EXAMPLE ONLY
NOT A REAL MONITORING PLAN

Sycamore Creek Bacterial Sources ID Project

Proposal Identification Number: SC417

Environmental Monitoring Project Plan

For one line of inquiry, with 3-line addendum

Prepared by: Patrick Tech

Sycamore County Resource Conservation District

This Monitoring plan is based on the CWT template, March 2006

Final draft
April 30, 2007

Note:

This is an example of a Monitoring Project Plan, not a real Plan.
It can be used for training purpose only.
The names of people and places are fictitious, but the roles, responsibilities, types of institutions, and regulatory drivers are real. Instruments, methods, QA requirements, and attainable data quality objectives are also real, and so are the management measures, watershed activities, types of communities, and types of problems. All these entities are realistically set in an imaginary landscape.

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Section 1. Plan Approval and Distribution

APPROVAL SIGNATURES

GRANT ORGANIZATION:

Title:	Name:	Signature:	Date*:
Project Manager	Armand Smith		
Laboratory Manager	Eric Graham		
RCD QA Officer	Jared Holmes		

REGIONAL BOARD

Title:	Name:	Signature:	Date*:
Contract Manager	Cecilia Regal		
RB QA Officer	Fred Arditi		

** This is a contractual document. The signature dates indicate the earliest date when the project can start.*

DISTRIBUTION LIST

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Contractor QA Officer	Jared Holmes, Sycamore RCD	209 333 5556	1
Regional Board Contract Manager	Cecilia Regal , RB	209 246 5577	ORIGINAL
Regional Board QA Officer	Fred Arditi , RB	209 246 5586	1
Technical Leader	Patrick Tech, Sycamore RCD	209 333 5557	2
Trainer	Christine Pond, Sycamore RCD	209 333 5559	1
Advisor	John Expert, Hilltop Advisors Inc	216 124 4609	1
Laboratory Manager	Eric Graham, Happy Flask Lab	209 334 3570	1
Laboratory QA/QC officer	Josh Cooper, Happy Flask Lab	209 334 3577	1

Section 2. Introductions and Overview

Bacterial monitoring in the Sycamore Creek watershed has revealed potential impairment of beneficial uses linked to contamination of the water with fecal matter. The Sycamore County Resource Conservation District (RCD) received a grant to characterize the water quality conditions and identify the sources of *E. coli* within the Sycamore Creek river network for the purpose of targeting resources to implement management measures that will alleviate some of these problems. The RCD will collaborate with other agencies and organizations that have an interest in this watershed to pool monitoring resources for the benefit of all stakeholders including community members, landowners, industry, and regulatory agencies.

This Monitoring Plan describes the monitoring efforts that will be undertaken by the Sycamore RCD pursuant to the grant proposal **# SC417** and ensuing Contract. Sycamore RCD staff and community members will conduct a survey to identify sources of indicator bacteria during the summer of 2008, and augment their findings with data from other sources.

The contract stipulates that all monitoring efforts be compatible with the Surface Water Ambient Monitoring Program (SWAMP) data collection effort, and this Plan has been developed with full consideration of **current** SWAMP requirements. Structurally, the Plan is based on tools and guidance developed by the Clean Water Team (CWT) to assist with preparation of comprehensive and communicative Project planning documents. It incorporates the use of SOPs, spreadsheets, and templates that are part of the Data Quality Management system implemented by CWT. Other materials available with the CWT, including the summary schematics that explain the roles and tasks needed for a typical monitoring Project as well as information about data quality and Quality Assurance Project Plan requirements were also conferred with during the preparation of this Monitoring Plan.

This Plan has been prepared for two purposes: (a) communicate with technical experts and receive their feedback and input before the monitoring resources are spent; and (b) share all the important elements of the planned activities with the Trainers, Field Operators, and Lab staff who will be doing the actual work, at the level of detail and the specificity they need (beyond the individual SOPs). Once approved, all operators throughout the life of the Project will confer this Plan.

The Plan is written for a specific monitoring effort, to be conducted within a small watershed, and is focused on one line of inquiry (i.e., monitoring question). **[[Note: for training purposes, the Addendum beyond the last Appendix shows examples for extrapolation of selected sections of this plan to three lines of inquiry]].**

Beyond the Plan approval and distribution page (Section 1) and this Introduction (Section 2), the contents of the Plan are organized in the following sections.

Section 3 provides the geographical settings and explains the reason for monitoring, starting with the problem statement and culminating with the question that the monitoring activities will attempt to answer
Section 4 describes the organizations involved in the Project, shows the roles and functions of personnel involved in Project Tasks, and lists the other people that have input to the Project (data users, other stakeholders, and advisors),
Section 5 shows the major tasks and timelines for their completion (and refers the reader to Appendix A for details)
Section 6 reiterates the study questions and provides all the "what, where, and when" information, including the sampling design principles and the power of the dataset as required for the intended use of the data. The section also lists other sources of data and information that will augment the data sets collected for this project.
Section 7 specifies the measurement quality objectives (MQOs) and other quality objective developed to enable the intended use of the data, and provides explanation on the data quality indicators that address these objectives.
Section 8 describes the methodology that will be used to achieve the MQOs
Section 9 is a focused Quality Assurance Project Plan that specifically addresses the way Project personnel will affect, check, record, and report the quality of the data, including accuracy, precision, resolution uncertainty, lack of contamination, lack of deterioration, and operator's competence. This section also communicates further information about data processing, including data verification and data validation, as well as about the overseeing and auditing tasks, both internal and external.
Section 10 provides a brief Health and Safety Plan for the Project.
Section 11 discusses how the data will be managed and shared, lists the data interpretation and analyses steps that may be relevant to this Project, and lays out the outline for the project's Technical Report.

Section 3. Problem Statement and Monitoring Objectives

3.1 Geographical Setting

Figure 3-1 would show a map that lays out the conceptual model of the Sycamore Creek watershed, including the relevant land use activities, to provide the landscape context of the problem. *[In this example Figure 3-1 has not been included.]*

Sycamore Creek flows east to west from its headwaters in the Snowy Mountains, through 30 miles of rolling foothills and about 10 miles of valley floor, into the Big Valley Wetland Monument, a remnant of historic wetlands that covered a considerable part of the Big Valley. The wetland has clearly defined waterways during the winter, and these are connected to a series of navigation canals and sloughs that, eventually, reach the Ocean. The river network is made of two major branches, the North fork that drains about 34 square miles and the South fork that drains 67 square miles. Total watershed area is 112 square miles.

More than half of the watershed area is a forest, and about 10% of the land – mostly in the foothills - is used for grazing. There are few urban centers in the watershed, but small communities are widely dispersed in the foothill areas, and many of them rely on septic systems. The most prominent of these communities is the town of Pensia, located close to the South Fork about two river miles above confluence with the North Fork of Sycamore Creek. The mountain and foothill segment of the stream is relatively undisturbed and has been designated the beneficial uses of WARM, COLD, AQUA, MUN, and WILD. The beneficial use of Municipal water supply is realized within the watershed by more than 50,000 households. These consumers are served by the Sycamore Water District (SWD), which draws creek water three river miles downstream of the North fork/South fork confluence.

3.2 Problem Statement

The problem addressed by this monitoring effort is: There appears to be a persistent source of bacterial contamination to the mainstem of Sycamore Creek during summer.

Sycamore Creek water is used for domestic supply to more than 50,000 households within the service area of the Sycamore Water District (SWD, or the District). The intake of the SWD treatment plant is located three river miles downstream of the North fork/South fork confluence, and the District is running routine bacteriological tests on its raw water. The District is also required to test water samples collected from different parts of the stream network at least four times during the summer. In the summers of 2005 and 2006 there have been several incidents of elevated *E. coli* concentrations in the main stem of Sycamore Creek just downstream of the South fork/North fork confluence, but the source of these contaminants is not known.

3.3 Monitoring Objective and Study Question

This monitoring effort will attempt to identify the source of bacterial contamination within the stream network. Specifically, the project will attempt to answer the following question shown in box 3-1:

Box 3-1: Monitoring Question

What are the sources of E. coli to the main stem of Sycamore Creek during summer?

One major line of inquiry will be implemented to answer the monitoring question stated above. Monitoring work under this Project will be performed during **dry weather** only, for all purposes; however this Project's data will be augmented by wet-weather sampling effort conducted by the Sycamore County Flood Control District as part of their Stormwater Characterization Program. Further detail is provided in Section 6 below.

Section 4. **Project Personnel, Roles, and Responsibilities**

4.1 Project Personnel.

The Sycamore County Resource Conservation District (RCD) received a small grant to identify the sources of *E. coli* within the Sycamore Creek river network. This organization is the lead agency on this effort, as it is the grant recipient, and will manage all field activities and laboratory analyses. The RCD has contracted Happy Flask Laboratory to conduct the laboratory analyses and recruited members of the Friends of Sycamore Creek to conduct the field monitoring. Table 4-1 lists the representatives from these three organizations who will assume all necessary Project Personnel roles to assure data quality and timely delivery of reliable and usable monitoring data. They will be responsible for all Project tasks and deliverables.

Armand Smith, the Project Manager, will be responsible for all contract management tasks including invoicing and reporting, management of the laboratory contract, and oversight of project progress. He will work closely with the Technical Leader and the QA officers, receive their reports, and assure that any problems are solved promptly.

Patrick Tech is the Technical Leader of this Project and the author of this Monitoring Project Plan. He has been charged with seeking expert advice and review during the process of Project Planning and design, and will be responsible for the scientific defensibility of the data collection effort, for the usability of the data, and for complete documentation of data quality. He will maintain his technical dialogs with advisors and experts, and will be responsible for collaboration with other agencies and stakeholders active in the watershed. Patrick Tech will be working closely with Jared Holmes, Sycamore RCD's Quality Assurance Officer. Patrick will be assisted by Dr. Don Ensin, a retired scientist who resides in Pensia and is a member of the Friends Sycamore Creek (FSC), who will provide the daily technical liaison with the contract laboratory.

Table 4-2. Project Personnel, their Roles, and Contact Information

Name	Affiliation	Role	Phone	Email
Armand Smith	Sycamore RCD	Project Manager	209 333 5555	Armand@Sycamore.org
Jared Holmes,	Sycamore RCD	QA Officer	209 333 5556	Jared@Sycamore.org
Patrick Tech,	Sycamore RCD	Technical Leader and data manager	209 333 5557	Pat@Sycamore.org
Christine Pond,	Sycamore RCD	Trainer, H&S officer, QA person	209 333 5559	Chris@Sycamore.org
Sharon Org	Friends of Sycamore Creek	Volunteer Coordinator	209 678 3345	sorg@hotmail.com
Don Ensin. Ph.D.	Friends of Sycamore Creek	Laboratory Liaison	209 679 1234	Densin2@yahoo.com

Dale Griffin	Sycamore RCD	Team Leader & Field Operator	209 333 5568	Dale@Sycamore.org
Eddie Joy	Sycamore RCD	Education and Outreach coordinator	209 333 5563	Eddie@Sycamore.org
Josh Cooper,	Happy Flask Laboratory	Laboratory QA officer	209 334 3577	Jcooper@happyflask.com

Friends Sycamore Creek (FSC) is a community-based organization interested in the assessment and improvement of their watershed. Eddie Joy of the RCD will design and carry out a public education campaign in the watershed in collaboration with FSC, and assist them with recruiting volunteers for monitoring. Christine Pond of the RCD and Sharon Org of FSC will be responsible for training volunteer field crews and for scheduling sampling days. Recruited FSC volunteers will commit to participate in the entire effort as field operators and possibly as Team Leaders.

