Quality Assurance Project Plan

For

PROJECT NAME: **Middle Santa Ana River Pathogen TMDL - BMP Implementation Project**

Proposal Identification Number: 8839

Date: April 3, 2008
(Revised)

NAME OF RESPONSIBLE ORGANIZATION: **Santa Ana Watershed Project Authority (SAWPA)**

Group A: Project Management
Approval Signatures

Grant Organization

Title	Name	Signature	Date*
SAWPA Project Director	Mark Norton		
SAWPA Project Coordinator	Rick Whetsel		
Strategic Planner, Risk Sciences	Tim Moore		
CDM Project Manager	Richard Meyerhoff		
CDM QA Officer	Barbara Wells		
Agricultural/Dairy Representative	Pat Boldt		
Brown & Caldwell Monitoring Manager	Chris Knoche		
Brown & Caldwell Monitoring QA Officer	Nancy Gardiner		
San Bernardino County Flood Control District (SBCFCD) Monitoring Manager	Matt Yeager		
SBCFCD Monitoring QA Officer	Janet Dietzman		
Orange County Public Health Water Quality Laboratory	Douglas Moore		
Orange County Public Health Water Quality Laboratory	Joseph Guzman		
OCWD Laboratory Director	Donald Phipps		
OCWD Laboratory QA Officer	Menu Leddy		
UC Davis Laboratory Director	Dr. Stefan Wuertz		
UC Davis Laboratory QA Officer	Dr. Alexander Schriewer		

Santa Ana Regional Water Quality Control Board

Title	Name	Signature	Date*
Contract Manager	William Rice		
QA Officer	Pavlova Vitale		

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

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ATTACHMENTS

APPENDICES

3. Distribution List

Title	Name (Affiliation)	Tel. No.	QAPP No.
Santa Ana Regional Water Quality Board ("Regional Board") Contract Manager	William Rice (Regional Board)	951-782-4130	8839
Regional Board QA Officer	Pavlova Vitale (Regional Board)	951-782-4130	8839
Grantee Project Director	Mark Norton (SAWPA)	951-354-4220	8839
Grantee Project Coordinator	Rick Whetsel (SAWPA)	951-354-4220	8839
MSAR Pathogen TMDL Workgroup	see Appendix D		8839
Contractor Strategic Planner	Tim Moore (Risk Sciences)	615-370-1655	8839
Contractor Project Manager	Richard Meyerhoff (CDM)	909-579-3500	8839
Contractor QA Officer	Barbara Wells (CDM)	909-579-3500	8839
Ag/ Dairy Representative	Pat Boldt	951-808-8531	8839
Monitoring Contractor Manager	Chris Knoche (Brown & Caldwell)	714-689-9836	8839
Monitoring Contractor QA Officer	Nancy Gardiner (Brown & Caldwell)	858-571-6742	8839
Monitoring Contractor Manager	Matt Yeager (SBCFCD)	909-387-8109	8839
Monitoring Contractor QA Officer	Janet Dietzman (SBCFCD)	909-387-8109	8839
OC Public Health Water Quality Laboratory Director	Douglas Moore	714-834-8379	8839
OC Public Health Water Quality Laboratory QA Officer	Joseph Guzman	949-219-0423	8839
Orange County Water District (OCWD) Laboratory Director	Donald Phipps	714-378-3200	8839
OCWD Laboratory QA Officer	Menu Leddy	714-378-3200	8839
University of California-Davis (UC Davis) Laboratory Director	Dr. Stefan Wuertz	530-754-6407	8839
UC Davis Laboratory QA Officer	Dr. Alexander Schriewer	530-752-1755	8839

4. Project/Task Organization

4.1 Involved Parties and Roles

In order to carry out the goal and objectives of this study, the Middle Santa Ana River (MSAR) Bacterial Indicator TMDL Task Force will be working with various agencies and contractors to carry out the Watershed-Wide, Urban Source Evaluation Plan (USEP), Agricultural Source Evaluation Plan (AgSEP), and Best Management Practices (BMP) Effectiveness monitoring programs as described by the MSAR Water Quality Monitoring Plan. The following outlines the roles of each of the participating parties in the monitoring program:

SAWPA

- Administer MSAR TMDL Task Force activities
- Administer project funding from Proposition 40 grant funds and funds received from Task Force members
- Administer contracts established with contractors
- Manage project database

MSAR TMDL Task Force

- Provide oversight and guidance of MSAR monitoring activities conducted as part of the implementation of the MSAR Bacterial Indicator TMDL
- Coordinate TMDL implementation activities with other basin planning processes within the Santa Ana River watershed
- Support funding of activities conducted as part of the implementation of the TMDL

Risk Sciences

- Provide strategic planning services to SAWPA to ensure that monitoring and reporting activities support TMDL implementation requirements

CDM

- Obtain the necessary permits (if required) to access the sampling sites and collect samples
- Develop sampling protocols
- Update the monitoring plan and the QAPP, as necessary
- Provide the monitoring design for the study (list of sampling sites, list of indicators, map of the study area depicting the sampling sites, etc.)
- Coordinate with all parties involved in the study
- Coordinate with Monitoring Contractors
- Coordinate with each of the laboratories conducting analyses for data reporting and payment of analytical services

- Coordinate with the laboratories for analysis of samples
- Coordinate with the laboratories to obtain data from the analyses
- Analyze the laboratory data results
- Conduct annual Quality reviews
- Compile the data and use for TMDL-related activities
- Conduct field sampling activities as assigned according to MSAR Water Quality Monitoring Plan. This role includes:
  - Providing sampling personnel and probe for each sampling activity according to MSAR Water Quality Monitoring Plan
  - Calibrating Horiba Multiparameter probe (pH, temperature, conductivity, dissolved oxygen, turbidity) prior to sampling activities
  - Calibrating Marsh-McBirney Model 2000 flow meter, if used, prior to sampling activities
  - Coordinating with each of the laboratories prior to sample collection events (request bottles, scheduling, etc.)
  - Ensuring that all necessary chain-of-custody forms are completed prior to surrendering samples to the laboratory
  - Transporting the samples to each of the laboratories for analysis within the required holding times

Monitoring Contractors: Brown & Caldwell (USEP Monitoring/BMP Effectiveness Monitoring), San Bernardino County Flood Control District (Watershed-Wide), and CDM (AgSEP (tentatively) and BMP Effectiveness Monitoring)

- Conduct field sampling activities as assigned according to MSAR Water Quality Monitoring Plan
- Provide sampling personnel and probe for each sampling activity according to MSAR Water Quality Monitoring Plan
- Calibrate Horiba Multiparameter probe (pH, temperature, conductivity, dissolved oxygen, turbidity) prior to sampling activities
- Calibrate Marsh-McBirney Model 2000 flow meter, if used, prior to sampling activities
- Coordinate with each of the laboratories prior to sample collection events (request bottles, scheduling, etc.)
- Ensure that all necessary chain-of-custody forms are completed prior to surrendering samples to the laboratory
- Transport the samples to each of the laboratories for analysis within the required holding times

Orange County Public Health Water Quality Laboratory

- Provide the necessary containers, preservatives (if required), chain of custody forms for the samples
- Analyze the samples for constituents as indicated in QAPP
- Operate according to laboratory quality assurance and quality control program in accordance with guidelines established by the State of California and the U.S. EPA
- Provide data in electronic and hard copy format to CDM

OCWD Laboratory

- Provide the necessary containers, preservatives (if required), chain of custody forms for the samples
- Conduct *Bacteroides* analyses
- Operate according to laboratory quality assurance and quality control program in accordance with guidelines established by the State of California and the U.S. EPA
- Provide data in electronic and hard copy format to CDM

UC Davis Laboratory

- Provide the necessary containers, preservatives (if required), chain of custody forms for the samples
- Conduct *Bacteroides* analyses
- Operate according to laboratory quality assurance and quality control program in accordance with guidelines established by the State of California and the U.S. EPA
- Provide data in electronic and hard copy format to CDM

Table 1. Personnel Responsibilities

Name	Organizational Affiliation	Title	Contact Information
William Rice	RWQCB	Grant Manager	951-782-4130
Mark Norton	SAWPA	Grantee Project Director	951-354-4220
Rick Whetsel	SAWPA	Grantee Project Manager	951-354-4220
Tim Moore	Risk Sciences	Strategic Planner	615-370-1655
Richard Meyerhoff	CDM	Contractor Project Manager	303-298-1311
Barbara Wells	CDM	Contractor Quality Assurance Officer	909-579-3500

Thomas Lo	CDM	Contractor Monitoring Manager	909-579-3500
Chris Knoche	Brown & Caldwell	Contractor Monitoring Manager	714-689-9836
Nancy Gardiner	Brown & Caldwell	Contractor Monitoring QA Officer	858-571-6742
Matt Yeager	SBCFCD Staff	Contractor Monitoring Manager	909-387-8109
Janet Dietzman	SBCFCD Staff	Contractor Monitoring QA Officer	909-387-8109
Douglas Moore	OC Public Health Water Quality Lab	OC Public Health Water Quality Laboratory Director	714-834-8379
Joseph Guzman	OC Public Health Water Quality Lab	OC Public Health Water Quality Laboratory QA Officer	949-219-0423
Donald Phipps	OCWD	OCWD Laboratory Director	714-378-3200
Menu Leddy	OCWD	OCWD Laboratory QA Officer	714-378-3200
Dr. Stefan Wuertz	UC Davis	UC Davis Laboratory Director	530-754-6407
Dr. Alexander Schriewer	UC Davis	UC Davis Laboratory QA Officer	530-752-1755

4.2 Quality Assurance Officer Role (QA Officer)

The QA Officer's role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling, contract field analysis, and contract laboratory analysis procedures. Barbara Wells, CDM, will serve as the QA officer and work with the CDM Project Manager and QA Officers affiliated with the monitoring contractor and laboratories to ensure QAPP procedures are followed. CDM's QA Officer will be responsible to ensure sampling protocols are followed by the Monitoring Contractor staff.

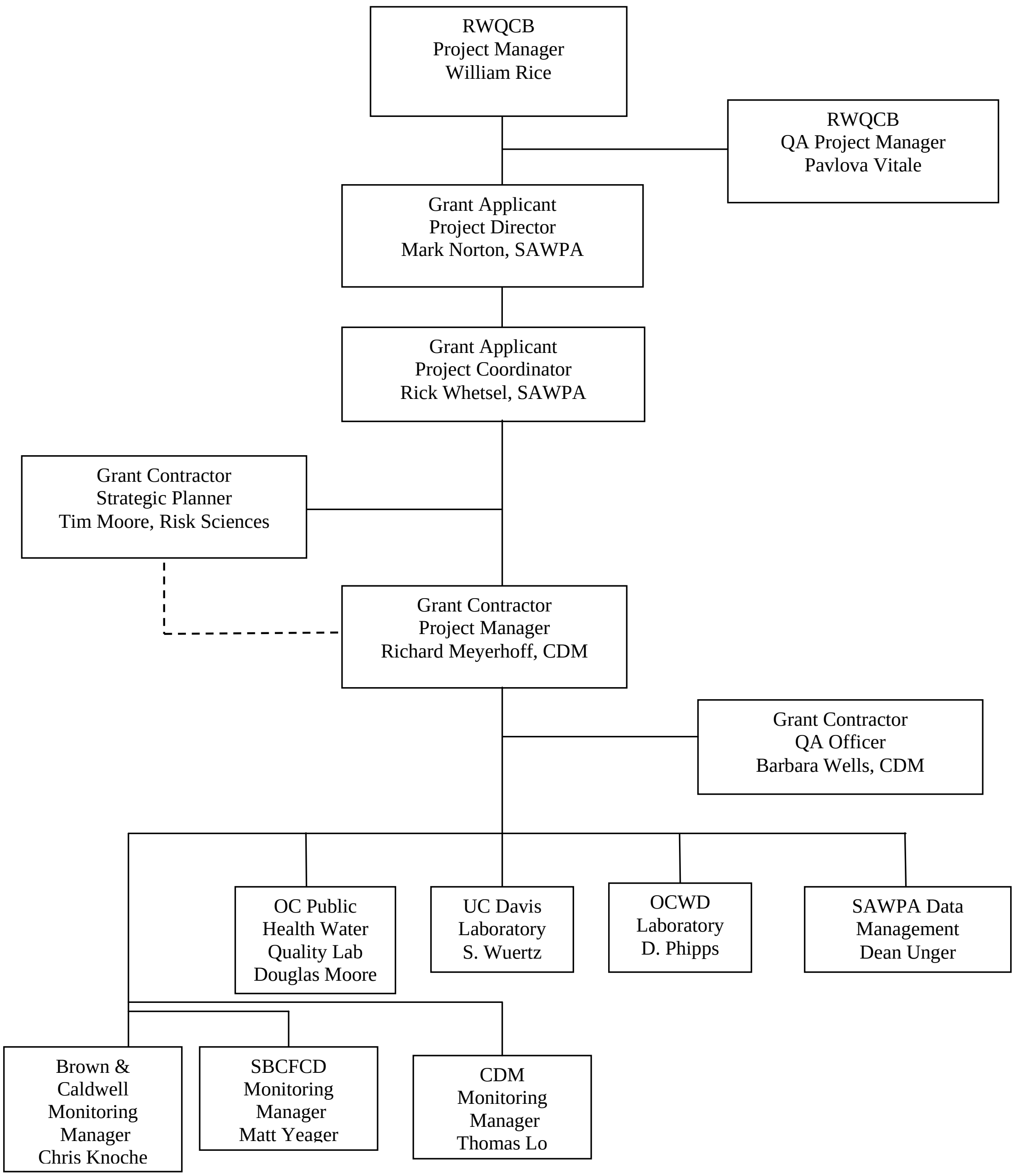
Barbara Wells will also review and assess all procedures during the life of the contract against QAPP requirements and will report all findings to Richard Meyerhoff, including all requests for corrective action. Reviews will be conducted quarterly: end of August 2007, November 2007, and February 2008. A QA report will accompany the final data and interpretive report that evaluates overall project compliance with the QAPP.

Barbara Wells may stop all actions, including those conducted by any subcontractor if there are significant deviations from required practices or if there is evidence of a systematic failure.

4.3 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by CDM's Project Manager and Quality Assurance Officer, and with the concurrence of other project participants, especially SAWPA and the Regional Board's Contract Manager and Quality Assurance Officer. CDM will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

4.4 Organizational Chart and Responsibilities



5. Problem Definition/Background

5.1 Introduction

Various waterbodies in the Middle Santa Ana River watershed are listed on the state 303(d) list of impaired waters due to high levels of fecal coliform bacteria. The Middle Santa Ana River (MSAR) Bacterial Indicator Total Maximum Daily Load (TMDL) was adopted by the Santa Ana Regional Water Quality Control Board (RWQCB) and approved by the State Water Resources Control Board (SWRCB) to address these fecal coliform impairments. Environmental Protection Agency (EPA) Region 9 approval is pending. As part of the TMDL Implementation Plan, four bacteria monitoring programs for the MSAR watershed are being implemented:

(a) Long term watershed-wide monitoring program to assess compliance with TMDL targets;

(b) A study to investigate potential sources of bacteria in the urban environment;

(c) A study to investigate the potential sources of bacteria from agricultural lands; and

(d) A study to evaluate the effectiveness of various treatment Best Management Practices (BMPs) to reduce bacteria.

This QAPP describes these four monitoring programs.

5.2 Regulatory Background

Table 3-1 of the Santa Ana Regional Water Quality Control Plan (Basin Plan) designates beneficial uses for surface waters in the Santa Ana River watershed (RWQCB 1995). The beneficial uses applicable to waterbodies in the MSAR watershed include Water Contact Recreation (REC-1), which is defined in the Basin Plan as follows:

> "waters are used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and use of natural hot springs" (Basin Plan, page 3-2).

The Basin Plan (Chapter 4) specifies fecal coliform as a bacterial indicator for pathogens ("bacterial indicator"). Fecal coliform present at concentrations above certain thresholds are believed to be an indicator of the presence of fecal pollution and harmful pathogens, thus increasing the risk of gastroenteritis in bathers exposed to the elevated levels. The Basin Plan currently specifies the following water quality objectives for fecal coliform:

REC-1 - *Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.*

The EPA published new bacteria guidance in 1986 (EPA 1986). This guidance advised that for freshwaters *Escherichia coli* (*E. coli*) is a better bacterial indicator than fecal coliform. Epidemiological studies found that the positive correlation between *E. coli* concentrations and the frequency of gastroenteritis was better than the correlation between fecal coliform concentrations and gastroenteritis.

The RWQCB is currently considering replacing the REC-1 bacteria water quality objectives for fecal coliform with *E. coli* objectives. This evaluation is occurring through the work of the Stormwater Quality Standards Task Force (SWQSTF). The SWQSTF is comprised of representatives from various stakeholder interests, including the Santa Ana Watershed Protection Authority, the counties of Orange, Riverside, and San Bernardino, Orange County Coastkeeper, Inland Empire Waterkeeper, the RWQCB, and EPA Region 9.

In 1994 and 1998, because of exceedences of the fecal coliform objective established to protect the REC-1 use, the RWQCB added various waterbodies in the MSAR watershed to the state 303(d) list of impaired waters. The MSAR Watershed TMDL Task Force ("TMDL Task Force"), which includes representation by many key watershed stakeholders, was subsequently formed to address this impairment through the development of a TMDL for the watershed. The MSAR Bacterial Indicator TMDL addresses bacterial indicator impairments in the following MSAR watershed waterbodies (Figure 1-1):

- Santa Ana River, Reach 3 – Prado Dam to Mission Boulevard in the City of Riverside
- Chino Creek, Reach 1 – Santa Ana River confluence to beginning of hard lined channel south of Los Serranos Road
- Chino Creek, Reach 2 – Beginning of hard lined channel south of Los Serranos Road to confluence with San Antonio Creek
- Mill Creek (Prado Area) – Natural stream from Cucamonga Creek Reach 1 to Prado Basin
- Cucamonga Creek, Reach 1 – Confluence with Mill Creek to 23rd Street in City of Upland
- Prado Park Lake

The implementation plan contained in the MSAR Bacterial Indicator TMDL requires that, no later than six months from the effective date of the TMDL (date of EPA approval), the U.S. Forest Service, the County of San Bernardino, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, Corona, Pomona, and Claremont [1], and agricultural operators in the watershed submit as a group (or individually) to the RWQCB for approval, a watershed-wide monitoring program that will provide the data necessary to review and update the adopted TMDL. The TMDL also requires the development and implementation of two plans: (1) the USEP to identify activities, operations, and processes in urban areas that contribute bacterial indicators to MSAR watershed waterbodies; and (2) the AgSEP to identify activities, operations, and processes in agricultural areas that contribute bacterial indicators to MSAR watershed waterbodies. The TMDL requires that the USEP and AgSEP be submitted to the RWQCB for approval by November 30, 2007.

