Year 3 Data Report and Quality Assurance Evaluation

For the Pilot Study of Constituents of Emerging Concern During Fiscal Year 2023-24

Version 1.0
Approved by the Board of Directors
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Prepared By:

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LIST OF ABBREVIATIONS AND ACRONYMS

ASTM	American Society of Testing and Materials
BPA	Bisphenol A
CDEC	California Data Exchange Center
CEC	Constituents of Emerging Concern

CEDEN	California Environmental Data Exchange Network
CV RDC	Central Valley Regional Data Center
CVRWQCB	Central Valley Regional Water Quality Control Board
DO	Dissolved Oxygen
DRMP	Delta Regional Monitoring Program
DWR	California Department of Water Resources
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
ESI	Electrospray Ionization
FY	Fiscal Year
GC/MS	Gas Chromatography/Mass Spectrometry
IDA	Isotope Dilution Analogue
LC/MS/MS	Liquid Chromatography/Tandem Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
MLJ	MLJ Environmental
MPSL-MLML	Marine Pollution Studies Laboratory at Moss Landing Marine Laboratories
MQO	Measurement Quality Objective
MRM	Multiple Reaction Mode
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ND	Non-Detect
NTU	Nephelometric Turbidity unit
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PPCP	Pharmaceutical and Personal Care Product
POTW	Publicly Owned Treatment Works
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SOP	Stand Operating Procedure

SSC	Suspended Sediment Concentration
SWAMP	State Water Resources Control Board's Surface Water Ambient Monitoring Program
SWRCB	State Water Resource Control Board
TAC	Technical Advisory Committee
TOC	Total Organic Carbon
UPLC/MS/MS	Ultra-Performance Liquid Chromatography/Tandem Mass Spectrometry
USGS	United States Geological Survey
YSI	Yellow Springs Instruments

LIST OF UNITS

°C	degrees Celsius
cfs	cubic feet per second
cm	centimeter
ft	feet
km	kilometer
L	liter
m	meter
mg	milligram
mL	milliliter
ng	nanogram
ng/L	nanogram per liter
NTU	Nephelometric Turbidity Unit
µg	microgram
µS	microsiemen

INTRODUCTION

BACKGROUND

This Year 3 Data Report summarizes the Delta Regional Monitoring Program's (DRMP's) sample collection, laboratory analysis, and data verification for Year 3 as part of the *Central Valley Pilot Study for Monitoring Constituents of Emerging Concern (CECs) Work Plan* (Stakeholder Work Plan). Implementation of the Stakeholder Work Plan by the DRMP is referred to as the CEC Pilot Study. The CEC Pilot Study includes a three-year study design beginning in 2020 for Year 1 and continuing through June 2022 for Year 2. Year 3 sampling was conducted under the study design approved in the Fiscal Year (FY) 22-23 Monitoring Workplan in October and November of 2023.

Year 3 CEC monitoring and data management was conducted under the *Quality Assurance Project Plan for the Pilot Study of Constituents of Emerging Concern under the Sacramento-San Joaquin Delta Regional Monitoring Program, Version 3.3* (CEC QAPP (v3)). The CEC Quality Assurance Project Plan (QAPP) was revised ahead of the third year of monitoring, with the final revision receiving approval from all signatories, including the State Water Resource Control Board (SWRCB) Quality Assurance (QA) Officer on October 9, 2023. The Data Management Team follows the guidance outlined in the QAPP and performs data review and verification to ensure data submitted by laboratories are timely, complete, and properly incorporated in the Regional Data Center database.

ANALYTICAL SCOPE

Year 3 CEC monitoring included the sampling and analysis for two major groups of CEC analytes: per- and polyfluoralkyl substances (PFAS) and pharmaceutical and personal care products (PPCPs) in water. In addition, two ancillary parameters, turbidity and suspended sediment concentration (SSC) were analyzed. The analyses conducted for Year 3 monitoring are defined in **Table 1** .

The specific CECs analyzed within each constituent group are consistent with the water parameters monitored for Years 1 and 2. A complete list of the analytical constituents is provided in **Appendix B**, **Table B.1.** Field measurements for dissolved oxygen (DO), pH, specific conductivity, temperature, and flow are collected during each sampling event alongside the collection of samples for chemical analysis (**Table 1**).

Table 1. Analytical scope of CEC Year 3 monitoring.

Analyte Category	Matrix	Fraction	Analyte/Parameter
Field Measures	Water	Total	Dissolved Oxygen
Field Measures	Water	NA	pH
Field Measures	Water	Total	Specific Conductivity [1]
Field Measures	Water	NA	Temperature
Field Measures	Water	NA	Midstream Depth [2]
Field Measures	Water	NA	Flowrate [2]
PFAS	Water	Total	Per- and Polyfluoroalkyl Substances (PFAS) [3]
PPCPs	Water	Total	Galaxolide
PPCPs	Water	Total	Pharmaceuticals [3]
PPCPs	Water	Total	Hormones [3]
Ancillary	Water	Particulate	Suspended Sediment Concentration (SSC)
Ancillary	Water	Total	Turbidity

[1] Specific conductivity may also be referenced as specific conductance. Specific conductivity is the naming convention followed by CEDEN and is defined as electrical conductivity at 25°C.
[2] Flow and depth measurements will only be collected at Year 3 gradient study sites. These measurements will not be collected at the two urban runoff sites.
[3] See **Appendix B Table B.1** for complete list.

INVOLVED ORGANIZATIONS

The CEC Year 3 monitoring includes five organizations performing administrative, laboratory, and/or field tasks. Organization details are included in **Table 2**.

Table 2. Involved organizations for CEC Year 3 monitoring.

Organization	Task(s)
Marine Pollution Studies Laboratory at Moss Landing Marine Laboratories (MPSL-MLML)	Data Management, Quality Assurance
MLJ Environmental (MLJ)	Project Management, Data Management, Quality Assurance, Sample Collection
Enthalpy Analytical Laboratory	Sample Analysis – PFAS (water)
Physis Environmental Laboratories, Inc.	Sample Analysis – PPCPs (water)
Weck Laboratories, Inc.	Sample Analysis – PPCPs (water)

[1] Enthalpy Analytical Laboratory purchased Vista Analytical Laboratory. Accreditation and CEDEN agency codes are currently maintained under Vista.

SAMPLING OVERVIEW

Sampling information and locations for Year 3 CEC monitoring are summarized in **Table 3** and detailed in the sections that follow.

Table 3. Sampling event information for CEC Year 3 CEC monitoring.

Event	CEDEN Station Code	CEDEN Station Name	Site ID	Station Type	Agency	Latitude	Longitude	Date	Time
1	519SACUR3	Sacramento Urban Runoff 3; Sump 111	MS4	Runoff	MLJ	38.60127	-121.49296	10/16/2023	9:30
1	519PGC010	Roseville Urban Runoff	MS4	Runoff	MLJ	38.80477	-121.32733	10/16/2023	10:50
1	511POTW02	POTW Source 2	EFF	Effluent	MLJ	38.34664	-121.90156	10/18/2023	9:00
1	511OACCLN	Old Alamo Creek at Chicorp Ln.	R1	Gradient Study Area 2	MLJ	38.347147	-121.887617	10/18/2023	10:30
1	511OACSBL	Old Alamo Creek at Sunnybrook Ln.	R2	Gradient Study Area 2	MLJ	38.344197	-121.869089	10/18/2023	11:10
1	511OACUNA	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	R3	Gradient Study Area 2	MLJ	38.329869	-121.869231	10/18/2023	12:00
1	511NACUOA	New Alamo Creek upstream of confluence with Old Alamo Creek	R4	Gradient Study Area 2	MLJ	38.329939	-121.888569	10/18/2023	12:30
1	511NACDOA	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	R5	Gradient Study Area 2	MLJ	38.329789	-121.860019	10/18/2023	13:30
1	511NACARD	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	R6	Gradient Study Area 2	MLJ	38.336511	-121.823136	10/18/2023	14:30
1	519DRYCRK	Dry Creek at Roseville WWTP	R0	Gradient Study Area 1	MLJ	38.7341	-121.31444	10/19/2023	8:30
1	519POTW01	POTW Source 1	EFF	Effluent	MLJ	38.73402	-121.32185	10/19/2023	9:30
1	519DRYCRB	Dry Creek at Cook Riolo Rd bridge	R1	Gradient Study Area 1	MLJ	38.73672	-121.33670	10/19/2023	10:50
1	519DRYWAB	Dry Creek at Watt Ave bridge	R2	Gradient Study Area 1	MLJ	38.73456	-121.39290	10/19/2023	11:50
1	519DRYRLB	Terminus of Dry Creek at Rio Linda Blvd	R3	Gradient Study Area 1	MLJ	38.67109	-121.45415	10/19/2023	13:30
1	519SHCDDC	Steelhead Creek main stem downstream of confluence with Dry Creek	R5	Gradient Study Area 1	MLJ	38.66407	-121.47720	10/19/2023	15:00
1	519SHCDRC	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	R7	Gradient Study Area 1	MLJ	38.6565	-121.475453	10/19/2023	16:00
2	519SACUR3	Sacramento Urban Runoff 3; Sump 111	MS4	Runoff	MLJ	38.60127	-121.49296	10/30/2023	8:50

Event	CEDEN Station Code	CEDEN Station Name	Site ID	Station Type	Agency	Latitude	Longitude	Date	Time
2	519PGC010	Roseville Urban Runoff	MS4	Runoff	MLJ	38.80477	-121.32733	10/30/2023	10:10
2	519DRYCRK	Dry Creek at Roseville WWTP	R0	Gradient Study Area 1	MLJ	38.7341	-121.31444	11/1/2023	8:50
2	519POTW01	POTW Source 1	EFF	Effluent	MLJ	38.73402	-121.32185	11/1/2023	9:20
2	519DRYCRB	Dry Creek at Cook Riolo Rd bridge	R1	Gradient Study Area 1	MLJ	38.73672	-121.33670	11/1/2023	11:30
2	519DRYWAB	Dry Creek at Watt Ave bridge	R2	Gradient Study Area 1	MLJ	38.73456	-121.39290	11/1/2023	12:30
2	519DRYRLB	Terminus of Dry Creek at Rio Linda Blvd	R3	Gradient Study Area 1	MLJ	38.67109	-121.45415	11/1/2023	13:30
2	519SHCDDC	Steelhead Creek main stem downstream of confluence with Dry Creek	R5	Gradient Study Area 1	MLJ	38.66407	-121.47720	11/1/2023	14:40
2	519SHCDRC	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	R7	Gradient Study Area 1	MLJ	38.6565	-121.475453	11/1/2023	15:30
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2	511NACDOA	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	R5	Gradient Study Area 2	MLJ	38.329789	-121.860019	11/1/2023	14:30
2	511NACARD	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	R6	Gradient Study Area 2	MLJ	38.336511	-121.823136	11/1/2023	16:00

STUDY BACKGROUND

A stakeholder group of National Pollutant Discharge Elimination System (NPDES) dischargers, the Central Valley Water Board, the SWRCB, and United States Environmental Protection Agency (USEPA) developed the *Central Valley Pilot Study for Monitoring Constituents of Emerging Concern (CECs) Work Plan* (Stakeholder Work Plan). The Stakeholder Work Plan provides details to implement the CEC Pilot Study based on the guidance provided by the SWRCB 2016 Statewide Monitoring Plan (Tadesse 2016). This CEC Pilot Study is the DRMP's implementation of the Stakeholder Work Plan as part of a statewide pilot study of CECs being conducted in different regions of California following a mandate and guidelines by the SWRCB. The stated goals in the statewide guidance document are:

> "This statewide pilot study implements the second phase of the recommendation which is to gather data to determine the occurrence and biological impacts of CECs. The result of this pilot study will help the State Water Board to develop a statewide CEC monitoring strategy and control action."
>
> "The objective of the CEC statewide pilot study monitoring plan is to generate statewide data to inform Water Board managers of the status and trends of CECs in water. The plan is designed to narrow the data gap among regions by producing comparable CEC data throughout the state."

As part of the CEC Pilot Study the DRMP collected samples for targeted chemistry analyses from ambient and source locations over a three-year period with phased study components and adaptive management elements as follows:

- Year 1 – ambient monitoring. The first year of monitoring includes ambient monitoring to assess the presence of the targeted CECs at specific locations in the Delta.
- Year 2 – ambient and source monitoring. The second year of monitoring continues the ambient monitoring conducted during the first year and adds source characterization sites to monitor Publicly Owned Treatment Works (POTW) effluent and urban runoff.
- Year 3 – gradient study. The third year continues only the source monitoring from Year 2 and adds gradient sampling upstream and downstream of POTWs and other identified sources.

Year 1 monitoring was completed in June 2021 (DRMP CEC Year 1 Data Report) and Year 2 monitoring was completed in June of 2022 (DRMP CEC Year 2 Data Report). The specific details of Year 3 monitoring were defined in the study design provided in the Fiscal Year (FY) 22-23 Monitoring Workplan submitted May 1, 2023.

Year 3 Objectives

The DRMP designed the Year 3 gradient study to characterize the spatial concentrations of CECs downstream from POTW discharges to effluent-dominated inland waters as identified in the Statewide CEC Pilot Study Monitoring Plan, namely, Dry Creek in Roseville, CA (Year 3 Gradient Study Area 1) and Old Alamo Creek near Vacaville, CA (Year 3 Gradient Study Area 2). The Year 3 gradient study design focuses on answering the following questions:

1. For each of the CEC constituents, what is the attenuation at distances downstream from the POTW discharge?
2. For each of the CEC constituents, can the relative magnitude of the type of attenuation (hydraulic or degradation/inputs) be quantified based on a simple mass balance with available flow, travel time, and concentration measurements or estimates?

This Year 3 gradient study evaluates two POTW effluent gradients, each consisting of one upstream site, one POTW effluent site, and up to five downstream sites in Old Alamo Creek and Dry Creek. Municipal separate storm sewer systems (MS4) urban runoff monitoring sites were sampled in Roseville and Sacramento that do not directly inform the Year 3 gradient study but are part of the full three-year CEC study. For each of the two events, the DRMP collected water or effluent samples at a total of sixteen site locations. The Year 3 constituents monitored included all CECs analyzed in water samples in Years 1 and 2 as recommended by the CEC TAC upon review of the previous results. In addition, Bisphenol A (BPA) was detected in method blanks and/or field blanks in previous monitoring years at concentrations similar to environmental concentrations. Therefore, BPA was recommended for additional Year 3 sample collection and analysis by multiple laboratories (i.e., laboratory replicates).

The Year 3 results discussed in this report are the final CEC Pilot Study dataset collected under the Stakeholder Work Plan. The Stakeholder Work Plan is then completed with this Year 3 Data Report, however, the DRMP may choose to perform additional interpretation or planning for future CEC monitoring. Results from all three years of the study will be used by the DRMP and the SWRCB to inform regional and statewide assessments of future CEC monitoring needs.

Year 3 Sampling Events

Year 3 CEC monitoring occurred over two sampling events in October and November of 2023. Event 1 occurred October 16 through 19, 2023 and Event 2 occurred October 30 through November 1, 2023. Both events were scheduled to capture dry weather conditions prior to the first major storm event, as required by the CEC QAPP (v3); sampling event criteria are provided in **Table 4**. Event 1 sampling was delayed from the originally planned time period while the CEC QAPP was under final review. Rainfall did occur between sampling Events 1 and 2, as defined in **Table 5**; however, all antecedent weather conditions defined in **Table 4** were met and both sampling events are considered dry weather events as defined by the CEC QAPP (v3).

Table 4. Sample event timing criteria for Year 3 CEC monitoring (reproduced from Table 13 of the CEC QAPP (v3)).

SAMPLING EVENT	SAMPLE COLLECTION	SAMPLING PERIOD	ADDITIONAL CRITERIA
Events 1 and 2	MS4 Urban Runoff Sampling	Within 3 days of each gradient monitoring.	None
Events 1 and 2	Pre-Sampling Reconnaissance	Two days prior to gradient monitoring.	Sampling Plan will be developed prior to gradient collection.
Event 1	Year 3 Gradient Study Event 1	August through September 2023	No rainfall greater than 0.1 inches within the study area for 72 hours prior to sampling.
Events 2	Year 3 Gradient Study Event 2	September through October 2023	The second sampling event must occur at least two weeks after the first sampling event. No rainfall greater than 0.1 inches within the study area for 72 hours prior to sampling.

Table 5. Antecedent precipitation (24-hour totals) for Year 3 CEC monitoring.
Gray highlighted rows indicate sampling dates for Event 1 and Event 2 monitoring. Precipitation events are noted with bolded and italicized numbers.

DATE	GRADIENT STUDY AREA 1 [1] (INCHES)	GRADIENT STUDY AREA 2 [2] (INCHES)
10/13/2023	0.0	0.0
10/14/2023	0.0	0.0
10/15/2023	0.0	0.0
10/16/2023	0.0	0.0
10/17/2023	0.0	0.0
10/18/2023	0.0	0.0
10/19/2023	0.0	0.0
10/20/2023	0.0	0.0
10/21/2023	0.0	0.0
10/22/2023	***1.19***	***0.30***
10/23/2023	0.0	***0.01***

Date	Gradient Study Area 1 [1] (Inches)	Gradient Study Area 2 [2] (Inches)
10/24/2023	0.0	0.0
10/25/2023	***0.04***	0.0
10/26/2023	0.0	0.0
10/27/2023	0.0	0.0
10/28/2023	0.0	0.0
10/29/2023	0.0	0.0
10/30/2023	0.0	0.0
10/31/2023	0.0	0.0
11/01/2023	0.0	0.0

[1] Rainfall for Year 3 Gradient Study Area 1 was determined using the Rio Linda (RLN) station from the Department of Water Resources (DWR) California Data Exchange Center (CDEC; https://cdec.water.ca.gov/dynamicapp/staMeta?station_id=RLN)
[2] Rainfall for Year 3 Gradient Study Area 2 for the Travis AFB (KCATRAVI7, KSUU) station was obtained from Weather Underground (https://www.wunderground.com/history/daily/us/ca/travis-afb/KSUU/date/2023-10-09); the DWR CDEC precipitation gauge defined in the CEC Year 3 QAPP was inoperable during the sample period.

Year 3 Monitoring Locations

The Year 3 CEC monitoring was conducted at the same source sites that were monitored in Year 2 with the addition of Year 3 gradient study sites along the effluent receiving water (**Figure 1** and **Figure 2**). The source sites added for Year 3 monitoring include two urban runoff sites and two POTW effluent locations (**Table 3**). Year 3 gradient sites were selected from the list of approved locations provided in the CEC QAPP (v3) according to the selection criteria based on downstream sites with sufficient flow to be used in the Year 3 gradient study.

Year 3 gradient study locations were positioned along the receiving tributary, main stem, or input tributaries downstream of each POTW effluent location. Each Year 3 gradient study area was assigned seven preferred sample locations to assess the effluent, an upstream input, and five downstream locations. Given the dry season conditions in which sampling was scheduled to occur, up to four alternate sites further downstream on the main stem and input tributaries were also identified such that a total of seven samples could be collected if the upstream input site and/or the main stem input site did not have flowing water to be sampled. All Year 3 monitoring locations were consistent with the CEC QAPP (v3).

Figure 1. Year 3 Gradient Study Area 1 monitoring locations for Year 3 CEC monitoring.

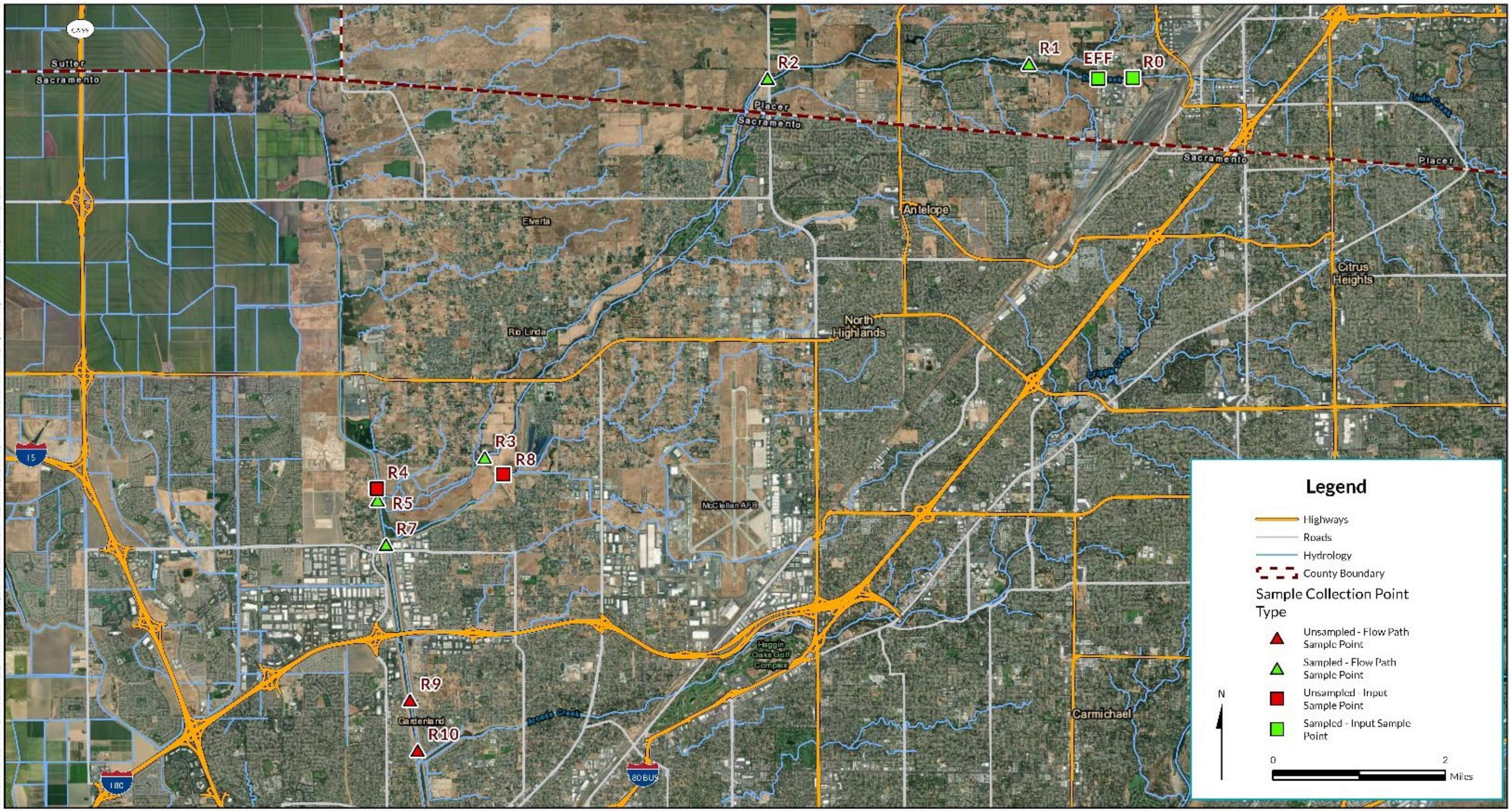
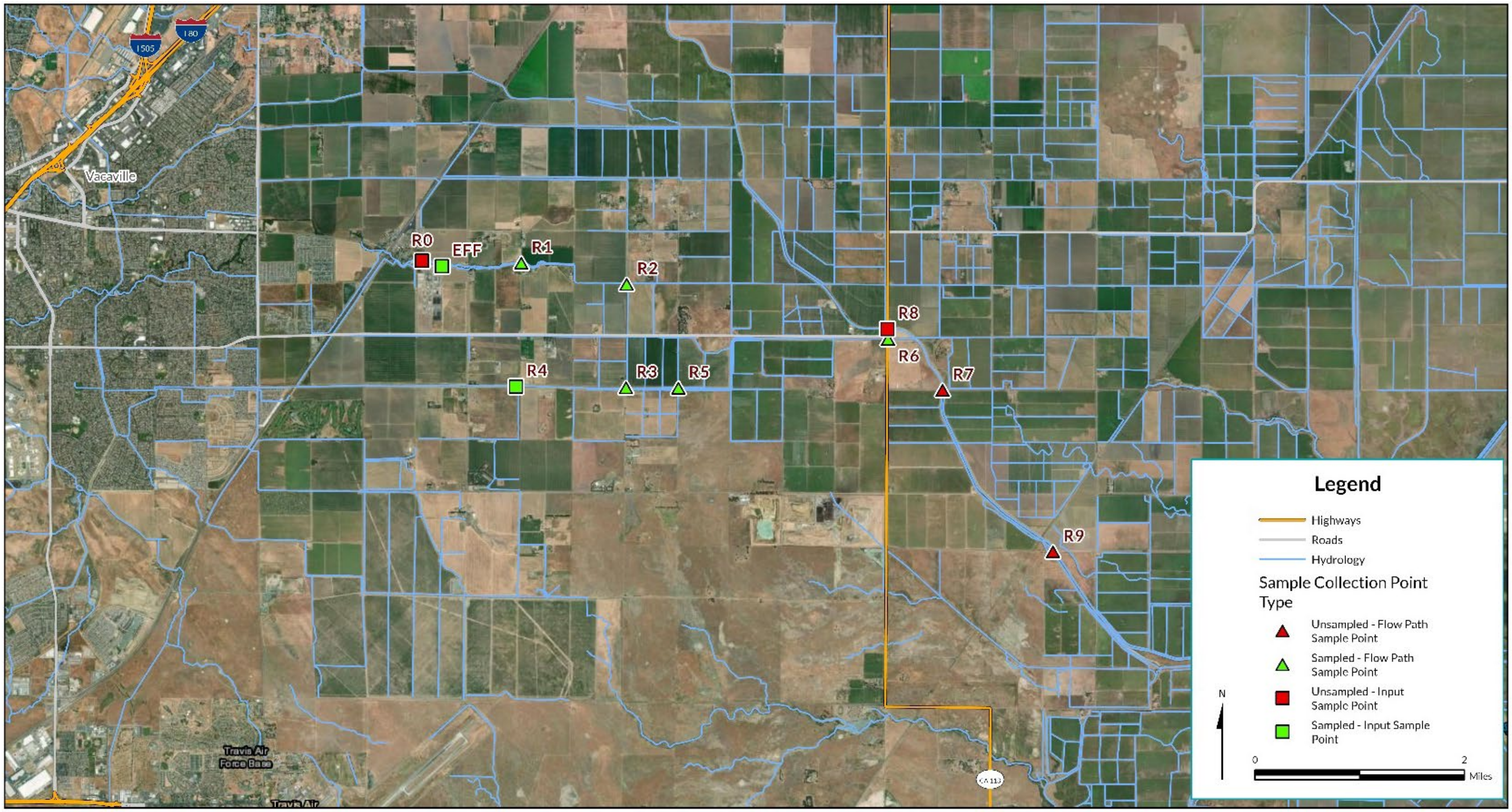