Christine Pond of Sycamore RCD will also take care of purchasing and maintaining equipment and calibration Standards, reviewing data sheets and calibration records, entering the data into electronic format, calculating measurement error, etc. In other words, Chris will be in charge of implementing Field QA procedures as described in this Monitoring Plan, and she will conduct periodic reviews to assure fulfillment of all QA requirements. Christine Pond is also the Health and Safety (H&S) Officer for the Project, and the keeper of the H&S Binder (see Section 10 below).

Dale Griffin of Sycamore RCD will be the lead field activities person. He will assist Christine Pond and Sharon Org in scheduling, conducting rep-event and post-events calibrations and accuracy checks, and packing the field kits, and he will be a Team Leader himself. Dale has already participated in all reconnaissance activities in the watershed.

Jared Holmes, the Sycamore RCD QA Officer, will interact with Fred Arditi **(**RWQCB QA Officer) and with Patrick and Christine on data quality issues during the training and planning phase and as needed. He will also maintain communication with Dr. Ensin and Josh Cooper of the Happy Flask Laboratory, and review some of the laboratory reports.

Josh Cooper is the Quality Assurance Officer for the Happy Flask Laboratory. Josh will be responsible for assuring that the analysis of submitted samples is done in accordance with all method and quality assurance requirements found in this Plan. He will interact with Patrick Tech and Dr. Ensin regarding data quality.

The attached Quality Assurance project Plan (QAPP) shows the organizational chart for the project, and the relationship between grant recipient organization's personnel and the Regional Board Staff.

4.2 Other Parties Associated with the Project.

Table 4-2 lists individuals who will be associated with the Project in various capacities but will not be a part Project personnel. John Expert is involved with review of the Project's planning documents and has already helped in development of a sound monitoring design. Regional Board staff has been, and will be, providing input on data needs and desired data quality, and will use the data for various purposes. Other interested parties and stakeholders include DHS staff, Sycamore Water District staff, Sycamore County Flood Control District staff, and numerous community members, who may be able to use the data to identify sources of *E. coli* and target implementation of management measures.

Table 4-2. Project Advisors, Data Users, and Stakeholders

Name	Affiliation	Phone	Email
John Expert	Hilltop Advisors Inc	209 333 5555	JohnE@Hilltopinc.com
Cecilia Regal	Foothills Regional WQ Control Board, NPS Division	209 246 5577	Cregal@waterboards.ca.gov
Ephraim Kandor	Foothills Regional WQ Control Board, TMDL Division	209 246 5598	Ekandor@waterboards.ca.gov
Tanya Coli	Dept, of Health Services	245 445 9088	Tanyacoli@DHS.co.inst
Riva Gill	Sycamore Water District	209 667 2233	rgill@sycamorewd.com
Fanny May	Sycamore County Flood Control District	245 334 6678	fannym@SCFCD.co.inst
Frank Carpio	Friends of Sycamore Creek	209 556 6678	
Judy Mansion	Sycamore Estates Homeowner Association	209 566 8890	Judysings@yahoo.com

Section 5. Project Tasks and Schedule

Sycamore RCD staff and community members will conduct a survey to identify sources of indicator bacteria during the summer and fall of 2008.

Figure 5-1 shows the major tasks that will be undertaken, and the anticipated time line for the performance of each task. Essentially, the first months of 2008 will be used to conduct all the preparations and training sessions needed to get the field crews ready and equipped for the bacterial source identification study. Source ID sampling events will be conducted three times during the summer and fall of 2008 and will be summarized by December 15, 2008. There will be an interim data validation and interpretation effort as soon as data from the first sampling round come in, and lessons learned will be immediately applied to refine logistics and methods for the second and third sampling round, as needed. Draft of the technical report will be submitted to the contract manager and the advisors no later than February 28, 2009, and the report will be finalized by May 30, 2009.

Task	**S,O,N 2007**	**D, J, F 07-08**	**M,A,M 08**	**J, J, A 08**	**S,O,N 08**	**D, J, F 08-09**	**M,A,M 2009**
Complete QAPP and have all parties' approval	■						
Conduct Training & preparation for bacterial source ID study		■	■				
Conduct Sampling & analysis for bacterial source ID study				■	■		
Conduct data validation and prepare draft Technical Report					■	■	
Solicit Review, receive comments, and finalize of Technical Report							■

Figure 5-1 –Project Time Line for Major Tasks

Figure notes: Time is divided into four periods of three-months, (a) Cold Season (Dec, Jan, Feb) Warming Season (Mar, Apr, May), Hot Season (Jun, Jul, Aug); and Cooling Season (Sept, Oct, Nov).

Appendix A provides the details for each task and sub-task at the Project level, with informational about responsible parties, deliverables, due dates, etc. The most current version is attached. This matrix serves as a planning, tracking, and management tool used by Project operators on the ground, and it may be amended as needed.

Section 6: Monitoring Strategy and Design

6.1 Water Quality Characteristics, Number of Samples, and Logistics Planned for this Project

Data collection will proceed in one line of inquiry. The Question – **"What are the sources of *E. coli* to the main stem of Sycamore Creek during summer?"** - will be addressed via three concerted "snapshot type" events, each including sampling at multiple locations within the river network conducted at the same time. Field activities will be led by Sycamore RCD staff, and lab analyses will be performed at Happy flask Laboratory.   Four team leaders will be selected from Sycamore RCD staff, and each will lead a field crew augmented by trained FCD volunteers.

Table 6-1 shows a summary of the groups of characteristics that will be monitored for this line of inquiry. The entire "Parameter package" is listed. It also shows responsible personnel, sampling frequency & intervals, time of day, target weather/flow conditions (e.g., dry, base flow), and the total number of Station Visits for each characteristic group. The paragraphs below provide a brief description of the logistics, methods, and sampling options.

Sycamore RCD staff and FCD volunteers will collect sterile water samples for *E. coli* and Total Coliform counts, and additional samples for analysis of chlorine, ammonia, nitrate, chloride, and fluoride (these additional characteristics may show correlations with the *E. coli* data, and this may provide insight on the potential sources of *E. coli*). While sampling, the field crews will conduct field measurements of temperature, pH, dissolved oxygen, specific conductivity, and turbidity (a.k.a, the five "vital signs") coupled with observation of flow conditions or estimation of the flow discharge; these data will provide information on the conditions in the stream at the time samples were collected. Provisions are also made for isolating *E. coli* colonies from samples that have high *E. coli* counts and sending the colonies for DNA ribotyping to determine the host species of that *E. coli* strain. However the QA procedures for that effort are not described in this Plan.

Field measurements will be performed using a variety of meters, electrodes, or probes.

Sample **containers** will be cleaned by the Happy Flask laboratory and delivered to the field crews before each sampling event. The containers will have a **label** with placeholder for the **Sample ID**, Station ID, Date, time, and operator initials; the operators will fill out this label before filling the container with sample water. All samples will be collected as **grabs, by wading** and filling the container directly. Field operators will follow SWAMP SOP (e.g., collect at the centroid of the flow, 0.1 m below the surface, facing upstream) as provided in appendix D of the SWAMP QAMP (SWAMP 2001). All containers will be rinsed three times with ambient water except for the sterile containers for *E. coli* counts and any container that already has preservative in it; those will be filled once, to the container's shoulder.   .   Alternative methods including extension of sampling devices from the bank will be used where needed, again following procedures delineated in Appendix D of the SWAMP QAMP. Devices will be decontaminated prior to collection at each Station. If sampling devices have to be used, it will be noted in the field data sheet. Field Operators will fill out the **Sampling Log** part of the data sheet immediately after sampling.

Water samples will be **delivered** to the staging area or directly to Happy Flask Laboratory for counts of total coliforms and *E. coli* using the IDEXX Colilert reagent and QuantiTray system. It has not been decided yet if sample preservatives will be added to the containers before sample collection or whether acidification will be done later at the staging area or at the lab. This depends on what the H&S Officer recommends, but handling of concentrated acid will be done by a trained chemist from Happy flask lab in all cases.   Happy Flask Laboratory will eventually receive the grab samples collected by the RCD and FSC field crews, and run the analyses of selected nutrients and ions (ammonia, nitrate, chloride, fluoride) and chlorine residues. Further detail on the instruments and methods to be used are provided in Section 8 below.

Table 6-1: Parameter Package and Logistics for the *E. coli* Source ID Study

Study question or intent	Characteristics (Parameter package)	Personnel	Activity type	Activity Frequency and Interval	Time of Day	Weather & flow conditions	# of Station Visits
Source ID	Five "vital signs" (*Note a*)	Sycamore RCD and FSC	Field measurements	3/Project, 4-6 weeks apart	Any	Dry, base flow	**60 planned** (3 sampling rounds, 4 crews collecting 5 Samples in each round), plus **36 optional**
	Estimated Flow	Sycamore RCD and FSC	Field measurements	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	E. coli and total coliform	Sampling RCD+FSC, lab Happy Flask	Sample; lab count	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	Nutrients (ammonia, nitrate)	"	Sample; lab analysis	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	Human use indicators (chlorine, chloride, and fluoride)	"	Sample; lab analysis	3/Project, 4-6 weeks apart	Any	Dry, base flow	"

Note a The five "vital signs" are: temperature, pH, dissolved oxygen, specific conductivity, and turbidity

Table 6.2: Intent and Design of the Three Data Sets Collected for the Sycamore Creek Bacterial Source ID Project

Dataset ID	Scenario/question	Station Type	Station Selection Intent	Sample Timing Intent	Reach Selection Design	Station Selection Design	Seasonal Sampling Design	Season of interest	Diurnal Sampling Design	Sampling frequency	Sampling interval
DTS-SC01	what are the *E. coli* counts and concentrations of related analytes in Sycamore Creek tributaries	River /Stream	source ID	dry weather discharge	directed	directed	directed	summer	not applicable	3/project	4-6 weeks
DTS-SC02	what are the *E. coli* and related analyte results in outfalls opening into Sycamore Creek & tributaries	Storm Drain Outfall	source ID	dry weather discharge	directed	non-deliberate (opportunistic)	directed	summer	not applicable	3/project	4-6 weeks
DTS-SC03	what are the Environmental conditions (DO,pH, T, EC, Turb) at time of sample collection for lab analysis	River /Stream, Storm Drain Outfall	support lab data	support lab data	directed to operations	directed to operations	directed to operations	summer	directed to operations	3/project	4-6 weeks

Definitions

Station Type: geographic feature where the monitoring activity occurs. Station types used for this study include:

- River/Stream: waterway with a defined channel that has water flowing in it all year or during winter
- Storm Drain Outfall: Pipe or ditch that transports storm runoff (or dry weather flows) into a receiving waters

Station Selection Intent: Reason for selecting the Station based on question that data from this Station should answer or what the data should represent. Spatial Intents used for this study include:

- Source ID: Identifying the source of a given constituent within a river network or land use activities

Sample Timing Intent: Reason for going out to monitor at a specific time. Temporal Intents used for this study include

- dry weather discharge: Monitoring streams and storm drain outfalls during dry weather to characterize non-storm flow discharge
- worst case scenario: Monitoring during the times anticipated to represent the most critical or the most extreme conditions within the natural fluctuations (not shown in this table).
- support lab data: Field measurements at the same time samples for lab analysis are collected, to support lab data with ambient conditions information; requires measurement and sampling at same time and place

Sampling design principles used to select Reach, Station, Timing , etc. as used for this study include:

- directed (to environment) - Deterministic approach, points selected deliberately based on knowledge of their attributes of interest as related to the environment monitored; also known as "targeted", "judgmental", "authoritative", "knowledge-based" etc.
- directed to operations: Deterministic approach, points selected deliberately based on operational requirements or constraints
- non-deliberate (anecdotal): Points selected causally or whenever/wherever, or by given constraints, or opportunistically
- random (stratified):Probabilistic approach, deliberate, points selected at random from a population stratified by specific attributes (not shown in this table).