[1] The cities of Pomona and Claremont are not participants of the TMDL Task Force and are not participants in any of the monitoring activities described in this Monitoring Plan.

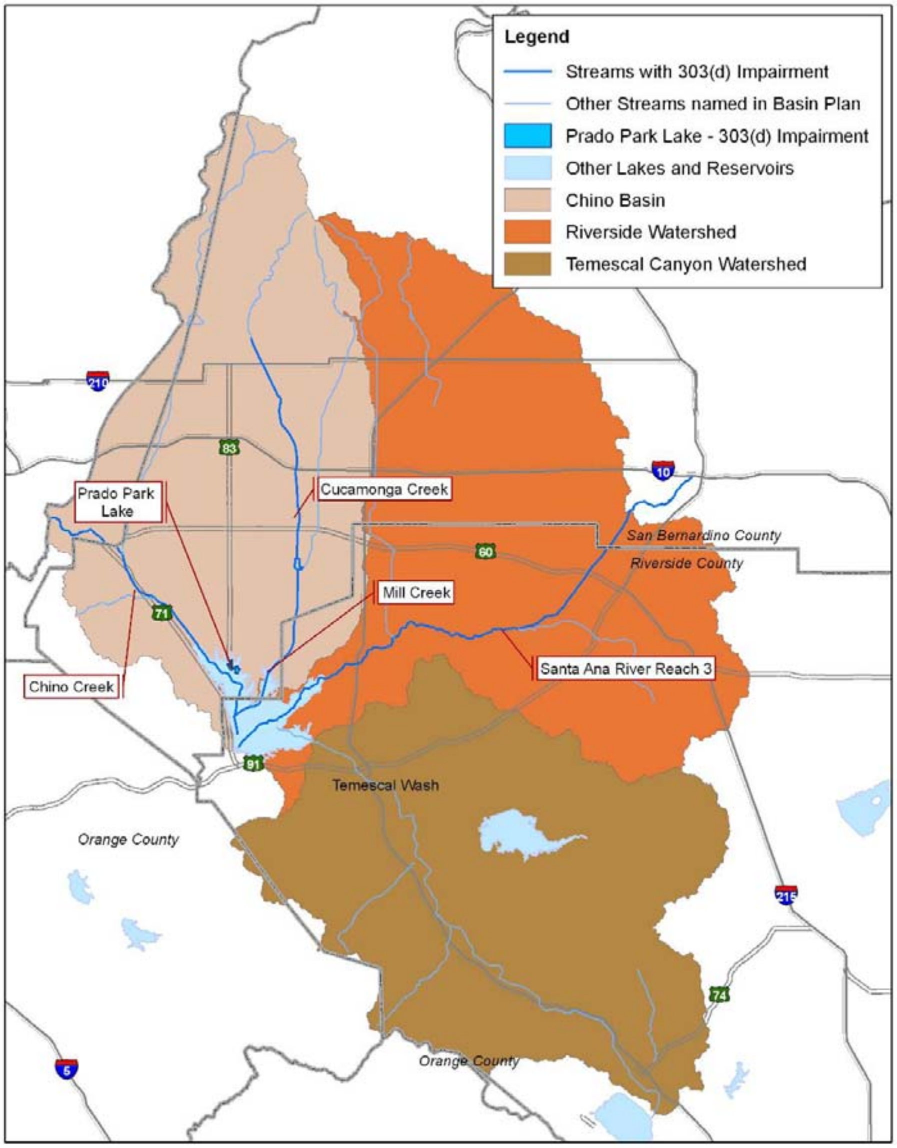


Figure 1
Bacterial Indicator Impairments in the MSAR Watershed

5.3 Proposition 40 State Grant

In anticipation of an approved TMDL, the Santa Ana Watershed Project Authority (SAWPA), in cooperation with the San Bernardino County Flood Control District (SBCFCD), Riverside County Flood and Water Conservation District (RCFWCD), and Orange County Water District (OCWD) submitted a Proposition 40 grant proposal to the SWRCB to support the implementation of TMDL requirements. This grant proposal, *Middle Santa Ana River Pathogen TMDL – BMP Implementation* (Grant Project), was developed, in part, to characterize urban bacteria sources within the watershed. This characterization will provide the basis for the development and implementation of the USEP requirements of the TMDL. The grant proposal also included a study to evaluate selected BMPs for their efficacy in removing or reducing bacteria in urban runoff. The state approved the grant proposal in fall 2006 and the Grant Project, which will be completed by December 2008, was initiated.

5.4 Agricultural Community Funding

In summer 2007, representatives of the Milk Producers Council and Chino Watermaster Agricultural Pool approved funding to support initiation of TMDL implementation tasks that are the responsibility of the agricultural community, i.e., development of the AgSEP which includes the Agricultural Source Evaluation Monitoring Program.

5.5 Watershed Description

The MSAR watershed covers approximately 488 square miles and lies largely in the southwestern corner of San Bernardino County, and the northwestern corner of Riverside County. A small part of Los Angeles County (Pomona/Claremont area) is also included. The MSAR watershed includes three sub–watersheds:

- Chino Basin (San Bernardino County, Los Angeles County, and Riverside Counties) – Surface drainage in this area, which is directed to Chino Creek and Mill-Cucamonga Creek, flows generally southward, from the San Gabriel Mountains toward the Santa Ana River and the Prado Flood Control Basin.

- Riverside Watershed (Riverside County) – Surface drainage in this area is generally westward or southeastward from the City of Riverside and the community of Rubidoux to Reach 3 of the Santa Ana River.

- Temescal Canyon Watershed (Riverside County) – Surface drainage in this area is generally northwest to Temescal Creek.

Land uses in the MSAR watershed include urban, agriculture, and open space. Although originally developed as an agricultural area, the watershed is rapidly urbanizing. Incorporated cities in the MSAR watershed include Chino, Chino Hills, Claremont, Corona, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, Riverside, and Upland. In addition, there are several pockets of urbanized unincorporated areas. Open space areas include National Forest lands and State Park lands.

The current population of the watershed, based upon 2000 census data, is approximately 1.4 million people. The principal remaining agricultural area in the watershed is the area formerly known as the Chino Dairy Preserve. This area is located in the south central part of the Chino Basin subwatershed and contains approximately 300,000 cows (although this number is quickly declining as the rate of development increases). Recently, the cities of Ontario, Chino, and Chino Hills annexed the San Bernardino County portions of this area. The remaining portion of the former preserve, which is in Riverside County, remains unincorporated.

5.5 Purpose of the QAPP

This QAPP supports the MSAR Water Quality Monitoring Plan which was prepared to fulfill four objectives:

(1) Establish and implement the Bacterial Indicator Watershed-Wide Monitoring Program required by the TMDL. The monitoring described for this program will continue until the numeric targets described in the MSAR Bacterial Indicator TMDL are achieved and waterbodies are removed from the 303(d) list upon adoption of the TMDL.

(2) Implement monitoring funded by the Grant Project (described above) to characterize urban sources of bacteria within the watershed and support the USEP element of the TMDL. The monitoring described for this program will occur only between July 1, 2007 and March 31, 2008.

(3) Implement monitoring to characterize agricultural sources of bacteria within the watershed and support the AgSEP element of the TMDL. The monitoring described for this program is currently planned to occur only between November 1, 2008 through March 2009; however, additional sampling may occur at these sites if approved by the TMDL Task Force

(4) Implement monitoring to evaluate the effectiveness of selected treatment BMPs (bioswale, extended detention basin, and proprietary devices) for reducing bacteria concentrations in urban runoff. The monitoring described for this program will occur between January 1, 2008 and June 15, 2008.

It is important to recognize that the Monitoring Plan elements associated with the USEP, AgSEP, and BMP Effectiveness Monitoring Programs should be considered distinct from the Monitoring Plan elements associated with the Watershed-Wide Monitoring Program. That is, once USEP, AgSEP, and BMP-related monitoring activities are complete, unless directed by the TMDL Task Force, the only elements of this QAPP that will continue are the elements associated with the Watershed-Wide Monitoring Plan.

6. Project/Task Descriptions

6.1 Work Statement and Produced Products

Four MSAR Bacterial Indicator TMDL-related monitoring tasks are addressed by this QAPP:

- Watershed-Wide Monitoring Program
- USEP Monitoring Program
- AgSEP Monitoring Program
- BMP Effectiveness Monitoring Program

Following is a description of the monitoring activities associated with each program.

Watershed-Wide Monitoring Program

Overview - The purpose of the Watershed-Wide Monitoring Program is to assess compliance with REC-1 use water quality objectives for fecal coliform and evaluate numeric targets established for *E. coli*. As noted above, the Basin Plan currently relies solely on fecal coliform as the bacterial indicator for protection of the REC-1 use. However, the RWQCB is currently evaluating the use of *E. coli* for the REC-1 use water quality objective in place of fecal coliform. In anticipation of the adoption of new *E. coli* water quality objectives, both fecal coliform and *E. coli* targets were incorporated into the TMDL and will be evaluated in water samples collected under this Watershed-Wide Monitoring Plan.

The TMDL compliance targets for fecal coliform and *E. coli* are equal to the water quality objectives set forth in the Basin Plan with a 10% margin of safety, and are presented below:

- *Fecal coliform:* 5-sample/30-day Logarithmic Mean less than 180 organisms/100 mL and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.

- *E. coli:* 5-sample/30-day Logarithmic Mean less than 113 organisms/100 mL and not more than 10% of the samples exceed 212 organisms/100 mL for any 30-day period.

In order to evaluate the geometric mean of 5 samples within a 30-day period, weekly sampling is necessary. A detailed schedule of sampling is documented in Section 10 of this QAPP for wet and dry season activities.

Sample Locations - As noted above, the purpose of the watershed-wide monitoring effort is to measure compliance with numeric targets established by the TMDL, which are derived from Basin Plan objectives established to protect the REC-1 beneficial use. Two key factors were used to select watershed sites:

The sites should be located on waterbodies that are impaired and thus incorporated into the TMDL. The pathogen 303(d) list impairments where compliance will be assessed are:

a. Santa Ana River Reach 3 – 26 miles

b. Chino Creek – 7.8 miles

c. Mill Creek (Prado area) – 1.6 miles

d. Cucamonga Creek – 9.6 miles

e. Prado Park Lake – 90 acres

The selected sites are located in reaches of the impaired waterbodies where REC-1 activity is most likely to occur, i.e., there is an increased risk from exposure to pathogens. One site was selected to assess background water quality conditions in the upstream watershed.

Using the impaired waters list, recreational use data developed by the Santa Ana River Watershed Stormwater Quality Standards Task Force, and recommendations from Regional Board staff, six sites were selected (Figure 2):

- Icehouse Canyon Creek
- Chino Creek at Central Avenue
- Santa Ana River at Pedley Avenue
- Santa Ana River at MWD Crossing
- Prado Park Lake at Lake Outlet
- Mill Creek at Chino-Corona Road

Table 2 provides a brief site description and GPS coordinate location for each of these six Watershed-Wide Monitoring Program sample locations.

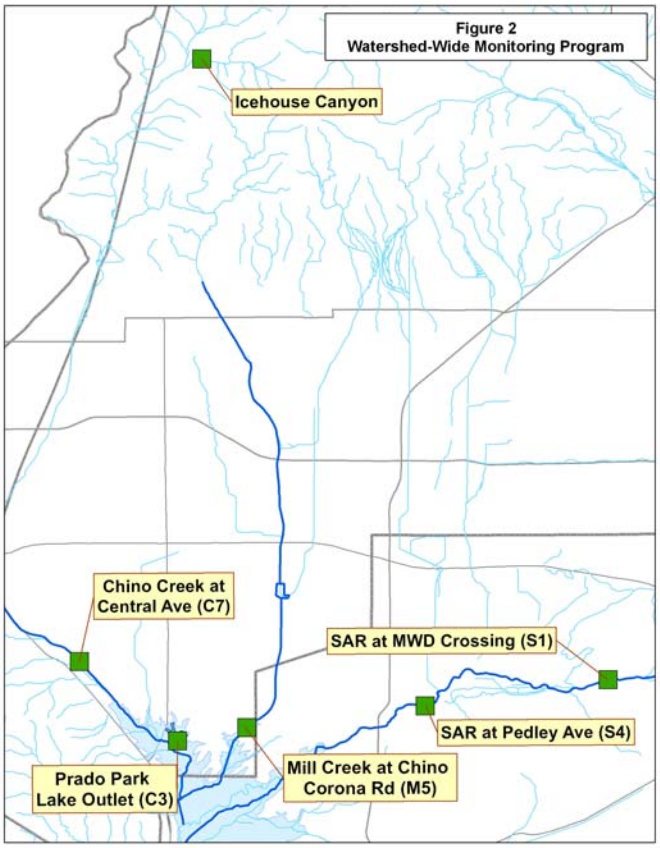


Figure 2
Watershed-Wide Monitoring Program
Icehouse Canyon
Chino Creek at Central Ave (C7)
SAR at MWD Crossing (S1)
SAR at Pedley Ave (S4)
Prado Park Lake Outlet (C3)
Mill Creek at Chino Corona Rd (M5)

Table 2. Watershed-Wide Monitoring Program Sample Locations			
Site No.	**Site Description**	**Longitude**	**Latitude**
WW-C1	Icehouse Canyon Creek	-117.6290	34.2604
WW-C3	Prado Park Lake at Lake Outlet	-117.6473	33.9400
WW-C7	Chino Creek at Central Avenue	-117.6884	33.9737
WW-M5	Mill Creek at Chino-Corona Rd	-117.6156	33.9460
WW-S1	Santa Ana River Reach 3 @ MWD Crossing	-117.4479	33.9681
WW-S3	Santa Ana River Reach 3 @ Pedley Ave	-117.5327	33.9552

Coordinates are shown as Geographic WGS 1984 World Datum

Urban Source Evaluation Monitoring Program

Overview - Elevated levels of indicator bacteria have been documented in most monitored waterbodies within the MSAR watershed; however, the sources of bacteria remain unknown. Thus, the primary goal of the USEP Monitoring Program is to guide efforts to control bacteria sources derived from discharges covered by MS4 NPDES permits. The water quality sampling and analyses conducted for this effort will be coordinated with the Watershed-Wide Monitoring Program described above, but only during the period that the Grant Project, which funds this effort, is active.

Sampling will occur for the USEP Monitoring Program from July 2007 to March 31, 2008. Once the USEP Monitoring Program sampling effort is completed, then no additional sample collection from the USEP sample locations will occur under this QAPP.

In order to evaluate the geometric mean of 5 samples within a 30-day period, weekly sampling is necessary for the watershed-wide monitoring program. For the USEP monitoring, weekly samples are also recommended in order to compare bacteria indicators from the tributary sites with the results from the impaired waterbodies (watershed-wide monitoring sites). A detailed schedule of sampling is documented in Section 10 of this QAPP for wet and dry season activities.

Sample Locations - Site selection was based on the following general collective and site-specific criteria:

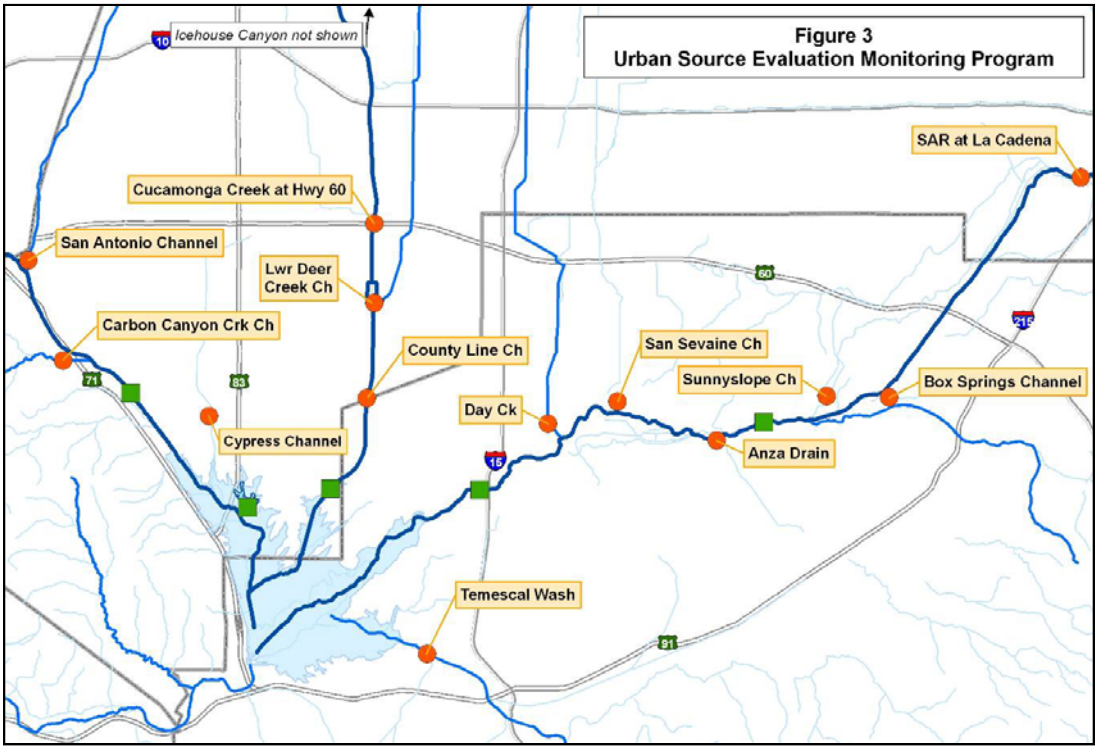
- Collectively, selected sites that discharge to an impaired water should, to the extent practical, characterize water quality tributary to the segment with the 303(d) listed impairment, which may include upstream segments of the same waterbody;

- Collectively, selected sites tributary to an impaired water should have the potential to contribute a high percentage of the flow (volumetrically) to the impaired water;

- A selected site should be close to the base of its watershed so that it characterizes the majority of flow reaching the impaired water from that tributary;

- Flow at a selected site should not include any permitted effluent discharge; and
- Flow at a selected site should generally occur under both dry and wet weather conditions.

Based on these general considerations, the following sites (with their association to an impaired waterbody) will be sampled under the USEP Monitoring Program (Figure 3):



- Santa Ana River, Reach 3
  - Santa Ana River at La Cadena
  - Box Springs Drain (Tequesquite Arroyo)
  - Sunnyslope Channel
  - Anza Drain
  - San Sevaine Channel
  - Day Creek
  - Temescal Wash
- Chino Creek, Reach 1

  - Cypress Channel
- Chino Creek, Reach 2
  - San Antonio Channel
  - Carbon Canyon Creek Channel
- Mill Creek (Prado Area)
  - Lower Deer Creek Channel
  - County Line Channel
- Cucamonga Creek, Reach 1
  - Cucamonga Creek at Hwy 60 (above RP1 discharge)

The specific sampling location on each of the above waterbodies was selected in coordination with staff from the SBCFCD and RCFWCD. Table 3 provides a brief site description and GPS coordinate location for each of the 13 USEP Monitoring Program locations.

