls files from same launch date/time
4. Organize the thermograph files numerically from lowest serial number to highest.
5. Copy the Date/Time and Temperature columns from lowest numbered unit, and paste them into the new worksheet.
6. Type the serial number in row 1 of the column with data (typing over the temperature (\*C) heading).
7. Type in the thermograph serial numbers from lowest to highest in successive columns in row 1.
8. Copy only the temperature column from each additional unit. (Highlight the top data point, hold “Ctrl+Shift+down arrow” to select all data. Hit “Ctrl+C” to copy the selected data. In the raw data file, hit “Ctrl+V” to paste the data below the appropriate serial number.
9. Make a worksheet using the same method for each launch date.
10. Make a worksheet in the same way with the NIST certified logger data.
11. Create an “averageNIST” column in which temperatures from the 3 NIST certified loggers are averaged. (Enter “=AVERAGE(B2:D2)” into column E2, then pull down the formula to the bottom of the data).
12. Make a copy of all data tabs and place them in the Adj\_thermograph\_template.xls” file.
13. Save file as “adj\_thermograph\_data\_downloaddate.xls”.
14. Insert a blank column B on all sheets except the NIST data sheets.
15. Copy the header information (rows 1-32) from an example data sheet and use “insert copied cells” to insert the header at the top of all the new data sheets except the NIST data sheet.
16. Copy the old NIST header information (rows 1-9) and use “insert copied cells to insert the header at the top the NIST data sheet.

On the NIST data sheet tab:

17. Determine the approximate times of the water bath and the ice bath. You can do this by graphing the data and looking for times when the temperature was stable. Select the times when the thermographs were in the water bath and the ice bath, excluding the times when the temperature was unstable, or the three NIST loggers did not give similar results. For visual ease, highlight the rows corresponding to the water bath one color and the rows corresponding to the water bath another color. Usually the water bath data are only good from about 10 pm to 6 am the next morning. For the ice bath, the data are usually good from a half hour or so after the calibration check was started until the thermographs were removed from the ice bath.
18. Cells highlighted with dots require new information in their formulas. Change the formula in these cells to point to the appropriate rows that you determined for both the water bath and ice baths.

On all other data tabs:

19. Extend header rows as far as there is data by copying rows 1 through 32 of one column and pasting into the top of all remaining columns.
20. Update the tidbit median formula for both the water bath and the ice bath in row 16, column B and row 24, column B to reference the new NIST worksheet (instead of the oldNist worksheet).
21. Find the rows in the deployed thermograph data corresponding to the times you determined for the water and ice baths in step 17. (They should be near the bottom of the data). Update all the successive columns in rows 16 and 24 so that the formulas refer to these rows.
22. Trim the bottom of the data away below the last data point for the calibration check.
23. Check to see if the slope and offset are all 1 and 0 respectively. If they are or not, create another, adjusted set of data in the subsequent columns:
24. Copy all serial numbers. After the last data, leave one column blank, and then paste the serial numbers again. (This should be in row 33- see the "Olddata" tab for an example).
25. Copy the formula from cell W34 of the "Olddata" tab and paste it directly below the first of the serial numbers you just pasted (this should be row 34: if you are in a different row for some reason, you will need to re-write the formula: it should be  $((\text{original data point} * \text{slope}) + \text{offset})$ ). Fill that formula down as far as the data goes in that tab. Then fill it across to correct all thermographs.
26. If the slope and offset for a given thermograph are all 1 and 0 respectively, these numbers will be the same as the raw data. Otherwise, they will be adjusted for whatever drift occurred in the unit.
27. Cells highlighted grey require entered information. Fill in grey header information.
28. Type in appropriate calibration start date/time for both water and ice bath calibrations.
29. Fill in launch date/time (should be the same for all thermographs on a tab).
30. Fill in deploy date/time from the field notes.
31. Fill in retrieve date/time from the field notes.
32. Fill in site information.
33. The thermographs automatically adjust their internal clocks for daylight savings time. To avoid overlapping times on graphs, you may want to adjust the times reported in daylight time (summer) to standard (winter) time by subtracting an hour from all of the times reported during daylight savings times.
34. Do a visual QC on the data by graphing the temperature over time. You should notice that the temperature changes more gradually once the thermograph is placed in the water. When the thermograph is out of the water, its behavior is usually somewhat erratic. Check for any odd behavior after the deployment time and before the retrieval time that might indicate the thermograph was out of the water or otherwise malfunctioning. In most systems, you should see a ~24 hour cycle as the water heats during the day and cools at night. It can also be helpful to graph the differences between consecutive measurements against time: large differences in consecutive measurements may indicate a problem.