Figure 2. Year 3 Gradient Study Area 2 monitoring locations for Year 3 CEC monitoring.



SAMPLING METHODS

Sampling for Events 1 and 2 was conducted by MLJ field crews at sites shown in **Figure 1** and **Figure 2** following procedures described in the CEC QAPP (v3). Water samples were collected for analysis of the CECs listed in **Appendix B** and field measurements were taken alongside all sample collections.

Water samples were collected from 16 locations for each Year 3 sampling event (**Table 3, Figure 1, Figure 2**). Sites were sampled as mid-stream, mid-depth ambient grab samples, unless otherwise specified (i.e., cross sectional composites downstream from mixing points at confluences). Cross sectional composite samples were collected by filling the sample bottle one-third for each of three mid-third, mid-depth locations in a transect across the main stem. If water was not wadable, shore grab samples were collected as close to mid-stream as possible considering conditions and safety concerns.

Field crews calculated volumetric flow (discharge) at all Year 3 gradient sites per the CEC QAPP (v3). Methods for measuring discharge are detailed in Appendix I of the CEC QAPP (v3), Field Sampling Procedures. Wherever the waterbody was wadable, field crews collected in-stream velocity measurements using a HACH FH 950 electromagnetic velocity meter and a top-setting wading rod. Measurements were taken at no more than five points along the cross section of each water body to minimize sediment disturbance and meet gradient study time constraints. Vertical measurement points were selected according to the total depth based on the USGS Current Meter Measurements by Wading protocol (USGS, 2010; depth intervals selected based on comparable meter, Price Type AA, Table 6). Velocity measurements for each location along a cross section were used to calculate partial discharge for the representative area and summed to estimate the total volumetric flow across entire channel.

When a site was not wadable or flow was otherwise unmeasurable, field staff used the surface float method to estimate volumetric flow rates. Average surface velocity was obtained by taking three successive measurements of the time required for a floating object to travel the length of a 10-meter segment of the water body. Depth was estimated using a top-setting wading rod placed as close to the maximum depth as could be safely accessed. Volumetric flow was then estimated using the measured channel geometry and adjusted by a roughness coefficient of 0.8 (for rougher substrate) or 0.85 (for smoother substrate conditions). Roughness coefficients were selected based on Surface Water Ambient Monitoring Program (SWAMP) guidelines; however, these guidelines note that the selection of these coefficients can be imprecise, and sources differ in recommendations for seemingly similar conditions. More recent studies indicate that surface float methods may overestimate discharge and lower coefficients (0.61 to 0.69) may be more appropriate (Stepenuck et al. 2024).

Water samples were collected directly into sample bottles wherever possible or, where sample containers were pre-charged with preservatives, poured off from a pre-cleaned bottle of the same material as the sample bottle. Water samples were stored in coolers with double-bagged wet ice from time of collection until delivery to the laboratory. Field crews collecting and handling water samples for PFAS analysis adhered to the contamination prevention protocols outlined in the CEC QAPP (v3) and CEC Field Sampling SOP. Water samples collected by all field crews were delivered to MLJ Environmental under standard Chain of Custody protocols; MLJ staff submitted all samples to the associated laboratory by shipment or hand delivery.

SAMPLE COLLECTION COMPLETENESS

Sample collection completeness is based on the number of samples successfully collected and transported to the laboratory for analysis compared to each analysis scheduled for each site over all events in the year. Completeness counts by individual constituent are provided in Appendix **Table C.2**. All 629 samples scheduled for Year 3 monitoring were successfully collected and transferred to the appropriate laboratories. Year 3 sample collection completeness was 100%.

FIELD ACTIVITIES

Field reports for Year 3 CEC sample collection are provided in **Appendix A**; collection activities are summarized below.

Event 1

Sampling Event 1 for CEC monitoring was completed from October 16, 2023, through October 19, 2023, according to the schedule outlined in **Table 6**. All activities were completed as planned with the exception of collecting the POTW 1 study area sample on Thursday, October 19, 2023, a postponement of one day from the schedule. The conditions leading to this decision are provided below.

Year 3 gradient study area monitoring was targeted for dates with antecedent dry conditions (i.e., rainfall ≤ 0.1 inches) of at least 72 hours (**Table 4**). No prior rainfall was recorded at either Year 3 gradient study area prior to sample collection on October 18 and 19, 2023.

Table 6. Event 1 monitoring schedule summary.

Date	Field Prep/Cleanup	Urban Site Monitoring	POTW 1 Area Monitoring	POTW 2 Area Monitoring
Monday, 10/16/2023	Equipment/materials preparation	Sample Collection	Site Reconnaissance	Site Reconnaissance

Date	Field Prep/Cleanup	Urban Site Monitoring	POTW 1 Area Monitoring	POTW 2 Area Monitoring
Tuesday, 10/17/2023	Reconnaissance report submitted to DRMP and CVRWQCB. Equipment/materials preparation	--	R5 Site Visit	--
Wednesday, 10/18/2023	Equipment/materials preparation	--	R5 Site Visit	Sample Collection
Thursday, 10/19/2023	--	PPCP sample shipment	Sample Collection	PPCP sample shipment
Friday, 10/20/2023	Post-calibration and equipment cleaning.	PFAS sample delivery	PFAS sample delivery	PFAS sample delivery
Monday, 10/23/2023	Field data entry	--	PPCP sample shipment	--

MLJ field crews successfully collected the urban runoff samples and completed gradient field reconnaissance on Monday, October 16, 2023. MLJ staff developed a gradient Sample Plan based on the observed conditions, which was submitted to the DRMP Program Manager and CVRWQCB QA Representative on the morning of Tuesday, October 17, 2023.

During the site reconnaissance for the POTW 1 study area, field crews noted that Sacramento County staff were in the process of pumping water out of the area of Steelhead Creek upstream of the flow control structure into the confluence area with Dry Creek near the sample area at R5. Field crews spoke with the personnel operating the pump, who indicated that their activities would be completed by the end of the day Monday. Field crews visited the site again on Tuesday to verify no activity was occurring, prior to beginning the gradient sampling on Wednesday, October 18, 2023. No activity was observed on Tuesday; however, during the Wednesday site visit, pumping crews were again present and operating the pump. As a result, field crews were instructed not to begin the POTW 1 sampling that day.

Field crews remained in contact with the pump operators and confirmed that pumping ceased on Wednesday the 18th. Field crews were instructed to resume sampling as scheduled on Thursday, October 19, 2023, after verifying that no pumping activity was occurring or planned upstream of R5. Given that the distance from the pumping location to the sampling location is approximately 100 meters, and that the mean velocity measured by field crews at the time of sampling was 0.23 meters per second, the pumped water upstream of the R5 location would be anticipated to be carried through the collection site within approximately seven minutes of ceasing pumping. Sample collection occurred at 3:00 PM on October 19, 2023, and was therefore unlikely to be influenced by the pumping activities that ceased approximately 15 hours prior. No other anomalies of note occurred during the POTW 1 area sampling.

Sampling for the POTW 2 study area was completed as scheduled on October 18, 2023. Sampling crews noted that discharge into Old Alamo Creek was occurring from adjacent irrigation canals at the R2 location. All other parameters were as expected during the POTW 2 area sampling.

One deviation from the CEC QAPP (v3) occurred due to the direction to postpone the sample collection to the following day, October 19, 2023. The additional sample collection day raised concerns regarding the ability to ship samples to labs located in Southern California prior to the weekend; therefore, field crews measured turbidity in the field when samples were collected. This measurement avoided hold time violations that would have occurred by collecting a turbidity sample for laboratory analysis. See **Deviations and Corrective Actions** for further discussion.

Quality Control Samples

Quality control (QC) samples were collected as outlined in **Table 7**. All scheduled QC samples were successfully collected as required by the CEC QAPP (v3).

Table 7. Event 1 quality control sample summary.

QC Sample Location	Sample Date	QC Type	Analytes	Scheduled/ Alternate
POTW 2, R4: 511NACUOA	10/18/2023	Equipment Blank – Conbar Dipper	PFAS, PPCPs, Turbidity, SSC	Scheduled
POTW 1, EFF: 519POTW01	10/19/2023	Equipment Blank - Bailer	PFAS, PPCPs, SSC	Scheduled
POTW 1, R3: 519DRYRLB	10/19/2023	Field Blank, Field Duplicate	PFAS, PPCPs, SSC	Scheduled

Sample Delivery

All samples were successfully delivered to the laboratories within the required time limits. Sample transfer delivery information is provided in **Table 8**. Samples were transported to MLJ offices and to laboratories in coolers with double bagged wet ice. Samples held in MLJ custody for an extended period of time were maintained within the required temperature ranges (0 to 6°C) in a secured refrigerator until time of shipping.

Table 8. Event 1 sample transfer and delivery information.

Date/Time Samples Shipped	Laboratory	Shipping Company	Comments
10/19/23 – 11:00	Weck and Physis	FedEX	First shipment from samples collected on 10/16 and 10/18.

Date/Time Samples Shipped	Laboratory	Shipping Company	Comments
10/20/23 – 15:00	Enthalpy	Direct delivery to lab by MLJ staff	PFAS samples from 10/16, 10/18, and 10/19 delivered directly to Enthalpy (Vista)
10/23/23 – 11:00	Weck and Physis	FedEX	Second shipment from samples collected on 10/19.

Event 2

Sampling Event 2 for CEC monitoring was scheduled to occur from October 30 through November 1, 2023. All activities were completed as planned for Event 2.

Table 9. Event 2 monitoring schedule summary.

Date	Field Prep/Cleanup	Urban Site Monitoring	POTW 1 Area Monitoring	POTW 2 Area Monitoring
Monday, 10/30/2023	Equipment/materials preparation	Sample Collection	Site Reconnaissance	Site Reconnaissance
Monday, 10/30/2023	Reconnaissance report submitted to DRMP and CVRWQCB. Equipment/materials preparation	--	--	--
Wednesday, 11/1/2023	Equipment/materials preparation	--	Sample Collection	Sample Collection
Thursday, 11/2/2023	Post-calibration and equipment cleaning.	Sample Shipment	Sample Shipment	Sample Shipment
Friday, 11/3/2023	Field data entry	--	--	--

Field crews successfully collected the urban runoff samples and completed gradient field reconnaissance on Monday, October 30, 2023. MLJ staff developed a gradient Sample Plan based on the observed conditions, which was submitted to the DRMP Program Manager and CVRWQCB QA Representative on the evening of Monday, October 30, 2023.

Sampling for the POTW 1 and 2 study areas were completed as scheduled on November 1, 2023. For the POTW 1 study area, sampling crews observed that the wet well area at the structure upstream of the R5 site from which pumping was occurring prior to Event 1 was completely dry, indicating no pumping occurred during Event 2. Likewise, for the POTW 2 area sampling crews noted that discharge into Old Alamo Creek was not occurring from adjacent irrigation canals at the R2 location as the adjacent channels were dry.

Though all antecedent precipitation requirements were met for each study area there were storm events that occurred in the region on October 22 and 25, 2023, seven and 10 days prior to sampling (**Table 5**). Nevertheless, no prior rainfall was recorded at either Year 3 gradient study area prior to sample collection on November 1, 2023, and all required antecedent dry conditions defined in the CEC QAPP (v3) were met. In general, discharge measurements were slightly higher at the POTW 1 sites for Event 2 compared to Event 1, which may have been influenced by this antecedent storm. In contrast, measured and observed flows in the POTW 2 study area were generally lower during Event 2. All other parameters were as expected during Event 2 sampling.

Quality Control Samples

Quality control (QC) samples were collected as outlined in **Table 10**. All scheduled QC samples were successfully collected as required by the CEC QAPP (v3).

Table 10. Event 2 quality control sample summary.

QC Sample Location	Sample Date	QC Type	Analytes	Scheduled/ Alternate
POTW 2, R4: 511NACDOA	11/1/2023	Equipment Blank – Conbar Dipper	PFAS, PPCPs, Turbidity, SSC	Scheduled
POTW 1, EFF: 519POTW01	11/1/2023	Equipment Blank - Bailer	PFAS, PPCPs, Turbidity, SSC	Scheduled
POTW 2, R1: 511OACCLN	11/1/2023	Field Blank, Field Duplicate	PFAS, PPCPs, Turbidity, SSC	Scheduled

Sample Delivery

All samples were successfully delivered to the laboratories within the required time limits. Sample transfer delivery information is provided in **Table 11**. Samples were transported to MLJ offices and to laboratories in coolers with double bagged wet ice. Samples held in MLJ custody for an extended period of time were maintained within the required temperature ranges (0 to 6°C) in a secured refrigerator until time of shipping.

Table 11. Event 2 sample transfer and delivery information.

Date/Time Samples Shipped	Laboratory	Shipping Company	Comments
11/2/23 – 11:30	Weck and Physis	FedEX	Samples collected on 10/30 and 11/1.
11/2/23 – 15:30	Enthalpy	Direct delivery to lab by MLJ staff	PFAS samples from 10/30 and 11/1, delivered directly to Enthalpy (Vista)

ANALYTICAL OVERVIEW

FIELD MEASUREMENTS

During each of the sampling events described in the **Sampling Overview**, field crews collected basic field measurements (i.e., air temperature, water temperature, specific conductivity, DO, pH, and turbidity) at a depth of 0.5 m using a YSI Pro Plus multi-parameter meter equipped with conductivity/temperature, DO, and pH sensors. The meters were calibrated using appropriate procedures and standards before each sampling event as described in the CEC QAPP (v3). Two hundred and thirty-one of the scheduled 231 field measurements (i.e., 100.0%) were successfully completed during the Year 3 CEC Monitoring (**Table C.3**).

ANALYTICAL LABORATORY METHODS

The preparation and analytical methods applied to DRMP CEC samples are identified in **Table 12**.

Table 12. Analytical laboratory methods for CEC Year 3 monitoring.

Matrix	Analyte	Laboratory	Preparation Method	Analytical Method
Water	PPCPs – Hormones	Weck	None	EPA 1694M
Water	PPCPs – Pharmaceuticals	Weck	None	EPA 1694M
Water	PPCP – Biphenol A and Galaxolide	Physis	None	EPA 625.1M
Water	PPCP - Triclocarbon	Physis	None	EPA 625.1M_MRM
Water	Turbidity	Physis	None	EPA 180.1
Water	Suspended Sediment Concentration	Weck	None	ASTM D3977
Water	PFAS	Enthalpy	None	EPA 537M

Analytical Methods – Enthalpy Analytical Laboratories

Enthalpy analyzed samples for PFAS (i.e., PFOA and PFOS) in water using a laboratory modification of EPA Method 537 for *Determination of PFAS in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)*. Target analytes were loaded by passing the collected samples, spiked with internal standards, through a solid-phase extraction cartridge, which was then eluted with methanol. The extract was concentrated to a reduced final volume, and the final extract analyzed on the ultra-performance liquid chromatography/tandem mass spectrometry (UPLC/MS/MS) system.

Analytical Methods – Physis Laboratories

Physis analyzed PPCPs using a laboratory modification of EPA 625.1, for *Base/Neutrals and Acids by GC/MS*. Samples were serially extracted with methylene chloride at pH 11 - 13 and again at a pH less than 2. The extract was concentrated to a reduced volume and analyzed by GC/MS. Qualitative identification of an analyte was made using the retention time and the relative abundance of two or more characteristic masses (m/z's) and quantified using an internal standard technique.

Physis analyzed water samples for turbidity using method EPA 180.1 for *Determination of Turbidity by Nephelometry*. Turbidity is determined by comparing the intensity of light scattered by the sample with the intensity of light scattered by a standard reference suspension.

Analytical Methods – Weck Laboratories

Weck analyzed water samples for PPCPs using their internal protocol for *Determination of Endocrine Disrupting Compounds, Pharmaceuticals, and Personal Care Products*. The method is a variant of EPA Method 1694. Solid-phase extraction was used for aqueous samples, with the extract quantified by liquid chromatography and electrospray ionization tandem mass spectrometry (LC- ESI/MS/MS). Isotopic dilution was used to account for effects from the analytical process and matrix interferences.

Weck analyzed water samples for SSC using a method derived from ASTM D3977. Suspended solids are separated from water samples, dried, and weighed.

ANALYTICAL COMPLETENESS

Analytical completeness is based on the number of constituents in each sample successfully analyzed and reported by the laboratory. Completeness is assessed as each analysis scheduled for each site over all events in the year. Completeness counts by individual constituent are provided in Appendix **Table C.2**. For Year 3 monitoring, results from 629 of the total 629 constituents scheduled for analysis were successfully reported and the overall analytical completeness was therefore 100%.

DATA VERIFICATION OVERVIEW

VERIFICATION PROCESS

The US EPA defines data verification as the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual specifications. Verification of DRMP CEC data was performed by MLJ and the Marine Pollution Studies Laboratory at Moss Landing Marine Laboratories (MPSL-MLML) based on the sample handling requirements and measurement quality objectives (MQOs) of the CEC QAPP (v3). Verification of instrument tuning, calibration standards, calibration verifications, and internal standards were the responsibility of the submitting laboratory.

Initial data verification by MLJ staff was conducted as individual electronic data deliverables (EDDs) received from the laboratories were processed and uploaded into the Central Valley Regional Data Center (CV RDC). These data processing steps occurred according to the procedures outlined in the CEC QAPP (v3). All project data underwent a secondary verification review by MPSL-MLML staff as a part of the data finalization process, at which point all verified data were assigned a classification and the corresponding California Environmental Data Exchange Network (CEDEN) compliance code described in the following sections.

Compliant

Data classified as “Compliant” meet all requirements specified in the CEC QAPP (v3). These data are considered usable for their intended purpose without additional assessment.

Qualified

Data classified as “Qualified” do not meet one or more of the requirements specified in the CEC QAPP. These data are considered usable for their intended purpose following an additional assessment to determine the scope and impact of the deficiency.

Estimated

Data classified as “Estimated” (i.e., EPA “J” flag) are assigned to data batches and sample results that are not considered quantifiable.

Screening

Data classified as "Screening" are considered non-quantitative and may or may not meet the minimum requirements specified in the CEC QAPP. These data may not be usable for their intended purpose and require additional assessment.

Rejected

Data classified as "Rejected" do not meet the minimum requirements specified in the CEC QAPP. These data are not considered usable for their intended purpose.

Not Applicable

Data classified as "Not Applicable" were not verified since there were no CEC QAPP requirements for the specific parameter (e.g., oxygen saturation) or a failure was reported and could not be verified.

VERIFIED DATASETS

This report details the above verification process as applied to the analytical batches appearing in **Table 13**. The findings of the data verification process are outlined in the sections below. A complete summary of the completeness and QC sample acceptability for each analysis performed during Year 3 is provided in **Appendix C**.

Table 13. Verified datasets (analytical batches) for CEC Year 3 monitoring.