Table 3. USEP Monitoring Program Sample Locations

Site Description		Longitude	Latitude
Santa Ana River, Reach 3			
US-SAR	Santa Ana River (SAR) at La Cadena Drive	-117.33065	34.04453
US-BXSP	Box Springs Channel at Tequesquite Avenue	-117.40272	33.97592
US-SNCH	Sunnyslope Channel near confluence with SAR	-117.42630	33.97620
US-ANZA	Anza Drain near confluence with Riverside effluent channel	-117.46795	33.96212
US-SSCH	San Sevaine Channel in Riverside near confluence with SAR	-117.50555	33.97430
US-DAY	Day Creek at Lucretia Avenue	-117.53192	33.96708
US-TEM	Temescal Wash at Lincoln Avenue	-117.57723	33.89412
Chino Creek, Reach 1			
US-CYP	Cypress Channel at Kimball Avenue	-117.66043	33.96888
Chino Creek, Reach 2			
US-SACH	San Antonio Channel at Riverside Drive	-117.73417	34.01703
US-CCCH	Carbon Canyon Creek Channel at Pipeline Avenue	-117.71585	33.98617
Mill Creek (Prado Area)			
US-CHRIS	Chris Basin Outflow (Lower Deer Creek)	-117.59802	34.00498
US-CLCH	County Line Channel near confluence with Cucamonga Creek	-117.60063	33.97492
Cucamonga Creek, Reach 1			
US-CUC	Cucamonga Creek at Highway 60 (above RP1)	-117.59973	34.02447

AgSEP Monitoring Program

Overview - Elevated levels of indicator bacteria have been documented in most monitored waterbodies within the MSAR watershed; however, the sources of bacteria remain unknown. Thus, the primary goal of the AgSEP Monitoring Program is to guide efforts to control bacteria sources derived from agricultural discharges which include stormwater runoff, wastewater release, and tailwater runoff from agricultural lands. Agricultural land uses in the MSAR watershed include concentrated animal feeding operations (CAFO) and irrigated and dry-land farming.

The water quality sampling and analyses conducted for this effort will be coordinated with the Watershed-Wide Monitoring Program as described above. Once the AgSEP Monitoring Program sampling effort is completed, then no additional sample collection from the AgSEP sample locations is currently planned. However, based upon findings from the monitoring carried out at AgSEP sites, the TMDL Task Force may determine that additional monitoring is necessary. If additional monitoring does occur at these sites, then this QAPP will be amended as deemed appropriate.

Sampling Locations - In the TMDL, Table 5-9a-a "Additional Watershed Storm Event Sampling Locations" listed four proposed wet weather sampling locations. Per the RWQCB, the primary reason for the inclusion of these wet weather sites in the TMDL was the need to assess water quality runoff in drains carrying runoff that primarily originates from agricultural areas (personal communication, William Rice, RWQCB).

These same four sites, as proposed in the TMDL, were considered for inclusion in the AgSEP Monitoring Program. After field review and based upon the recommendation of the RWQCB staff, the proposed sampling locations at Archibald Avenue at Cloverdale Avenue and Grove Channel at Pine Avenue were replaced due to increasing urban development within the vicinity of these sites since the development of the TMDL. In addition, a backup site has been selected for the Eucalyptus Avenue at Walker Avenue site because of uncertainty regarding the ability to sample this site under wet weather conditions (the sample team will make an on-site decision regarding where to sample during a storm event). The newly selected wet weather AgSEP Monitoring sites with designations are as follows (see Figure 3a and Table 3a):

- Grove Avenue Channel at Merrill Avenue (AG-G2)
- Eucalyptus Avenue at Walker Avenue (AG-G1)
    - Eucalyptus Avenue at Cleveland Avenue (AG-CL1) – [*backup site* to Walker Avenue site depending on wet weather flow conditions]
- Euclid Avenue Channel at Pine Avenue (AG-E2)
- Cypress Channel at Kimball Ave (AG-CYP1) – [dual site; same as USEP site, US-CYP]

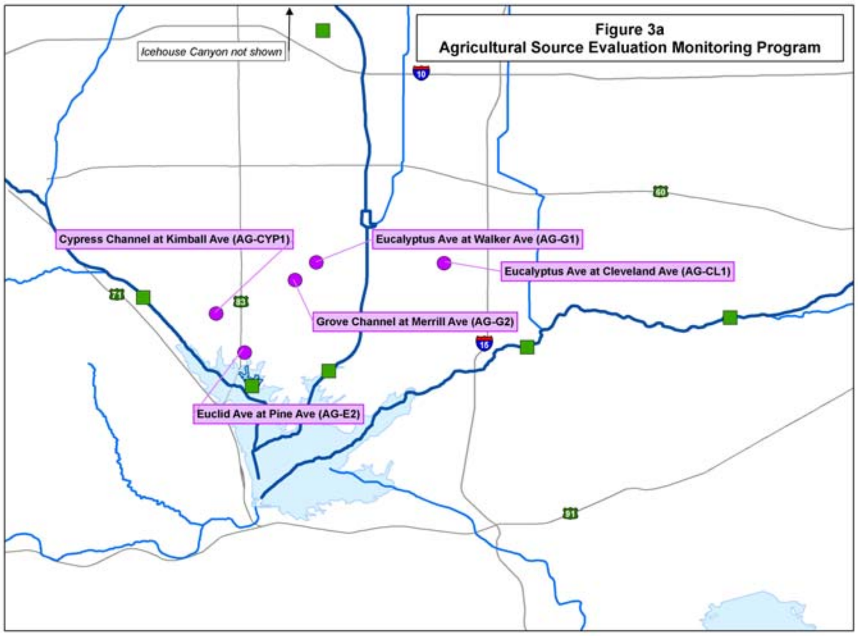


Table 3a
AgSEP Monitoring Program Site Locations

Site ID	Site Description	Latitude	Longitude
Prado Park Lake			
AG-G2	Grove Avenue Channel at Merrill Avenue	33 58.986	-117 37.685
AG-G1	Eucalyptus Avenue at Walker Avenue	33 59.425	-117 37.163
AG-E2	Euclid Avenue Channel at Pine Avenue	33 57.220	-117 38.926
Cucamonga Creek, Reach 1			
AG-CL1	Eucalyptus Avenue at Cleveland Avenue (*Backup to Walker Avenue, depending on flow conditions)* (CL1)	33 59.405	-117 34.031
Chino Creek, Reach 1			
AG-CYP1	Cypress Channel at Kimball Avenue (*dual site; same as USEP site US-CYP*)	33.96888	-117.66043

BMP Effectiveness Monitoring Program

Overview - Stormwater treatment BMPs (e.g., wet ponds, grass swales, stormwater wetlands, sand filters, dry detention, etc.) are widely used to reduce pollutant concentrations and loadings in urban runoff such as sediment, nutrients, oil and grease, etc. However, existing treatment BMP technologies in regards to treatment of bacteria in urban runoff are not widely studied in regards to their effectiveness in reducing bacteria in urban runoff discharged from storm drains. In Water Quality Management Plan (WQMP) Guidance for the Counties of Riverside and San Bernardino, treatment control BMP effectiveness for removal of bacteria is described as "unknown" for BMPs such as biofilters, detention basins, wet ponds, and wetlands, as well as manufactured proprietary devices. Thus, the primary goal of the BMP Effectiveness Monitoring Program is to identify BMPs within these above categories for inclusion in the monitoring program.

Sampling Locations - BMP monitoring locations were selected in collaboration with the cities of Canyon Lake, Corona, Fontana, Moreno Valley, Riverside, and the Flood Control Districts of the counties of Riverside and San Bernardino. Emphasis was placed on (1) selecting locations with structural BMPs for which bacteria removal effectiveness is generally unknown; and (2) identifying locations where proprietary BMPs could be tested. Ideal locations were those with relatively easy access for sampling dry weather and wet weather flows. In addition, a site was selected only if the site owner provided formal approval for installing or monitoring BMPs located within their right-of-way.

Using the above criteria, five sites were selected for this study. Three sites already have BMPs installed and operating. Proprietary BMPs were installed in existing drain inlets at two sites by the vendor Kristar in December 2007 and January 2008, respectively.

Comment [C1]: IEUA bioswale is dropped. Figure & other text changed accordingly.

Figure 3b depicts the location of the BMP sites. Table 3b summarizes selected BMP Effectiveness Monitoring Program site locations and characteristics for monitoring.

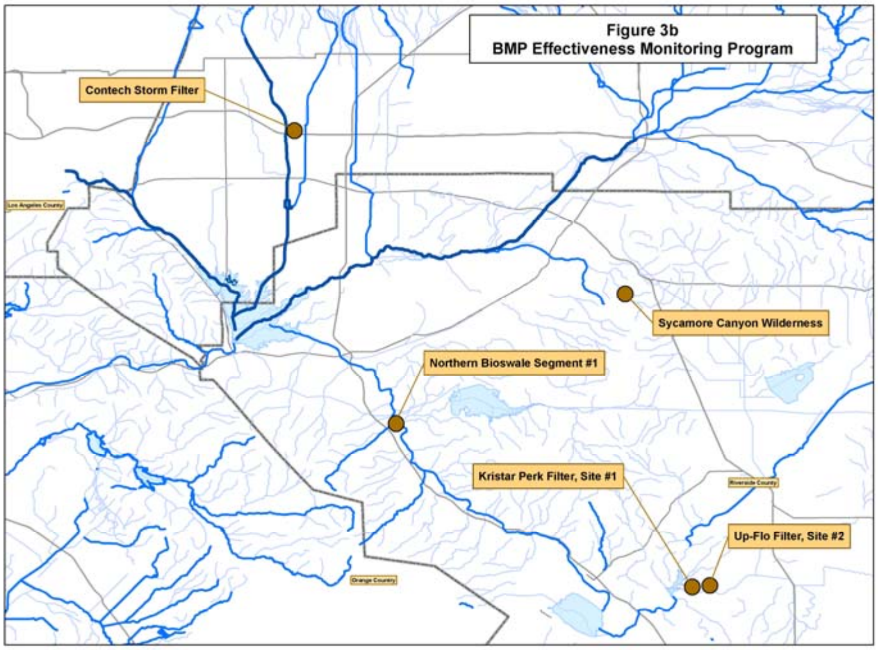


Table 3b BMP Effectiveness Monitoring Program Site Characteristics			
BMP Type	**Site Name**	**Wet Weather Sampling**	**Dry Weather Sampling**
Bioswale	Northern Bioswale Segment #1, City of Corona (BMP-BIO1)	X	X
Extended Detention Basin	Sycamore Canyon Wilderness Park, City of Riverside (BMP-EDB1)	X	X
Proprietary Device	Kristar Perk Filter, Site #1, City of Canyon Lake (BMP-PF1)	X	X
	Up-Flo Filter, Site #2, City of Canyon Lake (BMP-UF1)	X	X
	Contech StormFilter (BMP-SF1)	X	

6.2. Constituents to be Monitored and Measurement Techniques

The following water quality indicators will be measured at the Watershed-Wide, USEP, AgSEP, and BMP Effectiveness Monitoring sites, respectively.

Watershed-Wide Monitoring Program

Consistent with the TMDL, the following water quality indicators will be analyzed in water samples collected at each site on each sample date:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba Multiparameter probe
- *Water Quality Analysis*: Fecal coliform, *E. coli*, and total suspended solids (TSS) concentrations in grab samples will be analyzed by Orange County Public Health Water Quality Laboratory or another qualified laboratory.

USEP Monitoring Program

The following data will be collected when each USEP Monitoring Program site is sampled:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba Multiparameter probe
- *Water Quality Analysis*: Fecal coliform, *E. coli*, and TSS concentrations in grab samples will be analyzed by Orange County Public Health Water Quality Laboratory or another qualified laboratory.
- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a volumetric, cross-section velocity profile, or visual estimate method
- *Bacteroides Analysis*: A qualified laboratory will assay water grab samples for *Bacteroides* host-specific markers for humans, ruminant, and domestic canine to determine if they are present and to provide a semi-quantitative estimate of their relative abundance.

In addition to measuring flow at USEP sites, samplers will assess the hydrologic connectivity of the surface flow at each site to the downstream impaired waterbody (Santa Ana River Reach 3, Mill Creek, Cucamonga Creek, and Chino Creek Reach 1 and 2) to evaluate if the tributary drain is actually discharging any runoff to the downstream waterbody. If there is no connection of surface waters, then the flow rate is assumed to be zero. A full characterization of hydrologic connectivity will be conducted during at least one field sampling event in each 30-day sampling period in July and September 2007, and in February 2008. In addition, the hydrologic connectivity will be characterized to the extent possible during storm event sampling.

AgSEP Monitoring Program

The following data will be collected when each AgSEP Monitoring Program site is sampled:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba Multiparameter probe
- *Water Quality Analysis*: Fecal coliform, *E. coli*, and TSS concentrations in grab samples will be analyzed by Orange County Public Health Water Quality Laboratory or another qualified laboratory

- *Flow*: During each time a site is sampled, if conditions are safe, flow will be characterized using a visual estimate method.
- *Bacteroides Analysis*: A qualified laboratory will assay water grab samples for *Bacteroides* host-specific markers for humans, ruminant, and domestic canine to determine if they are present and to provide a semi-quantitative estimate of their relative abundance.

BMP Effectiveness Monitoring Program

Consistent with the TMDL, the following water quality indicators will be analyzed in water samples collected once at each site on each sample date:

- *Field Analysis*: Temperature, conductivity, pH, dissolved oxygen, and turbidity will be measured with a Horiba Multiparameter probe
- *Water Quality Analysis*: Fecal coliform, *E. coli*, and TSS concentrations in grab samples will be analyzed by Orange County Public Health Water Quality Laboratory or another qualified laboratory
- *Flow*: During each sample event, if conditions are safe, flow will be characterized using a visual estimate method.

6.3 Constraints to Monitoring

Under some circumstances, collection of water samples or field measurements may not be possible. For instance, if flow in the channel is high enough to make conditions dangerous for taking a flow measurement by developing a cross section velocity profile. Another potential constraint would occur if channel is dry, thus making it impossible to collect surface water samples. The field team will document any constraints in the field. The data manager will incorporate observational data from these site visits into the water quality database, indicating the reason why data was not collected at a given site.

6.4 Project Schedule

Table 4 shows the project schedule.

Table 4. Project Schedule			
Report	**Responsible Party**	**Deliverable Type**	**Deliverable Due Date**
Begin Watershed-Wide Monitoring Site Sampling	SBCFCD	Oral and email communication with CDM	Weekending 7/14/2007
Begin Urban Source Evaluation Monitoring Site Sampling	Brown & Caldwell	Oral and email communication with CDM	Weekending 7/14/07
Begin AgSEP Monitoring Site Sampling	CDM (tentatively)	Oral and email communication with CDM	November 1, 2008
Begin BMP Effectiveness Monitoring Site Sampling	CDM/Brown & Caldwell	Oral and email communication with CDM	January 1, 2008
Interim Progress Report	CDM	Report	Quarterly
Draft Data Analysis Report	CDM	Draft Document	July 31, 2008
Review of Draft Data Analysis Report	MSAR Pathogen TMDL Workgroup	Comments	August 15, 2008
Final Data Analysis Report	CDM	Final Document	August 31, 2008
Draft AgSEP Monitoring Program Data Analysis Report	CDM (*tentative*)	Draft Document	Dependent on when sampling occurs
Review of Draft AgSEP Monitoring Program Data Analysis Report	MSAR Pathogen TMDL Workgroup	Comments	1 month after submittal of draft AgSEP report for review
Final AgSEP Monitoring Program Data Analysis Report	CDM (*tentative*)	Final Document	1 month after comments received on draft AgSEP report
Draft BMP Effectiveness Study Report	CDM	Draft Document	July 31, 2008
Review of Draft BMP Effectiveness Study Report	MSAR Pathogen TMDL Workgroup	Comments	August 15, 2008
Final BMP Effectiveness Study Report	CDM	Final Document	August 31, 2008

7. Quality Objectives and Criteria for Measurement Data

Data Quality Objectives for this project include the following:

Measurement or Analyses Type	Applicable Data Quality Objective
▪ Field Measurements	▪ Accuracy, Precision, Completeness
▪ Bacterial Analyses	▪ Precision, Presence/Absence, Completeness
▪ TSS Analyses	▪ Accuracy, Precision, Recovery, Completeness

Accuracy will be determined by measuring one or more selected from performance testing samples or standard solutions from sources other than those used for calibration. Accuracy criteria for bacterial testing will be based on presence/absence testing rather than numerical limits owing to the difficulty in preparing solutions of known bacterial concentration.

Precision measurements will be determined on both field and laboratory replicates. The number of replicates for field measurements will be three, the number for TSS will be two, and for bacterial testing, the number of replicates will be five.

Recovery measurements will be determined by laboratory spiking of a replicate sample with a known concentration of the analyte. The target level of addition is at least twice the original sample concentration and is applicable only to TSS analyses.

Completeness is the number of analyses generating useable data for each analysis divided by the number of samples collected for that analysis.

Method sensitivity is dealt with by the inclusion of the required SWAMP Target Reporting Limits, where such values exist. Target Reporting Limits exist for fecal coliform, *E. coli*, and TSS.

No Target Reporting Limits were set for the field analyses.

Table 5. Data Quality Objectives for Field Measurements						
Group	**Parameter**	**Accuracy**	**Precision**	**Recovery**	**Target Reporting Limit**	**Completeness**
Field Measurements	Conductivity	+/-5%	No SWAMP requirement; will use ± 5%	NA	NA	No SWAMP requirement; will use 90%
Field Measurements	Dissolved Oxygen	±0.5 mg/L	No SWAMP requirement; will use ± 0.5 or 10%	NA	NA	No SWAMP requirement; will use 90%
Field Measurements	pH	+/- 0.5 units	No SWAMP requirement; will use ± 0.5 or 5%	NA	NA	No SWAMP requirement; will use 90%
Field Measurements	Temperature	+/- 0.5ºC	No SWAMP requirement; will use ± 0.5 or 5%	NA	NA	No SWAMP requirement; will use 90%
Field Measurements	Turbidity	No SWAMP requirement -suggest +/- 10% or 0.1, whichever is greater	No SWAMP requirement; will use ± 10% or 0.1, whichever is greater	NA	NA	No SWAMP requirement; will use 90%
Field Measurments	Flow (visual estimate)	No SWAMP requirement –suggest +/- 25% or 0.25, whichever is greater	No SWAMP requirement; Will use ± 25% 0r 0.25, whichever is greater	NA	NA	No SWAMP requirement; will use 90%
Field Measurements	Flow (via flow instruments)	No SWAMP requirement -suggest +/- 10% or 0.1, whichever is greater	No SWAMP requirement; will use ± 10% or 0.1, whichever is greater	NA	NA	No SWAMP requirement; will use 90%

Table 6. Data Quality Objectives for Laboratory Measurements						
Group	**Parameter**	**Accuracy**	**Precision**	**Recovery**	**Target Reporting Limits**	**Completeness**
Bacterial Analyses	Fecal Coliform & *E. coli*	Positive results for target organisms. Negative results for non-target organisms	R_{log} within 3.27*mean R_{log} (reference is section 9020B 18th, 19th, or 20th editions of *Standard Methods*)	NA	10 CFU/100 mL	90%
Conventional Constituents in Water	TSS	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 80% to 120% of true value	Blind field duplicate and Laboratory duplicate, or MS/MSD 25% RPD	Matrix spike 80% - 120% or control limits at ± 3 standard deviations based on actual lab data, whichever is more stringent	1.0 mg/L	No SWAMP requirement; will use 90%

8. Special Training Needs/Certification

Training for all persons involved in the field sampling activities for the Watershed-Wide and USEP Monitoring Programs will be conducted prior to any field sampling and is scheduled for June 4, 2007. Training will take place prior to the AgSEP and BMP Effectiveness Monitoring to ensure that sampling field members are familiar with the protocols and sampling sites. CDM will be conducting the training.