Source ID trips will be conducted **three times during the summer of 2008**; exact timing (the specific day within the week or the season) will be determined based on flow, water quality conditions, and anticipated activities. Unfortunately the time of day will not be selected deliberately, for logistical reasons, because each crew will need to be at five different locations during one sampling day. Monitoring work will be performed during daylight and dry weather only, but the data will be augmented with results of wet-weather monitoring conducted by other entities (see Section 6.4 below).

The total number of samples for the Project may reach 96, depending on flows. Four (4) field crews will be conducting measurements and sampling on each sampling event. Each Field Crew will visit five (5) Stations in one sampling event, and collect one set of sample containers (i.e., one Sample) at each Station. Each crew will have the option of collecting three additional Samples each trip, either from flowing outfalls or in the vicinity of a Station to characterize spatial variability. Thus, each crew may bring back up to eight (8) samples from each event. The crews will perform three (3) sampling events during the Project, visiting a total of 20 Stations during each sampling event. In summary, each Station will be sampled three times, some outfalls will be sampled, and some Stations will be represented by two or three separate Samples collected at the same event. The lab will be able to receive and process up to 32 samples per event. The total number of environmental samples collected and analyzed for this study will be 96. Please note that additional samples will be collected as field duplicates, and sets of sample containers will also be filled with clean water to serve as field blanks (see section 8 Below).

6.2 Sampling Design Principles Used to Select Locations and Timing.

Table 6.2 summarizes the Intent and Design of the three data sets that will be collected for this Project. A dataset is a group of monitoring results that share the same intent and design features, and therefore represent the same set of environmental attributes. The first dataset includes *E. coli* counts that will be collected in stream Stations, with other characteristics that will shed more light on potential sources of the bacteria.

Stations for the first dataset were selected with the intent of identifying the major source within the stream network, and the timing of sampling was selected with the intent of focusing on dry weather flows, during summer. None of the Stations was or will be selected at random. The sampling design principle used to select Stations is ‘directed’, meaning that location were selected based on RCD’s knowledge of the watershed, to target and include all major tributaries just above confluence with the main stem. The season was also selected using the ‘directed’ sampling design principle, but unfortunately it is impossible to select the time of day deliberately because the crews will have to visit multiple stations in one day. Thus, different Stations will end up representing different times in the day.

The second dataset includes the same characteristics but differs in two features: (a) the type of Station (storm drain outfalls rather than the stream itself); and (b) the Station selection design (non-deliberate rather than directed), because Stations will be selected opportunistically - when there is water coming out of the outfall.

The third dataset will include field measurements that document the water quality conditions in the creek **at the same time samples were collected**. The sampling design is directed to this specific intent: support lab data. This information is sometimes critical for interpretation of lab data. This dataset will also include notes and visual observations (expressed in verbal categories) captured during each Station visit.

6.3 Sampling Station Location

Sycamore Creek flows east to west from its headwaters in the Snowy Mountains, through 30 miles of rolling foothills and about 10 miles of valley floor, into the Big Valley Wetland Monument, a remnant of historic wetlands that covered a considerable part of the Big Valley. The wetland has clearly defined waterways during the winter, and these are connected to a series of navigation canals and sloughs that, eventually, reach the Ocean.

The river network is made of two major branches, the North fork that drains about 34 square miles and the South fork that drains 67 square miles. Total watershed area is 112 square miles. Figure 6.1 shows the potential sampling locations on a map of the watershed with the major waterways, roads, and townships.

Multiple Field crews will visit various locations on the North fork and the South fork of Sycamore Creek. Stations for this Project will be located at key points in the river network as well as upstream and downstream of the most prominent communities and resorts, to provide representation of potential sources of fecal bacteria. Planned sampling Stations will be selected from a list of access points that have already been established during the 2007 reconnaissance activities, mapped by GPS coordinates, and described by landmarks. All these points have been are listed and documented in the LOCATION spreadsheet of the Sycamore Project File (the MS Excel workbook prepared for this project). Figure 6-1 shows a map of the watershed with the access points identified during reconnaissance. (note: Figure 6-2 below shows the locations of Stations used by other agencies and groups active in the Sycamore Creek watershed).

*[**Figure 6-1** would show Creek Access Points Identified for the Microbial Source ID Study. In this example the inset map has not been included.]*

Actual sampling sites will be determined "on the run" during the first sampling trip, and the same spots will be visited again on consecutive trips if accessible and relevant. Inaccessible locations will be substituted with alternative sites in the same reach; those will be selected from the established list. Several outfalls have also been identified and noted during reconnaissance, and crews will collect samples from the outfalls that are found discharging when visited. In these cases they will collect an additional sample from the stream, upstream of the outfall. Where needed, crews will perform additional testing and/or sampling in the vicinity of an established Station to characterize the inherent spatial variability.   All new Stations (including outfalls) and sub-stations will be documented and added to the LOCATION spreadsheet in the Sycamore Project File.

6.4 Other Sources of Data and Information

Dry-weather data collected by the Sycamore RCD and the volunteers for this Project will be augmented by wet-weather sampling conducted by the Sycamore County Flood Control District as part of their Stormwater Characterization Program, which is described in the Monitoring Plan developed for this effort. In addition, the Regional Board surface Water Ambient Monitoring Program (SWAMP) efforts will augment this Project's data with sampling for the analysis of heavy metals, other priority pollutants selected from the 305(b) list, and toxicity in water and sediment; these trips will be conducted in April and October of 2008.   SWAMP crews will also deploy probes for continuous monitoring at their three fixed Stations on the main stem and make the data available to the Sycamore RCD. The friends of Sycamore Creek conduct routine monitoring every two weeks during spring, summer and fall, and their data will also be provided to augment this Project.

The Sycamore RCD Technical Leader will also use continuous flow discharge data from the Sycamore Water District (SWD) Stream Gauge, and will have access to all the results of the District's bacterial testing (conducted routinely at their water intake point and three times a year at other locations in the watershed). The agencies sharing these data are implementing SWAMP-compatible QA procedures as described in Section 9 below.

Figure 6-2 shows the watershed map with the three fixed stations used by SWAMP, as well as other stations used by SWD, the flood control District, and the Friends of Sycamore Creek.

*[**Figure 6-2,** for this example the inset map has not been included.]*

Section 7: Measurement Quality Objectives (MQOs)

Data acquisition activities will include both field measurements and laboratory analyses, and the quality objectives depend on the amount of error that can be tolerated. However, data collected for this Project has the potential of being used for additional purposes in conjunction with other data sets collected in accordance with SWAMP requirements, and the quality objectives selected for the Project have been refined to reflect this foresight. The quality objectives for field measurements are listed in Table 7-1;   Table 7-2 shows the quality objectives for laboratory analyses and bacterial counts.

Table 7-1 – Measurement Quality Objectives and Other Quality Objectives for Field Measurements

Study question or intent	**Characteristic (Parameter)**	**Unit**	**Accuracy** (unit or Percent) (Note a)	**Precision** (unit or RPD) (Note a)	**Reso-lution**	**Target Reporting Limit**	**Comp-leteness**
Source ID	pH	pH	± 0.2	± 0.2	0.1	nap	90%
	Specific Conductivity	uS/cm	± 2 or ± 10%	± 2 or ± 10%	1	1	90%
	Dissolved oxygen	mg/L	± 0.5 or 10%	± 0.5 or 10%	0.2	0.2	90%
	Temperature	C	± 1 or 10%	± 1 or 10%	0.5	-5	90%
	Turbidity	NTU	± 1 or 10%	± 1 or 10%	0.1	0.5	90%
	Velocity	m/sec	nap	± 0.2 or 50%	0.1	0.1	90%

Note a: Unit or percentage, whichever is greater.
RPD – Relative percent Difference – is the difference between two repeated measurements expressed as a percentage of their average.
uS/cm – microsiemen per centimeter, equivalent to micromhos/cm. Note: Specific conductivity is the value after correction for temperature, which is done by the instrument automatically.
nap – not applicable

Table 7-2 shows the quality objectives for all quantitation activities that will take place at Happy Flask laboratory.

Table 7-2: - Measurement Quality Objectives (MQOs) and Other Quality Objectives for Laboratory Analyses and Bacterial Counts

Study question or intent	**Character-istic (Parameter)**	**Unit**	**Accuracy** (or LCS Recovery)	**Precision** RPD	**Matrix Spike Recovery**	**Target Reporting Limit**	**Comp-leteness**
Source ID	*E. coli*	MPN /100mL	Meet Positive and Negative controls	± 50%	Not applicable	2	90%
	Total coliform	MPN /100mL	Meet Positive and Negative controls	± 50%	Not applicable	2	90%
	Total Ammonia	mg N/L	± 10	± 10	80–120%	0.05	90%
	Nitrate	mg N/L	± 20	± 20	70–130%	0.1	90%
	Chloride	mg/L	± 10	± 10	80–120%	0.05	90%
	Chlorine	mg/L	± 10	± 10	80–120%	0.01	90%
	Fluoride	mg/L	± 10	± 10	80–120%	0.05	90%

RPD – Relative Percent Difference – is the difference between two lab replicates (sample or spikes) or two field duplicates, expressed as a percentage of their average.
LCS Recovery –Laboratory Control Sample in clean water. Note: CRM (Certified Reference Material) solutions usually come with specified recovery limits and confidence level and the Project's quality objective is to meet those.

Section 8: Instruments and Methods for Field Measurements and Laboratory Analysis

This section describes the measurement systems that will be used to collect the data for the Sycamore Creek bacterial study. The words "Measurement System" are used here as a catch-all term for "Devices and/or procedures used for quantitation of environmental characteristics, including instruments used for field measurements and sampling & analysis processes". Each measurement system has typical capabilities and limitations, i.e., can attain a given level of accuracy and precision, and these "performance criteria" were consulted in the process of instrument/method selection. Field equipment was selected based on CWT guidance, and laboratory analyses were selected based on discussions with several laboratories in the area after a search in the National Environmental Methods Index (NEMI).

The measurement systems selected to achieve the Measurement Quality Objectives (MQOs) developed for **field** measurements are shown in **Table 8-1**. These meters and probes are described in detail in the INSTRUMENTS spreadsheet of the Sycamore Project File (the MS Excel workbook prepared for this project). As the table indicates, different crews may be using different types of instruments for field measurements, provided that all types used have adequate resolution and are capable of achieving the MQOs.

Measurement systems that involve **sampling and analysis** have a set of specifications that must be followed in order for the system to achieve its performance criteria and yield valid data. The following two tables provide information about the measurement systems that will be used for the Sycamore Creek bacterial Source ID Project. The information table related to field and storage operations (sample handling) is presented in **Table 8-2**. **Table 8-3** shows information related to the laboratory operations.