Lab	Analytical Category	Matrix	Datasets Produced	Datasets Reviewed	Reviewed Dataset (Batch) IDs
Enthalpy	PFAS	Water	2	2	ENTHALPY_DRMP_CEC_B23J253_W_PFAS ENTHALPY_DRMP_CEC_B23K040_W_PFAS
Physis	PPCPs (Bisphenol A, Galaxolide, and Triclocarban)	Water	4	4	Physis_DRMP_CEC_O-44004_W_BNs Physis_DRMP_CEC_O-44004b_W_BNs Physis_DRMP_CEC_O-44014_W_BNs Physis_DRMP_CEC_O-44014b_W_BNs
Physis	Turbidity	Water	2	2	Physis_DRMP_CEC_C-74082_W_Turb Physis_DRMP_CEC_C-74089_W_Turb
Weck	PPCPs (Hormones and Pharmaceuticals)	Water	6	6	WKL_DRMP_CEC_W3K1018_W_PPCP WKL_DRMP_CEC_W3K1019_W_PPCP WKL_DRMP_CEC_W3J2015_W_PPCP WKL_DRMP_CEC_W3J2017_W_PPCP WKL_DRMP_CEC_W3K0194_W_PPCP WKL_DRMP_CEC_W3K0195_W_PPCP
Weck	SSC	Water	3	3	WKL_DRMP_CEC_W3J2201_W_SSC WKL_DRMP_CEC_W3K0108_W_SSC WKL_DRMP_CEC_W3K1091_W_SSC

DATA VERIFICATION: SAMPLE HANDLING

During data verification, storage and holding times of CEC Year 3 samples were evaluated to ensure the integrity of the target analyte(s) in each matrix. For consistency with the SWRCB SWAMP and the Code of Federal Regulations, Title 40 *Protection of the Environment*, Section 136 *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, DRMP holding times are defined as follows:

- *Pre-Preservation/Extraction*: Required holding times for sample preservation or extraction begin at the time of sample collection and conclude when the sample is preserved or extracted, respectively.
- *Pre-Analysis*: Required holding times for sample analysis begin either at the time of sample collection, filtration or extraction and conclude when sample analysis is completed.

In Year 3, all 40 DRMP CEC samples were verified against the sample handling requirements in **Table 14**.

Table 14. Year 3 CEC QAPP sample handling requirements.

Matrix	Parameter Group	Pre-Preservation/Extraction		Pre-Analysis
		Storage	Holding Time	Holding Time
Water	PPCPs (Weck)	Preserve with sodium azide (200 mg) and Ascorbic acid (100 mg); store at <6 °C	28 days	40 days
	PPCPs (Galaxolide and Triclocarban only - Physis)	<6 °C	7 days	40 days
	PFAS	<10 °C	14 days	28 days
	SSC	<6 °C	NA	14 days
	Turbidity	<6 °C	NA	48 hours

A total of 99.3% of verified results (i.e., 1436 of 1446) met these DRMP CEC requirements (**Table C.5**). Analyses resulting in a holding time qualification appear in **Table 15** and includes environmental samples analyzed for galaxolide, triclocarban, and bisphenol A.

Table 15. Sample handling qualification for CEC Year3 monitoring.

Results appearing in this table were all flagged with the CEDEN QA code: H. QA code definitions are provided in Appendix **Table C.1.**

Dataset ID	Sample ID	Sample Date	Matrix	Analyte	Project Qualifier	Qualifier Description
Physis_DRMP_CEC_O-4404_W_BNs	519SACUR3	10/16/2023	Water	Bisphenol A	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404_W_BNs	519PGC010	10/16/2023	Water	Bisphenol A	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404_W_BNs	519SACUR3	10/16/2023	Water	Galaxolide	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404_W_BNs	519PGC010	10/16/2023	Water	Galaxolide	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404_W_BNs	519SACUR3	10/16/2023	Water	Galaxolide-d_6 (Surrogate)	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404_W_BNs	519PGC010	10/16/2023	Water	Galaxolide-d_6 (Surrogate)	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404b_W_BNs	519SACUR3	10/16/2023	Water	Triclocarban	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404b_W_BNs	519PGC010	10/16/2023	Water	Triclocarban	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404b_W_BNs	519SACUR3	10/16/2023	Water	Triclocarban-$^{13}C_6$ (Surrogate)	Qualified	Holding time violation; samples were extracted two days past holding time
Physis_DRMP_CEC_O-4404b_W_BNs	519PGC010	10/16/2023	Water	Triclocarban-$^{13}C_6$ (Surrogate)	Qualified	Holding time violation; samples were extracted two days past holding time

DATA VERIFICATION: FIELD MEASUREMENTS

Equipment used to take field data measurements must be calibrated according to Table 14.1 of the CEC QAPP (v3). At a minimum, the following equipment must be calibrated:

- Thermometers
- DO meters
- pH meters
- Conductivity meters
- Flow meters
- Multi-parameter field meters

After post-calibration checks are performed, the percent drift should be evaluated to confirm compliance with Table 14.1 of the CEC QAPP (v3). Non-compliant results should not be reported unless they have been flagged to indicate non-compliance.

A total of 231 (100.0%) field measurements were successfully collected for Year 3 monitoring (**Table C.3**). Of the 231 expected field measurement results reported, 193 results were classified as Compliant. Two discharge results were classified as Qualified since no calibration was performed. Four discharge results were classified as Not Applicable for no measurable flow. None of the 32 oxygen saturation results were verified since no MQO exists for this field measurement. Affected oxygen saturation results were classified as Not Applicable.

DATA VERIFICATION: CHEMISTRY

DRMP CEC chemistry data verification assesses QC samples associated with contamination, precision, and accuracy. For consistency with SWAMP, QC sample definitions are based on the January 2022 *Surface Water Ambient Monitoring Program Quality Assurance Program Plan.*

CONTAMINATION

Contamination for PFAS, PPCP, SSC, and turbidity analyses is assessed with the analysis of field blanks, equipment blanks, and laboratory blanks. Associated data verification results are detailed below.

Field Blanks

A field blank is a sample of analyte-free media that is transported to the sampling site, exposed to the sampling conditions, returned to the laboratory, and treated as a routine environmental sample. Preservatives, if any, are added to the sample container in the same manner as the environmental sample. The field blank matrix should be comparable to the sample of interest. This blank is used to provide information about contaminants that may be introduced during sample collection, storage, and transport.

For Year 3 DRMP CEC monitoring, two field blanks were collected for PFAS, PPCP, turbidity, and SSC analyses in water. Per **Table C.6***,* 92.3% of these results (i.e., 36 of 39) met the DRMP MQO by being below the reporting limit (RL). Analyses resulting in qualification appear in **Table 16** and include galaxolide and turbidity.

Table 16. Field blank qualification for CEC Year 3 monitoring.
Results appearing in this table were all flagged with the CEDEN QA code: IP. QA code definitions are provided in Appendix **Table C.1**.

Field Blank ID	Sample Date	Analyte	Sample Result	RL	Units	Project Qualifier
519DRYRLB	10/19/2023	Galaxolide	42.5	1	ng/L	Qualified
511OACCLN	11/1/2023	Galaxolide	72.9	1	ng/L	Qualified
511OACCLN	11/1/2023	Turbidity	0.62	0.02	NTU	Qualified

The DRMP qualifies only the field blank sample itself when contamination is detected, and the data qualifiers are not propagated to the associated environmental sample(s). Data users must cross reference environmental sample batch numbers with the associated field blank.

Equipment Blanks

An equipment blank is a sample of analyte-free media that has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling through clean equipment. This blank is useful in documenting adequate decontamination of sampling equipment (BC, 2003). This blank is used to provide information about contaminants/bias that may be introduced during sample collection when using filtration equipment or equipment that must be decontaminated between use.

For Year 3 DRMP CEC monitoring, four equipment blanks were collected for PFAS, PPCP, turbidity, and SSC analyses in water. Per **Table C.7**, 91.1% of these results (i.e., 72 of 79) met the DRMP MQO by being below the reporting limit (RL). Analyses resulting in qualification appear in **Table 17** and include galaxolide and turbidity.

Table 17. Equipment blank qualification for CEC Year 3 monitoring.
Results appearing in this table were all flagged with the CEDEN QA code: IP. QA code definitions are provided in Appendix **Table C.1**.

Field Blank ID	Sample Date	Analyte	Sample Result	RL	Units	Project Qualifier
511NACDQA	10/18/2023	Galaxolide	43.5	1	ng/L	Qualified
511NACDQA	10/18/2023	Turbidity	0.02	0.02	NTU	Qualified
519POTW01	10/19/2023	Galaxolide	62.1	1	ng/L	Qualified
511NACDQA	11/1/2023	Galaxolide	182	1	ng/L	Qualified
511NACDQA	11/1/2023	Turbidity	0.12	0.02	NTU	Qualified
519POTW01	11/1/2023	Galaxolide	76.9	1	ng/L	Qualified
519POTW01	11/1/2023	Turbidity	0.1	0.02	NTU	Qualified

The DRMP qualifies only the equipment blank sample itself when contamination is detected, and the data qualifiers are not propagated to the associated environmental sample(s). Data users must cross reference environmental sample batch numbers with the associated field blank.

Laboratory Blanks

A laboratory blank is free from the target analyte(s) and is used to represent the environmental sample matrix as closely as possible. The laboratory blank is processed simultaneously with and under the same conditions and steps of the analytical procedures (e.g., including exposure to all glassware, equipment, solvents, reagents, labeled compounds, internal standards, and surrogates that are used with samples) as all samples in the analytical batch (including other QC samples). The laboratory blank is used to determine if target analytes or interferences are present in the laboratory environment, reagents, or instruments. Results of laboratory blanks provide a measurement of bias introduced by the analytical procedure.

For Year 3 DRMP CEC monitoring, laboratory blanks were prepared and analyzed for all PFAS, PPCP, turbidity, and SSC batches. Laboratory blanks were analyzed at the required frequency of one per 20 samples or per batch (whichever is more frequent). 100% (54 of 54, **Table C.8**) of these results met the DRMP MQO by being below the MDL for PFAS, PPCP, and SSC, or below the RL for turbidity.

ACCURACY

Accuracy for PFAS, PPCP, SSC, and turbidity analyses is assessed with the analysis of laboratory control spike (LCS), matrix spike (MS), surrogate, and isotope dilution analogue (IDA) samples. Associated data verification results are detailed below.

Laboratory Control Spike

An LCS is a sample matrix representative of the environmental sample (e.g., water, sand) that is prepared in the laboratory and is free from the analytes of interest. The LCS is spiked with verified amounts of analytes or a material containing known and verified amounts of analytes. It is either used to establish intra-laboratory or analyst-specific precision and bias, or to assess the performance of a portion of the measurement system.

For Year 3 DRMP CEC monitoring, nine LCSs and six LCS/LCSD pairs were prepared and analyzed for all PFAS, PPCP, and SSC batches at the required frequency of one per batch. 100% of these results (i.e., 60 of 60, **Table C.9**) met the 50-150% recovery MQO.

Laboratory control spike samples were not performed with the turbidity batches analyzed for Year 3 monitoring, though they are indicated as required at a frequency of one per batch in Table 6 of the CEC QAPP (v3). These samples were omitted due to a miscommunication with laboratory staff regarding the additional DRMP QC requirements beyond those required by the method and typically performed by the laboratory. Affected turbidity batches are identified in **Table 18**; further details and corrective actions are provided as Deviation **2023-09: CEC Events 1 and 2 Physis Missing LCS samples for Turbidity.**

Table 18. Laboratory control spike qualification for CEC Year 3 monitoring.
Results appearing in this table were all flagged with the CEDEN Lab Submission Code: QI (Incomplete QC).

Dataset ID	Analyte	Project Qualifier
Physis_DRMP_CEC_C-74082_W_TURB	Turbidity	Qualified
Physis_DRMP_CEC_C-74089_W_TURB	Turbidity	Qualified

Matrix Spikes

An MS is a sample prepared by adding a known amount of the target analyte to an environmental sample in order to increase the concentration of the target analyte. The

MS is used to determine the effect of the matrix on a method's recovery efficiency and is a measure of accuracy. The MS is analyzed exactly like an environmental sample within the laboratory batch. The purpose of analyzing the MS is to determine whether the sample matrix contributes bias to the analytical results.

For Year 3 DRMP CEC monitoring, 12 matrix spikes (i.e., six MS duplicate pairs) were prepared and analyzed for bisphenol A, galaxolide, and triclocarban at the required frequency of one per 20 samples. In addition, MS samples were performed by Weck with PPCP batches analyzed by EPA 1694M for which the MSs were used to meet the laboratory duplicate requirement. MS samples are not required by the CEC QAPP (v3) as an evaluation of accuracy; recoveries of MS samples provided by Weck were therefore evaluated against the laboratory control limits of 50-150%. 95.5% of MS sample results (i.e., 86 of 90 **Table C.10**) met the recovery MQO, though two of these samples were marked as Compliant because the native concentration could not be compared to the spiked amount (these samples were flagged with the CEDEN QA code BB). Matrix spike analyses resulting in qualification appear in **Table 19**.

Table 19. Matrix spike qualification for CEC Year 3 monitoring.
Results appearing in this table were all flagged with the CEDEN QA codes: BB and GB. QA code definitions are provided in Appendix **Table C.1**.

DATASET ID	MS/MSD ID	ANALYTE	MS % RECOVERY	MSD % RECOVERY	PROJECT QUALIFIER
Physis_DRMP_CEC_O-44004b_W_BNs	519DRYRLB	Triclocarban	33	38	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	511POTW02	Ethynylestradiol, 17alpha-	-11	31	Qualified
Physis_DRMP_CEC_O-44014_W_BNs	511OACCLN	Galaxolide	Not Calculable [1]	Not Calculable [1]	Compliant

[1] Since the native concentration was >4x the spike concentration the percent recovery (PR) cannot be evaluated and therefore the project qualifier remains *Compliant*.

Surrogates

A surrogate is a non-target analyte that has similar chemical properties to the analyte of interest. The surrogate standard is added to the sample in a known amount and used to evaluate the response (e.g., loss) of the analyte to sample preparation and analysis procedures.

For Year 3 DRMP CEC monitoring, surrogates galaxolide-d_6 and triclocarban-$^{13}C_6$ were added to all environmental and QC samples analyzed for bisphenol A, galaxolide, and triclocarban. 100% (i.e., 100 of 100, **Table C.11**) of surrogate results met the laboratory recovery MQO.

Isotope Dilution Analogues

Isotope dilution analogues (IDA) are isotopically labeled versions of the target analytes (or chemicals similar to the target analytes) that are added to each environmental and QC sample prior to extraction and are used to quantify the result concentrations of the unlabeled analytes present in the sample matrix.

For Year 3 DRMP CEC monitoring, IDAs were added to all environmental and QC water samples analyzed for PFAS and the PPCPs analyzed by Weck; 97.9% of these results (i.e., 625 of 638) met the laboratory recovery MQO (**Table C.12**). Qualified IDAs appear in **Table 20**.

Table 20. Isotope dilution analogue qualification for CEC Year 3 monitoring.
Results appearing in this table were all flagged with the CEDEN QA code: GIDA. QA code definitions are provided in Appendix **Table C.1**.

Dataset ID	Sample ID	Isotope Dilution Analogue	IDA % Recovery	Project Qualifier
WKL_DRMP_CEC_W3J2017_W_PPCP	511NACARD	Naproxen-d_3 (IsoDilAnalogue)	46	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACCLN	Naproxen-d_3 (IsoDilAnalogue)	42	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACCLN	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	211	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACUNA	Naproxen-d_3 (IsoDilAnalogue)	44	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511POTW02	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	222	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	Gemifibrozil-d_6 (IsoDilAnalogue)	287	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	Bisphenol A-d_{16} (IsoDilAnalogue)	217	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	Triclosan-d_3 (IsoDilAnalogue)	269	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	250	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	Bisphenol A-d_{16} (IsoDilAnalogue)	238	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	Gemifibrozil-d_6 (IsoDilAnalogue)	228	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	Triclosan-d_3 (IsoDilAnalogue)	237	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	248	Qualified

For each IDA that recovers outside of the MQOs, the target analyte result which the IDA was used to quantify is also flagged to indicate a poor recovery of the associated labeled compound. Analytical results flagged in association with IDA recoveries outside of MQOs are provided in **Table 21**.

Table 21. Isotope dilution analogue qualification for CEC Year 3 monitoring: associated samples.

Results appearing in this table were all flagged with the CEDEN QA code: GIDA. QA code definitions are provided in Appendix **Table C.1**.

Dataset ID	Sample ID	Sample Date	Analyte	Project Qualifier
WKL_DRMP_CEC_W3J2017_W_PPCP	511NACARD	10/18/2023	Naproxen	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACCLN	10/18/2023	Naproxen	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACCLN	10/18/2023	Ethynylestradiol, 17alpha-	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511OACUNA	10/18/2023	Naproxen	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	511POTW02	10/18/2023	Ethynylestradiol, 17alpha-	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	10/16/2023	Ethynylestradiol, 17alpha-	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	10/16/2023	Gemifibrozil	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	10/16/2023	Bisphenol A	Qualified
WKL_DRMP_CEC_W3J2017_W_PPCP	519SACUR3	10/16/2023	Triclosan	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	10/30/2023	Ethynylestradiol, 17alpha-	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	10/30/2023	Triclosan	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	10/30/2023	Bisphenol A	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	519SACUR3	10/30/2023	Gemifibrozil	Qualified

PRECISION

Precision for PFAS, PPCP, SSC, and turbidity analyses is assessed with the analysis of field duplicates, laboratory duplicates, matrix spike duplicates (MSDs), and/or laboratory control spike duplicates (LCSDs). Associated data verification results are detailed below.

Field Duplicates

A field duplicate is an independent sample that, as closely as possible, utilizes the same sampling location, time, and methodology as the field sample.

For Year 3 DRMP CEC monitoring, two field duplicates were collected and analyzed for PFAS, PPCPs, SSC, and turbidity appear in **Table 22**.

Table 22. Field duplicates for CEC Year 3 monitoring.

Duplicate ID	Sample Date	Matrix	Analyte
519DRYRLB	10/19/2023	Water	PFAS, PPCPs, SSC
511OACCLN	11/1/2023	Water	PFAS, PPCPs, SSC, turbidity

100% of field duplicate results (i.e., 39 of 39, **Table C.13**) met the DRMP MQO by having a relative percent difference (RPD) <35% (not applicable if the concentration of either sample <MDL).

Laboratory Duplicate Samples (Unspiked)

A laboratory duplicate is an analysis or measurement of the target analyte(s) performed identically on two sub-samples of the same sample, usually taken from the same container. The results from laboratory duplicate analyses are used to evaluate analytical or measurement precision, and include variability associated with sub-sampling and the matrix (not the precision of field sampling, preservation, or storage internal to the laboratory).

For Year 3 DRMP CEC monitoring, turbidity laboratory duplicates were analyzed at the required frequency of one per 20 samples or per batch (whichever is more frequent); 100% of laboratory duplicate results (i.e., two of two, **Table C.14**) met the DRMP MQO by having an RPD <25% (not applicable if the concentration of either sample is <RL).

Laboratory Control Spike Duplicates

An LCSD is prepared alongside an LCS; both are performed on a sample matrix representative of the environmental sample (e.g., water, sand) that is prepared in the laboratory and is free from the analytes of interest. The LCSD is spiked with verified amounts of analytes or a material containing known and verified amounts of analytes. It is either used to establish intra-laboratory or analyst-specific precision and bias, or to assess the performance of a portion of the measurement system.

For Year 3 DRMP CEC monitoring, LCS/LCSD pairs were prepared and analyzed to monitor laboratory precision at the required frequency of one per batch for PFAS and PPCPs in the following batches:

- Physis_DRMP_CEC_O-44004_W_BNs
- Physis_DRMP_CEC_O-44004b_W_BNs

- Physis_DRMP_CEC_O-44014_W_BNs
- Physis_DRMP_CEC_O-44014b_W_BNs
- ENTHALPY_DRMP_CEC_B23J253_W_PFAS

In cases where an LCSD is not performed, an equivalent set of laboratory-generated replicates, such as an MSD may be used to meet the laboratory duplicate requirements. For Year 3 DRMP CEC monitoring, one of ten batches analyzed for PFAS and PPCPs were not performed with the required LCS/LCSD duplicates or an equivalent set of duplicates; this batch is outlined in **Table 23**.

Table 23. Laboratory duplicate frequency qualification for CEC Year 3 monitoring. Results appearing in this table were all flagged with the CEDEN Lab Submission Code: QI (Incomplete QC).

DATASET ID	ANALYTES	PROJECT QUALIFIER
ENTHALPY_DRMP_CEC_B23K040_W_PFAS	PFAS	Qualified

For Year 3 DRMP CEC monitoring, 100% of LCSD results (i.e., 8 of 8) met the DRMP MQO by having an RPD <30% (not applicable if the concentration of either sample <MDL) for PFAS and <25% (not applicable if the concentration of either sample <MDL) for PPCPs (**Table C.15**).

Matrix Spike Duplicates

An MSD is prepared with an MS. Both the MS and MSD samples are analyzed exactly like an environmental sample within the laboratory batch. The purpose of the MS/MSD sample analysis is to determine whether the sample matrix contributes bias to the analytical results, and to measure precision of the duplicate analysis.

For Year 3 DRMP CEC monitoring, MS/MSD pairs were prepared and analyzed to monitor laboratory precision at the required frequency of one per batch for all PPCPs analyzed by Physis or in the place on an LCSD for the following PPCP batches analyzed by Weck:

- WKL_DRMP_CEC_W3J2015_W_PPCP
- WKL_DRMP_CEC_W3J2017_W_PPCP
- WKL_DRMP_CEC_W3K0194_W_PPCP
- WKL_DRMP_CEC_W3K0195_W_PPCP
- WKL_DRMP_CEC_W3K1018_W_PPCP
- WKL_DRMP_CEC_W3K1019_W_PPCP

Of the MSD results, 95.6% (i.e., 43 of 45, **Table C.16**) met the DRMP MQO by having an RPD <25% (not applicable if the concentration of either sample is <MDL). Analyses resulting in qualification appear in **Table 24**.

Table 24. Matrix spike/matrix spike duplicate precision qualification for Year 3 samples analyzed by Weck.

Results appearing in this table were all flagged with the CEDEN QA codes: IL. QA code definitions are provided in Appendix **Table C.1**.