All individuals that participate in sampling activities are required to have attended (at a minimum) the "4-hour Basic Site Safety Training" provided by an appropriately qualified trainer and/or contractor of the Health and Safety branch of the State, and/or equivalent university training. The training will cover the general health and safety issues associated with fieldwork, including sampling. The monitoring manager will provide specific training, pertinent to the details of a particular sampling program. This training will include, but not be limited to, proper use of field equipment, health and safety protocols, sample handling protocols, and chain of custody protocols.

Field staff training is documented and filed at the Monitoring Contractor's office. Documentation consists of a record of the training date, instructor, whether initial or refresher, and whether the course was completed satisfactorily.

All commercial laboratories contracting with CDM or SAWPA will provide appropriate training to its staff as part of its Standard Operating Procedure (SOP). All contracting laboratories will maintain their own records of its training that comply with OSHA requirements. Those records can be obtained, if needed, from each contract laboratory through their Quality Assurance Officer.

9. Documents and Records

The following documentation and records procedures will be followed:

- The CDM Project Manager or QA Officer will maintain a record of all field analyses and samples collected and will be responsible to oversee the sampling collection training activities. All samples delivered to contract laboratories for analysis will include a Chain of Custody form (Attachment 2).
- All contracted laboratories will generate records for sample receipt and storage, analyses, and reporting.
- A MSAR Bacterial Indicator TMDL project database (as part of the Santa Ana Watershed Data Management System [SAWDMS]) will be maintained by SAWPA under the direction of the SAWPA Database Manager.
- All laboratory and field data submitted to SAWPA for inclusion in the database will follow the guidelines and formats established by California Surface Water Ambient Monitoring Program (SWAMP) (http://www.waterboards.ca.gov/swamp/qapp.html).
- All chemical monitoring records generated by these monitoring programs will be stored at SAWPA. Each of the contract laboratory records pertinent to the program will be maintained at the each of the contract laboratory main offices. Copies of all records held by the contract laboratories will be provided to SAWPA and stored in the SAWPA archives.
- Copies of this QAPP will be distributed to all parties involved with the project. Copies will be sent to each Contract Laboratory QA Officer for distribution to appropriate laboratory staff. Any future amended QAPPs will be held and distributed in the same fashion. All originals of this QAPP and its amendments will be held at SAWPA. Copies of versions, other than the most current, will be discarded so as not to create confusion.
- Each Project Administrator will provide interim and final reports to the Regional Board, State Board, or other applicable parties consistent with the requirements of their program.

Table 7. Document and Record Retention, Archival, and Disposition Information				
Identify Type Needed		**Retention**	**Archival**	**Disposition**
Sample Collection Records	Field Logs	Brown & Caldwell, SBCFCD, and CDM (copy)	CDM will retain a copy and review after each event	SAWPA will retain a copy for final disposition.
Analytical Records	Lab results	OC Public Health Water Quality Lab, OCWD Lab, UC Davis Lab, CDM (Copy)	CDM will retain a copy and review after each event	SAWPA will retain a copy for final disposition.
	Chain-of-Custody Forms	Brown & Caldwell, SBCFCD, CDM (copy)	CDM will retain a copy and review after each event	SAWPA will retain a copy for final disposition.
Assessment Reports	QA/QC Updates	OC Public Health Water Quality Lab, OCWD Lab, UC Davis Lab	CDM will review and retain copy	SAWPA will retain a copy for final disposition.
	QA/QC Final Report	OC Public Health Water Quality Lab, OCWD Lab, UC Davis Lab	CDM will review and retain copy	SAWPA will retain a copy for final disposition.
	Field Sampling Review	Contractor QA Officer	SAWPA and CDM will retain a copy	SAWPA will retain a copy for final disposition.
	Internal Technical Audit of Database Management	SAWPA Database Manager	SAWPA and CDM will retain a copy	SAWPA will retain a copy for final disposition.
Reports	Quarterly Progress Reports	CDM	Regional Board & SAWPA will review and retain	SAWPA will retain a copy for final disposition.
	Draft Data Analysis Report	CDM	Regional Board & SAWPA will review and retain	SAWPA will retain a copy for final disposition.
	Final Data Analysis Report	CDM	Regional Board & SAWPA will review and retain	Regional Board & SAWPA will retain a copy for final disposition.

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Group B: Data Generation and Acquisition

10. Sampling Process Design

Watershed-Wide Monitoring Program

Sample Frequency and Schedule

Table 8 provides a detailed schedule for monitoring activities at Watershed-wide monitoring sites. This sampling effort is generally described as follows:

- *Dry Season (April 1 – October 31)*: Four 30-day intervals (three 30-day periods in summer and fall 2007 and a 30-day period in May and June 2008) will be sampled with five samples collected approximately weekly during each 30-day period. Where possible, geometric means will be calculated as a rolling geometric mean.

- *Wet Season (November 1 – March 31)*: The goal of the wet season sampling effort is to obtain samples from both dry and wet weather conditions during the wet season. To best accomplish this goal, a sample schedule with some built-in flexibility has been established:

  - *Fixed Sample Dates* – Eleven samples will be collected over an eleven week period from mid-December to mid-February. The collection of samples over a continuous 11-week period will provide the opportunity to calculate a rolling geometric mean. This weekly sampling will occur on a regular schedule regardless of whether flows are at base levels or elevated because of wet weather.

  - *Flexible (Storm Event) Sample Dates* – The goal of having flexible sample dates is to obtain data from the falling limb of the hydrograph following at least one storm event during the wet season. To the extent practical, taking into account the timing of the storm event, when a storm event occurs, four samples will be collected from each site as follows: Sample 1 will be collected on the day of the storm event and samples 2, 3 and 4 will be collected 48, 72, and 96 hours following the storm event. If no wet weather events have occurred by late February, then samples will be added to the end of the fixed sample dates—weeks ending March 1 through March 22.

Urban Source Evaluation Monitoring Plan

Sample Frequency and Schedule

Table 8 also provides a detailed schedule for monitoring activities at USEP Monitoring Program sites. This sampling effort is generally described as follows:

- *Dry Season (April 1 – October 31)*: Two 30-day intervals will be sampled with five samples collected approximately weekly during each 30-day period. Sampling will occur within the timeframe established for the Watershed-Wide Monitoring Program sites (see above) – generally during the months of July/August and September/October.

- *Wet Season (November 1 – March 31)*: The goal of the wet season sampling effort is to obtain samples from both dry and wet weather conditions during the wet season. To best accomplish this goal, a sampling schedule with some built-in flexibility has been established. Accordingly, the sample effort is divided into a combination of fixed and flexible sample dates:

- *Fixed Sample Dates* – Six samples will be collected approximately weekly from mid-January through mid-February. Sampling will occur regardless of whether flows are at base levels or are elevated because of wet weather.

- *Flexible (Storm Event) Sample Dates* – The goal of having flexible sample dates is to obtain data from the falling limb of the hydrograph following at least one storm event during the wet season. To the extent practical, taking into account the timing of the storm event, when a storm event occurs, four samples will be collected from each site as follows: Sample 1 will be collected on the day of the storm event and samples 2, 3 and 4 will be collected 48, 72, and 96 hours following the storm event. If no wet weather events have occurred by mid-February, then samples will be added to the end of the fixed sample dates – Weeks ending March 1 through March 22.

AgSEP Monitoring Plan

Sample Frequency and Schedule

Table 8a provides a detailed schedule for monitoring activities at AgSEP Monitoring Program sites. This sampling effort is generally described as follows:

- *Wet Season (November 1 – March 31)*: The goal of the wet season sampling effort is to obtain samples from wet weather conditions during the wet season. To best accomplish this goal, a sampling schedule with some built-in flexibility has been established. Accordingly, the sample effort is comprised of flexible sample dates:

  Flexible (Storm Event) Sample Dates – The goal of having flexible sample dates is to obtain data from two storm events during the wet season. If two storm events do not occur in one wet season, then the second storm event will be sampled in the next wet season. To the extent practical, taking into account the timing of the storm event, when a storm event is sampled, two samples will be collected from each site as follows:

  - Sample 1 will be collected during the storm event upon arrival at the sample location; and

  - Sample 2 will be collected 30 minutes after the collection of the first sample.

BMP Effectiveness Monitoring Plan

Sample Frequency and Schedule

Table 8b provides a detailed schedule for monitoring activities at BMP Effectiveness Monitoring Program sites. This sampling effort is generally described as follows:

Wet Weather [2]: Two wet weather events will be sampled between January 1 and March 31, 2008.To the extent practical (taking into account the storm event/runoff conditions, timing of the arrival of sample teams, and safety concerns), when a storm event is sampled, three sets of influent and effluent grab samples will be collected from each BMP site, as described below.

Dry Weather: Dry weather flow samples will be collected during three sample events between April 1 and June 15, as described below. Dry weather sampling will occur only at the following BMP sites, where dry weather flows have been observed:

- Northern Bioswale Segment #1, Corona
- Extended Detention Basin, Sycamore Canyon Wilderness Park
- Kristar Perk Filter, Canyon Lake
- Up-Flo Filter, Canyon Lake

Influent and Effluent Sampling

A total of 30 influent and 30 effluent samples will be collected from the following sites: Northern Bioswale Segment #1, Corona; Extended Detention Basin, Sycamore Canyon Wilderness Park; Kristar Perk Filter, Canyon Lake; and Up-Flo Filter, Canyon Lake. A total of 20 influent and 20 effluent samples will be collected from the StormFilter site.

During both wet and dry weather sampling events, samples will be collected from the influent and effluent associated with each BMP site, as described in the following sections:

Influent Sampling: Six grab samples will be collected at the influent sampling point for each BMP site, with exception of the Contech StormFilter (Ontario) site. For the StormFilter site, ten grab samples will be collected at the influent sampling point. None of the samples will be composited.

After the first sample is collected, each of the successive influent samples will be collected after <u>10 minutes</u> of time has elapsed. For the Contech StormFilter site, samples will be collected after <u>6 minutes</u> of elapsed time.

Effluent Sampling: Six grab samples will be collected at the effluent sampling point for each BMP site, with exception of the Contech StormFilter (Ontario) site. For the StormFilter site, ten

[2] If no wet weather events occur prior to March 31, TMDL Task Force may consider approval for an extended wet weather period to increase opportunity for sampling wet weather events. Alternatively, the TMDL Task Force may decide to replace planned wet weather weather sampling events with dry weather events (e.g., change the planned 3 dry events to 5 dry events). If changed to all dry weather events, then all dry weather sampling protocols would apply.

grab samples will be collected at the effluent sampling point. None of the samples will be composited.

After the first sample is collected, each of the successive effluent samples will be collected after 10 minutes of time has elapsed. For the Contech StormFilter site, samples will be collected after 6 minutes of elapsed time.

With the exception of the Extended Detention Basin site, the timing of the collection of the first and subsequent effluent samples is generally based on a transit or "lag" time that is unique to the site. That is, influent water will have an expected lag time during which the BMP "treats" the water. By considering the lag time, then the effluent sample result can be paired with the influent sample result to provide paired sample results showing water quality characteristics before and after treatment. The estimation of lag time is based on the hydraulic characteristics of the BMP as either measured in the field or as provided by the proprietor of the treatment device. Information provided below describes the basis for the lag time estimated for each site and the expected timing of the collection of each effluent sample.

Although, to the extent practical, effluent samples will be linked to influent samples, practical considerations such as the ability to meet holding times and safety will have to be taken into account when attempting to sample effluent according to estimated lag times. For example, if the lag time is too long such that the 6-hour holding time for indicator bacteria would be compromised, then the timing of the collection of the effluent sample will be adjusted according to runoff conditions. The decision regarding when to collect effluent samples at a particular site will be made in the field. The basis for the decision will be documented on the data collection forms.

Northern Bioswale No.1, Corona - Lag time is based on the depth of water at the influent sampling point (Table 8c). The depth measurement to lag (travel) time relationship was established by applying Mannings Equation and evaluating flows of differing depths. A depth measurement will be performed when collecting the first influent grab sample. Based on the depth, Table 8c provides the corresponding lag time before the first effluent sample is to be collected. During dry weather, flows are expected to be relatively uniform and only one depth measurement to determine the lag time is necessary. However, during wet weather, a depth measurement should be made during the collection of each influent sample to make sure that the lag time has not changed.

Extended Detention Basin in Sycamore Canyon Wilderness Park - When collecting the effluent sample at the Extended Detention Basin in Sycamore Canyon Wilderness Park, a lag time will not be incorporated into the sampling protocol since this BMP is a volume-based BMP with very long lag times (in hours). Samples will be collected at the effluent sample location after influent samples have been collected.

Kristar Perk Filter and Up-Flo Filter, Canyon Lake - To determine the lag time, an estimated flow measurement will be made at the street gutter prior to the flow entering the drain inlet. Figure 3c provides the lag time for collection of the effluent samples based the flow measurements for the Kristar Perk Filter and Up-Flo Filter. For dry weather only one flow measurement is necessary. However, for wet weather flow measurements will be made when each influent sample is collected to verify that flow has not changed markedly.

Contech StormFilter (Ontario) - When collecting effluent samples for the Contech StormFilter, runoff flow conditions at the site determine the timing of collecting effluent samples. When at least 140 cubic feet (CF) of stormwater fills the filter cartridge chamber, the filter cartridges will continually siphon water and discharge treated effluent. Under this condition, a lag time of 14 minutes will be observed prior to collection of the effluent sample.

Depending on rain intensity and flow conditions, if less than 140 CF of stormwater has filled the filter cartridge chamber, effluent will intermittently discharge from the outlet chamber. Under this condition, samplers will collect effluent as soon as possible in order to collect enough required sample volume.

Table 8. Watershed-Wide and USEP Monitoring Program Sampling Schedule

Table 3. Sample Frequency/Schedule for Proposed Sample Sites		2007 Dry Season (Week Ending)																				
		15-Week Sampling Effort - Rolling Geometric Mean																				
		14-Jul			21-Jul			28-Jul			4-Aug			11-Aug			18-Aug			25-Aug		
	Site Location	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]
Watershed-Wide Monitoring	Icehouse Canyon Creek (WW-C1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Prado Park Lake at Lake Outlet (WW-C3)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Chino Creek at Central Avenue (WW-C7)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Mil Creek at Chino-Corona Road (WW-M5)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at MWD Crossing (WW-S1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
Urban Source Evaluation Monitoring	Santa Ana Reach (SAR) at La Cadena Drive (US-SAR)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Box Springs Channel at Tesquequite Avenue (US-BXSP)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Sunnyslope Channel near confluence with SAR (US-SNCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Anza Drain near confluence with Riverside Effluent Channel (US-ANZA)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	San Sevaine Channel in Riverside near confluence with SAR (US-SSCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Day Creek at Lucretia Avenue (US-DAY)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Temescal Wash at Lincoln Avenue (US-TEM)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Cypress Channel at Kimball Avenue (US-CYP)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	San Antonio Channel at Riverside Drive (US-SACH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Carbon Canyon Creek Channel at Pipeline Avenue (US-CCCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Chris Basin Outflow - Lower Deer Creek (US-CHRIS)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	County Line Channel near confluence with Cucamonga Creek (US-CLCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Cucamonga Creek at Hwy 60 - Above RP1 (US-CUC)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	OC	N	B&C	OC	N	N	N	N	N	N	N
	Sample Number (SBC)	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**
	Sample Number (B&C)	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - OCWD)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - UC)	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

		2007 Dry Season (Week Ending)																				
		15-Week Sampling Effort - Rolling Geometric Mean																				
		1-Sep			8-Sep			15-Sep			22-Sep			29-Sep			6-Oct			13-Oct		
	Site Location	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]
Watershed-Wide Monitoring	Icehouse Canyon Creek (WW-C1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Prado Park Lake at Lake Outlet (WW-C3)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Chino Creek at Central Avenue (WW-C7)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Mil Creek at Chino-Corona Road (WW-M5)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at MWD Crossing (WW-S1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
Urban Source Evaluation Monitoring	Santa Ana Reach (SAR) at La Cadena Drive (US-SAR)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Box Springs Channel at Tesquequite Avenue (US-BXSP)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Sunnyslope Channel near confluence with SAR (US-SNCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Anza Drain near confluence with Riverside Effluent Channel (US-ANZA)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	San Sevaine Channel in Riverside near confluence with SAR (US-SSCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Day Creek at Lucretia Avenue (US-DAY)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Temescal Wash at Lincoln Avenue (US-TEM)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Cypress Channel at Kimball Avenue (US-CYP)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	San Antonio Channel at Riverside Drive (US-SACH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Carbon Canyon Creek Channel at Pipeline Avenue (US-CCCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Chris Basin Outflow - Lower Deer Creek (US-CHRIS)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	County Line Channel near confluence with Cucamonga Creek (US-CLCH)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Cucamonga Creek at Hwy 60 - Above RP1 (US-CUC)	B&C	N	UC	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	N	N	N	N	N	N
	Sample Number (SBC)	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**
	Sample Number (B&C)	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - OCWD)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - UC)	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

		2007 Dry Season (Week Ending)			2008 Dry Season (Week Ending)														
		15-Week Sampling Effort - Rolling Geometric Mean			5-Week Sampling Effort (Geometric Mean)														
		20-Oct			17-May			24-May			31-May			7-Jun			14-Jun		
	Site Location	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]
Watershed-Wide Monitoring	Icehouse Canyon Creek (WW-C1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Prado Park Lake at Lake Outlet (WW-C3)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Chino Creek at Central Avenue (WW-C7)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Mil Creek at Chino-Corona Road (WW-M5)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at MWD Crossing (WW-S1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
Urban Source Evaluation Monitoring	Santa Ana Reach (SAR) at La Cadena Drive (US-SAR)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Box Springs Channel at Tesquequite Avenue (US-BXSP)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Sunnyslope Channel near confluence with SAR (US-SNCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Anza Drain near confluence with Riverside Effluent Channel (US-ANZA)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	San Sevaine Channel in Riverside near confluence with SAR (US-SSCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Day Creek at Lucretia Avenue (US-DAY)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Temescal Wash at Lincoln Avenue (US-TEM)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Cypress Channel at Kimball Avenue (US-CYP)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	San Antonio Channel at Riverside Drive (US-SACH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Carbon Canyon Creek Channel at Pipeline Avenue (US-CCCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Chris Basin Outflow - Lower Deer Creek (US-CHRIS)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	County Line Channel near confluence with Cucamonga Creek (US-CLCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Cucamonga Creek at Hwy 60 - Above RP1 (US-CUC)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	Sample Number (SBC)	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**
	Sample Number (B&C)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - OCWD)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Sample Number (Bacteroides - UC)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