Table 8-1 Instruments and Kits Used for Field Measurements

Character-istic (Parameter)	Method base	Type /Method	Features	Model	Calibration Mode	Range and Units	Resolution
pH		Dry electrode	Pocket meter without ATC	pHtstr1	automatic (pH 4,7,10)	0 to 14 pH units	0.1
pH		Glass combination electrode	probe mounted on Sonde, ATC via Sonde	6561	manual (3 points)	0 to 14 pH units	0.01 units
Specific Conductivity		Conductivity Cell	Pocket meter, waterproof, with ATC	ECTstr low+	manual	0 to 1990 uS	1
Specific Conductivity		Conductivity Cell	probe mounted on Sonde, ATC via Sonde	6560	manual	0 to 100 mS/cm	0.1, 1, 10, 100 uS/cm
Dissolved Oxygen		Polarographic	Meter with electrode		manual, mg/L or % saturation	0 to 20 mg/L	0.1
Dissolved Oxygen		Polarographic, Rapid Pulse	probe w membrane, mounted on Sonde	6552	manual, mg/ L or % saturation	0 to 50 mg/L	0.01 mg/ L
Temperature		spirit bulb thermometer	glass in plastic armor		non-adjustable	- 5 to 45 C	0.5
Temperature		Thermistor	extension from conductivity probe, mounted on Sonde	6560	non-adjustable	-5 to 45 C	0.01 C

ATC – built-in automatic temperature compensation device

Table 8-2: Specifications for Sample Handling

Characteristic	Method #	Method group	sample container material & property	minimum container volume (ml)	preservative	holding time (at 4 C)
E. coli and Total coliform	SM 9223B	Colilert kit	plastic, sterile	100	none or thiosulfate	12 h *(Note a)*
ammonia, total	4500-NH3 G	Colorimetric	Plastic (Polyethylene)	250	H_2SO_4 to pH<2	28 days
Nitrate	EPA 300.0	Ion chromatography	Plastic or glass	500	none	28 days
Chloride	EPA 300.0	Ion chromatography	Plastic or glass	500	None	28 days
Chlorine	4500-Cl G	Colorimetric	Plastic or glass	500	none	0 h
Fluoride	EPA 300.0	Ion chromatography	Plastic or glass	500	None	28 days

(Note a) EPA has three scenarios with three different requirements, depending on the sample source and the intended use of the data.

Table 8-3 Methods Selected for Bacterial Counts and Laboratory Analyses and their Performance Criteria

Parameter	**Unit**	**Method #** ***(Note a)***	**Method Name/Principle**	**Detection Limit**	**LCS Recovery in DI (**Lab Control Chart Limits)	**MS Recovery (**Lab Control Chart Limits)	**Repeatability** (%RPD of lab replicates	**Reproducibility (**%RPD **of field duplicates**
Total coliform	MPN /100mL	SM 9223B	Colilert (Enzyme-substrate)	2	Not applicable	Not applicable	40	50
E.coli	MPN /100mL	SM 9223B	Colilert (Enzyme-substrate)	2	Not applicable	Not applicable	40	50
Total Ammonia	mg N/L	4500-NH3 G	Ammonia by Automated Phenate	0.02	90-110%	80-120%	10	20
Nitrate	mg N/L	EPA 300.0	Inorganic Anions by Ion Chromatography	0.1	90-110%	80-120%	10	20
Chloride	mg/L	EPA 300.0	Inorganic Anions by Ion Chromatography	0.05	90-110%	80-120%	10	20
Chlorine	mg/L	4500-Cl G	Chlorine by DPD	0.01	Not available	Not available	Not available	Not available
Fluoride	mg/L	EPA 300.0	Inorganic Anions by Ion Chromatography	0.05	90-110%	80-120%	10	20

Note a: SM is the *Standard Methods for the Examination of Water and Wastewater*, 20th edition. (APHA 1998).

Section 9: Quality Assurance Plan

This section describes how the quality of the measurement data collected during this effort will be assured. Good data leans on competent operators, good capture of all supporting documentation, and effective protocols. These three factors are described below, with some examples of tools the Trainers and the Field Operators will be using. The procedures to affect (i.e., apply control) and check data quality are described next, followed by the procedures for recording and reporting the quality of the data generated by each of the measurement systems. The section also communicates further information about data processing, including data verification and data validation, as well as about the oversight and auditing tasks, both internal and external.

It must be emphasized that this section is NOT an official Quality Assurance Project Plan (QAPP). It is intended for the Project personnel of all roles as a working tool in their everyday operations. However, many of the tables shown here are also included in the official 24-Elements QAPP, which is the companion document to this Monitoring Plan.

9.1 Competent Operators

Field operators' competence will be assured via **training** (awareness and skills), and will be checked via informal or formal proficiency testing. **Box 9-1** shows the checklist used to check the proficiency of operators using the HACH 2100P Turbidimeter; other checklists are provided in Appendix B. All Project personnel will be offered courses that should help them to fulfill their roles. Field operators will participate in an 8-hour training class on field measurements and a six-hour class on water sampling techniques. Trainers will take a 12-hour Train the Trainer class and an 8-hour data validation class. The Technical Leader has already taken a 6-hour DQO course and 12-hour study design development course, and will take additional classes if time permits. Because of the transient nature of this effort, there will not be a need for training refreshers. The Projects will not utilize a formal **certification** process.

The only specialized training required for this Project is an 8-hour Health and Safety training, required for all the leaders of field crews (and optional for other crew members). The course participants receive a completion certificate and they need to maintain it current if they want to participate in additional Projects.

9.2 Documentation

Documentation or Project's data has already begun and will proceed throughout the life of the Project, using hardcopy field data sheets and MS Excel spreadsheets developed as part of the CWT data quality management (DQM) system for local Projects. These data management tools were selected after a careful evaluation of the options available to Sycamore RCD, which, unfortunately, did not include SWAMP database support in terms of training, access privileges, data entry forms, ongoing support, and database maintenance. Support for other MS Access database systems used in Central and

Southern CA was not available either, and none of the RCD staff has adequate proficiency in MS Access to create something new. Thus, the Project personnel opted to use the MS Excel system that has already been developed specifically for their needs.

All Project information will be entered into the appropriate spreadsheets in the Sycamore Project File workbook. Station locations will be constantly updated in the LOCATION spreadsheet; Project's intent and design will be copied (from Table 6-2 above) into the DATASET spreadsheet; Project personnel names, roles, and contact information (as shown in Table 4-1 above) will be copied into the PROJECT ORGANIZATION spreadsheet; field equipment will be logged into the INSTRUMENTS spreadsheet; and calibration standard solutions will be entered into the STANDARDS spreadsheet inventory. Laboratory data will be imported in electronic format into the RESULT-LAB spreadsheet, and information captured in the hardcopy field data sheets discussed below will be entered into the RESULT-FIELD spreadsheet and the CALIBRATION & ACCURACY CHECKS spreadsheet.

BOX 9-1: EXAMPLE OF OPERATOR'S PROFICIENCY CHECK LIST

Observed skill: Use of the HACH 2100P Turbidimeter

(placeholders provided for the name of the operator, date, and observer name)

The operator did the following:
____Shook sample bottle vigorously until no sediment is stuck to the bottom
____Poured shaken sample bottle water into HACH cell as soon as possible
____Filled HACH cell up to white label line and capped the cell
____Put 1 drop of silicone on HACH cell and wiped with cloth, did not wipe off sample label
____Shook HACH cell for at least 5 seconds
____Quickly inserted the HACH cell with white diamond point of cell label aligned with bar on case of HACH 2100P Turbidimeter
____Waited 2 seconds for air bubbles to rise before pressing the "read" button
____Recorded turbidity on data sheet
____Identified the need for dilution when the instrument was flashing "E3" or "1000+"
____Used the NTU Dilution sheet to record and calculate dilution data
____Shook sample vigorously, then quickly poured sample water into beaker.
____Recorded the volume in the beaker as " original volume"
____Added appropriate dilution volume and recorded as "1st dilution volume total"
____Mixed, poured into a clean HACH cell, and measured turbidity per protocol
____Continued dilutions and kept records until the turbidity was within the Instrument range
____Used the dilution records to calculate actual sample turbidity
____Turned the instrument off and cleaned the workspace per good laboratory practices

(*placeholder for observer's signature and comments)*

Source: Clark Fenton, Salmon Forever

Field activities will be recorded on the Field Data Sheets tailored to this Project, which include placeholders for the Station visit identifiers, the visual observations, the field measurements, and the sampling log (see Figure **9-1** below). This Field Data Sheet will be used with instructions as provided in DQM-SOP-9.2.1.1 (Appendix C and the CWT guidance compendium). Some of the field crews may opt to capture all information called for in the Field Data Sheet in electronic format while at the Station, using a Personal Digital Assistant (PDA). In that case, the crew will enter the field information into both hardcopy and electronic formats every third Station Visit (i.e., 33% duplication) and the "% mismatch" will be calculated and documented.

Calibration and accuracy check records for field instruments will be captured on the appropriate data sheet as shown in DQM-SOP-9.2.1.2 (Appendix C and the CWT guidance compendium). Each Instrument has a unique Instrument ID that will be used to track its performance.

The calibration and accuracy checks records on the data sheet (DQM-SOP-9.2.1.2) will include the following:

- Date, Time, Reason (pre-event or post event)
- Instrument ID
- Standard Material (ID of Standard solution, humid air, NIST thermometer)
- 'True' Value of Standard Material
- Reading of the Instrument before any adjustments
- Adjustments and outcome
- Operator
- Electrode voltage for instrument performance checks (for Sonde probes)

The concept of a unique Instrument ID has been implemented in the DQM for documenting the quality of field measurements, because it links a set of measurement results with the calibration records of the instrument that was used to collect them. Other bits of information will also be also linked via a unique ID, including Sample ID, Station ID, Project ID, Dataset ID, and Team Name. Figure 9**-2** shows how all the Sycamore Project File spreadsheets are linked together to provide a catch-all workbook for all Project's data and metadata. The file is constructed as a relational database, and selected fields of data and metadata will be easily "crosswalked" and exported into other relational databases as needed.

DQM Field Data Sheet for Water Quality Monitoring **Date** __________ Page ________ of ____________

Waterbody Name: __**Sycamore Creek**__

Project Names: Sycamore Creek Bacterial Sources ID

Arrival time ___________________________

Station ID: __________________________

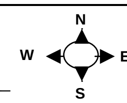
Station Name: __________________________

Team Name: __________________________, Sycamore RCD   Trip ID ________   Station Visit ID _________

Leader (name & phone #): Members: *(list additional names on back)*	Date of last rain

Observations: *Circle one underlined option:*   **Observations Time:** ______________________

Cloud cover	no clouds; partly cloudy; cloudy sky (overcast);	Wind Direction (From) _____
Precipitation	none ; misty; foggy; drizzle; rain; snow;	
Wind	calm; breezy; windy;	Wind Intensity (Beaufort) _____
Water Murkiness	clear water; cloudy water (>4" visibility), murky (<4" visibility). *[this pertains to the water itself, not to scum]*	
Flow Conditions	dry creekbed; isolated pools; trickle (<0.1cfs); full waterway no observed flow; >0.1cfs	
Estimated Flow Category	<0.1cfs; 0.1 - 1 cfs; 1 - 5 cfs; 5 - 20 cfs; 20 - 50 cfs; 50 - 200 cfs; >200 cfs	
Sample color	none; amber; yellow; green; brown; gray; other:	
Sample odor	none; fresh algae smell; chlorine; sulfide (rotten eggs); sewage; other	
Other (presence:)	algae or water plants; oily sheen; foam or suds; leaf litter; trash; other	



Water Quality Measurements

Instrument ID	**Parameter** (Characteristic)	**Unit**	**Result**	**Repeated** Measurement Result	**Bracket/ Resolution**	Measure ment **Time**	Measure ment **Depth***	**Comments**
	Total Depth (at Station) or Staff Gage readout	cm					not applicable	
	Specific conductivity	uS/cm						
	Dissolved oxygen (DO)	mg/l (ppm)						
	Temperature, water	°C						
	pH .	pH						
	Turbidity	NTU						

Grab Water Samples					**Collection time** _____________	
	Container type →	Plastic sterile 100 ml *(E. coli)*	Plastic _____ liter	Plastic _____ liter	glass Amber ___ liter	Comments
	Preservative →					
Sample ID	**Depth**	*(write number of containers of each type collected for each sample).*				

water sampling access (*circle*): walk-in (wading); bridge; bank;

water sampling device (circle) none; basket; pole&clamp; pump; bucket; pole& beaker; LaMotte Sampler; Kemmerer