## SOP SGC-06 Hach 2100P Turbidimeter Calibration and Use

### 2.2.1 Turbidity Measurement Procedure

1. Collect a representative sample in a clean container. Fill a sample cell to the line (about 15 mL), taking care to handle the sample cell by the top. Cap the cell.
2. Wipe the cell with a soft, lint-free cloth to remove water spots and fingerprints.
3. Apply a thin film of silicone oil. Wipe with a soft cloth to obtain an even film over the entire surface.
4. Press: **I/O**. The instrument will turn on. Place the instrument on a flat, sturdy surface. Do not hold the instrument while making measurements.
5. Insert the sample cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment. **Close the lid.**
6. Select manual or automatic range selection by pressing the **RANGE** key. The display will show **AUTO RNG** when the instrument is in automatic range selection.
7. Select signal averaging mode by pressing the **SIGNAL AVERAGE** key. The display will show **SIG AVG** when the instrument is using signal averaging. Use signal average mode if the sample causes a noisy signal (display changes constantly).
8. Press: **READ** The display will show - - - - **NTU**, then the turbidity in NTU. Record the turbidity after the lamp symbol turns off.

### 3.6 Calibration

Calibration of the 2100P Turbidimeter is based on formazin, the primary standard for turbidity. The instrument's electronic and optical design provide long-term stability and minimize the need for frequent calibration. The two-detector ratioing system compensates for most fluctuations in lamp output. **A formazin recalibration should be performed at least once every three months**, more often if experience indicates the need. When calibration is necessary, use a primary standard such as StablCal™ Stabilized Standards or formazin standards.

#### 3.6.3 Calibrating the Turbidimeter

*Note: For best accuracy use the same sample cell or four matched sample cells for all measurements during calibration. Always insert the cell so the orientation mark placed on the cell during the matching procedure is correctly aligned. (See Section 2.3.4 on page 26 for matching sample cells).*

**1.** Rinse a clean sample cell with dilution water several times. Then fill the cell to the line (about 15 mL) with dilution water or use StablCal <0.1 NTU standard.

*Note: The same dilution water used for preparing the standards must be used in this step.*

**2.** Insert the sample cell in the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid. Press I/O.

*Note: Choose signal average mode option (on or off) before pressing CAL – the SIGNAL AVERAGE key is not functional in calibration mode.*

**3.** Press: CAL.

The CAL and S0 icons will be displayed (the 0 will flash). The 4-digit display will show the value of the S0 standard for the previous calibration. If the blank value was forced to 0.0, the display will be blank (as shown). Press → to get a numerical display.

**4.** Press: READ

The instrument will count from 60 to 0, (67 to 0 if signal average is on), read the blank and use it to calculate a correction factor for the 20 NTU standard measurement. If the dilution water is  $\geq 0.5$  NTU, E 1 will appear when the calibration is calculated (See Section 3.6.2.3 on page 41 for more dilution water information). The display will automatically increment to the next standard. Remove the sample cell from the cell compartment.

*Note: The turbidity of the dilution water can be "forced" to zero by pressing → rather than reading the dilution water. The display will show S0 NTU and the ↑ key must be pressed to continue with the next standard.*

**5.** The display will show the S1 (with the 1 flashing) and 20 NTU or the value of the S1 standard for the previous calibration. If the value is incorrect, edit the value by pressing the → key until the number that needs editing flashes. Use the ↑ key to scroll to the correct number. After editing, fill a clean sample cell to the line with **well mixed** 20 NTU StablCal Standard or 20 NTU formazin standard. Insert the sample cell into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid.

**6.** Press: READ

The instrument will count from 60 to 0 (67 to 0 if signal average is on), measure the turbidity and store the value. The display will automatically increment to the next standard. Remove the sample cell from the cell compartment.

**7.** The display will show the S2 (with the 2 flashing) and 100 NTU or the value of the S2 standard for the previous calibration. If the value is incorrect, edit the value by pressing the → key until the number that needs editing flashes. Use the ↑ key to scroll to the correct number. After editing, fill a clean sample cell to the line with **well mixed** 100 NTU StablCal Standard or 100 NTU formazin standard. Insert the sample cell into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment. Close the lid.

## SOP SGC-07 YSI-556 Multiprobe

### 6.2 Calibration Procedures

#### 6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.
4. Press the **Enter** key. The Calibrate screen is displayed.