Dataset ID	MS/MSD ID	Analyte	MS % Recovery	MSD % Recovery	RPD (%)	Project Qualifier
WKL_DRMP_CEC_W3K1018_W_PPCP	511POTW02	Ethynylestradiol, 17alpha-	-11	31	486	Qualified
WKL_DRMP_CEC_W3K1018_W_PPCP	511POTW02	Triclosan	128	94	31	Qualified

DISCUSSION OF RESULTS

A summary of the Year 3 gradient study results is provided below. As outlined in the Fiscal Year (FY) 22-23 Monitoring Workplan, for each constituent detected the following evaluations are provided:

- Concentration vs. distance from discharge data plots for each gradient location and each constituent.
  - PFAS concentrations for Gradient Study Area 1: **Figure 11**
  - PFAS concentrations for Gradient Study Area 2: **Figure 15**
  - PPCP concentrations for Gradient Study Area 1: **Figure 19**, **Figure 24**, and **Figure 27**
  - PPCP concentrations for Gradient Study Area 2: **Figure 38**, **Figure 30**, **Figure 35**, and **Figure 41**
- Instantaneous mass load (or mass flux) vs. distance from discharge data plots for each gradient location and each constituent.
  - PFAS mass loads for Gradient Study Area 1: **Figure 12**
  - PFAS mass loads for Gradient Study Area 2: **Figure 16**
  - PPCP mass loads for Gradient Study Area 1: **Figure 20**, **Figure 25**, and **Figure 28**
  - PPCP mass loads for Gradient Study Area 2: **Figure 39**, **Figure 31**, **Figure 36**, and **Figure 42**
- Evaluate mass balance and in cases where inputs are not equal to outputs, provide an estimate of the error and unmeasured sources and sinks.
  - PFAS mass balances for Gradient Study Area 1: **Figure 13**, **Figure 14**, **Table 29**, and **Table 30**
  - PFAS mass balances for Gradient Study Area 2: **Figure 17**, **Figure 18**, **Table 31**, and **Table 32**
  - PPCP mass balances for Gradient Study Area 1: **Figure 21, Figure 22, Figure 23, Figure 26, Figure 29, Table 34**, **Table 35, Table 36, Table 37,** and **Table 38**

    - PPCP mass balances for Gradient Study Area 2: **Figure 40**, **Figure 33**, **Figure 34**, **Figure 37**, **Figure 43**, **Table 42**, **Table 39**, **Table 40**, **Table 41**, and **Table 43**
- Identification of the monitoring location where attenuation is observed for each constituent:
    - **Attenuation**
- Estimate of the contribution of attenuation caused by hydraulic dilution in study area, if any:
    - **Hydraulic Dilution**
- Provide a list and brief description of the unmeasured variables, field observations, and/or potential conditions that may influence CEC attenuation.
    - **Unmeasured Variables**

RESULTS SUMMARY

A total of 32 environmental water samples were collected and analyzed for PFAS, PPCPs, SSC, and turbidity over two sampling events for Year 3 CEC monitoring (**Table 25**). Environmental samples were collected from urban runoff sites, POTW effluent sites, and gradient monitoring locations (Year 3 Gradient Study Areas 1 and 2). In addition, two field duplicates, four equipment blanks, and two field blanks were collected alongside the environmental samples during both events for a total of 40 samples that were submitted to the laboratories for analysis during Year 3.

Table 25. Summary of field sample collections for CEC Year 3 monitoring.

Analyte Category	Station Type	Environmental Samples	Field Duplicate	Equip. Blank	Field Blank	Total Samples
PFAS, PPCPs,[1] SSC, Turbidity	Runoff	4	--	--	--	4
	Effluent	4	--	--	--	4
	Gradient Study Area 1	12	1	2	1	16
	Gradient Study Area 2	12	1	2	1	16
Total		**32**	**2**	**4**	**2**	**40**

[1] PPCP constituents analyzed by Physis include bisphenol A, galaxolide, and triclocarban. PPCP constituents analyzed by Weck include hormones and pharmaceuticals, excluding galaxolide and triclocarban.

A total of 1,734 environmental and QC sample results for PFAS, PPCPs, SSC, and turbidity were verified as a part of the Year 3 dataset (**Table 26**). Of those results, 1,568 met QAPP requirements and are considered Compliant. A total of 166 environmental and QC sample results presented in **Table 15** through **Table 24** did not meet DRMP QAPP requirements and are considered Qualified.

Table 26. Summary of verified results for CEC Year 3 monitoring.
Counts of results include all environmental and QC sample results. Percentage of total for each count by constituent group, laboratory, and matrix in parenthesis next to sample count.

Analyte Category	Lab	Matrix	Compliant	Qualified	Estimated	Rejected	NA	Total
PFAS	Enthalpy	Water	92 (51%)	88 (49%) [3]	0 (0%)	0 (0%)	0 (0%)	180
PPCPs [1]	Physis	Water	232 (93%)	18 (7%)	0 (0%)	0 (0%)	0 (0%)	250
PPCPs [2]	Weck	Water	1,190 (98%)	30 (2%)	0 (0%)	0 (0%)	0 (0%)	1,220
SSC	Weck	Water	46 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	46
Turbidity	Physis	Water	0 (0%)	30 (100%)	0 (0%)	0 (0%)	0 (0%)	30
Total Verified Results			**1,560 (90%)**	**166 (10%)**	**0 (0.0%)**	**0 (0.0%)**	**0 (0.0%)**	**1,726**

[1] PPCP constituents analyzed by Physis include bisphenol A, galaxolide, and triclocarban.
[2] PPCP constituents analyzed by Weck include hormones and pharmaceuticals, excluding galaxolide and triclocarban.
[3] Of the 88 PFAS sample results, 43 were qualified (49%) due to missing LCSD due to lab oversight. See deviation **2023-02: CEC Year 3 Event 2 Enthalpy Missing Laboratory Control Sample Duplicate** for additional information.

DETECTIONS OF CEC ANALYTE

The Year 3 CEC constituents were not detected consistently across all sites and events for the two gradient study areas and the urban runoff sites. The concentrations measured for each analyte are provided below in **Table 28** for PFAS constituents and **Table 33** for PPCPs. The specific sites and events for each analyte detected are also summarized in **Figure 3** for Gradient Study Area 1 and **Figure 4** for Gradient Study Area 2.

Of the seventeen CEC analytes, only PFOA, PFOS, and galaxolide were detected for both events in both Gradient Study Areas and the urban runoff sites. Conversely, 17 beta-estradiol, estrone, 17 alpha-ethynylestradiol, iopromide, progesterone, testosterone, and triclocarban were not detected in any Year 3 CEC samples. Bisphenol A was detected in urban runoff sites, but no gradient locations. Diclofenac and ibuprofen were detected at both gradient study areas, though not at all sites or for all events. Gemfibrozil and naproxen were only detected in Gradient Study Area 1 (**Figure 3**), while salicylic acid and triclosan were only detected at Gradient Study Area 2 (**Figure 4)**.

Table 27. Summary of CEC constituent detections for Year 3 CEC monitoring.
An “X” indicates that the associated constituent was detected in at least one sample for the indicated study area and event; “--” indicates all associated samples were non-detect.

Analyte Category	Analyte	MDL from QAPP (ng/L)	Reported MDL [1] (ng/L)	Gradient Study Area 1 Event 1	Gradient Study Area 1 Event 2	Gradient Study Area 2 Event 1	Gradient Study Area 2 Event 2	Urban Runoff Event 1	Urban Runoff Event 2
PFAS	PFOA [2]	1	1.08 – 1.18	X	X	X	X	X	X
	PFOS [2]	1	1.81 – 1.97	X	X	X	X	X	X
PPCPs	Bisphenol A [3]	1	1	--	--	--	--	--	--
		4	4 – 20	--	--	--	--	X	X
	Diclofenac	4	4 – 40	--	X	X	X	--	--
	Estradiol, 17beta-	4	4	--	--	--	--	--	--
	Estrone	4	4	--	--	--	--	--	--
	Ethynylestradiol, 17alpha-	4	4 – 200	--	--	--	--	--	--
	Galaxolide	0.1	0.1	X	X	X	X	X	X
	Gemfibrozil	4	4	X	X	--	--	--	--
	Ibuprofen	4	4 – 80	X	--	X	X	X	X
	Iopromide	4	4	--	--	--	--	--	--
	Naproxen	4	4 – 20	--	X	--	--	X	X
	Progesterone	4	4	--	--	--	--	--	--
	Salicylic Acid	100	100	--	--	X	X	X	X
	Testosterone	4	4	--	--	--	--	--	--
	Triclocarban	1	1	--	--	--	--	--	--
	Triclosan	8	8	--	--	--	X	--	--

[1] Reporting limits may vary and may be elevated from the QAPP due to matrix interferences. The range of reported MDLs is provided when applicable.
[2] Enthalpy reports sample specific detection limits (SDLs), which are determined from the data of each individual analysis and vary between analytical batches; the estimated minimum detectable area is determined based on the signal to noise ratio for each individual result, per the method. SDL data will be reported in the MDL field in CEDEN per State Board guidance.
[3] Bisphenol A was analyzed twice for each sample and event by two separate laboratories and methods per recommendations based on Years 1 and 2 sample results. Both sets of results were used indiscriminately and submitted to CEDEN.

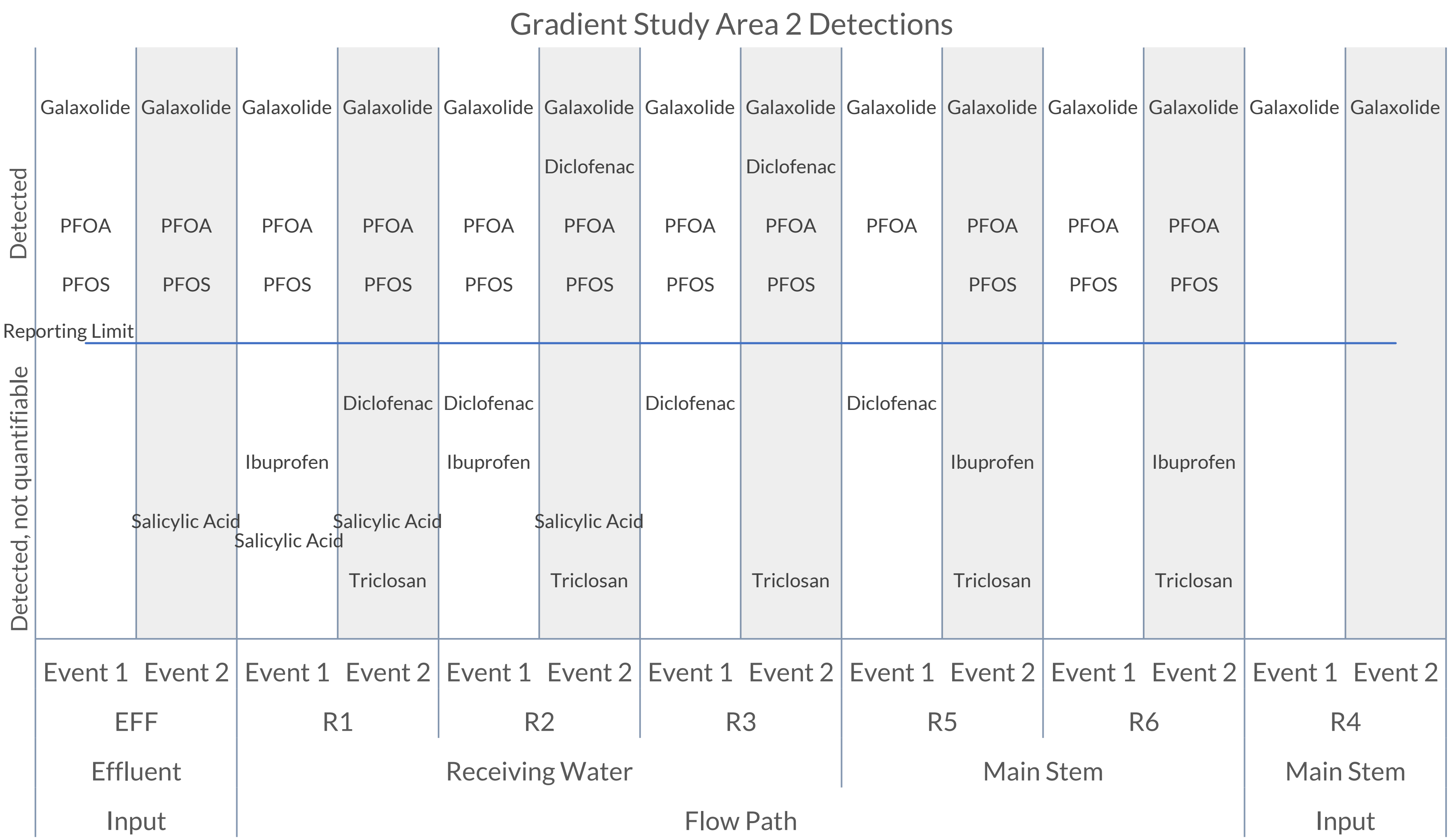
Figure 3. Constituents detected at Gradient Study Area 1 locations for Year 3 CEC monitoring.

Constituents listed were detected in laboratory samples for the associated site and event; the relative positions are not associated with magnitudes of concentration. Analytes listed above the reporting limits (blue line) were detected within the instruments' quantifiable ranges; those listed below were detected but not quantifiable and the results are considered estimated.

Gradient Study Area 1 Detections

	Input				Flow Path									
	Effluent		Receiving Water		Receiving Water						Main Stem			
	EFF		R0		R1		R2		R3		R5		R7	
	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
Detected	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide	Galaxolide
Detected		Naproxen				Naproxen		Naproxen		Naproxen		Naproxen		Naproxen
Detected		Diclofenac				Diclofenac		Diclofenac		Diclofenac				
Detected	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA	PFOA
Detected	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS	PFOS
Reporting Limit														
Detected, not quantifiable	Ibuprofen				Ibuprofen		Ibuprofen		Ibuprofen		Ibuprofen		Ibuprofen	
Detected, not quantifiable	Gemfibrozil	Gemfibrozil			Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil	Gemfibrozil

Figure 4. Constituents detected at Gradient Study Area 2 locations for Year 3 CEC monitoring.
Constituents listed were detected in laboratory samples for the associated site and event; the relative positions are not associated with magnitudes of concentration. Analytes listed above the reporting limits (blue line) were detected within the instruments' quantifiable ranges; those listed below were detected but not quantifiable and the results are considered estimated.



DISCHARGE MEASUREMENTS

Velocity measurements were taken at each Year 3 Gradient Study Area location and used to calculate discharge according to the procedures outlined in **Sampling Methods**. All measurements were obtained using the wading method except for R5 at Gradient Study Area 2 (New Alamo Creek downstream of confluence between New and Old Alamo Creeks) for both sampling events and R6 at Gradient Study Area 2 (Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek) for Event 1 where the surface float method was utilized. In addition, effluent discharge for Gradient Study Area 1 was obtained from the POTW for both events as it could not be measured from the sample access port. Calculated discharge values and individual velocity measurements are provided in Appendix **Table A.1** and **Table A.2**, respectively.

All required discharge measurements were successfully collected for the Year 3 Gradient Study Area locations. Nevertheless, the values calculated using the float method in Gradient Study Area 2 are associated with a greater level of uncertainty due to the method used. In addition, two discharge measurements taken via the wading method were flagged for data quality concerns during data review due to field collection errors that resulted in uneven spacing of velocity intervals. These two sites, the R2 site for Gradient Study Area 1 during Event 1 and the R4 site for Gradient Study Area 2 during Event 1, are also associated with uncertainty due to the assumptions regarding the larger cross-sectional area represented by a single velocity measurement. See deviation **2023-19: CEC Events 1 and 2 MLJ Environmental Discharge Measurement and Data Entry Error** for further discussion.

Obtaining measurements by wading along a cross-sectional area of the water body was employed as the preferred method when possible as it is more precise and likely more accurate than estimations based on surface velocity. Discharge estimates for Gradient Study Area 1 (**Figure 5**) and Gradient Study Area 2 (**Figure 6**) are used to convert concentrations measured by laboratories to instantaneous mass loading estimates for each sample collection. The instantaneous mass load (sometimes referred to as a flux) is the product of the constituent concentration and the discharge estimate and represents the instantaneous rate (expressed in units of mass/time) at which a constituent load is passing a point of reference on a stream or watercourse. Therefore, any increase in uncertainty surrounding discharge measurements results in an associated increase in uncertainty when comparing mass loads across sites. See **Unmeasured Variables** for further discussion.

Figure 5. Discharge (m^3/s) for Gradient Study Area 1 sites for Year 3 CEC monitoring.

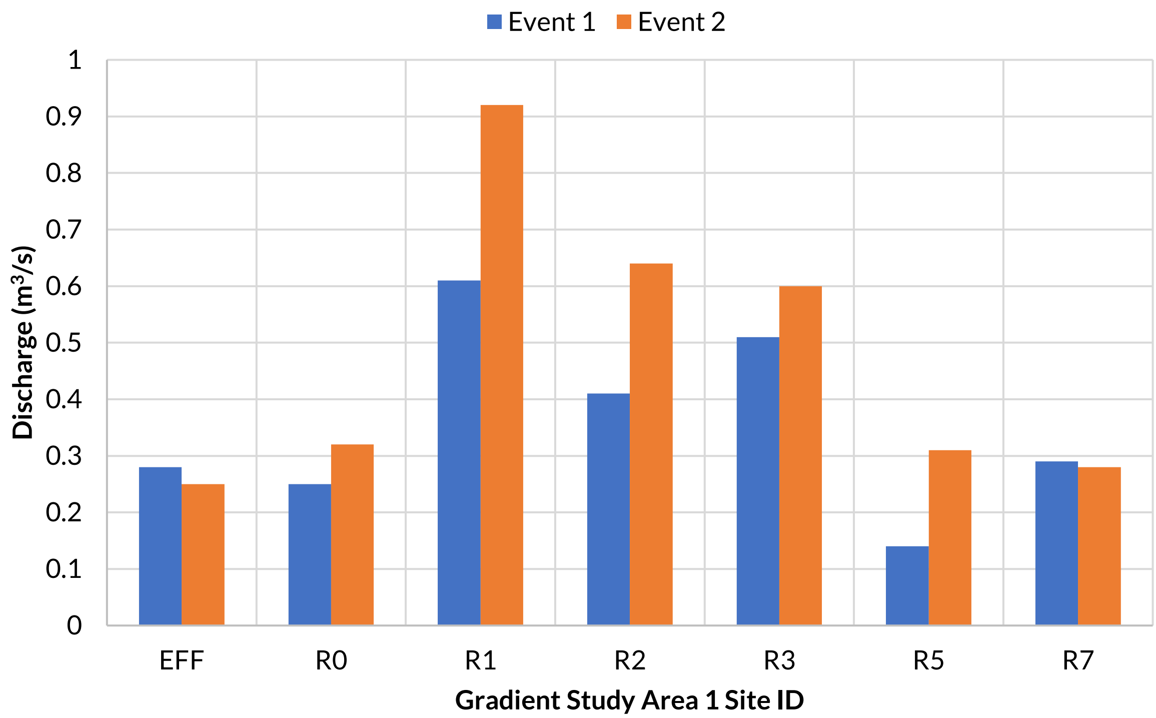
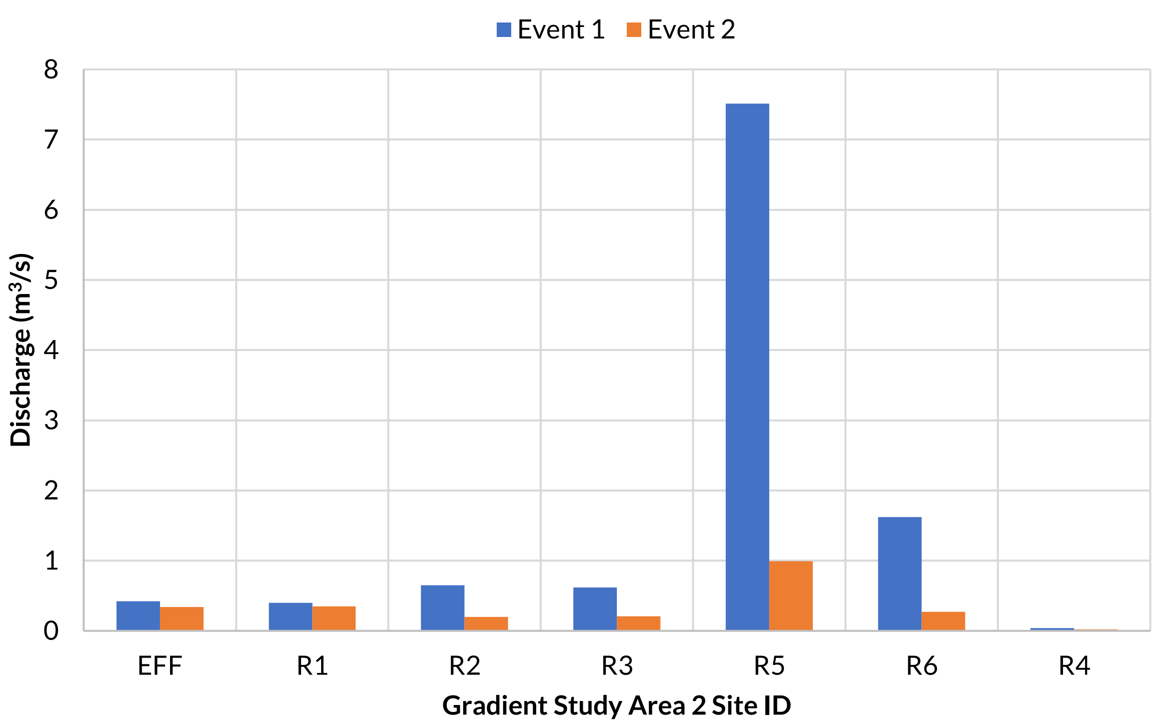


Figure 6. Discharge (m^3/s) for Gradient Study Area 2 sites for Year 3 CEC monitoring. Discharge was determined by float method during Event 1 at R5 and R6 and during Event 2 at R5.



MEAN FLOW RATES AND SAMPLE TIMING

The Year 3 CEC Gradient Study was not designed with the intention of collecting samples that track the progress of a single parcel of water released from the effluent source along the length of the receiving water. Such Lagrangian sampling approaches are time- and resource-intensive endeavors that were determined to be outside of the scope of the current Pilot Study. Nevertheless, the sample collection strategy employed is designed to assess potential attenuation and dilution along the receiving waters in a general sense, if not strictly as quantifiable as accounting for a single effluent pulse. As such, approximate comparisons of the sample collection times to potential effluent travel times are useful to inform evaluations of uncertainty associated with the Year 3 results (see **Unmeasured Variables**).

Since this study did not include an assessment of Lagrangian velocity of the effluent source water travel times along the waterbodies sampled, the actual trajectory of the original source samples for each event cannot be accurately assessed. The only data available to estimate such travel times are the discrete velocity measurements taken at each sample location in order to calculate total discharge. While these values do provide some information regarding the potential movement of water through the gradient study areas, they do not provide the water body velocity for the entire flow path or the data necessary to convert these discrete measurements to Lagrangian trajectory estimates. Therefore, only generalized estimates of the travel time can be derived from the information available. For each set of velocity measurements collected, the mean channel velocity was calculated based on measurements taken at each site. The overall velocity between two sample locations (e.g., from site R1 to site R2) was then estimated by taking the median of the two velocity estimates obtained from each end of the reach. Travel time estimates from the time of effluent sample collection for each Gradient Study Area and Year 3 monitoring event are provided in **Figure 7** through **Figure 10**.

Figure 7. Trajectory of sample collection times compared to estimated sample water travel time for Gradient Study Area 1, Event 1.

Travel time estimates approximated from discrete mean velocity measurements at each site compared to original effluent sample time (October 19, 2023, at 09:30 AM).