Sheet completeness review by ___________________________

Departure Time _________________________________

Office use only	
Entered dBase by ________	Date _______
checked by _____________	Date ______

Figure 9-1: Field Data Sheet for the Sycamore Creek Project

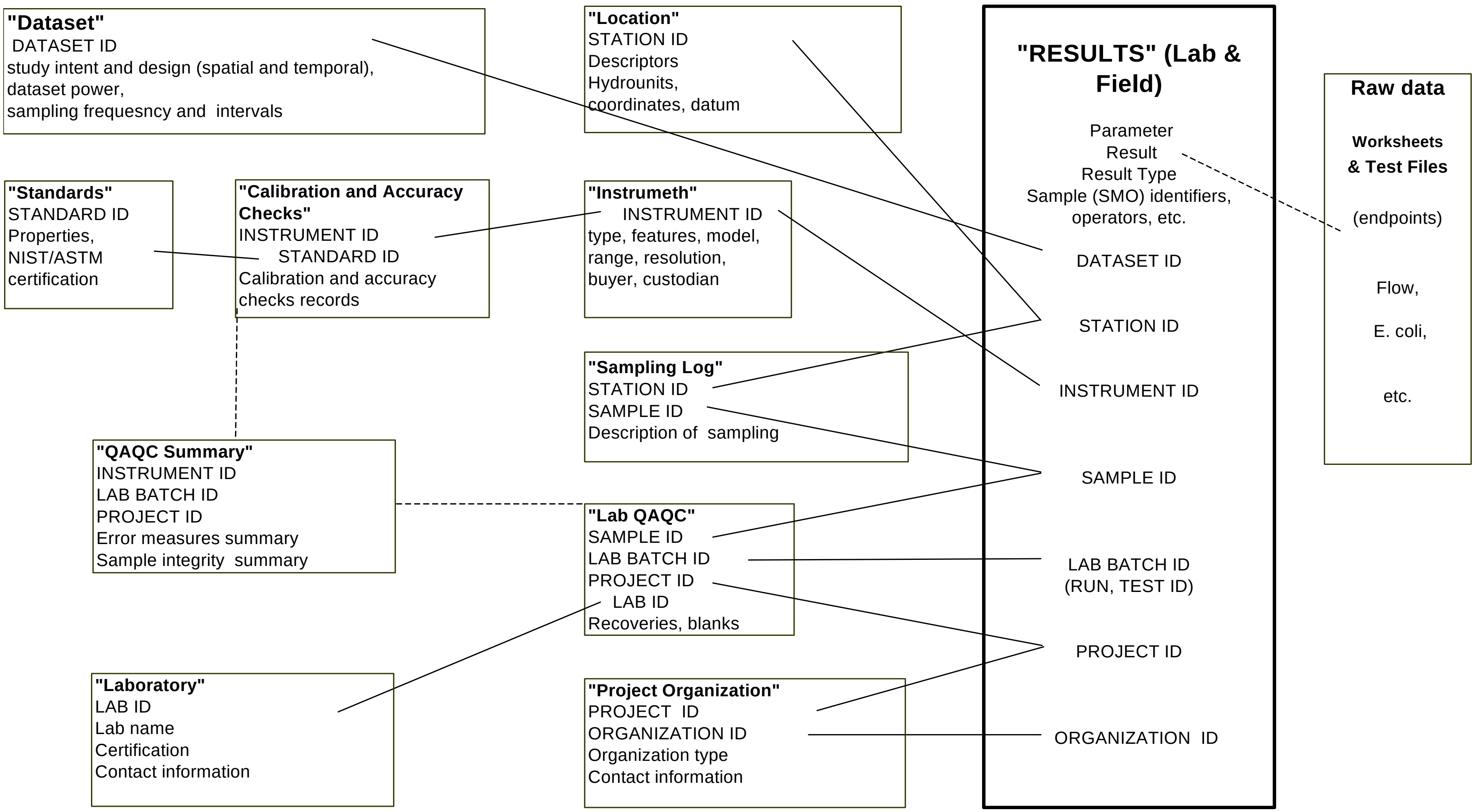


Figure 9-2: Linkages of Information within the Sycamore Project File

9.3 Protocols

Field operators using instruments with multiple probes (e.g., YSI or Hydrolab Sondes) will follow SWAMP protocols and manufacturer's instructions. For pocket meters, Operators will use instrument-specific DQM SOPs with detailed instructions for ways to affect/check/record/report (**ACRR)** data quality**.** Each SOP provides directions for the following actions:

- Affect (act to influence the outcome)
- Check (test to evaluate or verify)
- Record (keep everything documented), and
- Report (communicate the data quality indicator outcome).

General ACRR procedures are described below. [Note: ACRR was originally called CCRR ("C" for control, meaning Affect) and that's how it is still written is in CWT SOPs.]

Happy flask Laboratory will use established SOPs and protocols for each procedure and method and will provide copies upon request.

9.4 Procedures to Affect and Check Quality

The phrase "data quality" means different things to different people. There are several distinct aspects of data quality and each one calls for different types of actions. Table 9-1 shows different aspects of data quality that need to be addressed for general project performance, field measurement, sample handling, and lab analyses. The aspect of operator's competence, which is pertinent to all activities, is addressed by training and proficiency checks as described above in Section 9.1. Action regarding other aspects are discussed below.

Table 9-1: Summary of Actions to Affect and Check the Performance of the Project's Measurement Systems

Activity	**data quality aspect**	**Affect** *(act to influence outcome)*	**Check** *(test to evaluate or verify)*
All	operator's competence	train, refresh, supervise	run proficiency tests, review work products
Field Measurement	accuracy *(Note 1)*	calibrate (adjustable-reading instruments)	conduct accuracy check (all instruments)
	precision	use consistent procedures under same conditions	repeat measurements
Sample handling	lack of contamination	decontaminate sampling equipment and containers, seal & wrap samples	collect and analyze blanks (Trip, Field, Equipment)
	lack of deterioration	ship cold; preserve if appropriate	measure shipping temperature, pH upon arrival
Lab analyses	accuracy *(Note 1)*	calibrate, use certified calibrator Standards	run LCS, CRM, Matrix spikes, surrogates
	precision	use consistent procedures under same conditions	run lab replicates, matrix spike duplicates
	lack of contamination	decontaminate lab ware	analyze lab Blanks (method, reagent, etc.)
	lack of deterioration	analyze within holding time	calculate

(Note 1) General ways to control accuracy for all field measurements and lab analyses -
Use certified Standards for calibration and accuracy checks
clean the instrument, kit, test tube, or lab ware before and after each use
protect all field and lab equipment and Standards from extreme temperature, sunlight, excessive humidity, harmful liquids or vapors, etc.

9.4.1 Accuracy

One of the ways which will be used to assure accuracy of field measurements is frequent instrument calibration, as specified in **Table 9-2** below. It is the most effective way to minimize the instrument's drift from the calibrated state. In the laboratory, accuracy will be assured by calibration using reliable standards, and will be checked via LCS, CRM, and Matrix spikes recovery as specified in **Table 9-3** below and in the lab SOPs.

Table 9-2 describes the frequency of Calibrations and Accuracy Checks for field instruments, and the frequency of repeated measurements in the field. Because measurement accuracy is as accurate as the Standards used for instrument calibration, Sycamore Creek operators will only use standard solutions that are:

- certified, or traceable to NIST or ASTM
- used within expiration date
- stored in the dark at non-extreme temperature, never frozen
- compared with fresh standards before used up

Table 9-2: Frequency of Calibration Adjustments & Accuracy Checks and of Repeated Measurements for Field Instruments

Character-istic	mode	Instrument name or type	Standard Material	Frequency of Calibration &Accuracy checks	Frequency of repeated measurements
dissolved oxygen	Adjust-able	DO electrode (Meter) or Probe	Humid Air or saturated water	Daily, calibration adjustment before first and accuracy check after last measurement (midday or between Stations if needed)	20% or 2 per Trip
Temperature	non-adjust-able	Bulb Thermometer	NIST thermometer	Periodic accuracy checks, examine capillary daily	20% or 2 per Trip
Temperature	non-adjust-able	Temperature probe (with multimeter or DO meter)	NIST thermometer	Periodic accuracy checks	20% or 2 per Trip
Specific Conductivity	Adjust-able	Pocket EC meter	Salt Standard solution	Periodic accuracy checks and calibration adjustments	20% or 2 per Trip
Specific Conductivity	Adjust-able	conductivity Probe	Salt Standard solution	Periodic accuracy checks and calibration adjustments	20% or 2 per Trip
pH	Adjust-able	Pocket pH meter (dry electrode) or Probe	Standard buffer solution, pH 7, 10	Daily, calibration adjustment before first and accuracy check after last measurement	20% or 2 per Trip
Turbidity	Adjust-able	Nephelometer or turbidimeter	Formazin or other	Daily, calibration adjustment before first and accuracy check after last measurement	10% or 1 per Trip

(Note a) For Sonde data logger probes: Calibration adjustment before, accuracy check after, each deployment

Table 9-3 Frequency of Checks for Sample Integrity, Laboratory Accuracy, Laboratory Precision, and Process Reproducibility.

Charac-teristic	**Unit**	**Method #**	**Trip/Field blank frequency**	**Equipment blank frequency**	**other blanks and frequency**	**field duplicates frequency**	**Lab Control Sample (LCS) type/range and check frequency**	**CRM material, concentration range, and check frequency**	**Matrix Spike /MS Duplicate frequency**	**Sample lab replicates frequency**
E. coli	MPN /100 mL	SM 9223B	10% or 1 per Sample Batch (Note 1)	3 per Trip (if using devices)	gloves rinsate	20% or 1 per Sample Batch	positive & negative controls, 2 per reagent batch	Not applicable	Not applicable	40%
ammonia, total	mg/L	4500-NH3 G	5% or 1 per Sample Batch	1 per Sample Batch		10% or 1 per Sample Batch	1 per Lab Batch (Note 2)	QA-55D, 0.1-0.5ug/l, 1 per week	4 per Project	10% or 2 per Lab Batch?
nitrate	mg/L	EPA 300.0	5% or 1 per Sample Batch	1 per Sample Batch	**(Note 3).**	10% or 1 per Sample Batch	1 per Lab Batch (Note 2)	QA-55D, 0.1-0.5ug/l, 1 per week	4 per Project	10% or 2 per Lab Batch?
chloride	mg/L	EPA 300.0	5% or 1 per Sample Batch	1 per Sample Batch	**(Note 3).**	10% or 1 per Sample Batch	1 per Lab Batch (Note 2)	QA-55D, 0.1-0.5ug/l, 1 per week	4 per Project	10% or 2 per Lab Batch?
fluoride	mg/L	EPA 300.0	5% or 1 per Sample Batch	1 per Sample Batch	**(Note 3).**	10% or 1 per Sample Batch	1 per Lab Batch (Note 2)	QA-55D, 0.1-0.5ug/l, 1 per week	4 per Project	10% or 2 per Lab Batch?
chlorine	mg/L	4500-Cl G	5% or 1 per Sample Batch	1 per Sample Batch		10% or 1 per Sample Batch	1 per Lab Batch (Note 2)	QA-55D, 0.1-0.5ug/l, 1 per week	4 per Project	10% or 2 per Lab Batch?

Note 1: A Sample Batch is made of all samples collected by one Field Crew during one Trip.