#### 6.2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section 6.2.1 Accessing the Calibrate Screen.
2. Use the arrow keys to highlight the **Conductivity** selection.
3. Press **Enter**. The Conductivity Calibration Selection Screen is displayed.
4. Use the arrow keys to highlight the Specific Conductance selection.
5. Press **Enter**. The Conductivity Calibration Entry Screen is displayed.
6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

**NOTE:** For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- For fresh water use a 1 mS/cm conductivity standard.
- For brackish water use a 10 mS/cm conductivity standard.
- For seawater use a 50 mS/cm conductivity standard.

**NOTE:** Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.
8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

**NOTE:** The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
10. Use the keypad to enter the calibration value of the standard you are using.

**NOTE:** Be sure to enter the value in **mS/cm at 25°C**.

11. Press **Enter**. The Conductivity Calibration Screen is displayed.
12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.
15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.
16. Rinse the probe module and sensors in tap or purified water and dry.

### 6.2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section 6.2.1 *Accessing the Calibrate Screen*.

**NOTE:** The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

#### DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.

2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

**NOTE:** Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

**NOTE:** If the unit has the optional barometer, no entry is required.

**NOTE:** Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section 10.10 *Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

#### DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section 6.2.3 *Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

4. Place the probe module in water with a known DO concentration.

**NOTE:** Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen.
11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.
12. Rinse the probe module and sensors in tap or purified water and dry.

#### 6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.
2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.
3. Press **Enter**. The pH calibration screen is displayed.

- Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.
5. Press **Enter**. The pH Entry Screen is displayed.
6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

**NOTE:** For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

**NOTE:** Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.
8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

**NOTE:** The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

**NOTE:** Do not overtighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

**NOTE:** pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.
12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to

press **Enter** again to Continue.

**14.** Press **Enter**. This returns you to the Specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

**15.** Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

**16.** Repeat steps 6 through 13 above using a second pH buffer.

**17.** Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

**18.** Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

**19.** Rinse the probe module and sensors in tap or purified water and dry.

## 7.1 Real-Time Data

**NOTE:** Before measuring samples you must prepare the probe module (refer to Section 3.4 *Preparing the Probe Module*), attach the probe module to the instrument (refer to Section 3.6 *Instrument/Cable Connection*) and calibrate the sensors (refer to Section 6 *Calibrate*).

**1.** Press the **On/off** key.

OR select Run from the main menu to display the run screen.

**2.** Make sure the probe sensor guard is installed.

**3.** Place the probe module in the sample. Be sure to completely immerse all the sensors.

**4.** Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

**5.** Watch the readings on the display until they are stable.

**6.** Refer to Section 9 *Logging* for instructions on logging sample data.

## SOP SGC-08 Isokinetic Sampler Standard Operating Procedure

### Non-tidal Network Program Sampling Procedure

1. You will need to record the time and gage height at the beginning and end of the sample collection period on the field sheet. If you are sampling at the exact location of the gage, open the gage house and record the gage height and time before sampling and after you finish collecting samples. If you will not be sampling at the exact gage location stop at the gage and record a beginning gage height and time. If the gage is on-line you can get the end reading from the USGS web page. Check the recorded gage height against the cross reference list in the field pack to determine if maximum velocity expected is greater than or equal to 1.5 ft/sec. **If YES**, an isokinetic composite sample **MUST** be collected. If the maximum velocity is under 1.5 ft/sec or over 7.0 ft/sec a non-isokinetic composite sample is collected.

2. Set up cones on the road to block off enough room so that you feel safe on the downstream side of the bridge. Wear your orange safety vest.

3. Measure stream width by placing the measuring tape along the bridge from stream bank to stream bank. Measure from left to right looking downstream. Establish the number of increments (transects) you will sampling by using the table on page 3. After you determine the number of increments (transects) that will be sampled, use the formula below to determine the location of each vertical sample. A more detailed explanation of the new isokinetic sampling protocols can be found in the Non-tidal Field Pack. Check "Sampling Procedures and Protocols for the Chesapeake Bay Non-tidal Water Quality Network" report, page 6 or the USGS procedures.

Here is a formula to determine the number of transects and the location of verticals:

- Stream Width / number of transects = transect length
- 1st vertical = Transect length / 2
- 2nd vertical = Transect length + 1st vertical
- 3rd vertical = Transect length + 2nd vertical
- 4th vertical = Transect length + 3rd vertical
- 5th vertical = Transect length + 4th vertical

For example, if the stream is 60 feet wide and it is divided into 3 transects, the 1st sample should be taken at 10 feet from the left bank (while facing downstream), the 2nd at 30 feet, the 3rd at 50 feet. Record vertical locations in the comment section of the field sheet.