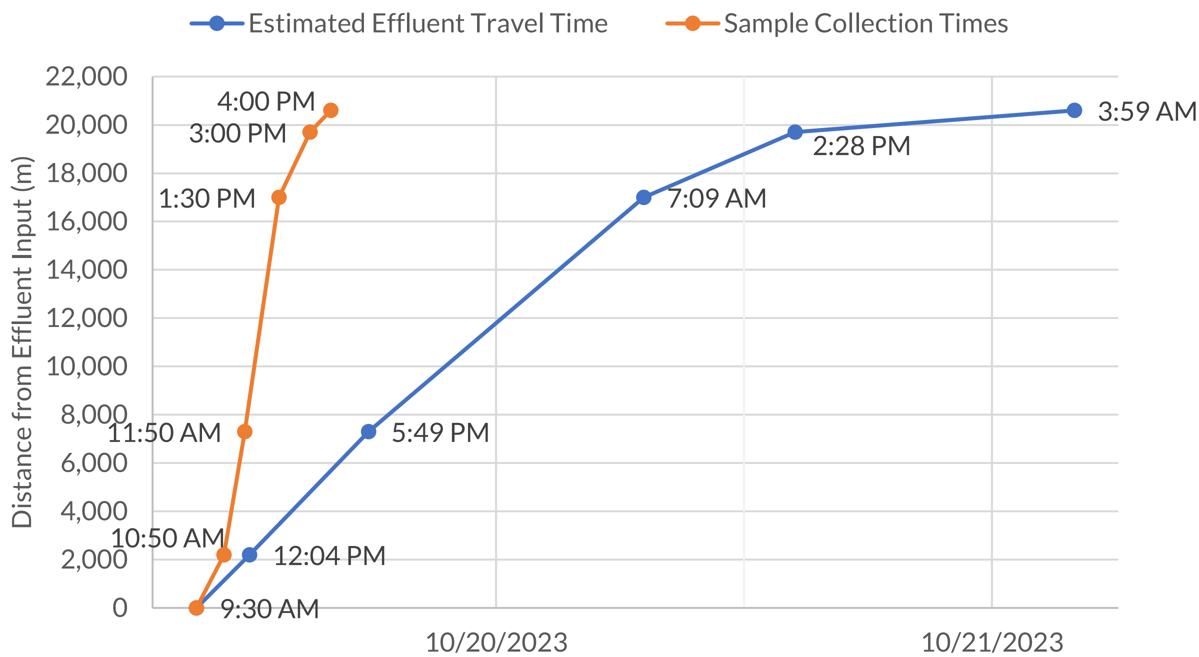


Figure 8. Trajectory of sample collection times compared to estimated sample water travel time for Gradient Study Area 1, Event 2.

Travel time estimates approximated from discrete mean velocity measurements at each site compared to original effluent sample time (November 1, 2023, at 09:20 AM).

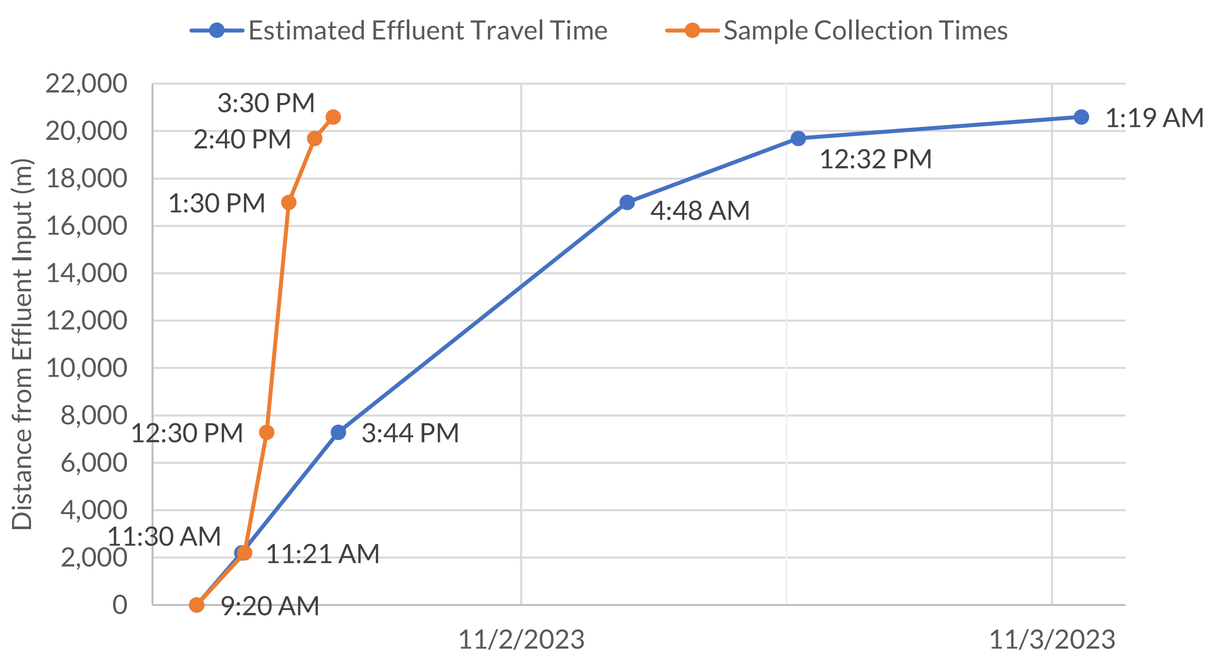


Figure 9. Trajectory of sample collection times compared to estimated sample water travel time for Gradient Study Area2, Event 1.

Travel time estimates approximated from discrete mean velocity measurements at each site compared to original effluent sample time (October 18, 2023, at 09:00 AM).

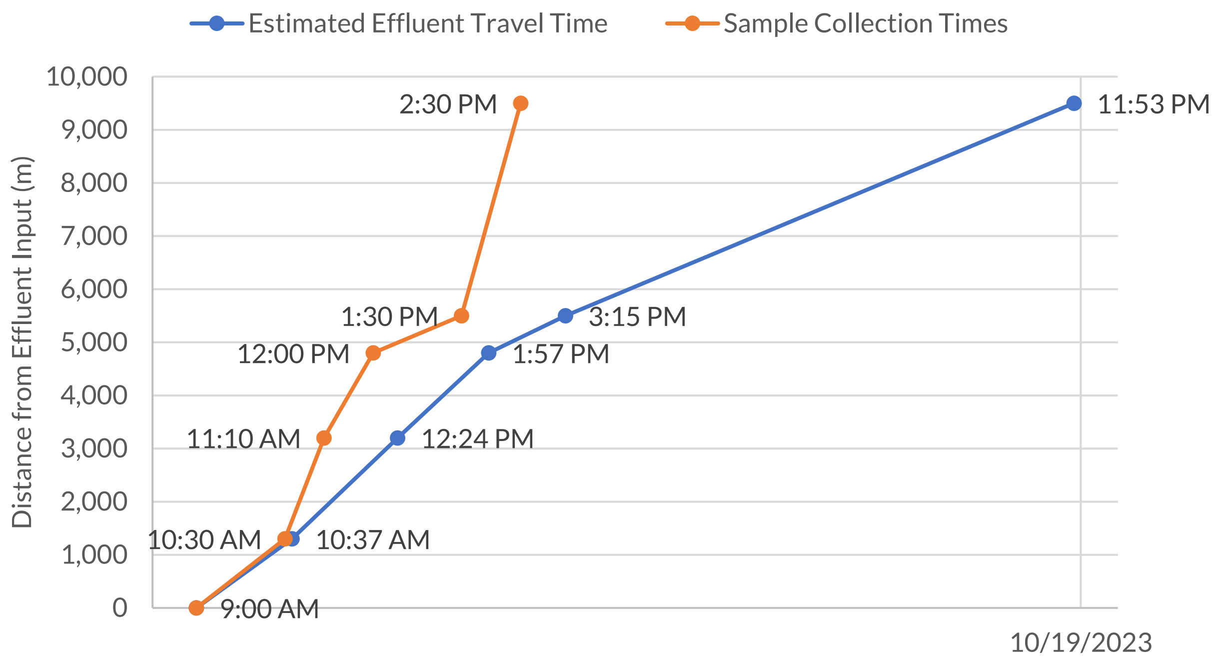
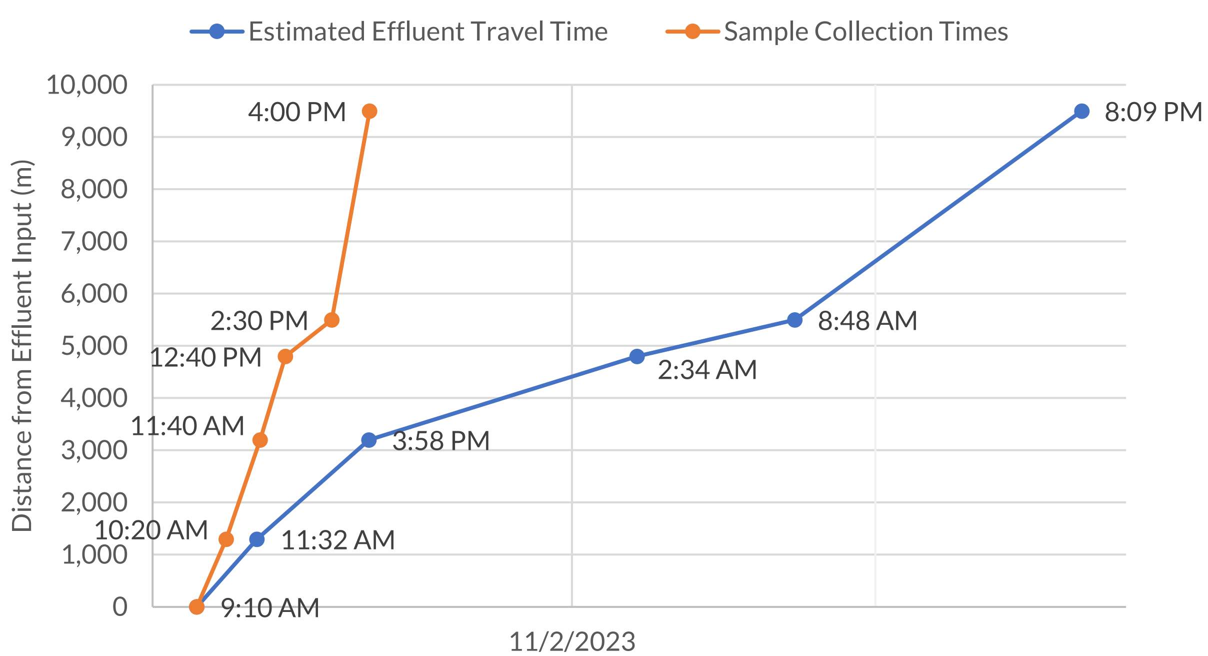


Figure 10. Trajectory of sample collection times compared to estimated sample water travel time for Gradient Study Area2, Event 2.

Travel time estimates approximated from discrete mean velocity measurements at each site compared to original effluent sample time (November 1, 2023, at 09:10 AM).



PFAS IN WATER

PFOS and PFOA were detected consistently at all sites throughout the year except at New Alamo Creek upstream of the confluence with Old Alamo Creek (all samples were non-detect for PFOS and PFOA) and Roseville Urban Runoff (all samples were non-detect for PFOS; **Table 28**).

PFOA concentrations were higher than PFOS concentrations at most locations for most events.

Table 28. PFOS and PFOA concentrations in environmental samples (water, ng/L).

Station Type	ID	Distance from Source (m)	Station Name	Event	PFOS (ng/L)	PFOA (ng/L)
Runoff	MS4	0	Sacramento Urban Runoff 3; Sump 111	1	3.76	13.6
				2	2.40	8.41
Runoff	MS4	0	Roseville Urban Runoff	1	ND	4.49
				2	ND	17.2
Gradient Study Area 1	R0	-60	Dry Creek at Roseville WWTP	1	3.30	3.01
				2	4.03	4.97
Effluent	EFF	0	POTW Source 1	1	4.43	7.57
				2	3.41	9.58
Gradient Study Area 1	R1	2,200	Dry Creek at Cook Riolo Rd bridge	1	4.76	5.78
				2	3.82	6.54
Gradient Study Area 1	R2	7,300	Dry Creek at Watt Ave bridge	1	3.36	6.22
				2	3.26	6.77
Gradient Study Area 1	R3	17,000	Terminus of Dry Creek at Rio Linda Blvd	1	4.02	6.06
				1- Dup	3.54	6.15
				2	4.10	7.98
Gradient Study Area 1	R5	19,700	Steelhead Creek main stem downstream of confluence with Dry Creek	1	3.29	5.82
				2	4.27	8.04
Gradient Study Area 1	R7	20,600	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	1	5.09	6.64
				2	5.68	9.11
Effluent	EFF	0	POTW Source 2	1	2.98	5.55
				2	3.52	8.60
Gradient Study Area 2	R1	1,300	Old Alamo Creek at Chicorp Ln.	1	3.24	5.64
				2	3.52	9.16
				2- Dup	3.78	8.51
Gradient Study Area 2	R2	3,200	Old Alamo Creek at Sunnybrook Ln.	1	2.84	4.79
				2	3.82	8.53
	R3	4,800		1	2.05	3.91

Station Type	ID	Distance from Source (m)	Station Name	Event	PFOS (ng/L)	PFOA (ng/L)
Gradient Study Area 2			Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	2	3.59	8.42
Gradient Study Area 2	R4	5,000	New Alamo Creek upstream of confluence with Old Alamo Creek	1	ND	ND
				2	ND	ND
Gradient Study Area 2	R5	5,500	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	1	ND	3.26
				2	3.33	8.07
Gradient Study Area 2	R6	9,500	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	1	2.21	3.83
				2	3.62	6.50

ND = Not Detected (<MDL).

PFAS Concentrations for Gradient Study Area 1

Measured concentrations of PFOA were generally higher than PFOS, though both were in a similar range (between 2 and 10 ng/L) within Gradient Study Area 1. For both events, PFOS and PFOA were detected upstream of the effluent input (R0) and the detections at R0 were at lower concentrations than the effluent input (EFF) (**Table 28, Figure 11**).

PFOA concentrations detected in the effluent input were the highest detections of any sites for both events. After the effluent input, PFOA concentrations dropped at the R1 site for both events, indicating possible attenuation of PFOA within the first 2,200 meters from the effluent input. Concentrations then rose slightly in the 5,000 meters between R1 and R2 locations (**Table 28, Figure 11**). However, PFOS concentrations did not exhibit the same decrease between the effluent input and the R1; the decrease in concentrations did not occur until R2 for both events (**Table 28, Figure 11**).

Concentrations for both constituents for both events generally remained similar or rose slightly from R2 to R3 with a slight drop in concentrations for both constituents between R3 and R5 for Event 1. Concentrations of PFOS and PFOA increased between R5 and R7, indicating the possibility of other inputs along the Steelhead Creek main stem, either from the unmeasured Robla Creek input (R9) or human activity along the main stem (**Table 28, Figure 11**).Concentrations of PFOS and PFOA increased between R5 and R7, indicating the possibility of other inputs along the Steelhead Creek main stem, either from the unmeasured Robla Creek input (R8) or human activity along the main stem (**Table 28, Figure 11**).

PFAS Mass Loads for Gradient Study Area 1

Instantaneous mass loads (or mass fluxes) were calculated for each site with a flow by converting the discharge values to volume in liters and multiplying by the concentration. Mass load information is captured in **Table 29** for PFOS and **Table 30** for PFOA for Gradient Study Area 1. The patterns observed across both PFAS constituents and events become more consistent when concentrations were converted to instantaneous mass loading values (**Figure 12**).

An illustration of the instantaneous load and change in mass is depicted in **Figure 13** and **Figure 14** for PFAS and PFOA, respectively. Instantaneous loads were higher in Event 2 than Event 1 for both PFOS and PFOA (**Figure 13** and **Figure 14).**

Based on instantaneous loads, both PFAS constituents reached their peak loading at the R1 site 2,200 meters downstream from the effluent input (**Table 29** and **Table 30)**. Loads for both PFOS and PFOA fell between R1 and R2, rose slightly again at R3, fell once more at R5, and finally rose at the R7 site.

The percent change in mass loading from R0 (i.e., background levels) to R7 for PFOS was 29% and 26% for Event 1 and Event 2, respectively **(Table 29)** and for PFOA was 34% and 37% for Event 1 and Event 2, respectively (**Table 30**). The overall percent change in mass loading from the peak load at R1 to the final measurement at R7 was 50% and 55% decrease for Event 1 and Event 2 for PFOS (**Table 29)** and 46% and 58% decrease for PFOA for Event 1 and Event 2 (**Table 30**).

Figure 11. PFAS concentrations (ng/L) for Gradient Study Area 1.

The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow; attenuation was not observed for PFOS (Events 1 and 2) and PFOA (Event 2).

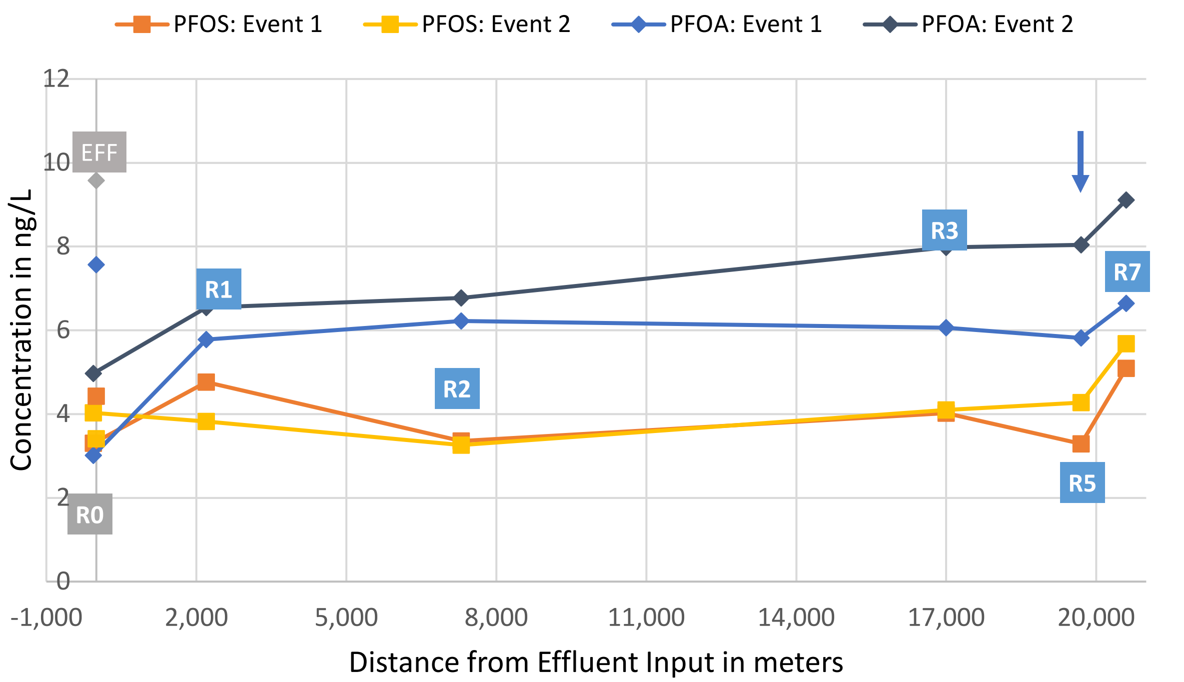


Figure 12. PFAS instantaneous mass loads (ng/s) for Gradient Study Area 1.