Note 2: A Lab Batch is made of all the samples analyzed in one day by one lab instrument between calibrations

Note 3: add 1 lab reagent blank & 1 lab fortified blank per sample batch; add 1 calibration blank per sample batch for Nitrate

9.4.2 Precision

Good precision of field measurements will be achieved via awareness training and checked via repeated measurements. Laboratory precision will be enhanced by training and checked via lab replicates and matrix spikes duplicates. The reproducibility of the entire sampling and analysis process will be assessed by analyzing the field duplicate samples (field duplicates will be collected from the creek in a separate container but at the same time and the same spot). **Tables 9-2 and 9-3** show the frequency of precision checks for the field and the lab, respectively.

9.4.3 Sample Integrity

Before and during field operations, sample integrity will be assured by decontamination of sampling equipment and training operators on all aspects of the sampling process and available equipment. Actions to assure **lack of contamination** will include implementing decontamination procedures, use of clean trays to place caps, use of plastic bags to wrap individual samples in the cooler, and use of other devices to separate samples from contamination. **Lack of deterioration** will be assured by careful attention to sample cooling, shipping and storage. Sample integrity will **be checked** by collecting and analyzing trip blanks, field blanks, equipment blanks, and/or rinsates (if relevant), as well as noting sample temperatures during staging and shipping. The frequency of blank samples is shown in **Table 9-3** as well.

In the laboratory, sample preparation and analytical procedures will be conducted per good laboratory practices including cleaning of lab ware, protecting it from contamination as needed, sample storage at 4 C, and analysis within holding time. Lack of contamination will be checked by collecting and/or analyzing filter blanks, test tube blanks, reagent blanks, etc.

9.5 Procedures to Record and Report Quality

The MS Excel tools developed for information-capture in the field as described in Section 9.2 above, will be used to record all the quality checks conducted for field measurements and –of course – all the measurement Results including repeated measurements. The same spreadsheets will also be used to calculate and report the accuracy and precision of field measurements as described below.

Accuracy will be calculated the from calibration records as captured on the CALIBRATON & ACCURACY CHECKS data sheet and/or spreadsheet. The difference between the instrument's reading and the Standard value will be calculated and recorded per DQM-SOP-9.3.2.2(Err). This value, the "instrument drift", will be used to report accuracy in measurement units (e.g., for pH) or as a percentage of the true value of the Standard (Standards will be selected at values that are as close as possible to expected ambient values).

Laboratory LCS, CRM, surrogates, and MS recoveries will be recorded,, and recovered concentration will be reported as the percent of the nominal concentration spiked using a similar formula. .

Precision will be recorded as pairs of repeated measurement results (for field measurements) and as paired results of two replicate test tubes (or matrix spike and matrix spike duplicate) for lab analyses. Precision will be reported as RPD – Relative Percent Difference – which is the difference between the two repetition in each pair, expressed as a percentage of their average. As specified in DQM SOP-9.3.2.2(Err), if there are several pairs of repeated measurements taken with the same instrument at the same event, the worst case scenario RPD for that Instrument will be reported with the Results collected during that event with that instrument. Selecting the widest error will assure the data user that "it probably does not get worse than this".

Detection Limit and Reporting limits will be recorded and reported for each Result point (i.e., for each sample) if sample matrix presents interference that increases them (i.e., decreases the sensitivity of the analysis).

Resolution - records on the resolution of field instruments are already shown (reported) in Table 8-1 above and in the INSTRUMENTS spreadsheet of the Sycamore Project file; Resolution is very relevant to field equipment with poor resolution, which drives the range of error/uncertainty around each measurement.

Sample integrity - the results of blanks representing each batch of samples will be evaluated and data batches will be flagged as needed. Results of analyses made beyond holding time will be flagged as well.

9.6 Data Verification and Validation

The process of data verification involves checking whether all monitoring activities have been performed as required and planned, all samples have been properly tracked, accounted for, and analyzed, and all the Results data have been recorded and entered correctly. This process has to start in the field. The process of data validation is about assuring that all the measurement systems were functional and operated within their performance criteria. Beyond these two processes there is a process of data quality assessment, i.e., looking at what the validation outputs actually mean in terms of our ability to use the data, and looking for ways "to do it better next time".

Table 9-4 show the major phases in the data verification and validation process as will be undertaken for the Sycamore study after each monitoring event. The MS Excel data quality management tools described in Section 9 above will be used to perform the steps and attach the final qualifiers to each Result. Completeness will be assessed after data validation and be reported as the percentage of successful activities (measurements or sampling and analyses that have yielded valid data) as a percentage of the total activities **planned** for the Project.

Table 9-4: Phases and Tasks of Processing Water Quality Monitoring Data

function	Phase	Phase #	Example of Tasks	Means/tools	Outcome or output
Verification	Inventory	1.1	Tally sites, Station visits, Samples, number of each type of Quality Checks, etc	Field Data Sheets, Calibration and Accuracy checks records, lab reports, etc.	Inventory of monitoring Results and quality checks
Verification	Monitoring Plan and/or QAPP comparisons	1.2	Compare activities inventory w Plan	Inventory from Phase 1.1 and planning documents	Extent of compliance of QA actions and quality check frequencies with planning document
Verification	Alignment and matching	1.3	Align Teams & Stations with Samples, Instruments and Calibration and Accuracy checks records	Field Data Sheets, Chain of Custody records, container labels, Calibration and Accuracy checks records, etc	Verified IDs, consistent records
(Transfer)	Data entry, upload, and conversion	1.4	Type data, prepare batches for upload	Data Entry Forms or spreadsheets, upload tools	LIMS, Project File, or Database
Verification	Correctness Check (for manual data entry)	1.5	Run spot-check or full check for data entry errors, or utilize double-entry tools	Eyes (checks) or macro (double-entry)	Correctness evaluator (per entry batch or entry operator)
Validation	Sample validation	2.1	Summarize blank checks outcome, Review field notes	lab reports Re; blanks	Sample Integrity Report chapter with narrative of findings
Validation	Error Calculation	2.2	Calculate accuracy and precision by Instrument or lab batch	Calibration and Accuracy checks records and repeated measurements records, lab QA reports (matrix spikes & duplicates etc.)	Max RPD (a measure of imprecision) and % inaccuracy per Field Instrument use period; RPDs and % recovery per lab batch.
Validation	Performance acceptability assessment	2.3	Compare error to lab control chart for each Measurement System; review detection/reporting limits	output of phase 2.1, output of phase 2.2; Field notes Re: instrument response, lab reports	Extent of compliance with performance criteria of each batch of each measurement system; % completeness
Validation	Validity status assessment	2.4	Compare output of phase 2.2 with Project's Measurement Quality Objectives (MQOs) and with SWAMP MQOs.	Outputs of phases 2.1, and 2.2	Validity Status Qualifier, SWAMP comparability statement

Notes: 'QA Actions' include calibration and decontamination; 'Quality Checks' include all samples and checks done to document accuracy, precision, and sample integrity;
RPD (relative percent difference): the difference between two repeated measurements divided by their average times 100

Table 9-5: Result qualifiers for this Project's data.

Qualifier	Definition
Unknown	Information for review is not available
Not Checked	Data quality has not been reviewed
Not Valid ("R")	("R" for rejected) existing information indicates that the result was obtained in an analytical run or *E. coli* test that were not acceptable, or with the use of malfunctioning instrument
Estimated ("J")	"J"; by best professional judgment - not valid but flaw not detrimental; result can be used but with caution
Valid	Measurement system met its performance criteria: e.g., Analytical run or bacterial test were acceptable; recoveries were within control chart, positive/negative control results were acceptable, instrument was functional, sample integrity was preserved
Valid and meets Project MQOs	Result was valid and accuracy & precision error was within the measurement quality objectives specified for the dataset; dataset met completeness objective
SWAMP comparable	Result is Valid and meets SWAMP MQOs, data set meets all SWAMP requirements

Table 9-5 shows the verbal categories to be used as Result qualifiers for this Project's data, and the definition of each option.

As mentioned in Section 8 above, each measurement system (MS) has its own set of acceptance or performance criteria. The Happy Flask Laboratory has established "lab control charts for all the methods they will be using to analyze this Project's samples. The data review will include comparison of accuracy, precision, and detection limit performance for each lab batch to the MS performance criteria (e.g., is the recovery within the lab control chart?) and data that met these criteria will be classified as Valid. Results from batches that did not, but can still be used with caution, will be classified as "estimated". Data with unknown validity status will not be used for this Project, nor will the RCD use data that were Rejected.

Many Projects have multiple datasets (a dataset is a group pf Results that share the same intent, design, and measurement quality objectives (MQOs)). If we keep in mind that the measurement systems (MS) that were selected for the datasets in this Project should be able to generate data that meet the MQOs of these datasets, it is obvious that data that meet MS performance criteria would also meet dataset MQOs. In addition, this Project is testing some of the characteristics with SWAMP MQOs, and for these data, being Valid also means SWAMP comparable. However the RCD may want to use data from other sources, e.g., the routine monitoring data collected by the Friends of Sycamore Creek, for comprehensive data interpretation. The Friends often use instrument with low resolution, which limits their performance, but the data is perfectly fine if they meet the performance criteria for those instruments. In this case, data that are Valid but do not meet Project dataset or SWAMP MQOs can still be used with confidence.

9.7 Internal and External Review of Adherence to QA/QC Procedures

Field activities will be overseen by the Trainer, and in some cases by other Project personnel. The QA/QC Officer will audit the field operations on at least one event and conduct spot-checks for proficiency. Apparent lack of skill in using a given Instrument or collecting a sample will be noted, data collected by that Team (field crew) for that parameter will be flagged, and all field operators from that team will get refresher training ASAP. External review of QA/QC procedures will be conducted during the review of QA/QC results.

Lessons learned, protocol deviation, QA/QC results, and data validation outcomes will be compiled and reported as Interim Reports after each event. These reports will be prepared by the Sycamore RCD QA Officer in collaboration with the Technical Leader and the Trainer, and be submitted to the project director and to the Regional Board's Contract Manager.

9.8 Administrative Reports

Quarterly Administrative Progress Report will be prepared by the Project Manager and sent to the Regional Board's Contract Manager with the quarterly invoice.

9.9 Contents of the Attached Quality Assurance Project Plan (QAPP)

Because monitoring Projects that are funded by Federal or State grants (including but not limited to Projects that must be compliant with SWAMP) are required to develop a 24-Element Quality Assurance Project Plan (QAPP) per EPA's guidance, some of the contents of this chapter plus other portions of this Monitoring Plan have been adapted to the 24-Element QAPP structure and are included the companion document attached. Pieces that are common to both Plans are highlighted in blue font in the QAPP, and also show [in square parentheses] the section numbers where the same piece is found in the Monitoring Plan (so you do not need to read it twice! ☺)

Section 10 Health and Safety Plan

This section describes the activities and the tools implemented to assure health and safety (H&S) of all Project Field Operators. Happy Flask Lab has its own H&S Plan, available from the lab manager.