4. Once you have established a location for each vertical, record Hydrolab readings for each vertical by immersing the Hydrolab in the stream directly (if equipment and stream velocity are suitable) or by collecting a rinsed bucket at each vertical. Refer to Hydrolab Sampling Procedures for a detailed explanation of this process. Review these readings. The stream is well mixed if no set of readings for any one parameter differs by 20 %. If the stream is well mixed, record the median value for each parameter on the field sheet and begin collecting samples. If stream is not well mixed, increase the numbers of verticals by at least two and repeat steps 3 & 4.

5. Based on the stream velocity and sampler choices available, choose a sampler to use. Rinse the sampler collection bottle and all whole water sample bottles three times with stream water (directly in stream or from a freshly collected bucket of stream water). Rinse the churn splitter with 2 to 4 L of stream water. Run a liter of water through the spigot.

DH-81 (Hand held wading sampler, optional isokinetic/ non-isokinetic)

If stream velocity is >1.5 ft/s and considered safely wadable, you may use the DH-81 as an isokinetic sampler by using the appropriate nozzle (usually 5/16"). If flows are less than 1.5 ft/s the DH-81 may be used without the nozzle to obtain a grab sample.

A. Select the area of stream that you will be sampling and secure the tape measure across the stream.

Measure from left to right looking downstream. Establish the number of increments (transects) you will be sampling and location across the transect where you will be collecting your vertical sample based on the width of the stream.

B. Once you have established a location for each vertical, record Hydrolab readings for each vertical. Have one person on the stream bank recording the numbers while the other person handles the Hydrolab. See Hydrolab Sampling Procedures for a detailed explanation of the process.

C. Rinse the DH-81, including bottle, nozzle (if needed), cap and the churn splitter in the stream. Make sure you are downstream of the sample area to ensure that you do not stir up the streambed prior to sampling.

D. Assemble the DH-81 by screwing the cap onto the liter sample bottle and attach the nozzle to the cap (if the stream velocity is under 1.5 ft/sec you can sample without the nozzle). Secure the DH-81 to the wading rod by snapping it into place over the cap.

E. Decide who will be the clean hands person (who handles the sample) and who is the dirty hands person (who handles the equipment). The clean hands person must wear rubber gloves during the sampling. They will only touch the sample bottle and churn splitter.

F. Enter the stream down river of the sampling location and walk up to the sampling location in the centroid (maximum) of the stream flow. Raise and lower the sampler at a constant rate such that the sample bottle is 1/2 - 3/4 full when breaking the surface.

**G. If the sample bottle is too full pour out sample and speed up your transit rate or use a smaller nozzle or a combination of both until the sample bottle fills 1/2 - 3/4 when the sampler is raised out of the water column. Likewise, if the sample is not full enough, pour out the sample and use a larger nozzle or slow your transit rate to increase sample volume.**

H. Empty the collected sample into the churn splitter. Move to the next vertical and repeat the collection process.

I. Repeat the sample collection process until there is sufficient volume to fill the 4 or 8 Liter churn splitter.

J. Follow the instructions under Churn Splitter Sub-Sampling Procedure at the end of this section.

## Appendix G Soil Control Lab Standard Operating Procedure – Analytic Balance Calibration

### **Standard Operating Procedure Soil Control Lab**

Title: Mettler AE166 Electronic Balance, Calibration, Use and Maintenance

SOP #: G-2      Revision Date: August 15, 1995

Laboratory Director:

Q.A. Officer:

#### **1.0 Scope and Application**

##### 1.1 Scope

1.1.1 This SOP describes the operation and maintenance of the Mettler AE166 Electronic Balance.

##### 1.2 Application

1.2.1 The Mettler AE166 electronic balance is calibrated once a day. Calibration is verified using a set of analytical weights. The balance has a weighing range of 160 g, reading to 0.1 mg.

#### **2.0 Definitions**

2.1 None.

#### **3.0 Personnel**

3.1 This procedure can only be performed by personnel familiar with all aspects of the procedure and any other procedures specified within this document. They must have read and understood this SOP in full and have a working knowledge of all aspects of this procedure as well as all pertinent safety precautions (section 0.0). Only personnel who are trained for this procedure are allowed to perform this procedure.