		Wet Season (Week Ending or Sample No)																				
		11 Week Sampling Effort (Rolling Geometric Mean)																				
		15-Dec			22-Dec			29-Dec			5-Jan			12-Jan			19-Jan			26-Jan		
	Site Location	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]
Watershed-Wide Monitoring	Icehouse Canyon Creek (WW-C1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Prado Park Lake at Lake Outlet (WW-C3)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Chino Creek at Central Avenue (WW-C7)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Mil Creek at Chino-Corona Road (WW-M5)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at MWD Crossing (WW-S1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
Urban Source Evaluation Monitoring	Santa Ana Reach (SAR) at La Cadena Drive (US-SAR)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Box Springs Channel at Tesquequite Avenue (US-BXSP)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Sunnyslope Channel near confluence with SAR (US-SNCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Anza Drain near confluence with Riverside Effluent Channel (US-ANZA)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	San Sevaine Channel in Riverside near confluence with SAR (US-SSCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Day Creek at Lucretia Avenue (US-DAY)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Temescal Wash at Lincoln Avenue (US-TEM)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Cypress Channel at Kimball Avenue (US-CYP)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	San Antonio Channel at Riverside Drive (US-SACH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Carbon Canyon Creek Channel at Pipeline Avenue (US-CCCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Chris Basin Outflow - Lower Deer Creek (US-CHRIS)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	County Line Channel near confluence with Cucamonga Creek (US-CLCH)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Cucamonga Creek at Hwy 60 - Above RP1 (US-CUC)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B&C	N	UC	B&C	OC	N
	Sample Number (SBC)	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**
	Sample Number (B&C)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**
	Sample Number (Bacteroides - OCWD)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**
	Sample Number (Bacteroides - UC)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**

		Wet Season (Week Ending or Sample No)																							
		11 Week Sampling Effort (Rolling Geometric Mean)												Storm Event Sampling[4]											
		2-Feb			9-Feb			16-Feb			23-Feb			1			2			3			4		
	Site Location	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]	W[1]	Bt (OCWD)[2]	Bt (UC)[3]
Watershed-Wide Monitoring	Icehouse Canyon Creek (WW-C1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Prado Park Lake at Lake Outlet (WW-C3)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Chino Creek at Central Avenue (WW-C7)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Mil Creek at Chino-Corona Road (WW-M5)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at Pedley Avenue (WW-S4)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
	Santa Ana River Reach 3 at MWD Crossing (WW-S1)	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N	SBC	N	N
Urban Source Evaluation Monitoring	Santa Ana Reach (SAR) at La Cadena Drive (US-SAR)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Box Springs Channel at Tesquequite Avenue (US-BXSP)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Sunnyslope Channel near confluence with SAR (US-SNCH)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Anza Drain near confluence with Riverside Effluent Channel (US-ANZA)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	San Sevaine Channel in Riverside near confluence with SAR (US-SSCH)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Day Creek at Lucretia Avenue (US-DAY)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Temescal Wash at Lincoln Avenue (US-TEM)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Cypress Channel at Kimball Avenue (US-CYP)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	San Antonio Channel at Riverside Drive (US-SACH)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Carbon Canyon Creek Channel at Pipeline Avenue (US-CCCH)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Chris Basin Outflow - Lower Deer Creek (US-CHRIS)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	County Line Channel near confluence with Cucamonga Creek (US-CLCH)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Cucamonga Creek at Hwy 60 - Above RP1 (US-CUC)	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N	B&C	N	UC	B&C	OC	N
	Sample Number (SBC)	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**6**	**0**	**0**
	Sample Number (B&C)	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**	**13**	**0**	**0**
	Sample Number (Bacteroides - OCWD)	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**
	Sample Number (Bacteroides - UC)	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**0**	**0**

SBC = San Bernardino County Flood Control District; B&C = Brown & Caldwell; OCWD = Orange County Water District; UC = University California Davis

1 Collection of water quality samples for laboratory analysis (fecal coliform, E. coli and TSS), field parameter data (temperature, dissolved oxygen, turbidity, pH, and conductivity), or for pathogen scoping study. Samples collected by either San Bernardino County Flood Control District (SBC) or Brown & Caldwell (B&C) staff. "N" means that no sample is collected during that week.

2 Water samples collected for analysis of Bacteroides (Bt) by Orange County Water District (OCWD)

3 Water samples collected for analysis of Bacteroides (Bt) by University of California Davis (UC)

4 Sampling conducted during storm event (Day 0) and for days 2, 3 and 4 (representing 48, 72 and 96 hrs) after storm event. If no such event occurs, then sampling will occur weekly beginning week ending March 1

Table 8a. AgSEP Monitoring Program Sampling Schedule

AgSEP Sample Frequency/Schedule for Proposed Sample Sites		Wet Season							
		Storm Event 1 Sampling [3]				Storm Event 2 Sampling [3]			
Site Location		Sample 1		Sample 1 + 30 min		Sample 1		Sample 1 + 30 min	
		W[1]	Bt (UC) [2]	W[1]	Bt (UC) [2]	W[1]	Bt (UC) [2]	W[1]	Bt (UC) [2]
Agricultural Source Evaluation (AGSEP) Monitoring	Cypress Channel at Kimball Avenue (AG-CYP1)	CDM	UC	CDM	UC	CDM	UC	CDM	UC
	Euclid Avenue Channel at Pine Avenue (AG-E2)	CDM	UC	CDM	UC	CDM	UC	CDM	UC
	Eucalyptus Avenue at Walker Avenue (AG-G1)	CDM	UC	CDM	UC	CDM	UC	CDM	UC
	Grove Avenue Channel at Merrill Avenue (AG-G2)	CDM	UC	CDM	UC	CDM	UC	CDM	UC
	Sample Number (CDM)	**4**	**0**	**4**	**0**	**4**	**0**	**4**	**0**
	Sample Number (Bacteroides - UC)	**0**	**4**	**0**	**4**	**0**	**4**	**0**	**4**

CDM = Camp Dresser & McKee; UC = University California Davis

1 Collection of water quality samples for laboratory analysis (fecal coliform, E. coli and TSS), field parameter data (temperature, dissolved oxygen, turbidity, pH, and conductivity), or for pathogen scoping study. Samples collected by CDM *(Tentatively)* or Consultant Team (TBD)

2 Water samples collected for analysis of Bacteroides (Bt) by University of California Davis (UC)

3 Multiple Sampling conducted during storm event with second sample collected 30 minutes after initial sample.

Table 8b. BMP Effectiveness Monitoring Program Sampling Schedule

BMP Effectiveness Monitoring Sample Frequency/Schedule for Proposed Sample Sites		Sample Period (January 1 to June 15, 2008)									
		Storm Event 1 Sampling									
Site Location		Influent 1 + Effluent 1	Influent 2 + Effluent 2	Influent 3 + Effluent 3	Influent 4 + Effluent 4	Influent 5 + Effluent 5	Influent 6 + Effluent 6	Influent 7 + Effluent 7	Influent 8 + Effluent 8	Influent 9 + Effluent 9	Influent 10 + Effluent 10
		W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1
BMP Effectiveness Monitoring	Northern Bioswale Segment #1, City of Corona (BMP-BIO1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Extended Detention Basin, Sycamore Canyon Wilderness Park, City of Riverside (BMP-EDB1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Kristar Perk Filter, Site #1, City of Canyon Lake (BMP-PF1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Up-Flo Filter, Site #2, City of Canyon Lake (BMP-UF1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Contech StormFilter, City of Ontario (BMP-SF1) [3]	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C
Sample Number (CDM)		0	0	0	0	0	0	0	0	0	0
Sample Number (B&C)		10	10	10	10	10	10	2	2	2	2

BMP Effectiveness Monitoring Sample Frequency/Schedule for Proposed Sample Sites		Sample Period (January 1 to June 15, 2008)									
		Storm Event 2 Sampling									
Site Location		Influent 1 + Effluent 1	Influent 2 + Effluent 2	Influent 3 + Effluent 3	Influent 4 + Effluent 4	Influent 5 + Effluent 5	Influent 6 + Effluent 6	Influent 7 + Effluent 7	Influent 8 + Effluent 8	Influent 9 + Effluent 9	Influent 10 + Effluent 10
		W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1
BMP Effectiveness Monitoring	Northern Bioswale Segment #1, City of Corona (BMP-BIO1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Extended Detention Basin, Sycamore Canyon Wilderness Park, City of Riverside (BMP-EDB1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Kristar Perk Filter, Site #1, City of Canyon Lake (BMP-PF1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Up-Flo Filter, Site #2, City of Canyon Lake (BMP-UF1)	B & C	B & C	B & C	B & C	B & C	B & C	--	--	--	--
	Contech StormFilter, City of Ontario (BMP-SF1) [3]	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C	B & C
Sample Number (CDM)		0	0	0	0	0	0	0	0	0	0
Sample Number (B&C)		10	10	10	10	10	10	2	2	2	2

BMP Effectiveness Monitoring Sample Frequency/Schedule for Proposed Sample Sites		Dry Season (April 1 to June 15, 2008)																		
		Dry Event 1 Sampling						Dry Event 2 Sampling						Dry Event 3 Sampling						
Site Location		Influent 1 + Effluent 1	Influent 2 + Effluent 2	Influent 3 + Effluent 3	Influent 4 + Effluent 4	Influent 5 + Effluent 5	Influent 6 + Effluent 6	Influent 1 + Effluent 1	Influent 2 + Effluent 2	Influent 3 + Effluent 3	Influent 4 + Effluent 4	Influent 5 + Effluent 5	Influent 6 + Effluent 6	Influent 1 + Effluent 1	Influent 2 + Effluent 2	Influent 3 + Effluent 3	Influent 4 + Effluent 4	Influent 5 + Effluent 5	Influent 6 + Effluent 6	
		W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	W 1	
BMP Effectiveness Monitoring	Northern Bioswale Segment #1, City of Corona (BMP-BIO1)	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	
	Extended Detention Basin, Sycamore Canyon Wilderness Park, City of Riverside (BMP-EDB1)	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	
	Kristar Perk Filter, Site #1, City of Canyon Lake (BMP-PF1)	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	
	Up-Flo Filter, Site #2, City of Canyon Lake (BMP-UF1)	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	CDM	
	Contech StormFilter, City of Ontario (BMP-SF1) [3]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Total
Sample Number (CDM)		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	144
Sample Number (B&C)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136

CDM = Camp Dresser & McKee; Brown & Caldwell (B&C)

1 Collection of water quality samples for laboratory analysis (Fecal coliform, E. coli and TSS), field parameter data (temperature, dissolved oxygen, turbidity, pH, and conductivity), or for pathogen scoping study. Samples collected by CDM and Brown & Caldw

2 For a sample events, effluent samples are collected factoring a lag time after its paired influent sample is collected.

3 No dry weather flows at Contech Stormfilter.

Table 8c.
Lag Time between Influent and Effluent Sample Collection Based on Depth at the Influent Sample Point

Northern Bioswale No.1 (Corona)

Depth (ft)	Lag Time (min)
0.5	40
1	25
1.5	19
2	16
2.5	14
3	12
3.5	11
4	10
4.5	9
5	9

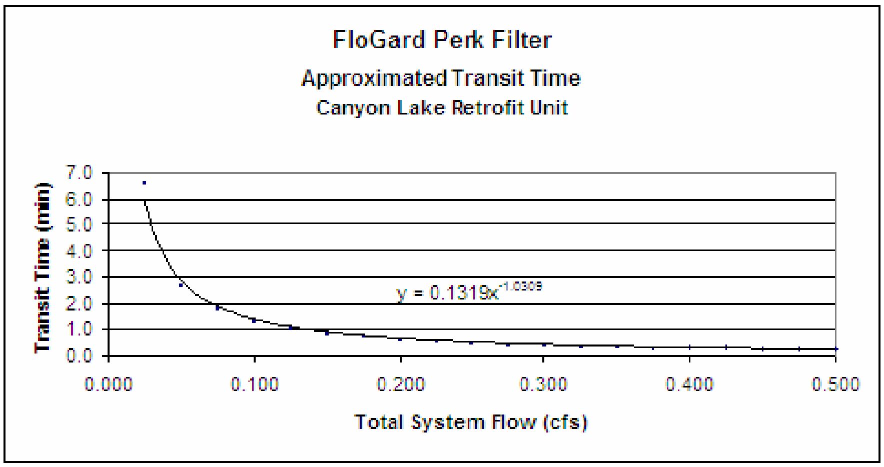

Figure 3c. Relationship between Transit Time and Total System Flow – Perk Filter/ Up-Flo Filter

11. Sampling Methods

11.1 Sample Collection

In-stream sampling consists of grab samples collected approximately mid-stream and at the water surface during designated sample activities following sampling methods presented in Table 9. Water samples are best collected before any other work is done at the site. If other work is done prior to the collection of water samples (for example, flow measurement or other field measurements), it might be difficult to collect representative samples for water chemistry and bacteria analysis from the disturbed stream. Wading by sample collection staff shall not occur during collection of samples for bacterial and TSS analyses.

Water samples are collected from a location in the stream where the stream visually appears to be completely mixed. Ideally this would be at the centroid of the flow (*Centroid* is defined as the midpoint of that portion of the stream width that contains 50% of the total flow), but depth and flow do not always allow centroid collection. In addition, the sample should be collected in an area free of debris or algae. Samples shall not be collected if conditions are determined to be unsafe during an on- site assessment by the field team leader.

For sites where the samples will be taken from a distance, a sampling pole will be used. This sampling pole is approximately 7 feet long and has a mechanism that holds the sample bottle in place. The mechanism should be sterilized in the field with a 70 percent ethanol solution prior to the collection of each sample. Allow the pole to air-dry before the sample is taken. A similar sampling pole that extends to greater height may be used for sites where sampling from a bridge is necessary.

The following lists contain specific steps to take when collecting a water sample (adapted from EPA's Volunteer Stream Monitoring: A Methods Monitoring Manual, EPA 841-B-97-003, November 1997):

1) Label each container with Site ID, Sample ID, analysis information, Project ID, date, and time (some of this information may be pre-labeled on the containers). After sampling, secure the label by taping it around the bottle with clear packaging tape.
2) When wading (if applicable) to the sampling point, try not to disturb bottom sediment.
3) Stand in the water, facing upstream. Collect the water sample on your upstream side, in front of you. Hold the bottle upright under the surface while it is still capped. Open the lid carefully to slowly let water run in. Avoid touching the inside of the bottle or cap. If you accidentally touch the inside, use another bottle. Fill the bottle leaving a 1-inch air space so that the sample can be shaken just before analysis.
4) For fecal coliform and *E. coli* samples the bottle will contain sodium thiosulfate for chlorine elimination; therefore, the bottle cannot be held under the water to collect a sample. Therefore, use a new sterilized water collection bottle to collect water for these parameters at each site. Water can then be decanted from this bottle into the sample container for the laboratories.
5) The TSS sample containers will be sterilized by the lab so that they can be used for collection and decanting of water into the preserved fecal coliform and *E. coli* sample bottles.

6) Collect the water sample on your upstream side, in front of you. You may also tape your bottle to an extension pole to sample from deeper water. Hold the bottle near its base and plunge it (opening downward) below the water surface. If you are using an extension pole, remove the cap, turn the bottle upside down, and plunge it into the water, facing upstream.

7) Recap the bottle carefully, remembering not to touch the inside.

8) Place the bottles in a cooler with cold packs for transport to the laboratory. The maximum holding time prior to water quality analysis for bacteria concentrations is 6 hours; the maximum holding time prior to *Bacteroides* analysis is 24 hours. Bottles will be provided by the laboratories for each sample and will include:

   - Water Quality Analysis Laboratory – A single 120 mL bottle for both fecal coliform and *E. coli*, and one 1000 mL bottle for TSS
   - OCWD or UC Davis Laboratory – 1 (1000 mL) bottles for *Bacteroides* analysis

9) Field QA Samples:

Field Equipment Blanks – One set of field equipment blank samples (equal volume for each constituent) will be included for each sample event (Note: one sample event encompasses samples collected within a given week). Sterile deionized (DI) water is poured through any equipment used to collect samples at the site where the field equipment blank is being collected and then into the respective sample containers for each constituent. For Watershed-Wide and USEP Monitoring Programs, the site selected for collection of a field blank is shown in Table 9. For AgSEP Monitoring, Table 9a lists the site selected for collection of field equipment blanks. For BMP Effectiveness Monitoring, Table 9b lists the site selected for collection of field equipment blanks.

Field Replicates – Field replicates will be collected from at least 5 percent of the total number of samples collected per sample event for the USEP or Watershed-Wide sampling efforts. This frequency results in one replicate collected for each week that the USEP sites are sampled and each week the Watershed-Wide sites are sampled. The site selected for collection of a field replicate for either sampling effort is shown in Table 9. Field replicates are taken by collecting two sets of samples at the same location within five minutes of each other. For AgSEP Monitoring, Table 9a lists the site selected for collection of field replicates. For BMP Effectiveness Monitoring, Table 9b lists the site selected for collection of field replicates.