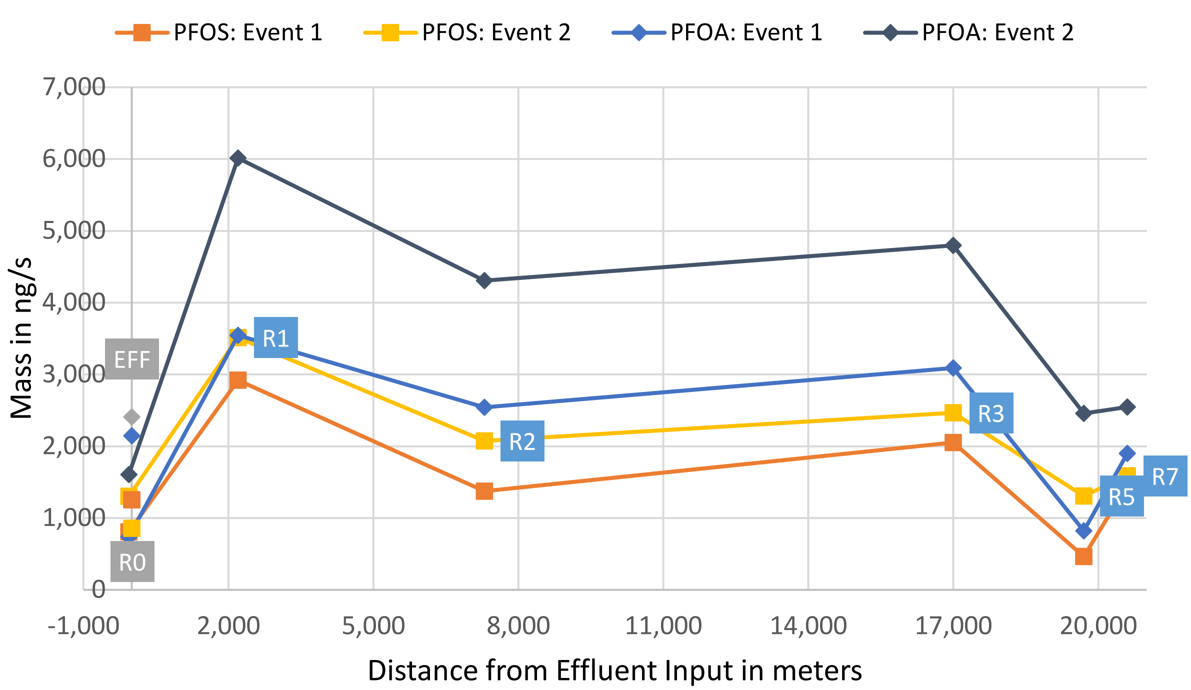


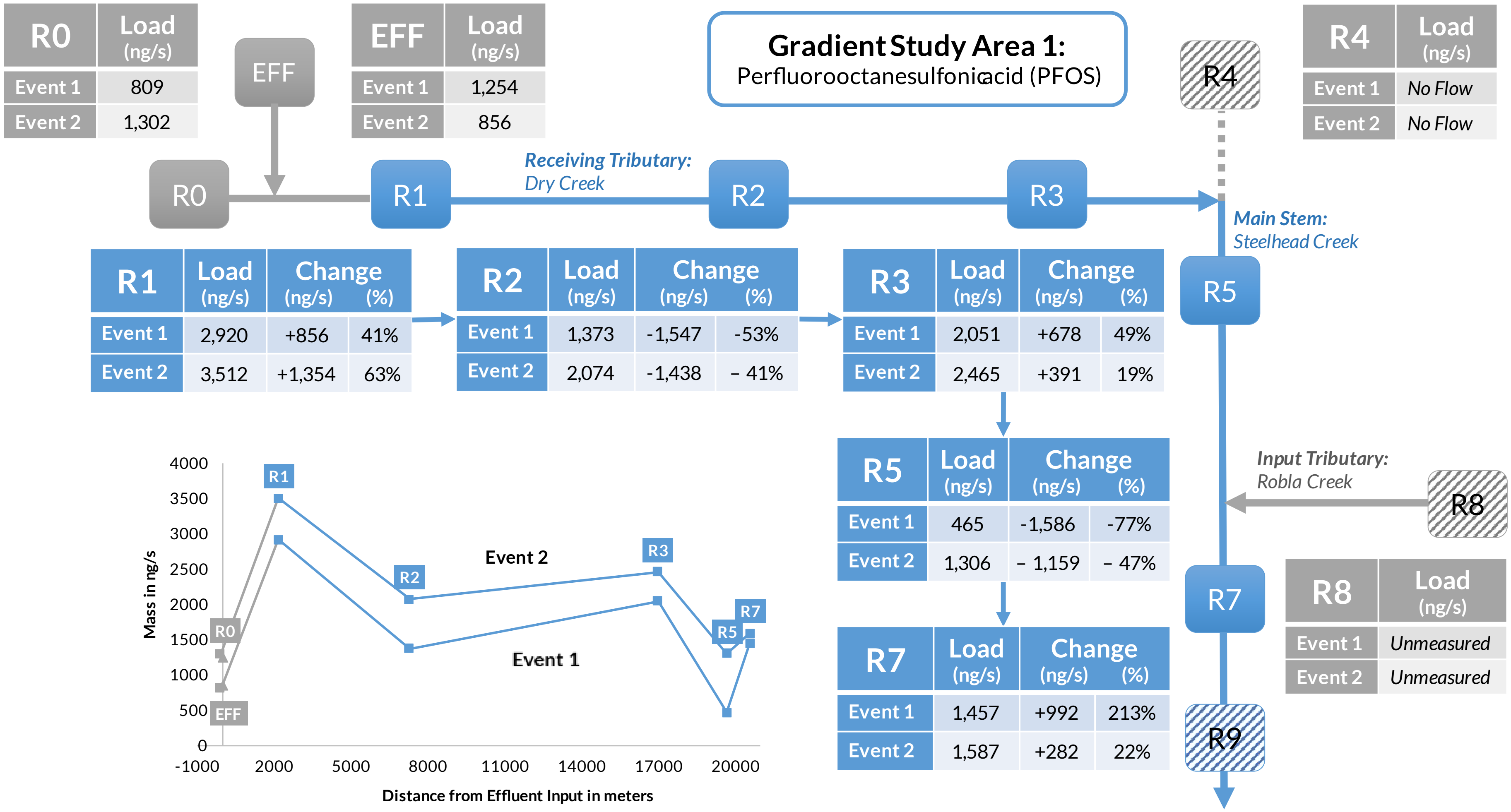
Table 29. PFOS mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 not sampled due to total number of sites reached. No R6 exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	809	--	--	--	1,302	--	--	--
Effluent	EFF	1,254	--	--	--	856	--	--	--
Total Receiving Tributary Input			**2,064**			**Total Input**	**2,159**		
Receiving Tributary	R1	--	2,920*	(+) 856	(+) 41%	--	3,512*	(+)1,354	(+) 63%
	R2	--	1,373	(–) 1,547	(–) 53%	--	2,074	(–) 1,438	(–) 41%
	R3	--	2,051	(+) 678	(+) 49%	--	2,465	(+) 391	(+) 19%
Main Stem	R5	--	465	(–) 1,586	(–) 77%	--	1,306	(–) 1,159	(–) 47%
Input Tributary	R8	*Unmeasured*	--	--	--	*Unmeasured*	--	--	--
Main Stem	R7	--	1,457	(+) 992	(+) 213%	--	1,587	(+) 282	(+) 22%
Total Mass Balance (Total Input)				**(–) 606**	**(–) 29%**	**Total Mass Balance (Total Input)**		**(–) 571**	**(–) 26%**
Mass Balance from Peak Load (*)				**(-) 1,462**	**(-) 50%**	**Mass Balance from Peak Load (*)**		**(-) 1,925**	**(-) 55%**

Figure 13. PFOS mass balance flow diagram for Gradient Study Area 1.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	809
Event 2	1,302

EFF	Load (ng/s)
Event 1	1,254
Event 2	856

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,920	+856	41%
Event 2	3,512	+1,354	63%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,373	-1,547	-53%
Event 2	2,074	-1,438	– 41%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,051	+678	49%
Event 2	2,465	+391	19%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	465	-1,586	-77%
Event 2	1,306	– 1,159	– 47%

R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,457	+992	213%
Event 2	1,587	+282	22%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

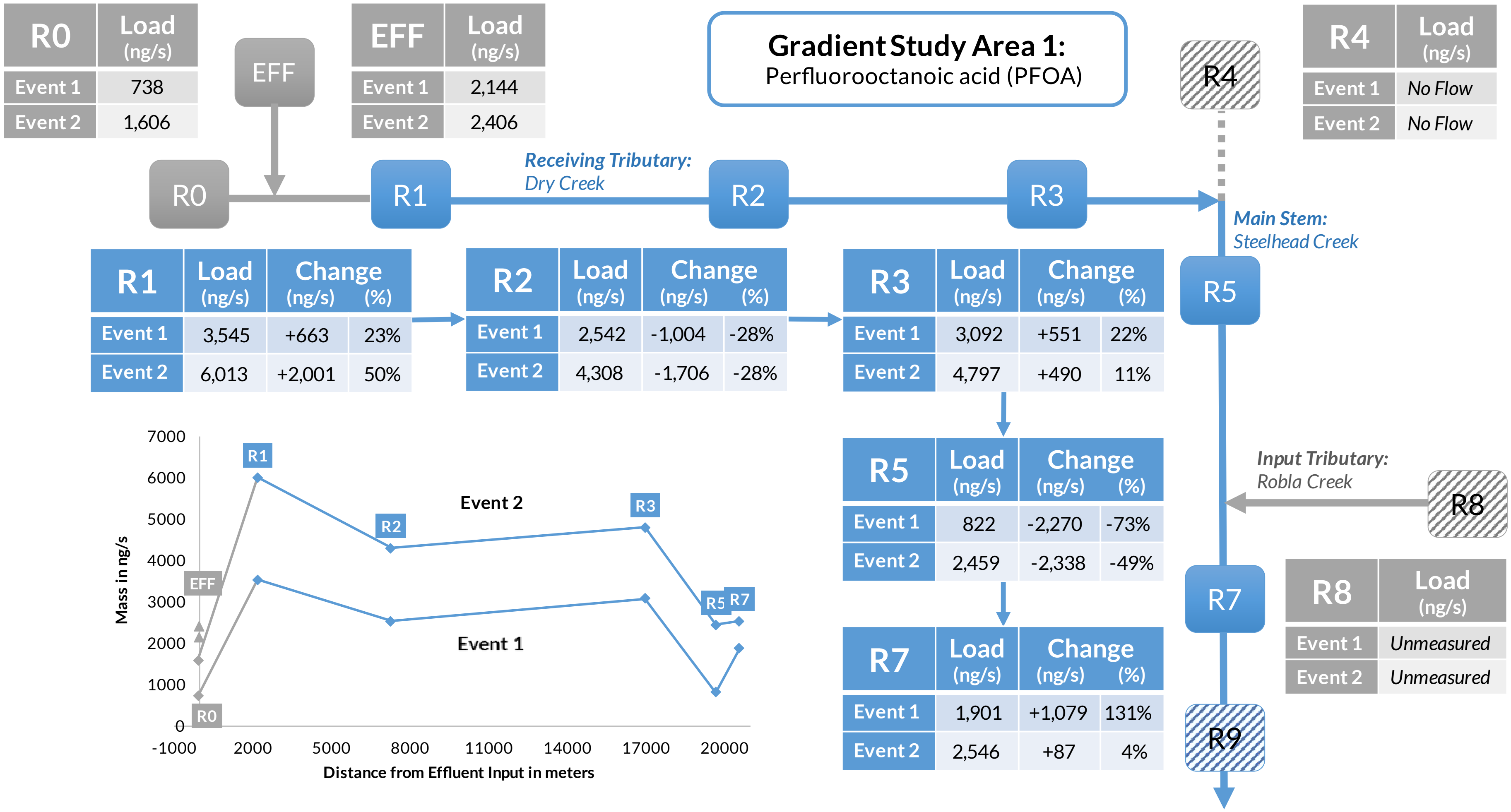
Table 30. PFOA mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	738	--	--	--	1,606	--	--	--
Effluent	EFF	2,144	--	--	--	2,406	--	--	--
Total Receiving Tributary Input			**2,882**			**Total Input**	**4,012**		
Receiving Tributary	R1	--	3,545*	(+) 663	(+) 23%	--	6,013*	(+) 2,001	(+) 50%
	R2	--	2,542	(-) 1,004	(-) 28%	--	4,308	(-) 1,706	(-) 28%
	R3	--	3,092	(+) 551	(+) 22%	--	4,797	(+) 490	(+) 11%
Main Stem	R5	--	822	(-) 2,270	(-) 73%	--	2,459	(-) 2,338	(-) 49%
Input Tributary	R8	*Unmeasured*	--	--	--	*Unmeasured*	--	--	--
Main Stem	R7	--	1,901	(+) 1,079	(+) 131%	--	2,546	(+) 87	(+) 4%
Total Mass Balance (Total Input)				**(-) 981**	**(-) 34%**	**Total Mass Balance (Total Input)**		**(-) 1,466**	**(-) 37%**
Mass Balance from Peak Load (*)				**(-) 1,644**	**(-) 46%**	**Mass Balance from Peak Load (*)**		**(-) 3,467**	**(-) 58%**

Figure 14. PFOA mass balance flow diagram for Gradient Study Area 1.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	738
Event 2	1,606

EFF	Load (ng/s)
Event 1	2,144
Event 2	2,406

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,545	+663	23%
Event 2	6,013	+2,001	50%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,542	-1,004	-28%
Event 2	4,308	-1,706	-28%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,092	+551	22%
Event 2	4,797	+490	11%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	822	-2,270	-73%
Event 2	2,459	-2,338	-49%

R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,901	+1,079	131%
Event 2	2,546	+87	4%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

PFAS Concentrations for Gradient Study Area 2

In Gradient Study Area 2, measured concentrations of PFOA were generally higher than PFOS, with concentrations in Event 2 generally higher than those measured for Event 1 for each constituent **(Table 28**). Both constituents were detected at similar concentrations (if not slightly higher) in samples collected from R1 compared to the effluent input. Concentrations generally decreased along the receiving tributary of Old Alamo Creek, with concentrations further decreasing in the first main stem site of R5 (**Figure 15**).

Neither constituent was detected in the upstream main stem R4 input site for either event; PFOS was not detected in the R5 main stem flow path either for Event 1. Both constituents were detected in the R6 downstream site for both events, with all detections except for PFOA in Event 2 showing an increase from the previous R5 measurement (**Table 28, Figure 15**).

PFAS Mass Loads for Gradient Study Area 2

Instantaneous mass load information is captured in **Table 31** for PFOS and **Table 32** for PFOA for Gradient Study Area 2. The patterns observed across both PFAS constituents and events become more consistent when concentrations were converted to instantaneous mass load (or mass flux) values (**Figure 12**).

Though concentrations decreased, the pattern observed between the final receiving tributary (R3) results and the first main stem (R5) results are different when accounting for instantaneous mass loading values. With the exception of the non-detect result for PFOS at R5, instantaneous loads increased along the main stem for Event 1 (from R3 to R5). The large increase in loads is a function of concentrations remaining relatively consistent between the two sites while the discharge increased between Old and New Alamo Creeks, with the main stem having a wider and deeper channel than Old Alamo Creek. However, for Event 1, the R5 site was not wadable by field crews and the discharge was measured using the float method. The float method is a less precise method to use for discharge than using the wading method and may have contributed to a larger increase in loads of PFOA and PFAS for Event 1. All loads decreased from R5 to R6.

Both PFOS and PFOA showed a net increase in mass loading during Event 1 from the final R6 site compared to the initial effluent value (**Figure 17**, **Figure 18**). Conversely, both PFAS constituents had a net decrease in mass loading for Event 2, though the increases for Event 1 of 189% (PFOS, **Table 31**) and 169% (PFOA, **Table 32**) were of a greater magnitude than the decreases -16% (PFOS, **Table 31**) and -38% (PFOA, **Table 32**) of Event 2. Peak loads were observed in the final two sites for both constituents and events, with the PFOS load peaking in the final (R6) site for Event 1 and all other PFAS showing peak loading at the R5 main stem site.

Figure 15. PFAS concentrations (ng/L) for Gradient Study Area 2.
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow.

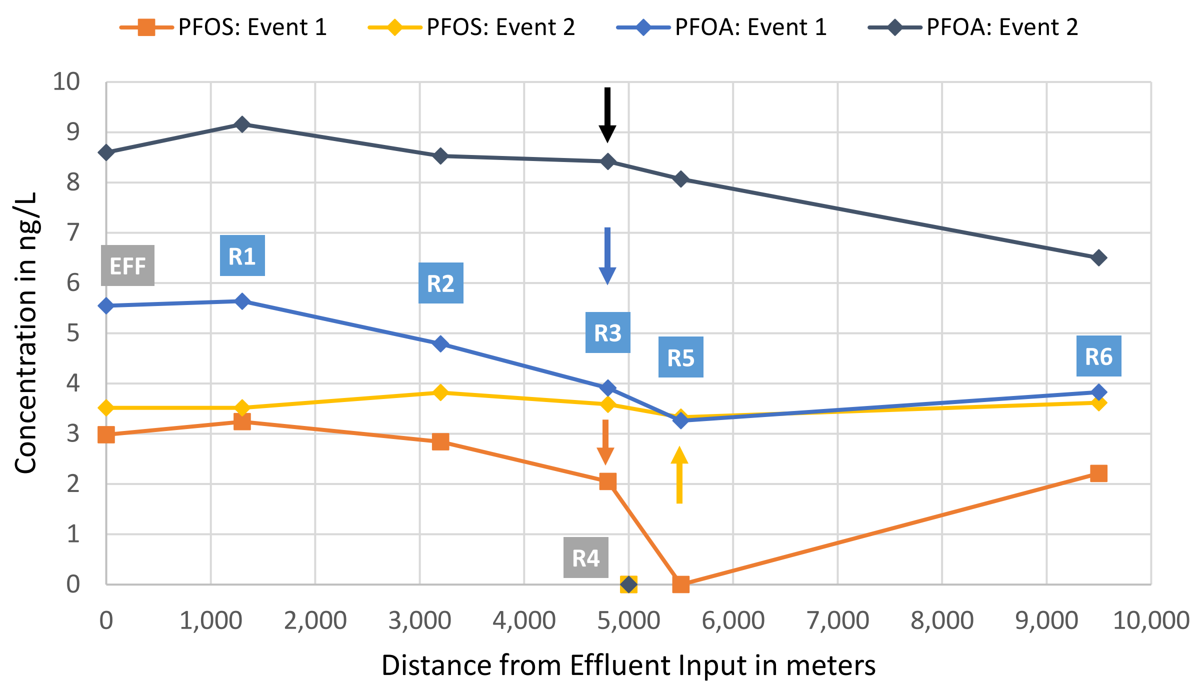


Figure 16. PFAS instantaneous mass loads (ng/s) for Gradient Study Area 2.

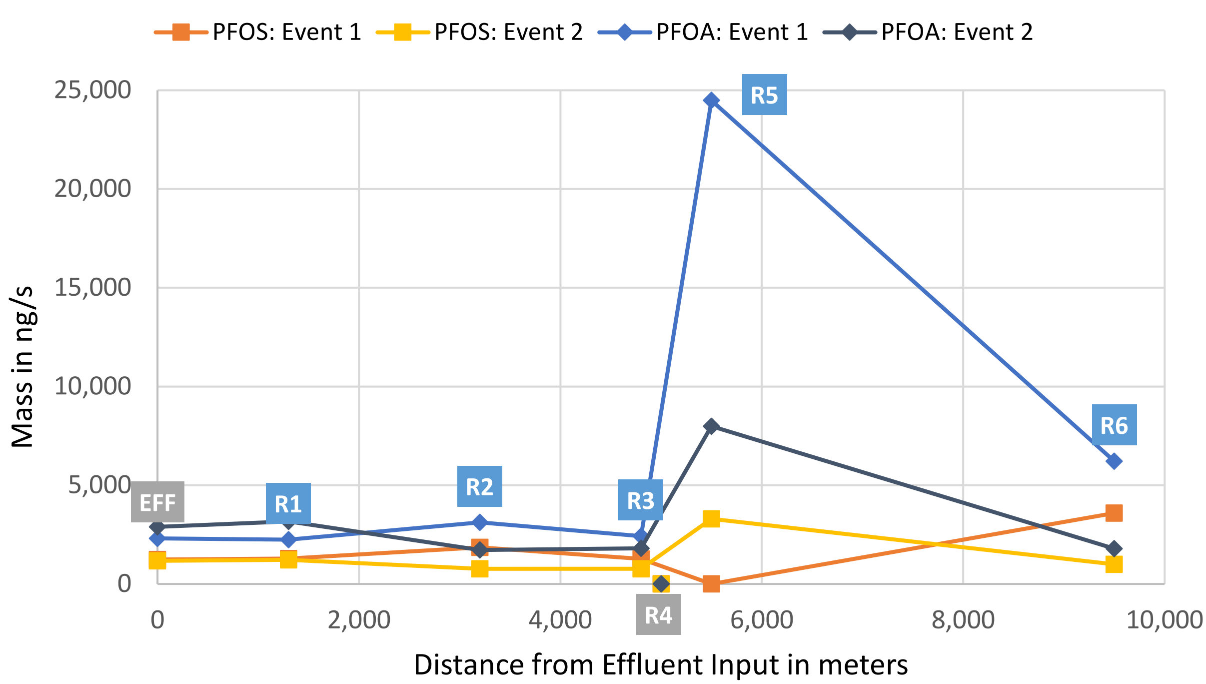


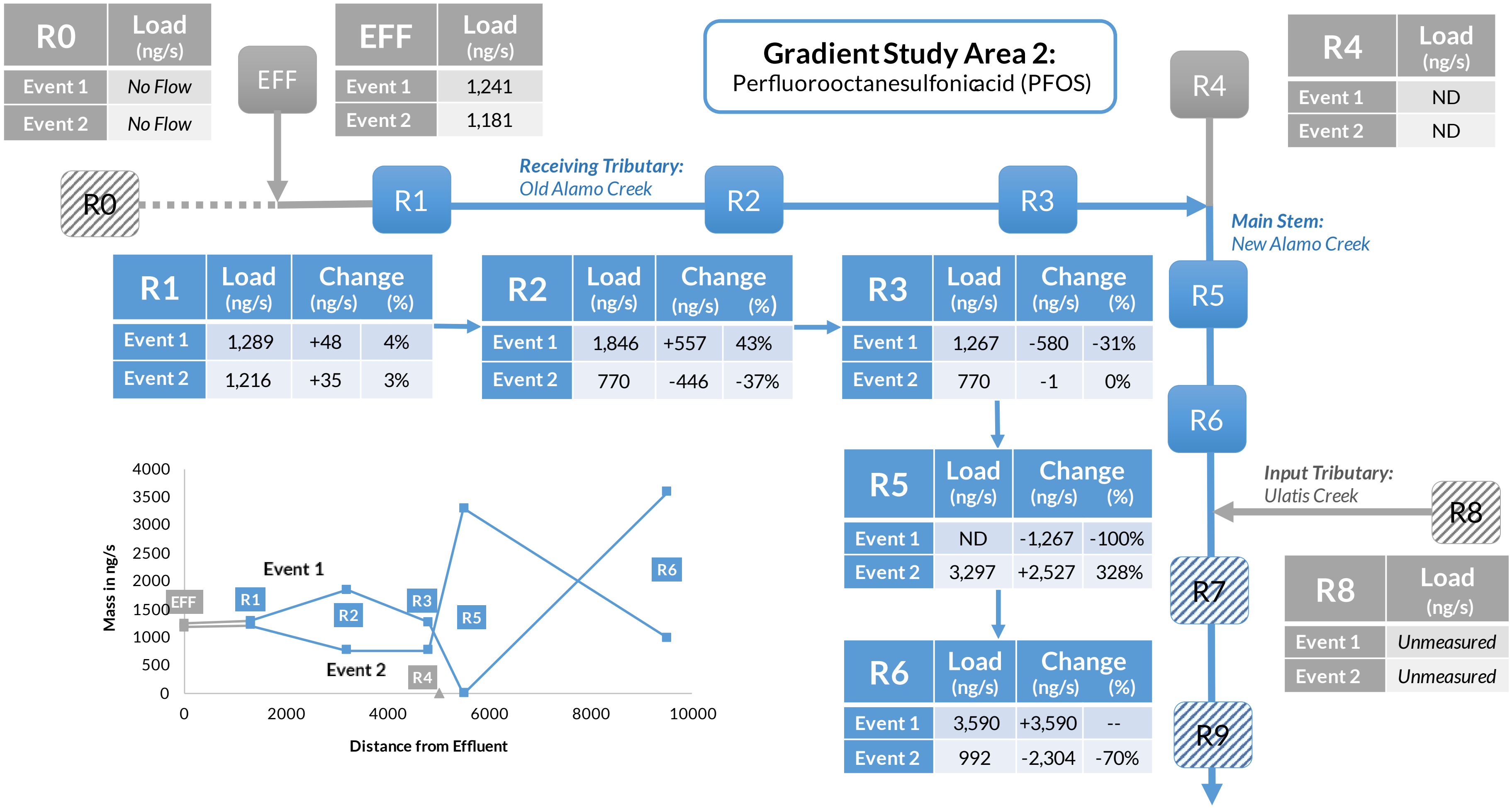
Table 31. PFOS mass balances for Gradient Study Area 2.