10.1 Health and Safety Responsibilities

Christine Pond of Sycamore RCD is the Health and Safety (H&S) Officer for the Project, and the keeper of H&S information. Her duties include:

- Assuring that personnel carry out H&S practices in Occupational Safety and Health Administration (OSHA), state and local safety regulations.
- Maintenance and update of the H&S binder
- Upkeep of Material Safety Data Sheets (MSDSs) Binder
- Providing initial training and mandatory retraining of all field personnel
- Documentation of all training, including signature sheets when appropriate
- Communication of any new safety and injury prevention practices
- Purchase of safety equipment and training field operators how to use it
- Briefing of all field operators about H&S before each trip to reinforce the need to put safety above samples
- Assuring that no one goes to do field work alone
- Assuring availability of the chemist to do sample acidification at the staging area after each event

10.2 The Health and Safety Binder

A dedicated H&S Binder has already been established for the Sycamore Creek watershed, and this binder holds permanent information related to all field activities performed at all watershed Locations. The binder will be updated as more information is discovered. The original H&S Binder will reside at the Sycamore RCD office, and relevant parts will be reproduced for each field crew before the first sampling event. The binder will contain the following types of items:

- Maps showing nearest hospital and quickest route to it from key locations, plus alternative routes
- Map showing location of police HQs, fire Dept, and other emergency resources
- All contact information of emergency resources
- Map showing areas of concern or potential hazards as gleaned in the reconnaissance activities and updated over time
- Checklists: vehicle safety, H&S equipment, etc.
- MSDSs of chemicals routinely used in the field
- Instructions for chemical spill, automotive accident and personal injury response

10.3 Laminated H&S Awareness flyers

All field operators will be supplied with laminated flyers addressing the following rules:

- Always be aware of your surroundings. Never risk your personal safety.
- Wear appropriate clothing and footwear for work in your station environment.
- Protect yourself from exposure to the elements, poison oak, nettle, broken glass, polluted water, etc.
- Be aware of wildlife, snakes and insects such as ticks, hornets and wasps.
- Do not walk on unstable stream banks

- Wear reflective vests or highly visible clothing on roads and be aware of traffic.
- Avoid sampling at night.
- If you sense danger or are asked to leave a monitoring site, leave without question
- Wade in only it is safe to do so and be constantly aware of depth, current velocity, holes, and slippery surfaces
- If wading, use hip waders rather than chest waders
- Do not wade into streams known to be polluted or hazardous

10.4 Disposal of Hazardous Materials

The project will generate only one type of material that may be potentially hazardous: the *E. coli* and other fecal bacterial cultures that grow in the colilert reagent in the quantitrays used for bacterial counts. The intact sealed trays will be autoclaved at Happy flask Laboratory immediately after count confirmation and end-point derivation.

10.5 Special procedures

Field operators will not be responsible for adding concentrated acids as preservatives to sample containers. Samples will be acidified in the staging area by a trained chemist using appropriate pipettes and wearing appropriate protective gear (goggles, gloves, etc.). Chemists will work in well-ventilated areas and avoid inhalation of preservatives at all times.

Section 11 Data Management, Interpretation, and Reporting

11.1 Data Integration and Management

Documented, validated and qualified data generated in this Project will be stored in the Sycamore Project File as described in sections 9.2 and 9.6 above. Selected information fields will be exported to one or more of the following data repositories:

- A local database, in MS Excel or MS Access, that holds data collected in the Sycamore Creek watershed by all monitoring entities, including but not limited to the Friends of Sycamore Creek, RCD, SWD, SFCD, and others.
- A central database such as the SWAMP database, STORET, or other. Data upload to the central database may be a one-time event, meaning there will not be further changes to the data in the future.
- A Data Exchange Node that will be connected to other data through the California Environmental Data Exchange Network (CEDEN)

The local database will be maintained by Sycamore RCD and will be mined for data interpretation and presentation, using MS Excel sort/filter commands or MS Access queries.

11.2 Statistical Analyses

Monitoring results generated in this project will be grouped according to what they represent in the environment (e.g., stream or outfall) and descriptive statistics such as average or median will be derived if meaningful. The nature of this study limits the need for hypothesis testing or for statistical comparisons between two "populations" of data, but the appropriate tests (e.g., t-test or ANOVA) will be applied if meaningful. In contrast, analysis of correlations will be widely used to discover relationships between different characteristics (e.g., *E. coli* counts and nitrate) across space and time.

11.3 The Scientific (Technical) Report

Technical Report will be prepared by the Technical leader with input from the technical experts who assisted with the study design. The report will be submitted to Regional Board's Contract Manager and other stakeholders.

The Presentation format or choice for this Project, being a Source ID study, is a map. For example, detections and severity of counts or concentrations will be depicted on the watershed map in meaningful icons. If the required software becomes available, concentrations (e.g., of total ammonia) will be shown as proportionally sized dots on the watershed map for each sampling event. Correlations will be shown graphically or in tabular formats. A summary of all Project data will be provided in hardcopy table in an appendix.

The Technical Report will include the following Sections:

- 1.0 Introduction: background, problem, objective, question
- 2.0 Location and methods
- 3.0 Results and discussion: Project findings, how they may be related to each other, and what they might mean in combination with data collected by others
- 4.0 Conclusion and Recommendations: Result main point, major conclusion from this study, and recommendations for next study or management measure implementation activities based on this study and other data.
- 5.0 References
- Appendices

REFERNCES

U. S. Environmental Protection Agency (USEPA) 2002. Guidance on Environmental Data Verification and Data Validation, EPA QA/G-8. USEPA publication EPA/240/R-02/004, Office of Environmental Information, Washington DC. November.

U. S. Environmental Protection Agency (USEPA) 2002. Guidance on Choosing Sampling Design for Environmental Data Collection, EPA QA/G-5S. USEPA publication EPA/240/R-02/005, Office of Environmental Information, Washington DC. December.

NEMI website
www.nemi.gov

End of Example Monitoring Plan. See Appendices and Addendum, as available, below the sources and resources section.

Sources and Resources

This imaginary Plan was prepared by Revital Katznelson, who is willing to take the blame, the credit, and the questions at (510) 622 2470 or rkatznelson@waterboards.ca.gov

More information and access to data quality management SOPs is provided in the Clean Water Team Guidance Compendium at http://www.waterboards.ca.gov/nps/cwtguidance.html

Environmental Monitoring Project Plan

ADDENDUM for 3 LINES OF INQUIRY

This Addendum includes selected parts for an Environmental Monitoring Project Plan developed for the Sycamore Creek scenario. To avoid confusion, this Project has a different name and proposal number. It has three distinct study questions and develops 3 separate lines of inquiry to answer them. Selected sections or subsections in this Addendum include the following:
Title page,
Section 3 (problem definition and monitoring questions),
Section 5 (schedule)
Section 6 (Activities and Design tables plus supplemental work statements)
Section 7 (Quality Objectives tables)

Title:

Environmental Monitoring Project Plan

For

Sycamore Creek 2008-2009 Monitoring Project

Proposal Identification Number: SC445

Section 3. Problem Statement and Monitoring Objectives

3.1 Problem Statement

The problems addressed by this monitoring effort are: There is a gap in knowledge whether ambient conditions in Sycamore Creek enable attainment of beneficial uses, and there appears to be a persistent source of bacterial contamination to the mainstem of the Creek during summer.

Sycamore Creek flows east to west from the Snowy Mountains into the Big Valley through an array of rolling foothills. More than half of the watershed area is a forest, and about 10% of the land – mostly in the foothills - is used for grazing. There are few urban centers in the watershed, but small communities are widely dispersed in the foothill areas, and many of them rely on septic systems. The most prominent of these communities is the town of Pensia, located close to the South Fork about two river miles above confluence with the North Fork of Sycamore Creek. The mountain and foothill segment of the stream is relatively undisturbed and has been designated the beneficial uses of WARM, COLD, AQUA, MUN, and WILD.

However, little data exist to support assignment of these beneficial uses, and ambient conditions have not been documented in the last 15 years. The Regional Board has been charged with providing an assessment of the conditions in Sycamore Creek watershed as part of its Clean Water Act 305(b) requirements, and this calls for ambient water quality monitoring. Ambient monitoring is also needed for characterization effort associated with the bacterial contamination problems discussed below.

Sycamore Creek water is used for domestic supply to more than 50,000 households within the service area of the Sycamore Water District (SWD, or the District). The intake of the SWD treatment plant is located three river miles downstream of the North fork/South fork confluence, and the District is running routine bacteriological tests on its raw water. The District is also required to test water samples collected from different parts of the stream network at least four times during the summer. In the summers of 2005 and 2006 there have been several incidents of elevated E. coli concentrations in the main stem of Sycamore Creek just downstream of the South fork/North fork confluence, and fingers have been pointed to the septic systems within the community of Pensia. The source of these contaminants is not known.

3.2 Monitoring Questions

This monitoring effort will address the watershed characterization and 305(b) reporting needs, and will also attempt to identify the source of bacterial contamination within the stream network and at a local scale. Specifically, the project will attempts to answer the following questions shown in box 3-1:

Box 3-1: Monitoring Questions

(1) What are the ambient water quality conditions in the Sycamore Creek hydrologic system, and does it support all its designated beneficial uses?

(2) What are the sources of E. coli to the main stem of Sycamore Creek during summer?

(3) Are failing septic systems in the community of Pensia an important source of E. coli during dry weather?

Three major lines of inquiry will be implemented to answer the monitoring questions stated above. Monitoring work under this Project will be performed during **dry weather** only, for all purposes; however this Project’s data will be augmented by wet-weather sampling effort conducted by the Sycamore County Flood Control District as part of their Stormwater Characterization Program. Further detail is provided in Section 6 below.

Section 5. Project Tasks and Schedule

Sycamore RCD staff and community members will perform routine water quality monitoring during 2008 and 2009, conduct a survey to identify sources of indicator bacteria during the summer and fall of 2008, and support their findings with forensic studies related to potential leakages from failing septic systems during the summers and falls of 2008 and 2009.

Figure 5-1 shows the major tasks that will be undertaken, and the anticipated time line for the performance of each task. The tasks and the Reports generated are further described below. The reader is also referred to Appendix A for a comprehensive and highly-detailed list of Project phases, tasks, responsible parties, products, and due dates.

Routine field measurements and sampling for watershed characterization will proceed from January 2008 through December 2009. Data will be reported annually in a summary report delivered by February 28th. The first months of 2008 will be used to conduct all the preparations and training sessions needed to get the field crews ready and equipped for the bacterial source identification study. Source ID sampling events will be conducted three times during the summer and fall of 2008 and will be summarized and reported by December 15, 2008. Results of the 2008 septic system special study will be reported to the Sycamore Estate Homeowners Association (SEHA) by December 15, 2008, and a public report will be issued during February 2009. If the septic system study proceeds through 2009, the same annual schedule will apply.

Task	**S, O, N** 07	**D, J, F** 07-08	**M, A, M** 08	**J, J, A** 08	**S, O, N** 08	**D, J, F** 08-09	**M, A, M** 09	**J, J, A** 09	**S, O, N** 09	**D, J, F** 09-10
Complete QAPP and have all parties' approval										
Training and gearing up for routine monitoring										
Routine monitoring and data quality assessments										
Routine monitoring data summary & annual reports										
Training ,preparation for bacterial source ID study										
Sampling for bacterial source ID study										
Bacterial source ID study data validation and reporting										
Data collection for septic system special study										
Homeowner review of Septic system special study data										
Septic system special study reporting										
Final Project report (two or three lines of inquiry) to Regional Board										

Figure 5-1 –Project Time Line for Major tasks

Figure notes: Year is broken into 4 periods, three months each; Cold includes Dec, Jan, Feb; Warming includes Mar, Apr, May; Hot includes Jun, Jul, Aug; and cooling includes Sept, Oct, Nov. Dark shade: planned; light shade: optional.

Appendix A provides the details for each task and sub-task at the Project level, with informational about responsible parties, deliverables, due dates, etc. The most current version is attached. This matrix serves as a planning, tracking, and management tool used by Project operators on the ground, and it may be amended as needed.
(not included in this example, please see SOP-9.4.1.1 in the CWT Guidance Compendium)

Section 6: Monitoring strategy and design

Data collection to answer the three monitoring questions will proceed in three distinct lines of inquiry.

Question # 1 - What are the ambient water quality conditions in the Sycamore Creek hydrologic system, and does it support all its designated beneficial uses? – will be addressed by adding routine water quality monitoring data to information generated by others (see below).

Question # 2 - What are the sources of E. coli to the main stem of Sycamore Creek during summer? - will be addressed via three concerted “snapshot type” events, each including sampling at multiple location within the river network and at the same time.