Table 9. Schedule for Watershed-Wide and USEP Program Collection of Field Replicate and Field Equipment Blank Water Samples		
Sample Week Ending Date	**Watershed-Wide**	**USEP**
7/14/2007	Icehouse Canyon Creek	Santa Ana River Reach 3 at La Cadena Drive
7/21/2007	Prado Park Lake at Lake Outlet	Box Springs Channel at Tequesquite Avenue
7/28/2007	Chino Creek at Central Avenue	Sunnyslope Channel near confluence with SAR
8/4/2007	Mill Creek at Chino-Corona Road	Anza Park Drain near confluence with Effluent Channel
8/11/2007	Santa Ana River Reach 3 at Pedley Avenue	San Sevaine Channel near confluence with SAR
8/18/2007	Santa Ana River Reach 3 at MWD Crossing	
8/25/2007	Icehouse Canyon Creek	
9/1/2007	Prado Park Lake at Lake Outlet	Day Creek at Lucretia Avenue
9/8/2007	Chino Creek at Central Avenue	Temescal Wash at Lincoln Avenue
9/15/2007	Mill Creek at Chino-Corona Road	Cypress Channel at Kimball Avenue
9/22/2007	Santa Ana River Reach 3 at Pedley Avenue	San Antonio Channel at Riverside Drive
9/29/2007	Santa Ana River Reach 3 at MWD Crossing	Carbon Canyon Creek Channel at Pipeline Avenue
10/6/2007	Icehouse Canyon Creek	
10/13/2007	Prado Park Lake at Lake Outlet	
10/20/2007	Chino Creek at Central Avenue	
12/15/2007	Chino Creek at Central Avenue	
12/22/2007	Mill Creek at Chino-Corona Road	
12/29/2007	Santa Ana River Reach 3 at Pedley Avenue	
1/5/2007	Santa Ana River Reach 3 at MWD Crossing	
1/12/2007	Icehouse Canyon Creek	
1/19/2007	Prado Park Lake at Lake Outlet	Chris Basin Outflow (Lower Deer Creek)
1/26/2007	Chino Creek at Central Avenue	County Line Channel at Cucamonga Creek confluence
2/2/2007	Mill Creek at Chino-Corona Road	Cucamonga Creek at Hwy 60 (Above RP1)
2/9/2007	Santa Ana River Reach 3 at Pedley Avenue	Santa Ana River Reach 3 at La Cadena Drive
2/16/2007	Santa Ana River Reach 3 at MWD Crossing	Box Springs Channel at Tequesquite Avenue
2/23/2007	Icehouse Canyon Creek	Sunnyslope Channel near confluence with SAR
Storm 1	Prado Park Lake at Lake Outlet	Anza Park Drain near confluence with Effluent Channel
Storm 1 + 48hrs	Chino Creek at Central Avenue	San Sevaine Channel near confluence with SAR
Storm 1 + 72hrs	Mill Creek at Chino-Corona Road	Day Creek at Lucretia Avenue
Storm 1 + 96 hrs	Santa Ana River Reach 3 at Pedley Avenue	Temescal Wash at Lincoln Avenue
5/17/2008	Mill Creek at Chino-Corona Road	
5/24/2008	Santa Ana River Reach 3 at Pedley Avenue	
5/31/2008	Santa Ana River Reach 3 at MWD Crossing	
6/7/2008	Icehouse Canyon Creek	
6/14/2008	Prado Park Lake at Lake Outlet	

Table 9a
Schedule for Collection of Field Replicate and Field Equipment Blank Water Samples
AgSEP Monitoring Program

Storm Event No.	AgSEP
Storm 1	Euclid Avenue Channel at Pine Avenue (AG-E2)
Storm 1 + 30 min	Grove Avenue Channel at Merrill Avenue (AG-G2)
Storm 2	Eucalyptus Avenue at Walker Avenue (AG-G1)
Storm 2 + 30 min	Cypress channel at Kimball Avenue (AG-CYP1)

Table 9b
Schedule for Collection of Field Replicate and Field Equipment Blank Water Samples
BMP Effectiveness Monitoring Program

Event No.	Field Equipment Blank	Field Replicate
Wet Weather		
Storm 1, Influent 1	Northern Bioswale Segment #1, City of Corona (BIO1)	Northern Bioswale Segment #1, City of Corona (BIO1)
Storm 1, Influent 1	-NA-	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)
Storm 1, Influent 1	-NA-	Up-Flo Filter, City of Canyon Lake (UF1)
Storm 2, Influent 1	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)	StormFilter, Ontario (SF1)
Storm 2, Influent 1	-NA-	Northern Bioswale Segment #1, City of Corona (BIO1)
Storm 2, Influent 1	-NA-	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)
Dry Weather		
Dry Event 1, Influent 1	Up-Flo Filter, City of Canyon Lake (UF1)	Up-Flo Filter, City of Canyon Lake (UF1)
Dry Event 1, Influent 1	-NA-	StormFilter, Ontario (SF1)
Dry Event 1, Influent 1	-NA-	Northern Bioswale Segment #1, City of Corona (BIO1)
Dry Event 2, Influent 1	Northern Bioswale Segment #1, City of Corona (BIO1)	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)
Dry Event 2, Influent 1	-NA-	Up-Flo Filter, City of Canyon Lake (UF1)
Dry Event 2, Influent 1	-NA-	Northern Bioswale Segment #1, City of Corona (BIO1)
Dry Event 3, Influent 1	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)	Extended Detention Basin, Sycamore Canyon Wilderness Park (EDB1)
Dry Event 3, Influent 1	-NA-	Up-Flo Filter, City of Canyon Lake (UF1)
Dry Event 3, Influent 1	-NA-	StormFilter, Ontario (SF1)

Table 10. Sampling Locations and Sampling Methods										
Sampling Location	**Location ID Number**	**Matrix**	**Depth (units)**	**Analytical Parameter**	**# Samples (include field duplicates)**	**Sampling SOP #**	**Sample Volume**	**Containers #, size, type**	**Preservation (chemical, temperature, light protected)**	**Maximum Holding Time: Preparation/ analysis**
Field Analyses										
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	Conductivity	NA	Refer to Monitoring Plan (MP)	Instream	NA	NA	Measured on site
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	Dissolved Oxygen	NA	Refer to MP	Instream	NA	NA	Measured on site
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	pH	NA	Refer to MP	Instream	NA	NA	Measured on site
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	Temperature	NA	Refer to MP	Instream	NA	NA	Measured on site
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	Turbidity	NA	Refer to MP	Instream	NA	NA	Measured on site
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	Flow	NA	Refer to MP	Instream	NA	NA	Measured on site
Laboratory Analyses										
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	*E. coli* & Fecal Coliform	580	Refer to MP	100 ml	1 bottle, 120 ml, sterile plastic (high density polyethylene or polypropyle ne) container	Sodium thiosulfate pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark	6 hours at 4°C, dark; lab must be notified well in advance
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	TSS	580	Refer to MP	1000 ml	1 bottle, 1000 ml, Cool to 4ºC, dark	Cool to 4ºC, dark	7 days at 4ºC, dark
Molecular Analyses										
See Section 10, Table 8, 8a, 8b	See Section 10, Table 8, 8a, 8b	Water	Water surface	*Bacteroides* Assay	300	Refer to MP	1000 ml	2 bottles, 500 ml, Cool to 4°C; dark.	Cool to 4°C; dark.	24 hours at 4ºC, dark; lab must be notified in advance

11.2 Field Measurements

After collecting the water samples, record the water temperature, pH, conductivity, turbidity, and dissolved oxygen concentration. These parameters as well as other field data are measured and recorded using a Horiba Multiparameter probe. When field measurements are made with a multi-parameter instrument, it is preferable to place the sonde in the body of water to be sampled and allow it to equilibrate in the dissolved oxygen mode while water samples are collected. Field measurements are made at the centroid of flow, if the stream visually appears to be completely mixed from shore to shore. For routine field measurements, the date, time and depth are reported as a grab. Below is a brief discussion of each recorded field measurement:

- Dissolved Oxygen – Calibrate the dissolved oxygen sensor on the multi-probe instrument at the beginning of each day of field measurements. Preferably, dissolved oxygen is measured directly in-stream close to the flow centroid. The dissolved oxygen probe must equilibrate for at least 90 seconds before dissolved oxygen is recorded to the nearest 0.1 mg/L. Since dissolved oxygen takes the longest to stabilize, record this parameter after temperature, conductivity, and pH.
- pH – If the pH meter value does not stabilize in several minutes, out-gassing of carbon dioxide or hydrogen sulfide or the settling of charged clay particles may be occurring. If out-gassing is suspected as the cause of meter drift, collect a fresh sample, immerse the pH probe and read pH at one minute. If suspended clay particles are the suspected cause of meter drift, allow the sample to settle for 10 minutes, and then read the pH in the upper layer of sample without agitating the sample. With care, pH measurements should be accurately measured to the nearest 0.1 pH unit.
- Conductivity – Preferably, specific conductance is measured directly in-stream close to the flow centroid. Allow the conductivity probe to equilibrate for at least one minute before specific conductance is recorded to three significant figures (if the value exceeds 100 mS/cm). The primary physical problem in using a specific conductance meter is entrapment of air in the conductivity probe chambers. The presence of air in the probe is indicated by unstable specific conductance values fluctuating up to ±100 mS/cm. The entrainment of air can be minimized by slowly, carefully placing the probe into the water; and when the probe is completely submerged, quickly move it through the water to release any air bubbles.
- Temperature - Temperature is measured directly in-stream close to the flow centroid. Measure temperature directly from the stream by immersing a Horiba Multiparameter instrument.
- Turbidity - Turbidity is measured directly in-stream close to the flow centroid. Measure turbidity directly from the stream by immersing a Horiba Multiparameter instrument.

11.3 Instantaneous Flow Monitoring

For USEP Monitoring Program sites, flow measurements will be recorded by field personnel for every site visit during the period of the Grant Project. A depth-discharge rating curve can be developed by conducting multiple flow measurements at water depths in 0.1 ft increments. Once developed, only depth measurements would be required during site visits, assuming the depth of flow is within 0.1 ft of a previously completed flow measurement.

11.3.1 Measured Flow Estimate

Where possible, volumetric measurements and a cross-section velocity profile will be developed according to the following procedures:

Volumetric **-** Where possible, a volumetric flow measurement approach will be used. This method shall not be used if conditions are determined to be unsafe by an on-site assessment by the field team leader. A volumetric flow measurement entails estimation of the time in seconds (t) required to fill a 5 gallon bucket with concentrated runoff. Sites with low flow and a free outfall would allow for this type of flow measurement. The following equation would then give the flow rate for a test with one 5-gallon bucket of volume captured, Q (cfs) = 0.67 * t. If there are multiple points where runoff is concentrated, then volumetric measurements can be made at each point along the stream and summed to provide total discharge.

Cross-Section Velocity Profile **-** The following steps guide the development of a velocity profile for a streamflow cross section. This approach will require that the field personnel be equipped with a Marsh-McBirney flow meter or equivalent, top-setting wading rod (preferably measured in tenths of feet), and a tape measure (with gradations every tenth of a foot).

1. Stretch the measuring tape across the stream at right angles to the direction of flow. When using an electronic flow meter, the tape does not have to be exactly perpendicular to the bank (direction of flow). Avoid measuring flow in areas with back eddies. The first choice would be to select a site with no back eddy development. However, this cannot be avoided in certain situations. Measure the negative flows in the areas with back eddies. If necessary and possible, modify the measuring cross section to provide acceptable conditions by building dikes to cut off dead water and shallow flows, remove rocks, weeds, and debris in the reach of stream one or two meters upstream from the measurement cross section. After modifying a streambed, allow the flow to stabilize before starting the flow measurement
2. Record the following information on the flow measurement form (Attachment 3):
   i. Site Location and Site ID
   ii. Date
   iii. Time measurement is initiated and ended
   iv. Name of person(s) measuring flow
   v. Note if measurements are in feet or meters
   vi. Total stream width and width of each measurement section
   vii. For each cross-section, record the mid-point, section depth, and flow velocity
3. Determine the spacing and location of flow measurement sections. Measurements will be taken at the midpoint of each of the flow measurement sections. Flow measurements will be taken at the following locations:
   - A point from the left bank representing 10% of the total width. This measurement will provide a velocity estimate for the section representing 0% – 20% of the total width from the left bank.

- A point from the left bank representing 50% of the total width. This measurement will provide a velocity estimate for the section representing 20% – 80% of the total width from the left bank.
- A point from the left bank representing 90% of the total width. This measurement will provide a velocity estimate for the section representing 80% – 100% of the total width from the left bank.

4. Place the top setting wading rod at each flow measurement point.
5. Using a tape measure, measure the depth of water to the nearest ½ inch.
6. Adjust the position of the sensor to the correct depth at each flow measurement point. The purpose of the top setting wading rod is to allow the user to easily set the sensor at 20%, 60%, and 80% of the total depth. On the wading rod, each single mark represents 0.10 foot, each double mark represents 0.50 foot, and each triple mark represents 1.00 foot. Position the meter at 60% of the total depth from the water surface (if depth of flow is greater than 2.5ft, then take two readings, at 20% and 80% of total depth).
7. Measure and record the velocity and depth. The wading rod is kept vertical and the flow sensor kept perpendicular to the cross section. Permit the meter to adjust to the current for a few seconds. Measure the velocity for a minimum of 20 seconds with the Marsh-McBirney meter. When measuring the flow by wading, stand in the position that least affects the velocity of the water passing the current meter. The person wading stands a minimum of 1.5 feet downstream and off to the side of the flow sensor.
8. Report flow values less than 10 ft^3/s to two significant figures. Report flow values greater than 10 ft^3/s to the nearest whole number, but no more than three significant figures.
9. Calculate flow by multiplying the width x depth (ft^2) to derive the area of each flow measurement section. The area of the section is then multiplied by the velocity (ft/s) to calculate the flow in cubic feet per second (cfs or ft^3/sec) for each flow measurement section. <u>Do not treat cross sections with negative flow values as zero.</u> Negative values obtained from areas with back eddies should be subtracted during the summation of the flow for a site. When flow is calculated for all of the measurement sections, they are added together for the total stream flow.

11.3.2 Visual Flow Estimate

Flow estimate data may be recorded for a non-tidally influenced stream when it is not possible to measure flows by the volumetric or cross section velocity profile methods described above either because flows are too high or so shallow that obtaining a velocity measurement is difficult or impossible. Visual flow estimates are subjective measures based on field personnel's experience and ability to estimate distances, depths, and velocities.

1. Observe the stream and choose a reach of the stream where it is possible to estimate the stream cross section and velocity. Estimate stream width (feet) at that reach and record.
2. Estimate average stream depth (feet) at that reach and record.
3. Estimate stream velocity (ft/s) at that reach and record. A good way to do this is to time the travel of a piece of floating debris. This can be done by selecting points of reference along

the stream channel which can be used as upper and lower boundaries for an area of measurement. After establishing the boundaries, measure the length of the flow reach. One person stands at the upper end of the reach and drops a floating object and says “start.” A second person stands at the lower end of the reach and times the number of seconds for the floating object to float the reach. This measurement is conducted three times and the three results are averaged. The velocity is the length of the reach in feet divided by the average time in seconds.

If doing this method from a bridge (for example, because flows are too high to be in the channel), measure the width of the bridge. Have one person drop a floating object (something that can be distinguished from other floating material) at the upstream side of the bridge and say “start”. The person on the downstream side of the bridge will stop the clock when the floating object reaches the downstream side of the bridge. Divide the bridge width by the number of seconds to calculate the velocity. The velocity should be measured at multiple locations along the bridge at least three times. These velocities are averaged.

Multiply stream width (feet) by average stream depth (feet) to determine the cross sectional area (ft^2) which when multiplied by the stream velocity (ft/s) and a correction constant, gives an estimated flow (ft^3/s).

12. Sample Handling and Custody

12.1 Pre-Sampling Procedures

Prior to the collection of field data, the sample teams will complete the following activities:

1. Horiba Multiparameter probe should be calibrated every morning prior to sampling (See the equipment operation manual for specific calibration instructions). Calibrations will be conducted by the QA officer for Brown & Caldwell (Nancy Gardiner), SBCFCD (Janet Dietzman), and CDM (Thomas Lo). Sampling activities will not be conducted until calibrations can be completed per equipment operations manual.
2. Prepare ice coolers with ice packs or crushed ice to transport samples to the laboratory.
3. Obtain sample containers from labs, including field blanks and water collection bottles
4. Pre-label sampling containers with Site Identification Number (Site ID) and leave blank fields for date and time.
5. Prepare 70 percent ethanol solution for field sterilization of sampling equipment.
6. Pack a flat head screw driver to loosen the band that holds the sampling bottle to the sampling pole.
7. Pack safety gear such as waders, protective gloves, and safety vests.
8. Pack waterproof pen and field log book.
9. Make sure that a vehicle is available and fueled.
10. Pack supplies for shipping samples.
11. Pack chain of custody forms, field data sheets, camera, and zip lock bags.

12.2 Field Documentation

Field crews are required to keep a field log. Field documentation will be completed using indelible ink, with any corrections made by drawing a single line through the error and entering the correct value. The following items should be recorded in the field log for each sample collected at each sample location (An example Field Data Sheet Form is included as Attachment 1):

- Date and time of sample collection
- Site Name and Site ID
- Unique IDs for any replicate or blank samples collected from the site
- The results of any field measurements (conductivity, dissolved oxygen, flow, pH, temperature, and turbidity) and the time that measurements were made

- Qualitative descriptions of relevant water conditions (e.g. color, flow level, clarity) or weather (e.g. wind, rain) at the time of sample collection
- For USEP sites when such characterizations are required, a characterization of the hydrologic connectivity of the surface flow at the site to the downstream impaired water to which it is tributary. If no connectivity is observed, then the characterization shall, at a minimum, describe the general distance between the point where surface flow ceases and the channel confluences with the downstream impaired water. If connectivity is observed, then the characterization shall, at a minimum, describe the typical width and depth of the surface flow reaching the downstream impaired water, any observations that suggest that flows have recently been higher than what is currently observed.
- A description of any unusual occurrences associated with the sampling of that site, particularly those that may affect sample or data quality

Field crews are required to take digital photographs when sampling each site and maintain a photo log of all photographs taken. At a minimum, the following digital photographs should be taken at each site:

- A photograph which shows a view of the waterbody upstream of the sample site
- A photograph which shows a view of the waterbody downstream of the sample site.
- Photographs which characterize the width and depth of flow and aesthetic characteristics such as water clarity and algal growth

To the extent possible, the photographs that provide an upstream and downstream view of the waterbody should be taken from the same point during each site visit. A photo log of all photographs taken at each sample site shall be maintained that documents the purpose of the photo (for example, upstream or downstream view) and the date and time of the photograph.

12.3 Sampling Handling & Delivery to Laboratory

Proper gloves must be worn to prevent contamination of the sample and to protect the sampler from environmental hazards (disposable polyethylene, nitrile, or non-talc latex gloves are recommended). Wear at least one layer of gloves, but two layers help protect against leaks. One layer of shoulder high gloves worn as first (inside) layer is recommended to have the best protection for the sampler. Safety precautions are needed when collecting samples, especially samples that are suspected to contain hazardous substances, bacteria, or viruses.

Properly store and preserve samples as soon as possible. Usually this is done immediately after returning from the collection by placing the containers on top of bagged, crushed or cube ice in an ice chest (**do not bury sample containers under ice**). Sufficient ice will be needed to lower the sample temperature to at least 4°C within 45 minutes after time of collection. Sample temperature will be maintained at 4°C until delivered to the appropriate laboratory. Care should be taken at all times during sample collection, handling, and transport to prevent exposure of the sample to direct sunlight.

Samples that are to be analyzed for bacteria indicators must be kept on ice or in a refrigerator and delivered to **Orange County Public Health Water Quality Laboratory, (700 Shellmaker Road, Newport Beach, CA, 92660; 949-219-0423)** water quality laboratory within 6 hours.