Total Mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	1,241	--	--	--	1,181	--	--	--
Receiving Tributary	R1	--	1,289	(+) 48	(+) 4%	--	1,216	(+) 35	(+) 3%
	R2	--	1,846	(+) 557	(+) 43%	--	770	(–) 446	(–) 37%
	R3	--	1,267	(-) 580	(-) 31%	--	770	(–) 1	0%
Input Tributary	R4	ND	--	--	--	ND	--	--	--
Total Main Stem Input			**1,267**			**Total Input**	**770**		
Main Stem	R5	--	ND	(–)1,267	(–) 100%	--	3,297*	(+)2,527	(+) 328%
	R6	--	3,590*	(+) 3,590	--	--	992	(–) 2,304	(–) 70%
Total Mass Balance (Effluent)				**(+) 2,348**	**(+) 189%**	**Total Mass Balance (Effluent)**		**(–) 189**	**(–) 16%**
Mass Balance from Peak Load (*)				**--**	**0%**	**Mass Balance from Peak Load (*)**		**(-) 2,304**	**(-) 70%**

Figure 17. PFOS mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	1,241
Event 2	1,181

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,289	+48	4%
Event 2	1,216	+35	3%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,846	+557	43%
Event 2	770	-446	-37%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,267	-580	-31%
Event 2	770	-1	0%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	-1,267	-100%
Event 2	3,297	+2,527	328%

R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,590	+3,590	--
Event 2	992	-2,304	-70%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

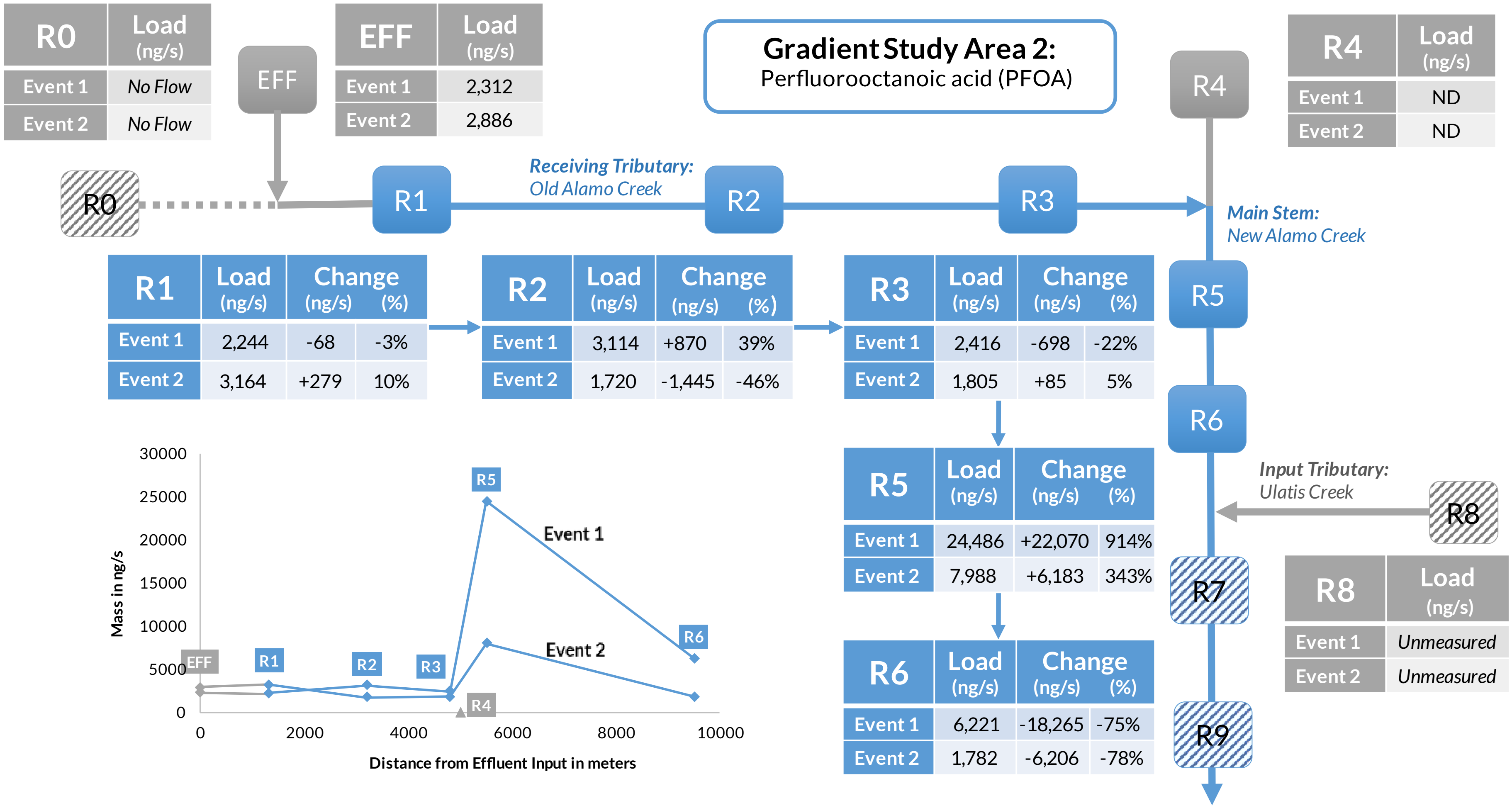
Table 32. PFOA mass balances for Gradient Study Area 2.

Total Mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	2,312	--	--	--	2,886	--	--	--
Receiving Tributary	R1	--	2,244	(-) 68	(-) 3%	--	3,164	(+) 279	(+) 10%
	R2	--	3,114	(+) 870	(+) 39%	--	1,720	(-) 1,445	(-) 46%
	R3	--	2,416	(-) 698	(-) 22%	--	1,805	(+) 85	(+) 5%
Input Tributary	R4	ND	--	--	--	ND	--	--	--
Total Main Stem Input			2,416			**Total Input**	**1,805**		
Main Stem	R5	--	24,486*	(+) 22,070	(+) 914%	--	7,988*	(+) 6,183	(+) 343%
	R6	--	6,221	(-) 18,265	(-)75%	--	1,782	(-) 6,206	(-) 78%
Total Mass Balance (Effluent)				**(+) 3,909**	**(+) 169%**	**Total Mass Balance (Effluent)**		**(-) 1,104**	**(-) 38%**
Mass Balance from Peak Load (*)				**(-) 18,265**	**(-) 75%**	**Mass Balance from Peak Load (*)**		**(-) 6,206**	**(-) 78%**

Figure 18. PFOA mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	2,312
Event 2	2,886

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,244	-68	-3%
Event 2	3,164	+279	10%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,114	+870	39%
Event 2	1,720	-1,445	-46%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,416	-698	-22%
Event 2	1,805	+85	5%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	24,486	+22,070	914%
Event 2	7,988	+6,183	343%

R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	6,221	-18,265	-75%
Event 2	1,782	-6,206	-78%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

PPCPS IN WATER

Of the 15 PPCPs analyzed in samples collected during Year 3 CEC monitoring, eight PPCPs were detected in environmental samples. These included galaxolide, BPA (in samples analyzed by Weck), diclofenac, gemfibrozil, ibuprofen, naproxen, salicylic acid and triclosan (**Table 33**).

Galaxolide was detected in every sample, though it should be noted that some of these detections were at a level similar to that observed in corresponding field or equipment blank samples, indicating they may be influenced by contamination. Nevertheless, the majority of galaxolide detections were orders of magnitude higher than the contamination measured in control samples, and therefore are unlikely to be solely attributable to measurement bias.

Bisphenol A was detected at both runoff MS4 locations but only during Event 2; it was not detected in either gradient study area.

Diclofenac was detected in Gradient Study Area 1 only during Event 2 at the Effluent, R1, R2, and R3 locations. In Gradient Study Area 2, diclofenac was detected in both Event 1 and Event 2 but not in the effluent. The first detection of diclofenac (below the RL and noted with a J flag) occurred at R1 during Event 2 and R2 during Event 1. Other samples with detections of diclofenac include R3 and R5.

Gemfribrozil was detected at all sites in Gradient Study Area 1 (except for R0) for both Event 1 and 2 and was not detected in the runoff MS4 locations nor in any locations in Gradient Study Area 2.

Ibuprofen was mostly detected below the RL (noted with a J flag) except for detections above the RL at the runoff MS4 locations (both in Event 2) and at the Effluent location in Gradient Study Area 1 during Event 2.

Naproxen was detected above the RL during Event 2 at all locations in Gradient Study Area 1 except R0, and at both runoff MS4 locations during Event 2. There were no detections of naproxen in samples collected from Gradient Study Area 2 during either Event 1 or 2.

Salicylic acid was detected below the RL (noted with a J flag) in samples collected from the runoff MS4 locations and from Gradient Study Area 2 locations including the Effluent (Event 2), R1 (both events), and R2 (Event 2). There were no detections of salicylic acid in samples collected from Gradient Study Area 1.

Triclosan was detected below the RL (noted with a J flag) at all locations in Gradient Study Area 2 except R0, Effluent, and R4; all detections occurred during Event 2.

Table 33. PPCP concentrations in environmental samples (water, ng/L).

Cells populated with a “--” indicate a non-detect result. Results with a (J) indicate a detection between the MDL and RL for which the result could be detected but not quantified and should be considered an estimate. All results are reported in ng/L.

Station Type	ID	Distance From Source (m)	Event	Physis (ng/L)			Weck (ng/L)												
				Galaxolide	Triclocarban	Bisphenol A	Bisphenol A	Diclofenac	Estradiol, 17beta-	Estrone	Ethynylestradiol, 17alpha-	Gemfibrozil	Ibuprofen	Iopromide	Naproxen	Progesterone	Salicylic Acid	Testosterone	Triclosan
Runoff	MS4	0	1	218	--	--	--	--	--	--	--	--	--	--	--	--	130(J)	--	--
			2	175	--	--	63	--	--	--	--	--	230	--	63	--	460(J)	--	--
Runoff	MS4	0	1	134	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			2	109	--	--	51	--	--	--	--	--	74	--	120	--	390(J)	--	--
Gradient Study Area 1	R0	-60	1	62.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			2	84.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Effluent	EFF	0	1	13,800	--	--	--	--	--	--	--	12	18	--	--	--	--	--	--
			2	1,300	--	--	--	49	--	--	--	140	--	--	66	--	--	--	--
Gradient Study Area 1	R1	2,200	1	6,190	--	--	--	--	--	--	--	6.4(J)	6.2(J)	--	--	--	--	--	--
			2	5,970	--	--	--	20	--	--	--	46	--	--	33	--	--	--	--
Gradient Study Area 1	R2	7,300	1	4,840	--	--	--	--	--	--	--	7.8(J)	7.2(J)	--	--	--	--	--	--
			2	5,640	--	--	--	19	--	--	--	36	--	--	33	--	--	--	--
Gradient Study Area 1	R3	17,000	1	2,760	--	--	--	--	--	--	--	5.1(J)	4.7(J)	--	--	--	--	--	--
			1-Dup	2,510	--	--	--	--	--	--	--	5.3(J)	7.4(J)	--	--	--	--	--	--
			2	3,970	--	--	--	20	--	--	--	22	--	--	20	--	--	--	--
Gradient Study Area 1	R5	19,700	1	1,920	--	--	--	--	--	--	--	7.5(J)	6.2(J)	--	--	--	--	--	--
			2	3,120	--	--	--	--	--	--	--	26	--	--	13	--	--	--	--
Gradient Study Area 1	R7	20,600	1	1,460	--	--	--	--	--	--	--	9(J)	4.5(J)	--	--	--	--	--	--
			2	2,940	--	--	--	--	--	--	--	22	--	--	16	--	--	--	--

Station Type	ID	Distance From Source (m)	Event	Physis (ng/L)			Weck (ng/L)												
				Galaxolide	Triclocarban	Bisphenol A	Bisphenol A	Diclofenac	Estradiol, 17beta-	Estrone	Ethynylestradiol, 17alpha-	Gemfibrozil	Ibuprofen	Iopromide	Naproxen	Progesterone	Salicylic Acid	Testosterone	Triclosan
Effluent	EFF	0	1	13,600	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			2	1,300	--	--	--	--	--	--	--	--	--	--	--	--	120(J)	--	--
Gradient Study Area 2	R1	1,300	1	12,500	--	--	--	--	--	--	--	--	6.2(J)	--	--	--	100(J)	--	--
			2	11,400	--	--	--	8.1(J)	--	--	--	--	--	--	--	--	220(J)	--	8.4(J)
			2-Dup	11,000	--	--	--	7.8(J)	--	--	--	--	--	--	--	--	210(J)	--	--
Gradient Study Area 2	R2	3,200	1	8,270	--	--	--	4.2(J)	--	--	--	--	4.2(J)	--	--	--	--	--	--
			2	10,000	--	--	--	11	--	--	--	--	--	--	--	--	110(J)	--	11(J)
Gradient Study Area 2	R3	4,800	1	6,730	--	--	--	4.9(J)	--	--	--	--	--	--	--	--	--	--	--
			2	8,580	--	--	--	24	--	--	--	--	--	--	--	--	--	--	12(J)
Gradient Study Area 2	R4	5,000	1	42.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			2	150	--	--	--	-	--	--	--	--	--	--	--	--	--	--	--
Gradient Study Area 2	R5	5,500	1	4,700	--	--	--	5.7(J)	--	--	--	--	--	--	--	--	--	--	--
			2	6,730	--	--	--	--	--	--	--	--	4.5(J)	--	--	--	--	--	14(J)
Gradient Study Area 2	R6	9,500	1	2,320	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			2	5,220	--	--	--	--	--	--	--	--	8.4(J)	--	--	--	--	--	12(J)

J = detected not quantifiable

PPCP Results for Gradient Study Area 1

A total of five of the 15 PPCP analytes were detected at Gradient Study Area 1 sites across two events. Of these five, two analytes, gemfibrozil and galaxolide, were detected during both events. The remaining three PPCPs, diclofenac, ibuprofen, and naproxen, were each only detected during one of the monitoring events (**Table 33**).

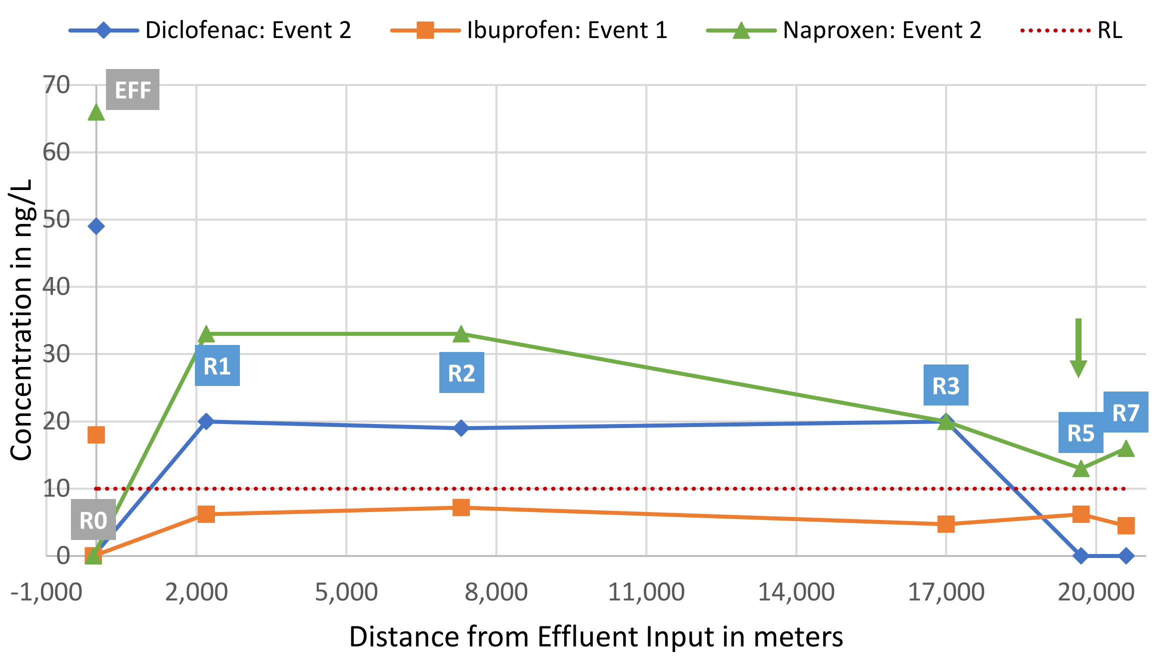
Diclofenac, Ibuprofen, and Naproxen

Diclofenac, ibuprofen, and naproxen are all non-steroidal anti-inflammatory drugs and were all detected at Gradient Study Area 1 sites, though not consistently across events; ibuprofen was only detected during Event 1, while diclofenac and naproxen were each only detected during Event 2 (**Figure 19**).

Each of these constituents showed a peak in the effluent concentration with a decrease in concentrations at the following R1 location. None were detected at the R0 site upstream of the effluent input (**Figure 19**). All ibuprofen detections were below the RL of 10 ng/L except for the sample from the Effluent site (**Figure 19**). Detections below the RL are flagged for being outside the quantifiable range of the instrument and are considered estimates.

Figure 19. Diclofenac, ibuprofen, naproxen concentrations (ng/L) for Gradient Study Area 1.

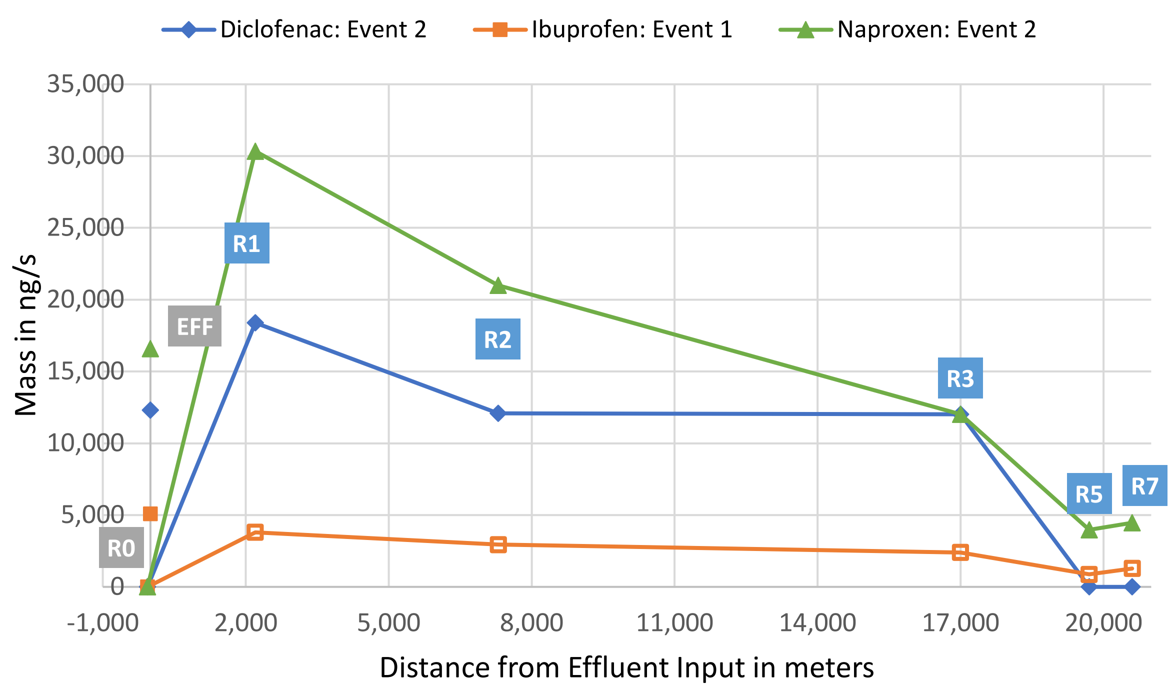
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow; attenuation was not observed for diclofenac (Event 2) and ibuprofen (Event 1).



When using discharge to account for the instantaneous mass loading associated with each measured concentration, the R1 site becomes the peak location for diclofenac and naproxen (**Figure 20**). Both PPCPs show reductions in mass loading at each of the subsequent sites, with a small increase observed at the final R7 site. Ibuprofen mass loads are lower at all receiving water and main stem sites compared to the effluent, with a similar pattern of moderate decreases in subsequent sites with a slight increase at R7; the behavior of ibuprofen loading in the flow path sites should be considered estimated, since these loading rates are calculated based on estimated concentrations below the RL (**Figure 20**).

Figure 20. Diclofenac, ibuprofen, and naproxen instantaneous mass loads (ng/s) for Gradient Study Area 1.

Open datapoints represent mass loads based on a concentration detected below the RL.



Diclofenac was not detected in the main stem R5 and R7 sites during Event 2, indicating that the overall mass balance for diclofenac was equal to the amount contributed by the effluent, and the receiving water returned to the background level of non-detect. Mass balances for diclofenac during Event 2 are outlined in (**Table 34, Figure 21**).

Ibuprofen had an overall decrease of 66% in mass loading from the R1 (peak loading along the receiving water) to the final sampling location (R7) during Event 1 (**Table 35**). Detections occurred at all monitored locations downstream of the Effluent; these detections were below the RL and are considered estimates. The mass balance of ibuprofen along the Gradient Study Area 1 flow path is shown in (**Figure 22**).

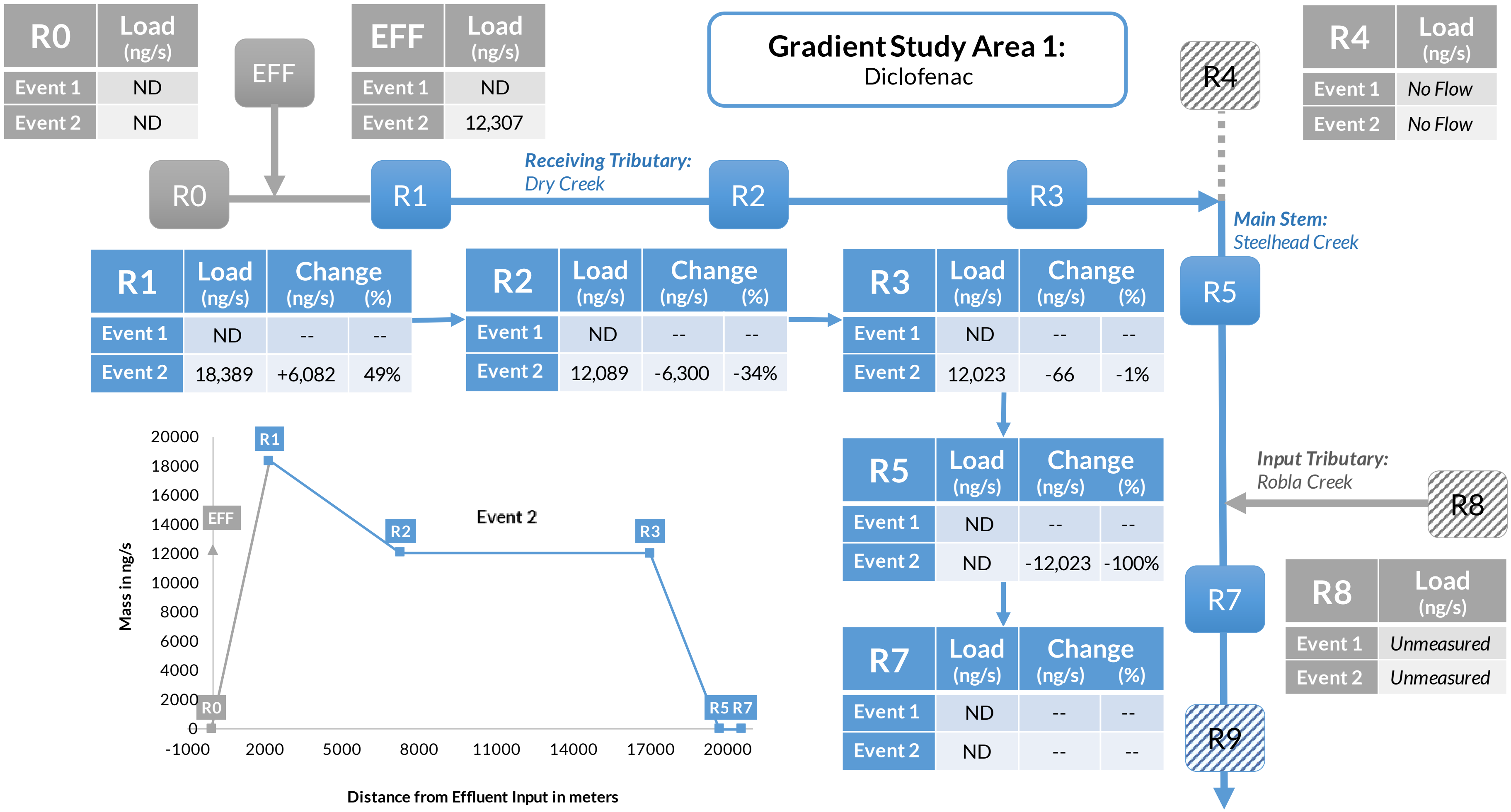
Naproxen also showed a substantial decrease in overall mass loading compared to the peak value (85%) when it was detected during Event 2 (**Table 36**). Naproxen was also still present at low levels in the main stem sites, though still at levels high enough to be quantifiable by the laboratory. The mass balance of naproxen along the Gradient Study Area 1 flow path is shown in **Figure 22**.