#### **4.0 Equipment and Materials (recommended)**

4.1 Mettler AE166 Electronic Balance.

4.2 Brush.

#### **5.0 Sample Handling**

5.1 None.

#### **6.0 Standards Preparation**

6.1 None.

#### **7.0 Procedures**

7.1 Preliminary Preparation

- 7.1.1 Check voltage setting.
  - 7.1.1.1 If the voltage setting printed on the tag does not agree with the power supply voltage, or if the tag is missing, the setting of the voltage selector switch on the read wall must be checked, and if needed, changed.
  - 7.1.1.2 Admissible power supply voltages with switch positions:
    - 115 v: 92 v....132 v
    - 220 v: 184 v....265 v
- 7.1.2 Location
  - 7.1.2.1 Place the balance on a stable (non-vibrating) location.
  - 7.1.2.2 Make sure there are no large temperature fluctuations.
  - 7.1.2.3 Avoid direct sunlight or drafts.
- 7.1.3 Leveling balance
  - 7.1.3.1 Adjust the two leveling screws so that the bubble in the split level is in the center of the circle. Any time the location of the balance is changed, re-check the leveling.
- 7.1.4 Switching balance on/off
  - 7.1.4.1 To switch on: Briefly press control bar. All display elements light up for several seconds. Then all zeros will appear.
  - 7.1.4.2 To switch off: Briefly lift control bar. If the balance displays "OFF" the control bar must be pressed again.
- 7.1.5 Taring
  - 7.1.5.1 Place a container on the pan. The weight is displayed.
  - 7.1.5.2 Briefly press control bar. Display is blanked out, then all zeros will appear. The container weight is now tared out.
- 7.1.6 "Brief Operating Instructions"
  - 7.1.6.1 Located beneath the balance is a swing-out card on which an abbreviated form of the operating instructions are printed.
- 7.2 Balance Operation
  - 7.2.1 Brush away any dust or foreign particles off weigh pan.
  - 7.2.2 Calibrate balance by holding the "MODE" bar down until [CAL...] is displayed, then release bar.
  - 7.2.3 When display flashes [CAL100], slide "CAL" lever back (away from yourself), located on the right side of balance. This drops an internal weight onto the balance.
  - 7.2.4 When the balance is finished with calibration, the display will read [100.0000], then a flashing [0] will appear. This indicates that calibration is complete.
  - 7.2.5 Slide "CAL" level forward (towards yourself). Display will now read [0.0000g].
  - 7.2.6 Calibrate with pre-calibrated weights and log readings into appropriate logbook. Balance must be calibrated every day, prior to use.
- 7.3 Weighing-in
  - 7.3.1 Place container on weighing pan.
  - 7.3.2 Press control bar to tare and the zero display will appear.
  - 7.3.3 Weigh-in up to desired target weight.
- 7.4 Care and Maintenance
  - 7.4.1 Cleaning balance
    - 7.4.1.1 A cloth and some soapy water are sufficient for cleaning the weigh pan and balance housing.
    - 7.4.1.2 **DO NOT USE** any strong solvents.
    - 7.4.1.3 **DO NOT** blow air into the chamber under any circumstances.
    - 7.4.1.4 Brush away any dust or foreign particles off weigh pan and the surrounding areas.

## 7.5 Replacing the Microfuse

- 7.5.1 Disconnect power cable.
- 7.5.2 Remove cap with screwdriver.
- 7.5.3 Replace defective fuse (replacement fuse is located in holder).
- 7.5.4 Put a new replacement fuse in the holder for next use.
- 7.5.5 Place fuse holder back in balance and lightly press in.
- 7.5.6 Reconnect power cable.

## 8.0 Quality Control Limits

### 8.1 Calibrated weights

- 8.1.1 Each calibrated weight (Class S) must read within 0.1%.

## 9.0 Corrective Action Procedures

### 9.1 Calibration

- 9.1.1 If calibrated weights are not within 0.1%, repeat sections 0 - 0.
- 9.1.2 If the above action did not correct the problem, inform the Division Manager, Quality Assurance Officer, or Laboratory Director.

## 10.0 Documentation Description and Example Forms

- 10.1 None.

## 11.0 Safety Precautions and Miscellaneous Notes

### 11.1 Safety

- 11.1.1 Wear laboratory coats, eye protection and gloves when working with test materials and chemicals.
- 11.1.2 Work with volatile or toxic chemicals under an approved fume hood.
- 11.1.3 Package, store and dispose of test materials and chemicals following appropriate local, state and federal regulations.

## 12.0 References

- 12.1 *Mettler AE166 Electronic Balance Manual.*