Samples analyzed for *Bacteroides* must be kept on ice or in a refrigerator and delivered to the appropriate laboratory, **Orange County Water District laboratory (10500 Ellis Avenue, Fountain Valley, CA, 92708; 714-378-3313, contact Menu Leddy) *or* University California Davis laboratory (University of California, Department of Civil & Environmental Engineering, One Shields Avenue, Davis, CA 95616, 3157 Engineering III; 530-754-6407, contact Dr. Stefan Wuertz)** within 24 hours of collection.

A detailed sample delivery schedule is presented in Table 3, Table 3a, and Table 3b of the Monitoring Plan. Every shipment must contain a complete Chain of Custody (COC) Form (see Attachment D) that lists all samples taken and the analyses to be performed on these samples. COCs must be completed every time samples are transported to a laboratory. Include any special instructions to the laboratory. The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy. Samples collected should have the depth of collection and date/time collected on every COC.

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed inside a large plastic bag inside the ice chest for shipping. The bag can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the laboratory beyond the required holding time. Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

Samples will be delivered to analytical laboratories by the Brown & Caldwell, SBCFCD, and CDM field sampling teams either directly by sampling team personnel or via courier.

12.4 Chain of Custody

Every shipment must contain a complete Chain of Custody (COC) Form (see Attachment 2) that lists all samples taken and the analyses to be performed on these samples. The Chain of Custody form will identify the sample number, sampling location description, date, time, sample type, number of containers, tests required, and relinquishing signatures. COCs must be completed every time samples are transported to a laboratory. Include any special instructions to the laboratory. The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy. Samples collected should have the depth of collection and date/time collected on every COC.

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed separately inside large plastic bags and placed in the ice chest for shipping. The bags can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the laboratory beyond the required holding time. Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

13. Analytical Methods

Tables 11 and Table 12 summarizes the analytical methods that will be used for the Watershed-wide, USEP, AgSEP, and BMP Effectiveness Monitoring Programs.

Table 11. Field Methods

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Target Reporting Limit (units, wet or dry weight)	Field Method	
				Analytical Method/ SOP	Modified for Method yes/no
Conductivity *	Field monitoring	1.09 mS/cm	0 - 100 mS/cm	SM**2510B	No
Dissolved Oxygen	Field monitoring	5 mg/L	0 - 19.9 mg/L	SM4500OG	No
pH	Field monitoring	6.5 to 8.5	0 – 14 pH	SM4500-H+B	No
Temperature (water)	Field monitoring	June to Oct: not > 90 °F (32°C); Rest of Year: not > 78°F (25°C) as a result of controllable water quality factors	0 – 50 °C	SM2550B	No
Turbidity	Field monitoring	5 to 10 NTU	0 – 800 NTU	SM2130B	No
Flow	Field monitoring	NA	-0.5 to 19.99 ft/sec	Cross-section velocity profile or Visual flow estimate (see text)	No

Notes:

- Project Action Limits: Applied Basin Plan Water Quality Objectives for conductivity by converting a TDS value of 700 ppm to a conductivity value.
- SM: *Standard Methods for the Examination of Water and Wastewater*, 20^{th} edition.

Table 12. Laboratory Analytical Methods							
Analyte	**Laboratory /Organization**	**Project Action Limit (units, wet or dry weight)**	**Target Reporting Limit (units, wet or dry weight)**	**Analytical Method**		**Achievable Laboratory Limits**	
				Analytical Method/ SOP	**Modified for Method yes/no**	**MDLs**	**Method**
E. coli	OC Public Health Water Quality Lab	See notes below	10 CFU/100mL	EPA 1603	No	Not applicable	10 CFU/100 mL
Fecal Coliform	OC Public Health Water Quality Lab	See notes below	10 CFU/100mL	SM 9222D	No	Not applicable	10 CFU/100 mL
Total Suspended Solids	OC Public Health Water Quality Lab	See notes below	1.0 mg/L	SM 2540D	No	Not applicable	1.0 mg/L

Notes: Project Action Limits for *E. coli*, Fecal Coliform, and TSS are as follows:

- *E. coli*: 5-sample/30-day Logarithmic Mean less than 113 organisms/100 mL, and not more than 10% of the samples exceed 212 organisms/100 mL for any 30-day period.
- *Fecal coliform*: 5-sample/30-day Logarithmic Mean less than 180 organisms/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.
- TSS: Inland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.

14. Quality Control

All laboratories contracted by SAWPA will follow quality assurance and quality control programs in accordance with guidelines established by the State of California and the U.S. EPA. Laboratories are required to submit a copy of their SOPs for laboratory quality control to the Quality Assurance Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

All laboratory data will be entered into the project database (Santa Ana Watershed Data Management System [SAWDMS]), and will be filed in the project archives maintained by SAWPA along with related materials such as field forms, chain of custody forms, photographs, correspondence, etc.

The CDM Project Manager and QA Officer will review all laboratory data and will request additional re-analysis as warranted. Table 13 through Table 15 describe Sampling (Field) QC activities. Table 14 and Table 15 describe Analytical QC activities.

Table 13. Sampling (Field) QC

Matrix: Water		
Sampling SOP: per Monitoring Plan		
Analytical Parameter(s): Field Parameters		
Analytical Method/SOP Reference: NA		
Field QC	**Frequency/Number per sampling event**	**Acceptance Limits**
Other: Field Measurements	When taking readings, at least 1 minute or longer (if needed) shall be allowed for until stabilization of readings.	See Section 7, Table 5

Table 14. Sampling (Field) QC

Matrix: Water		
Sampling SOP: per Monitoring Plan		
Analytical Parameter(s): TSS		
Analytical Method/SOP Reference: SM2540D		
Field QC	**Frequency/Number per sampling event**	**Acceptance Limits**
Equipment Blanks	1/sample event	< Target reporting limit
Cooler Temperature	4º C	4º C
Field Duplicate Pairs	5 percent of total number of samples collected per sample event	< 25 percent

Table 15. Sampling (Field) QC

Matrix: Water
Sampling SOP: per Monitoring Plan
Analytical Parameter(s): Fecal coliform, *E. coli*
Analytical Method/SOP Reference: Fecal Coliform (SM9222D); *E. coli* (EPA 1603)

Field QC	Frequency/Number per sampling event	Acceptance Limits
Equipment Blanks	1/ sample event	No detectable amounts or <1/5 of sample concentration
Cooler Temperature	4º C	4º C
Field Duplicate Pairs	5 percent of total number of samples collected per sample event	< 25 percent

Table 16. Analytical QC

Matrix: Water
Sampling SOP: per Monitoring Plan
Analytical Parameter(s): TSS
Analytical Method/SOP Reference: SM 2540D

Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	1/20 samples or 1/batch	< Target Reporting Limit
Laboratory Duplicate	1/20 samples or 1/batch	< 25 percent
Laboratory Matrix Spike	1/20 samples or 1/batch	80 - 120
Matrix Spike Duplicate	1/20 samples or 1/batch	80 – 120; RPD < 25 percent

Table 17. Analytical QC

Matrix: Water
Sampling SOP: per Monitoring Plan
Analytical Parameter(s): Fecal Coliform; *E. coli*
Analytical Method/SOP Reference: Fecal Coliform (SM9222D); *E. coli* (EPA 1603)

Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	1/lot minimum	No detectable amounts
Laboratory Duplicate	10 percent of samples or one sample per test run	< 3.27*R*
Laboratory Control sample (Accuracy)	For each lot of medium received, each laboratory prepared batch of medium, and each lot of purchased prepared medium	Verify appropriate response by testing with known positive and negative control cultures for the organism(s) under test

15. Instrument/Equipment Testing, Inspection, and Maintenance

All laboratories contracted by SAWPA will operate using quality assurance and quality control programs to maintain their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the analytical method. Laboratories are required to submit a copy of their SOPs for laboratory equipment maintenance to the Contract QA Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

Instruments used to gather field measurements (temperature, conductivity, dissolved oxygen, pH and turbidity) will properly maintained and calibrated per the manufacturers requirements. Instruments will be tested prior to the start of field sampling to verify that the instrument is operating appropriately. If the instrument fails to operate within appropriate parameters the Monitoring Contractor will take the appropriate steps to ensure that the equipment is repaired or replaced in a timely manner.

.Table 18. Testing, Inspection, Maintenance of Sampling Equipment and Analytical Instruments

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
Horiba Multiparameter Monitoring	Maintenance and Calibrations	▪ Janet Dietzman (SBCFCD) ▪ Nancy Gardiner (Brown & Caldwell) ▪ Thomas Lo (CDM)	▪ <u>Maintenance</u> – conducted per mfg specifications; ▪ <u>Calibrations</u> - prior to each sampling activity	Per manufacturer specifications
Marsh McBirney Model 2000 flow meter	Maintenance and Calibrations	▪ Janet Dietzman (SBCFCD) ▪ Nancy Gardiner (Brown & Caldwell) ▪ Thomas Lo (CDM)	▪ <u>Maintenance</u> – conducted per mfg specifications; ▪ <u>Calibrations</u> - prior to each sampling activity	Per manufacturer specifications
Laboratory analytical instruments for Conventional Constituents	Maintenance and Calibrations	▪ Joseph Guzman (OC Public Health Lab) ▪ Menu Leddy (OCWD) ▪ Dr. Alexander Schriewer (UC Davis)	▪ <u>Maintenance</u> – conducted per mfg specifications; External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression r2 < 0.995 ▪ <u>Calibrations</u> - verification every 20 samples after initial calibration. Standard source different that that used for initial calibration. Recovery 80% - 120%.	Per individual Lab SOP manual and per equipment maintenance specifications

16. Instrument/Equipment Calibration and Frequency

All laboratories will implement quality assurance and quality control programs to calibrate their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Laboratories are required to submit a copy of their SOPs for laboratory equipment calibration to the Contract Quality Assurance Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

A Horiba Multiparameter probe will be used to make field measurements for conductivity, dissolved oxygen, pH, temperature, and turbidity. It will be properly calibrated according to manufacturer specifications prior to each use.

A Marsh-McBirney Model 2000 flow meter will be used to make flow measurements. It will be properly calibrated according to manufacturer specifications prior to each use.

See Section 15, Table 18.

17. Inspection/Acceptance of Supplies and Consumables

Contract laboratories will supply all the sample containers necessary for the monitoring program. Other consumable supplies such as latex gloves, plastic storage bags, and waterproof pens.

All laboratories will implement quality assurance and quality control programs to calibrate their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Laboratories are required to submit a copy of their SOPs for laboratory equipment calibration to the project Quality Assurance Officer for review and approval (see Appendices to this QAPP for the SOPs of laboratories being used by this project).

Table 19. Inspection/acceptance testing requirements for consumables and supplies.

Project-Related Supplies / Consumables	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
Sample bottles	Check bottles integrity; check for preservatives (*E. coli*/Fecal Coliform)	Ensure no cracks, intact bottle caps; preservative present	Prior to sample collection	Sampling team
Latex gloves	Look for tears/holes	Intact, no tears	Prior to use	Each sampler
Storage bags, pens	Presence/absence of supplies	Ensure supplies are in field bin	Prior to going to field	Sampling team

18. Non-Direct Measurements (Existing Data)

18.1 Data Sources and Uses

During the course of the monitoring programs previously existing relevant water quality and flow data from the sample locations will be gathered. Sources for these data include the Regional Board, SAWPA, U.S. Geological Survey, SBCFCD and RCFCD. These data will be included as appropriate to evaluate trends in water quality in relation to flow. This analysis will support the evaluation of compliance with TMDL numeric targets.

Descriptive data for each of the monitoring locations will be acquired through field observations, collection of GPS coordinates, and review of the MSAR Pathogen TMDL Staff Report. With approval from the entity which collected the data, it will be used to populate site information fields in the Project database. Existing data will be used by field sampling personnel to determine exact sample collection locations and specific procedures to be followed at each site.

Existing water quality data will be collected based on historical monitoring at each of the Watershed-Wide, USEP and AgSEP sites. Water quality results from this Project will be compared to historical data to assess temporal trends in water quality conditions. Existing data analysis from previous studies within the MSAR and other southern California watersheds will be reviewed and used to guide the data analysis approach for this Project. Other bacteria TMDL compliance monitoring programs will guide the analysis of data collected for the Watershed-Wide monitoring. For the USEP and AgSEP monitoring programs, other bacteria source studies in southern California will be collected and reviewed. Findings of the MSAR USEP and AgSEP studies will be compared to other watersheds where similar work is conducted.

18.2 Data Acceptability

Existing data will be considered acceptable for inclusion in data analyses to support the purposes of this study only if it meets the following criteria:

- Data was collected with an approved Quality Assurance Project Plan;
- The sampling methodology and timing are functionally equivalent, including the method for collecting the water samples and the timing of sample collection (e.g., collection during dry vs. wet weather or collection from base flows vs. storm flows); and
- The laboratory analysis methods are functionally equivalent.

Other existing data may be reviewed and discussed to provide additional waterbody or watershed information, but the use of the data is for qualitative purposes only and will not be incorporated into quantitative data analyses. If these data are used, the constraints associated with the use and interpretation of the data will be described.

19. Data Management

Data will be maintained as described in Section 9 (Documents and Records). The SAWPA Project Coordinator will maintain an inventory of data and its forms, and will periodically check the inventory against the records in their possession. Data samples will be collected according to the procedures outlined in Section 10 (Sampling Process Design). Field measurements will be recorded on standard Field Log forms included as Attachment 1. Analytical samples will be transferred to the laboratory under required COC procedures using a standard COC form included as Attachment 2. For any site where velocity cross section profile flow measurement is taken, standard forms will be used to record necessary measurements (Attachment 3).

All laboratory and field measurement data submitted to SAWPA for inclusion in the project database will follow the guidelines and formats established by SWAMP (http://www.waterboards.ca.gov/swamp/qapp.html). Data transmitted to SAWPA in a standard electronic format and uploaded to the database through batch set electronic means.

All contract laboratories will maintain a record of transferred records and will periodically assess their record of transferred records against those actually held by the SAWPA. Prior to upload, a QA/QC review will be conducted by the SAWPA Project Coordinator to check new data against existing data in the database for completeness, validity of analytical methods, validity of sample locations, and validity of sample dates. The QA/QC will involve using automated data checking tools, which assess that new data to be uploaded follow specified rules, including issues such as alpha-numeric formatting, units of measurement, missing information, and others. The sample location information will be checked to ensure that sites are correctly referenced and that identifiers and descriptions match corresponding records from the existing database. Data not passing this QA/QC review will be returned to the originating laboratory or generator for clarification and or correction. When all data within a batch set have passed QA/QC requirements, the data will be uploaded to the database. A unique batch number, date loaded, originating laboratory, and the person who loaded the data will be recorded in the database, so that data can be identified and removed in the future if necessary.

The project database is backed up using built-in software backup procedures. In addition, all data files will be backed up on tape on a weekly basis as part of SAWPA's SOP for disaster recovery. Back up tapes are kept for a minimum of four weeks before they are written over. Tapes are rotated off-site for separate storage on a monthly (or more frequent) basis, in accordance with SAWPA Information Systems SOPs. Each back up session validates whether the files on tape are accurate copies of the original. SAWPA also maintains an access log showing who accessed the database, when, and what was done during the session. All changes to the database are stored in a transaction database with the possibility of rollback, if necessary.

Data will be stored on a Windows 2003 Server with a 2 GHz + CPU and 2Gb RAM with a fail safe RAID 5 configuration. The server checks for operating system updates daily and downloads and installs patches and service packs as necessary. The current server is two years old, and as per SAWPA policy, will be replaced after a maximum of 4 years of service. The server is also protected with Norton Anti-Virus software which is updated daily. The database software is Microsoft SQL Server 2000 standard edition with Service Pack 4. The database administrator checks the Microsoft Website for new patches and service packs on a monthly basis and installs updates as necessary. The general policy for updating operating system and database software is to evaluate the software on a test machine after a new version has been out for approximately 1 year. The new version is then installed at the discretion of the network or database administrator.

The database will be operated with a transaction log recording all changes with ability to roll back if necessary. Full database backups will occur on a weekly basis and immediately before batch uploads. It is expected TMDL data will be loaded quarterly to twice per year. At the time when data is uploaded, the SAWPA Project Coordinator will check that the inventory of monitoring activities adequately matches with the number and type of records in the database.

Data will be exported from SAWDMS into the SWAMP format using a pre-made query that will map data fields from SAWDMS to the SWAMP template. The exported data will then be sent to the SWRCB IM Coordinator for processing into the SWAMP database. The data will be retrieved for analysis and report writing by exporting from SAWDMS using pre-made queries.

Group C: Assessment and Oversight

20. Assessments & Response Actions

All reviews will be made once per year, preferably early in the beginning of the dry season sampling schedule, by the Contractor QA Officer or its Contractor QA Officer and may include the Santa Ana Regional Board QA Program Manager. Reviews will include:

- Audits of all contract laboratories;
- Audits and field observations of all field sampling teams;
- Review of the SWAMP comparable database for accuracy and completeness.

The Contractor QA Officer will conduct reviews of sampling procedures on an annual basis. Reviews will involve observations of field sampling practices by contractor against those found in this QAPP. The Contractor QA Officer will also audit all contract laboratories annually. This review will involve observation of methods being used in relation to practices within the contract laboratory's SOPs and an audit of data from the contract laboratory's quality assurance and quality control program.

Reports will be developed by the Contractor QA Officer to document the results of annual reviews. These reports will be shared with the MSAR Pathogen TMDL Taskforce following approval be the RWQCB Project Manager. Table 20 summarizes the types of reviews to be completed and the scheduled date for the completion of a report of findings.

Table 20. Summary of Project Assessments and Reviews

Review	Reviewer	Type	Report Date
OC Public Health Water Quality Laboratory	Contractor QA Officer	On-site Observation, as needed	October 1
OCWD Water Quality Laboratory	Contractor QA Officer	On-site Observation, as needed	October 1
UC Davis Laboratory	Contractor QA Officer	On-site Observation, as needed	October 1
San Bernardino County Flood Control District	Contractor QA Officer	Field Observation	August 15
Brown and Caldwell	Contractor QA Officer	Field Observation	August 15
Database Management	SAWPA Database Manager	Internal Technical Audit	August 15

If an audit discovers any discrepancy, the SAWPA Project Coordinator and Contractor QA Officer will discuss the observed discrepancy with the appropriate person responsible for the activity (see organizational chart). The discussion will begin with whether the information collected is accurate, what were the cause(s) leading to the deviation, how the deviation might impact data quality, and what corrective actions might be considered.

Internal reviews will be made in the form of a technical system audit of the project database and discussion of data management tasks with the responsible SAWPA Database Manager. The SAWPA Project Coordinator will check that the inventory of monitoring activities adequately matches with SAWDMS.

The SAWPA Project Coordinator and/or QA Officer have the power to halt all sampling and analytical work by contract laboratories if the deviation(s) noted are considered detrimental to data quality. Alternatively, the Contractor QA Officer can require that certain corrective actions be made within a defined time schedule. This approach could be used to keep to the monitoring schedule presented in Section 10.