Question # 3 - Are failing septic systems in the community of Pensia a significant source of E. coli during dry weather? – will be addressed by local forensic investigation using specific indicators.

Table 6-1 shows a summary of the groups of characteristics that will be monitored for each line of inquiry. The entire “Parameter package” is listed for each line. It also shows the responsible personnel, the frequency, and the total number of Station visits for each characteristic group.

Table 6-1: Parameter Package and Logistics for the three Sycamore Creek Studies

Study question or intent	Characteristics (Parameter package)	Personnel	Activity type	Activity Frequency and Interval	Time of Day	Weather & flow conditions	# of Station Visits
Character-ization	Five "vital signs" (*Note a*)	Friends of Sycamore Creek (FSC)	Field measurements	Biweekly (dry season); or monthly (wet);	9 to 11 AM	Dry, base flow	54
	Flow discharge	FSC	Field measurements	monthly	9 to 11 AM	Dry, base flow	54
	Nutrients (Ammonia, Nitrate Ortho-phosphate Total Phosphorous Total Kjeldahl nitrogen (TKN))	Happy flask lab (sampling and analysis	Sample; lab analysis	monthly	9 to 11 AM	Dry, base flow	36
	Hardness & Chloride	Happy flask lab (sampling and analysis	Sample; lab analysis	monthly	9 to 11 AM	Dry, base flow	36
Source ID	Five "vital signs" (*Note a*)	Sycamore RCD and FSC	Field measurements	3/Project, 4-6 weeks apart	Any	Dry, base flow	**60 (or up to 96)**
	Estimated Flow	Sycamore RCD and FSC	Field measurements	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	E. coli and total coliform	Sampling RCD+FSC, lab Happy Flask	Sample; lab count	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	Nutrients (ammonia, nitrate)	"	Sample; lab analysis	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
	Human use indicators (chlorine, chloride, and fluoride)	"	Sample; lab analysis	3/Project, 4-6 weeks apart	Any	Dry, base flow	"
Septic leakage	Visual Observations	RCD	Observation	TBD	TBD	Dry, base flow	TBD
	Optical Brightners integration	"	Field Measurement	TBD	TBD	Dry, base flow	"
	pH and Specific Conductivity	"	Field Measurement	TBD	TBD	Dry, base flow	"
	Ammonia (by field kit)	"	Field Measurement	TBD	TBD	Dry, base flow	"

	Nutrients (ammonia, nitrate, phosphate)	Sampling: RCD, lab: Happy Flask	Sample; lab analysis	TBD	TBD	Dry, base flow	"
	Human use indicators (chlorine, chloride, and fluoride)	"	Sample; lab analysis	3/Project, 4-6 weeks apart	Any	Dry, base flow	"

Note a The five "vital signs" are: temperature, pH, dissolved oxygen, specific conductivity, and turbidity

Supplement to Section 6: summary of Work Statements for the 3 lines of Inquiry

Three lines of inquiry will be implemented to answer the monitoring questions stated above. Sycamore RCD staff and community members will perform routine water quality monitoring during 2008 and 2009, conduct a survey to identify sources of indicator bacteria during the summer of 2008, and support their findings with forensic studies related to potential leakages from failing septic systems during the summers and falls of 2008 and 2009. Monitoring work will be performed during dry weather only, for all purposes.

Question # 1: Watershed Characterization

Three sampling Stations have already been established on the main stem of Sycamore creek and will be used for routine monitoring to characterize ambient conditions and to augment the long-term database created for this watershed. The first Station is located near the mouth of the Creek, just upstream from the Big Valley Wetland Monument. The second is located about 17 river miles upstream, below the town of Sycamore Haven, and the third is located the intake of the SWD treatment plant, about three river miles downstream of the North fork/South fork confluence.

Ambient monitoring for the watershed characterization study will include routine monitoring of temperature, pH, dissolved oxygen, specific conductivity, and turbidity (a.k.a, the five "vital signs") coupled with observation of flow conditions and measurement of stage (water level) or flow discharge. These field measurements will be performed by the Friends of Sycamore creek, every two weeks during the summer (May-October) and once a month during winter, between 9 AM and 11 AM. The Friends will visit the three Stations on each trip, and will move from Station to Station in the same order each time.

Water samples for the analysis of total ammonia, nitrate, and phosphate, total phosphorous, Kjeldahl nitrogen, hardness, and chloride will be collected every month, at the same three Stations, and will be delivered to Happy Flask Laboratory for analysis. Happy Flask Lab crews will join the Friends on their routine monitoring trips and will collect these samples while the friends conduct complementary field measurements at the same time and place.

Question # 2: *E. coli* Source Identification

Sycamore RCD staff will collect sterile water samples and conduct field measurements for the five "vital signs" and flow at various locations on the North fork and the South fork of Sycamore Creek. Stations for this part of the Project will be located just above the confluence of every important tributary as well as upstream and downstream of the most prominent communities and resorts, to provide representation of potential sources of fecal bacteria. They will be selected from a pool of access points already established by GPS coordinates and described by landmarks. Actual sampling sites will be determined "on the run" during the first sampling trip, and will be visited again on consecutive trips if accessible and relevant. Source ID trips will be conducted three times during the summer of 2008; exact timing will be determined based on flow, water quality conditions, and anticipated activities. Samples will be delivered to Happy Flask Lab for counts of total coliforms and E. coli using the IDEXX Colilert reagent and QuantiTray system. Provisions are also made for isolating E. coli colonies from samples that have high E. coli counts and sending the colonies for DNA ribotyping to determine the host species of that E. coli strain.

Question # 3: Status of Septic Systems in the community of Pensia

Septic System failure may manifest itself in two major ways. The first and most obvious one is overflow from the tank, which is evident on the surface; this type of failure is constantly monitored by homeowners and landowners especially during periods of high usage of facilities, and does not involve monitoring covered by this Plan. The second way a septic system failure might affect water quality is more subtle and is related to inadequate treatment of the effluent within the leach field. Particulates such as E. coli cells are usually filtered out if the effluent seeps through soil, but if there are fissures or breaks tunnels they can be found in the receiving creek water.

The Sycamore RCD crews, with help from the Friends of Sycamore Creek, will conduct forensic monitoring at suspected entry points to the creek. Segments for Stream Walks will be selected based on septic system specifications and history if available and based on on-site observations of unusual growth of algae, soil appearance, presence of fissured and tunnels, channel or bank anomalies, and other tell-tale signs. Timing will be focused towards minimal flow and maximum influx of groundwater from the sides. The crews will measure specific conductivity and pH at high resolution, and ammonia using field kits, at several locations in the channel and along the bank upstream and downstream of suspected infiltration spots. They will also measure flow or record stage at a representative location in the channel.

If a drastic spatial change in specific conductivity is observed, or if ammonia is detected, an array of samples will be collected for E. coli counts and for analysis of, ammonia, nitrate, phosphate, chlorine, chloride, and fluoride at Happy Flask laboratory. The first round of Special study activities will take place during late summer and fall of 2008, and results will be used to select timing and locations of the second round, anticipated in the summer/fall of 2009.

Section 7

Table 7-1 – Measurement Quality Objectives and Other Quality Objectives for Field Measurements

Study question or intent	**Characteristic (Parameter)**	**Unit**	**Accuracy** (unit or Percent) (Note a)	**Precision** (unit or RPD) (Note a)	**Reso-lution**	**Target Reporting Limit**	**Comp-leteness**
Character-ization	pH	pH	+ 0.2	+ 0.2	0.1	nap	90%
	Specific Conductivity	uS/cm	+ 2 or + 10%	+ 2 or + 10%	1	1	90%
	Dissolved oxygen	mg/l	+ 0.5 or 10%	+ 0.5 or 10%	0.2	0.2	90%
	Temperature	C	+ 1 or 10%	+ 1 or 10%	0.5	-5	90%
	Turbidity	NTU	+ 1 or 10%	+ 1 or 10%	0.1	0.5	90%
Source ID	pH	pH	+ 0.2	+ 0.2	0.1	nap	90%
	Specific Conductivity	uS/cm	+ 2 or + 10%	+ 2 or + 10%	1	1	90%
	Dissolved oxygen	mg/l	+ 0.5 or 10%	+ 0.5 or 10%	0.2	0.2	90%
	Temperature	C	+ 1 or 10%	+ 1 or 10%	0.5	-5	90%
	Turbidity	NTU	+ 1 or 10%	+ 1 or 10%	0.1	0.5	90%
	Velocity	m/sec	nap	+ 0.2 or 50%	0.1	0.1	90%
Septic leakage	pH	pH	+ 0.05	+ 0.05	0.01	nap	nap
	Specific Conductivity	US/cm	+ 0.5 or + 5%	+ 0.5 or + 5%	0.1	nap	nap
	Ammonia	mg/l	+ 0.5 or 10%	+ 0.2 or 10%	0.1	0.1	nap

Note a: Unit or percentage, whichever is greater.
RPD – Relative percent Difference – is the difference between two repeated measurements expressed as a percentage of their average.
uS/cm – microsiemen per centimeter, equivalent to micromhos/cm
nap – not applicable

Table 7-2: - Measurement Quality Objectives (MQOs) and Other Quality Objectives for Laboratory Analyses and Bacterial Counts

Study question or intent	**Character-istic (Parameter)**	**Unit**	**Accuracy** (or LCS Recovery)	**Precision** RPD	**Matrix Spike Recovery**	**Target Reporting Limit**	**Comp-leteness**
Character-ization	Total Ammonia	mg N/L	± 10	± 10	80–120%	0.05	90%
	Nitrate	mg N/L	± 20	± 20	70–130%	0.1	90%
	Ortho-phosphate	mg P/L	± 20	± 20	70–130%	0.1	90%
	total phosphorous	mg P/L	± 10	± 10	70–130%	0.5	90%
	Kjeldahl nitrogen	mg N/L	± 1 or 10%	± 1 or 10%	70–130%	0.5	90%
	Hardness	mg CaCO3/L	± 30	± 30	70–130%	0.1	90%
	Chloride	mg/L	± 10	± 10	80–120%	0.05	90%
Source ID	*E. coli*	MPN /100mL	Meet Positive and Negative controls	± 50%	Not applicable	2	90%
	Total coliform	MPN /100mL	Meet Positive and Negative controls	± 50%	Not applicable	2	90%
	Total Ammonia	mg N/L	± 10	± 10	80–120%	0.05	90%
	Nitrate	mg N/L	± 20	± 20	70–130%	0.1	90%
	Chloride	mg/L	± 10	± 10	80–120%	0.05	90%
	Chlorine	mg/L	± 10	± 10	80–120%	0.01	90%
	Fluoride	mg/L	± 10	± 10	80–120%	0.05	90%
Septic leakage	*E. coli*	MPN /100mL	Meet Positive and Negative controls	± 50%	Not applicable	2	
	Total Ammonia	mg N/L	± 10	± 10	80–120%	0.05	90%
	Nitrate	mg N/L	± 20	± 20	70–130%	0.1	90%
	Ortho-phosphate	mg P/L	± 20	± 20	70–130%	0.1	90%
	Chloride	mg/L	± 10	± 10	80–120%	0.05	90%
	Chlorine	mg/L	± 10	± 10	80–120%	0.01	nap
	Fluoride	mg/L	± 10	± 10	80–120%	0.05	90%

RPD – Relative Percent Difference – is the difference between two lab replicates (sample or spikes) or two field duplicates, expressed as a percentage of their average.
LCS Recovery –Laboratory Control Sample in clean water. Note: CRM (Certified Reference Material) solutions usually come with specified recovery limits and confidence level, and the Project's quality objective is to meet those.