21. Reports to Management

CDM will share data and preliminary analyses with the MSAR Pathogen TMDL Workgroup, including the RWQCB, in the form of oral presentations with supporting slides at regularly scheduled Taskforce meetings, when appropriate and in quarterly progress reports. All contract laboratories will prepare a QA/QC report, which summarizes the Projects overall adherence to established analytical SOPs, and responds to information from the results of the audit and on-site observations and final assessments by the Contractor QA Officer. Table 21 summarizes reports that will be developed for the Project.

Table 21. Summary of Project Reporting			
Report	**Reporter**	**Type**	**Report Date**
Interim Progress Update	CDM	Oral Presentations	Workgroup Meetings
Interim Progress Report	CDM	Report	Quarterly
QA/QC Updates	OC Public Health Water Quality Lab	E-mail status update	Quarterly
QA/QC Final Report	OC Public Health Water Quality Lab	Report	June 30, 2008
QA/QC Updates	OCWD Water Quality Laboratory	E-mail status update	Quarterly
QA/QC Final Report	OCWD Water Quality Laboratory	Report	June 30, 2008
QA/QC Updates	UC Davis Water Quality Laboratory	E-mail status update	Quarterly
QA/QC Final Report	UC Davis Water Quality Laboratory	Report	June 30, 2008
Field Sampling Review	Contactor QA Officer	Report	June 30, 2008
On-site Laboratory Review, where conducted	Contractor QA Officer	Report	June 30, 2008
Internal Technical Audit of Database Management	Contractor QA Officer	Report	June 30, 2008
Draft Data Analysis Report	CDM	Draft Document	July 31, 2008
Review of Draft Data Analysis Report	MSAR Pathogen TMDL Workgroup	Comments	August 15, 2008
Final Data Analysis Report	CDM	Final Document	August 31, 2008
Draft AgSEP Monitoring Program Data Analysis Report	CDM (*tentative*)	Draft Document	Dependent on when sampling occurs
Review of Draft AgSEP Monitoring Program Data Analysis Report	MSAR Pathogen TMDL Workgroup	Comments	1 month after submittal of draft AgSEP report for review
Final AgSEP Monitoring Program Data Analysis Report	CDM (*tentative*)	Final Document	1 month after comments received on draft AgSEP report
Draft BMP Effectiveness Study Report	CDM	Draft Document	July 31, 2008
Review of Draft BMP Effectiveness Study	MSAR Pathogen TMDL Workgroup	Comments	August 15, 2008
Final BMP Effectiveness Study Report	CDM	Final Document	August 31, 2008
Wet Weather Season Data Analysis Report	TBD	Report	May 31st (of each yr)
Dry Weather Season Data Analysis Report	TBD	Report	December 31st (of each yr)

Group D: Data Validation and Usability

22. Data Review, Verification, and Validation Requirements

Data generated by project activities will be reviewed by the Contractor QA Officer against the data quality objectives cited in Section 7 and the quality assurance/quality control practices cited in Sections 14, 15, 16 and 17. Data validation will be performed for each indicator regardless of water body. Data validation protocols are presented in Section 23 of this QAPP.

Data will be separated into three categories: (1) Data meeting all data quality objectives; (2) data failing precision or recovery criteria; and (3) data failing to meet accuracy criteria. Data meeting all data quality objectives, but with failures of quality assurance/quality control practices will be set aside until the impact of the failure on data quality is determined. Once determined, the data will be moved into either the first or last category.

Data falling in the first category are considered usable by the project. Data falling in the last category are considered not usable. Data falling in the second category will have all aspects assessed. If sufficient evidence is found supporting data quality for use in this project, the data will be moved to the first category, but will be flagged with a "J" as per EPA specifications.

23. Verification and Validation Methods

All data recorded in the field including field measurements, observations, and chain of custody will be checked visually by the Contractor QA Officer and recorded as checked by initials and dates. Field data will be checked to ensure that all necessary data and activities were completed; including collection of all water samples, field blanks, and field replicates, correct units of measurement are reported and values fall within expected ranges. The validation will also check to ensure that samples were delivered to laboratories within required holding times and that all sample handling and custody protocols were followed.

In addition to field data validation, there will be a validation of water quality analysis results. This will involve a review of 10% of all laboratory water quality analysis reports. The review will involve verifying that all required parameters were measured, reported in the correct units, and that results fall within expected ranges.

The Contractor Project Manager will be responsible for all field data validation reviews. Each of the contract Laboratory QA Officers will perform checks of all of its records and each of the contract Laboratory Directors will recheck 10%. All checks by the contract laboratories will be reviewed by appropriate Project personnel.

Issues, including missing data, incomplete site visits, reporting errors (such as incorrect units of measure or incorrect date/time information, etc.), or data management errors will be communicated to responsible party immediately and documented in the QA/QC Reports for either field sampling, laboratory activities, or database management. Reconciliation and correction will be done by a committee composed of the SAWPA Project Coordinator, Contractor Project Manager, Contractor QA Officer, Monitoring Manager, Regional Board Project Manager; and the Contract Laboratory QA Officers, and Laboratory Directors. Any corrections require a unanimous agreement that the correction is appropriate.

24. Reconciliation with User Requirements

The purposes of the monitoring programs addressed by this QAPP are described in the following sections.

24.1 Watershed-Wide Monitoring Program

The Watershed-Wide Monitoring Program, a required element of the MSAR Bacterial Indicator TMDL, is intended to gather data to demonstrate compliance with the TMDL numeric targets. Per the TMDL the objectives of the Watershed-Wide monitoring program are to: "provide data necessary to review and update the TMDL" and "[determine] compliance with the TMDLs, WLAs, and LAs." Accordingly this monitoring program will continue at least until it can be demonstrated that the following numeric targets are complied with on a regular basis during both dry and wet seasons.

- *Fecal coliform*: 5-sample/30-day Logarithmic Mean less than 180 organisms/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.

- *E. coli*: 5-sample/30-day Logarithmic Mean less than 113 organisms/100 mL, and not more than 10% of the samples exceed 212 organisms/100 mL for any 30-day period.

(However, note that per the TMDL, the fecal coliform targets become ineffective if the Regional Board replaces the fecal coliform objectives with *E. coli* objectives).

Water quality data results collected from Watershed-Wide Monitoring sites will be regularly compared to the above targets to evaluate compliance status. If data gathered over a sufficient period time demonstrate compliance, then the Regional Board can de-list the waterbodies from the 303(d) list of impaired waters. To evaluate compliance, applicable descriptive statistics will be calculated, e.g., geometric means and frequency of exceedance of the compliance targets. In addition to evaluating compliance with the TMDL targets, other data analyses to be developed include:

- Temporal Trends – Trends in bacteria concentrations will be evaluated by graphically presenting sample results over time to illustrate current conditions and progress towards achieving compliance with TMDL targets. Trend evaluations will be developed on a waterbody specific basis and consider season and flow conditions.

- Correlations – Bacteria data results will be evaluated in the context of other data collected (field parameters, TSS, and flow) to identify any data relationships of interest, e.g., correlations between TSS concentrations or water temperatures with bacteria concentrations.

24.2 Urban Source Evaluation Monitoring Program

The purpose of USEP Monitoring Program is to drive the implementation of efforts to control bacteria sources derived from stormwater discharge facilities. USEP monitoring occurs early in the implementation of the TMDL so that efforts to control sources can be prioritized. The outcome of the USEP Monitoring Program will tell stakeholders where to focus efforts on implementation of controls and what follow-up studies are needed to narrow the identification of sources.

Specifically, the first step in identifying the "specific activities, operations and processes…that contribute bacterial indicators" (the purpose for conducting the USEP) is to identify the source waters that contribute the highest concentrations of bacteria to the MSAR impaired waterbodies. Once these waters are so categorized, then the next step is to identify which waters are of greatest concern with regards to the source of the bacteria.

Sites where human sources of bacteria are most commonly observed would have the highest priority for the implementation of source controls and/or additional monitoring efforts to further refine the sources. Lower priority sites would be those where the sources are non-human.

24.3 Agricultural Source Evaluation Monitoring Program

The purpose of AgSEP Monitoring Program is to drive the implementation of efforts to control bacteria sources derived from agricultural discharges. AgSEP monitoring occurs early in the implementation of the TMDL so that efforts to control sources can be prioritized. The outcome of the AgSEP Monitoring Program will tell stakeholders where to focus efforts on implementation of controls and what follow-up studies are needed to narrow the identification of sources.

Specifically, the first step in identifying the "specific activities, operations and processes…that contribute bacterial indicators" (the purpose for conducting the AgSEP) is to identify areas that contribute high concentrations of bacteria to the MSAR impaired waterbodies. Areas where anthropogenic bacteria sources related to agricultural activities are observed will be targeted for additional source investigation activities by the appropriate regional stakeholders.

24.4 BMP Effectiveness Monitoring Program

The Proposition 40 State Grant project (see Section 1.2) included a BMP Pilot Study to evaluate selected BMPs for their effectiveness in removing or reducing bacteria in urban runoff. The purpose of the BMP Effectiveness Monitoring Program is to evaluate stormwater treatment BMPs with regard to their effectiveness in reducing bacteria in urban runoff. These BMPs include biofilters, detention basins, wet ponds, wetlands, and manufactured proprietary devices. The results of this effort will be compared to other available studies published in the primary scientific literature and to the regulatory literature (e.g., guidance documents published by EPA or the Water Environment Research Foundation).

ATTACHMENT 1

EXAMPLE MSAR BACTERIAL INDICATOR TMDL
FIELD DATA SHEET FORM

MSAR Pathogen TMDL
Field Data Sheet

General Information:

Site Name: ______________________

Site ID: _________________________

Date: ___/___ /_____

Time (24-hr clock): ____________

Sampling Team: __________________ /_____________________

Field Measurements:

Conductivity: _______________________ (m S/cm)

Dissolved Oxygen: ___________________ (mg/L)

pH: ________________________________

Turbidity: ___________________________ (NTU)

Temp (water): ________________________ (ºC)

For USEP and AgSEP Monitoring Program Sites Only:

Flow: ________________ (ft/sec)

Flow Connectivity (USEP Sites Only): Y/N (Describe)

____

____

Grab Sampling: Filled and labeled (check)

1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)

for ***E. coli*** and **Fecal Coliform**: _______

1 – 1,000 mL polyethylene bottle for **TSS**: _______

Additional Grab Sampling For USEP and AgSEP Monitoring Program Sites Only:

1 – 1,000 mL polyethylene bottle for ***Bacteroides*** _______

Note:

Additional bottles sets are included for field duplicates and field blanks

(Check if applicable): _______

Other Observations:

____

____

____

MSAR Pathogen TMDL Field Data Sheet
(For BMP Effectiveness Monitoring only)

General Information:

Site Name: ____________________

Site ID: _______________________

Date: ___/___ /_____

Time (24-hr clock): ___________

Sampling Team: _________________ /____________________

Field Measurements:

Conductivity: ______________________ (m S/cm)

Dissolved Oxygen: __________________ (mg/L)

pH: ______________________________

Turbidity: __________________________ (NTU)

Temp (water): _______________________ (ºC)

Flow: _______________ (ft/sec)

==

Grab Sampling: Filled and labeled (check)

INFLUENT Sample 1:

- Sample Time (24-hour clock): _____________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 1:

- Sample Time (24-hour clock): _____________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

==

INFLUENT Sample 2:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 2:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

INFLUENT Sample 3:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 3:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

INFLUENT Sample 4:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 4:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

===

INFLUENT Sample 5:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 5:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

INFLUENT Sample 6:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 6:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

INFLUENT Sample 7:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 7:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

INFLUENT Sample 8:

- Sample Time (24-hour clock): _______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: ________
- 1 – 1,000 mL polyethylene bottle for **TSS**: ________

Lag Time: _______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 8:

- Sample Time (24-hour clock): _______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: ________
- 1 – 1,000 mL polyethylene bottle for **TSS**: ________

==

INFLUENT Sample 9:

- Sample Time (24-hour clock): _______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: ________
- 1 – 1,000 mL polyethylene bottle for **TSS**: ________

Lag Time: _______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 9:

- Sample Time (24-hour clock): _______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: ________
- 1 – 1,000 mL polyethylene bottle for **TSS**: ________

==

INFLUENT Sample 10:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

Lag Time: ______ min

Comments: (Provide reasons for deviation from lag time procedures)

____

____

EFFLUENT Sample 10:

- Sample Time (24-hour clock): ______________
- 1 – 120 mL polyethylene bottle (includes sodium thiosulfate preservative)
  for ***E. coli*** and **Fecal Coliform**: _______
- 1 – 1,000 mL polyethylene bottle for **TSS**: _______

==

Note:

Additional bottles sets are included for field duplicates and field blanks

(Check if applicable): _______

Other Observations:

____

____

____

ATTACHMENT 2

EXAMPLE CHAIN OF CUSTODY FORMS

County of Orange, Health Care Agency
Water Quality Laboratory
700 Shellmaker Rd.
Newport Beach, CA 92660
PHONE: (949) 219-0423 FAX: (949) 219-0426

ELAP #2545

STUDY:

SUBMITTING AGENCY:

WEATHER:

To be completed by Field Sampler	To be completed by Laboratory

FIELD DATA / **LABORATORY REPORT**

Date Collected | Date Received___ Received by___
Sampler | Time In___ Time Run___ Date/Time Read___

Constituent	Time	Sample Type (Grab, Duplicate, Equipment Blank)	Station Number / Location of Sampling Station	Total Suspended Solids	Fecal Coliforms		Escherichia coli		
				TSS	m-FC Agar		m-TEC		Report Date/ Initials
				mg TSS/1L	CFU's	CFU/100ml	CFU's	CFU/100ml	
Laboratory No.									

FIELD DATA / **LABORATORY REPORT**

Date Collected | Date Received___ Received by___
Sampler | Time In___ Time Run___ Date/Time Read___

Constituent	Time	Sample Type (Grab, Duplicate, Equipment Blank)	Station Number / Location of Sampling Station	Total Suspended Solids	Fecal Coliforms		Escherichia coli		
				TSS	m-FC Agar		m-TEC		Report Date/ Initials
				mg TSS/1L	CFU's	CFU/100ml	CFU's	CFU/100ml	
Laboratory No.									

FIELD DATA / **LABORATORY REPORT**

Date Collected | Date Received___ Received by___
Sampler | Time In___ Time Run___ Date/Time Read___

Constituent	Time	Sample Type (Grab, Duplicate, Equipment Blank)	Station Number / Location of Sampling Station	Total Suspended Solids	Fecal Coliforms		Escherichia coli		
				TSS	m-FC Agar		m-TEC		Report Date/ Initials
				mg TSS/1L	CFU's	CFU/100ml	CFU's	CFU/100ml	
Laboratory No.									

FIELD DATA / **LABORATORY REPORT**

Date Collected | Date Received___ Received by___
Sampler | Time In___ Time Run___ Date/Time Read___

Constituent	Time	Sample Type (Grab, Duplicate, Equipment Blank)	Station Number / Location of Sampling Station	Total Suspended Solids	Fecal Coliforms		Escherichia coli		
				TSS	m-FC Agar		m-TEC		Report Date/ Initials
				mg TSS/1L	CFU's	CFU/100ml	CFU's	CFU/100ml	
Laboratory No.									

SUBMITTOR INFORMATION / SUBMITTOR NUMBER

Field or Lab Remarks:

ORANGE COUNTY WATER DISTRICT

10500 Ellis Avenue, Fountain Valley, CA 92708

Telephone: (714) 378-3200 Fax: (714) 378-3373

CHAIN OF CUSTODY RECORD

NO.	SAMPLING AGENCY	WRMS STATION NAME	Sample Date	Sample Time	Sampled BY	COMMENTS		NO. OF Bottles	ANALYSIS
1						EC=	Ph=		
						TEMP=	DO=		
2						EC=	Ph=		
						TEMP=	DO=		
3						EC=	Ph=		
						TEMP=	DO=		
4						EC=	Ph=		
						TEMP=	DO=		
5						EC=	Ph=		
						TEMP=	DO=		
6						EC=	Ph=		
						TEMP=	DO=		
7						EC=	Ph=		
						TEMP=	DO=		
8						EC=	Ph=		
						TEMP=	DO=		
9						EC=	Ph=		
						TEMP=	DO=		
10						EC=	Ph=		
						TEMP=	DO=		

RELINQUISHED BY:	DATE/TIME	ED BY:	
RELINQUISHED BY:	DATE/TIME	ED BY:	DATE/TIME
SPECIAL INSTRUCTIONS:	**BILL ACCOUNT NO.:**		

Dr. Wuertz

University of California, Davis Civil & Environmental Engineering TEL: 530.754.6407 FAX: 530 752 7872

CHAIN-OF-CUSTODY **DATE** **Lab**

Origination							REQUESTED								
ADDRESS															
PHONE															
FAX															
SAMPLED															
PROJECT:															
Wuertz															
Wuertz PROJECT															
Client Sample	Sample Date	Sample Time	Sample Matric	Container											Note
				#	Type	Pres.									

SENDER	RELIQUINSHED	
	Signature:	
	Print	
	Company	
	Date:	Time
LABORATORY	RECEIVED	
	Signature:	
	Print	
	Company	
	Date:	Time

ATTACHMENT 3

FLOW MEASUREMENT FORM

FLOW MEASUREMENTS

Location ________

Portable Flowmeter Used ________________ Recorder ________

Date ________

Time ________

Left Bank ________________ Right Bank ____________ Page ___ of ___

	Distance from IP	Width	Total Depth	Flow Velocity				Average V*	Area A**	Discharge (avg VXA)
				VO.6	VO.2	VO.8	VO.9			
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
									Total Discharge	

Stream Flow Conditions (I.e., muddy, clear, debris, etc…): ______________________

____

* Average Velocity =VO.6 for stream depths between 0.3 and 2.5 feet (six-tenths method).
=(VO.2 + VO.8)/2 for stream depths greater than 2.5 feet (two-point method).
=VO.9 if flow is less than 0.3 feet deep (maximum velocity X 0.9).

** Area =total depth x width

IP =Initial Point

APPENDICES

APPENDIX A

ORANGE COUNTY PUBLIC HEALTH WATER QUALITY LABORATORY STANDARD OPERATING PROCEDURES

APPENDIX B

ORANGE COUNTY WATER DISTRICT LABORATORY STANDARD OPERATING PROCEDURES

APPENDIX C

UNIVERSITY CALIFORNIA DAVIS LABORATORY STANDARD OPERATING PROCEDURES

APPENDIX D

MSAR PATHOGEN TMDL WORKGROUP CONTACT LIST

MSAR Pathogen Workgroup Distribution List

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Linda Candelaria	lcandelaria@waterboards.ca.gov
Linda Garcia	lcgarcia@co.riverside.ca.us
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