Table 34. Diclofenac mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 site exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	ND	--	--	--
Effluent	EFF	12,307	--	--	--
Total Receiving Tributary Input			**12,307**		
Receiving Tributary	R1	--	18,389*	(+) 6,082	(+) 49%
	R2	--	12,089	(-) 6,300	(-) 34%
	R3	--	12,023	(-) 66	(-) 1%
Main Stem	R5	--	ND	(-) 12,023	(-) 100%
Input Tributary	R8	*Unmeasured*	--	--	--
Main Stem	R7	--	ND	--	--
Total Mass Balance (Total Input)				**(-) 12,307**	**(-) 100%**
Mass Balance from Peak Load (*)			**(-) 18,389**		**(-) 100%**

Figure 21. Diclofenac mass balance flow diagram for Gradient Study Area 1.
Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	ND
Event 2	ND

EFF	Load (ng/s)
Event 1	ND
Event 2	12,307

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	18,389	+6,082	49%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	12,089	-6,300	-34%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	12,023	-66	-1%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	ND	-12,023	-100%

R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	ND	--	--

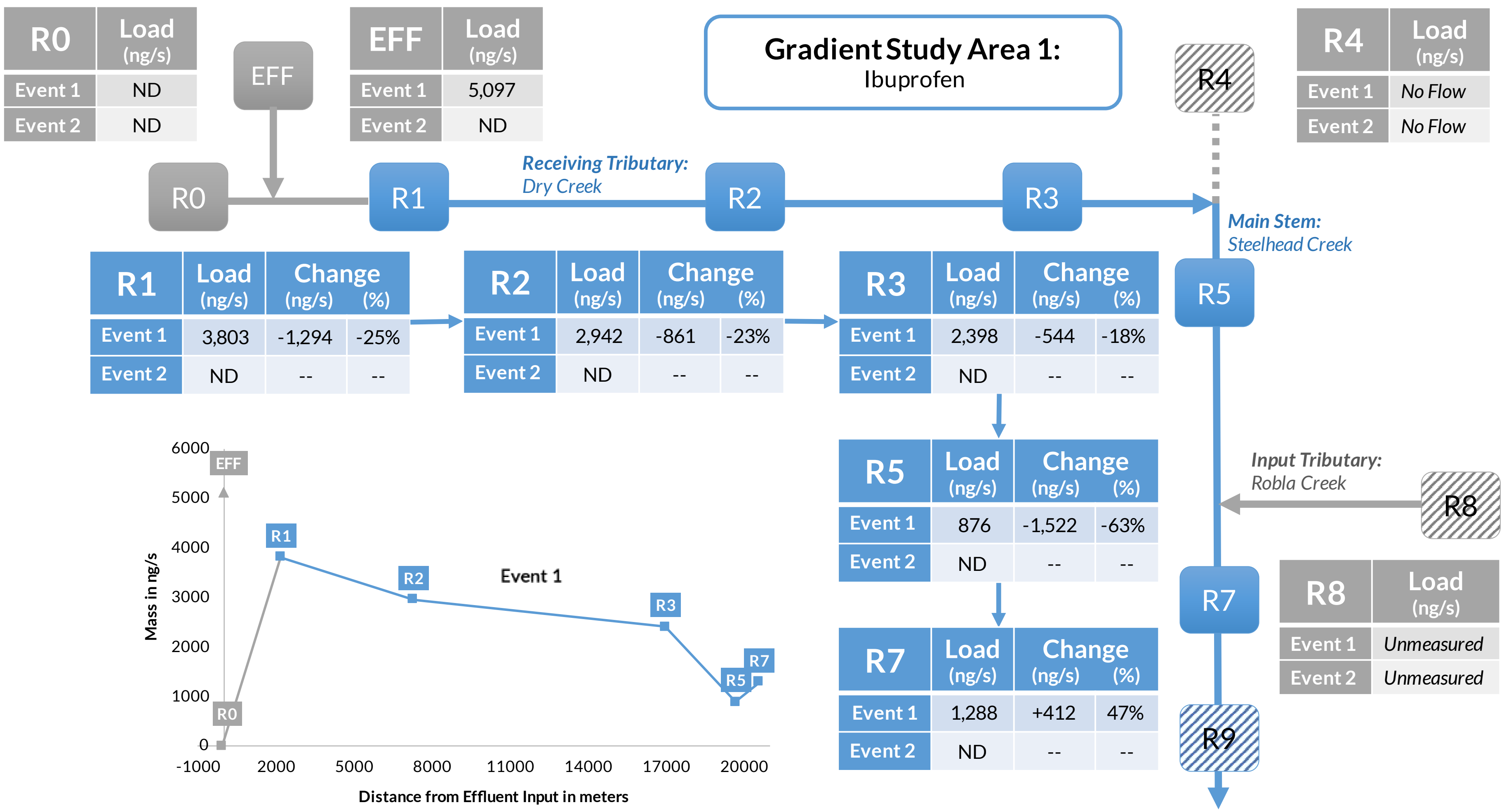
R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Table 35. Ibuprofen mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 site exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

WATERBODY TYPE	SITE	EVENT 1			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	ND	--	--	--
Effluent	EFF	5,097	--	--	--
Total Receiving Tributary Input			**5,097**		
Receiving Tributary	R1	--	3,803*	(-) 1,294	(-) 25%
	R2	--	2,942	(-) 861	(-) 23%
	R3	--	2,398	(-) 544	(-) 18%
Main Stem	R5	--	876	(-) 1,522	(-) 63%
Input Tributary	R8	*Unmeasured*	--	--	--
Main Stem	R7	--	1,288	(+) 412	(+) 47%
Total Mass Balance (Total Input)				**(-) 3,809**	**(-) 75%**
Mass Balance from Peak Load (*)				**(-) 2,514**	**(-) 66%**

Figure 22. Ibuprofen mass balance flow diagram for Gradient Study Area 1.
Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	ND
Event 2	ND

EFF	Load (ng/s)
Event 1	5,097
Event 2	ND

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,803	-1,294	-25%
Event 2	ND	--	--

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,942	-861	-23%
Event 2	ND	--	--

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,398	-544	-18%
Event 2	ND	--	--

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	876	-1,522	-63%
Event 2	ND	--	--

R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,288	+412	47%
Event 2	ND	--	--

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

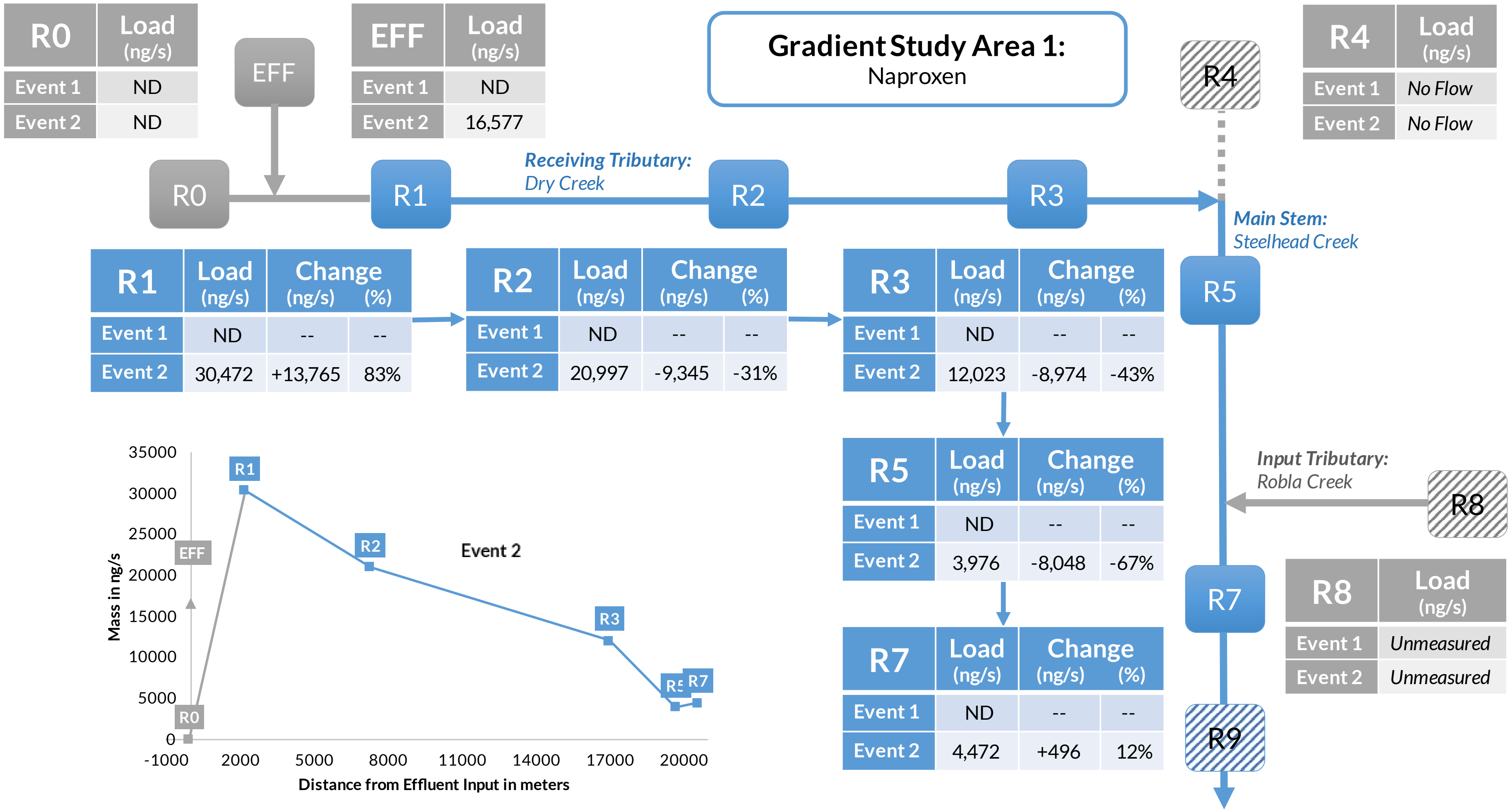
Table 36. Naproxen mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 site exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

WATERBODY TYPE	SITE	EVENT 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	ND	--	--	--
Effluent	EFF	16,577	--	--	--
Total Receiving Tributary Input			**16,577**		
Receiving Tributary	R1	--	30,472	(+) 13,765	(+) 83%
	R2	--	20,997	(-) 9,345	(-) 31%
	R3	--	12,023	(-) 8,974	(-) 43%
Main Stem	R5	--	3,976	(-) 8,048	(-) 67%
Input Tributary	R8	*Unmeasured*	--	--	--
Main Stem	R7	--	4,472	(+) 496	(+) 12%
Total Mass Balance (Total Input)				**(-) 12,105**	**(-) 73%**
Mass Balance from Peak Load (*)				**(-) 25,870**	**(-) 85%**

Figure 23. Naproxen mass balance flow diagram for Gradient Study Area 1.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	ND
Event 2	ND

EFF	Load (ng/s)
Event 1	ND
Event 2	16,577

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	30,472	+13,765	83%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	20,997	-9,345	-31%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	12,023	-8,974	-43%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	3,976	-8,048	-67%

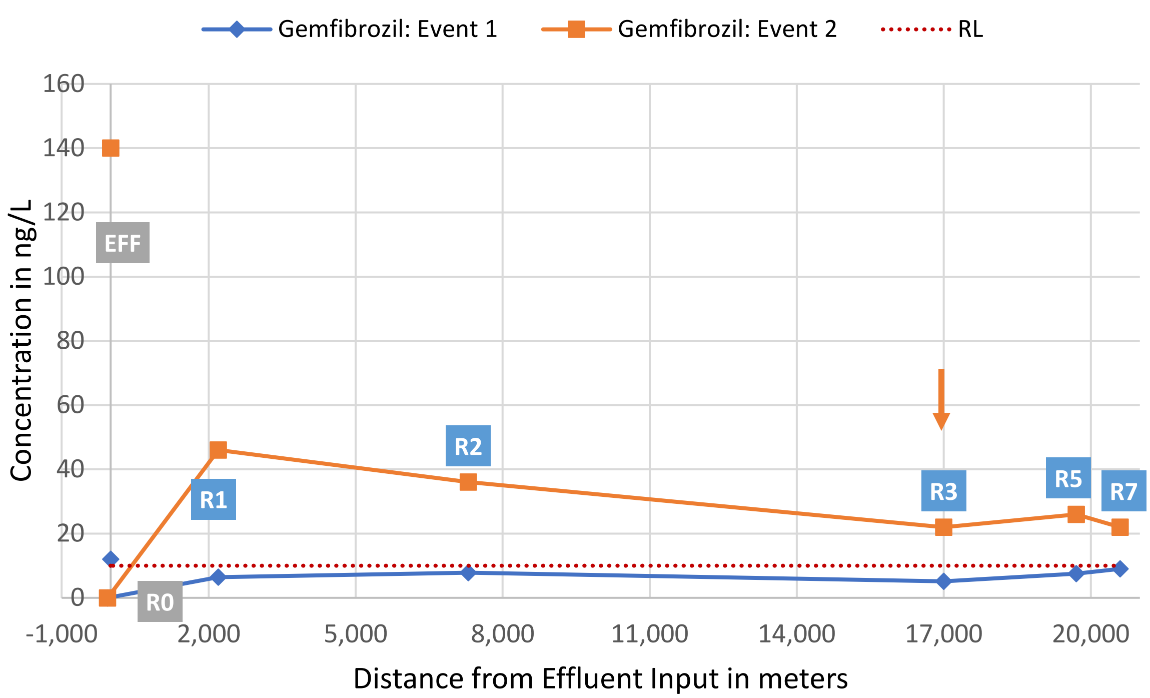
R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	4,472	+496	12%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Gemfibrozil

Gemfibrozil (prescription drug used to treat high lipid levels) was detected in Gradient Study Area 1 samples for both events, though at higher concentrations for Event 2. The first detection of gemfibrozil occurred at the Effluent with the highest concentration compared to samples collected downstream of the Effluent location (**Figure 24**). Concentrations decreased to the following R1 site and remained low in subsequent samples, though not back down to below the MDL as was observed upstream. All gemfibrozil detections during Event 1 were below the RL and therefore considered estimates with the exception of the effluent measurement (**Figure 24**).

Figure 24. Gemfibrozil concentrations (ng/L) for Gradient Study Area 1.
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow; attenuation was not observed for gemfibrozil (Event 1).



In terms of instantaneous load, the highest load of gemfibrozil occurred at the R1 site for both events, though the loading at the site for Event 2 was an order of magnitude higher than that observed in the first event (**Figure 25**).

The overall mass balance for gemfibrozil decreased for both events, though the magnitude of this decrease was notably higher for Event 2 (85%) than Event 1 (34%) where the input load and R1 peak were also notably higher (**Table 37**, **Figure 25**). The mass balance of naproxen along the Gradient Study Area 1 flow path is shown in **Figure 26**.

Figure 25. Gemfibrozil instantaneous mass loads (ng/s) for Gradient Study Area 1.
Open datapoints represent mass loads bases on a concentration detected below the RL.

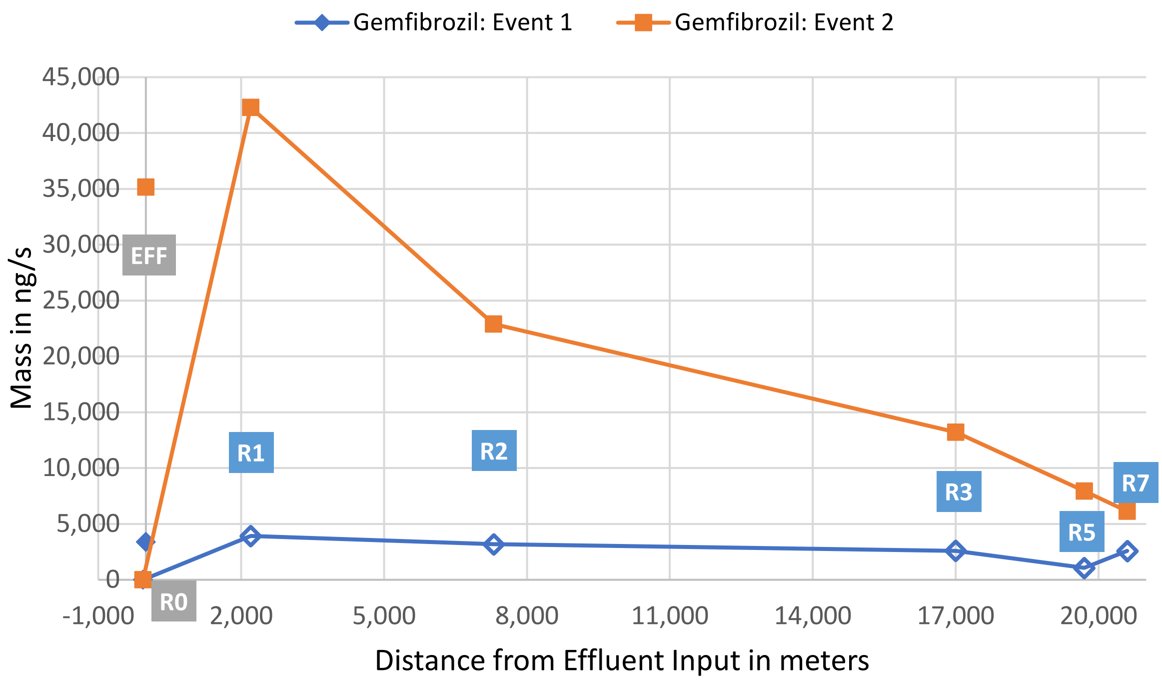


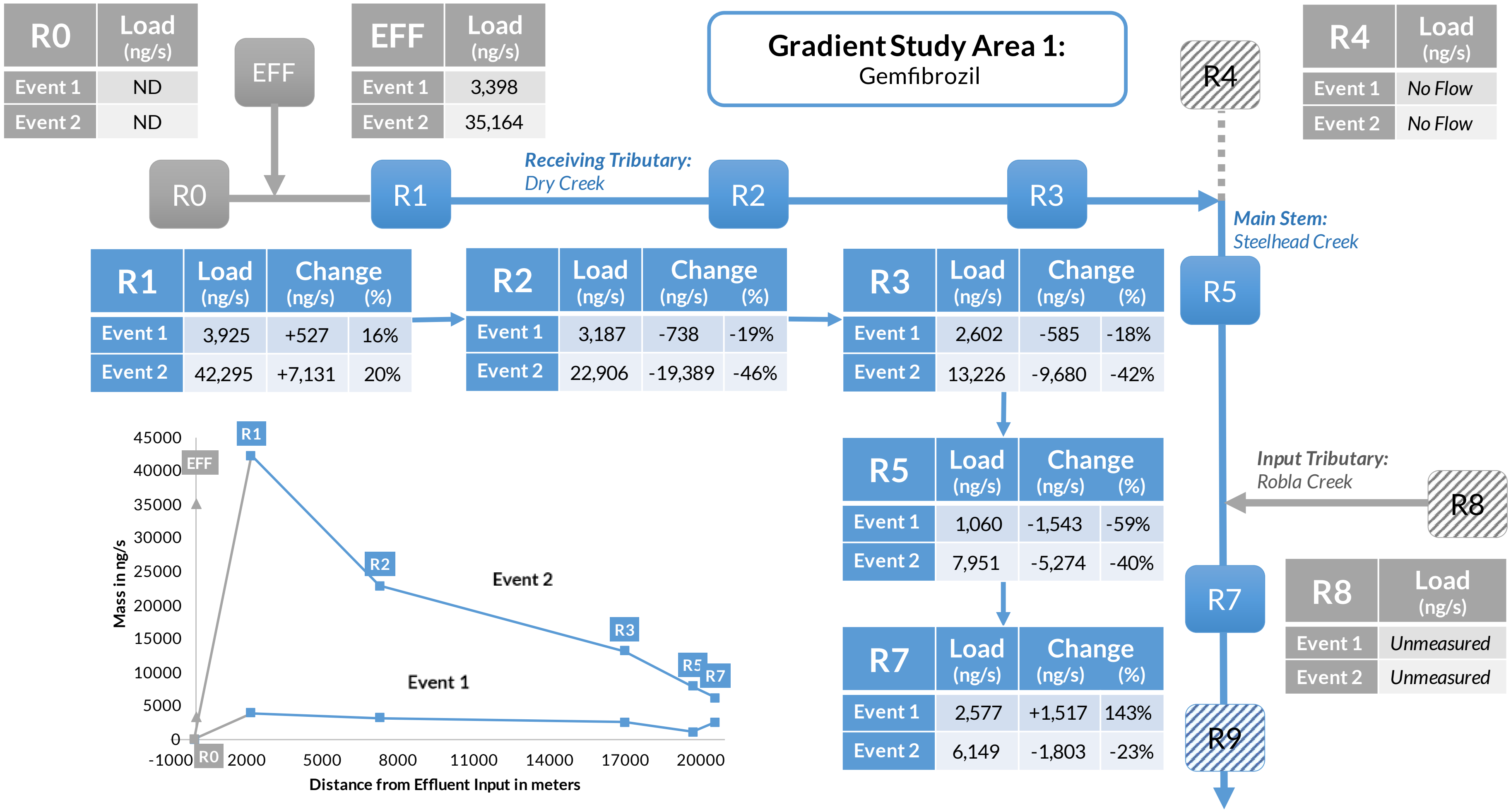
Table 37. Gemfibrozil mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 site exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Receiving Tributary	R0	ND	--	--	--	ND	--	--	--
Effluent	EFF	3,398	--	--	--	35,164	--	--	--
Total Receiving Tributary Input			**3,398**			**Total Input**	**35,164**		
Receiving Tributary	R1	--	3,925*	(+) 527	(+) 16%	--	42,295*	(+) 7,131	(+) 20%
	R2	--	3,187	(-) 738	(-) 19%	--	22,906	(-) 19,389	(-) 46%
	R3	--	2,602	(-) 585	(-) 18%	--	13,226	(-) 9,680	(-) 42%
Main Stem	R5	--	1,060	(-) 1,543	(-) 59%	--	7,951	(-) 5,274	(-) 40%
Input Tributary	R8	*Unmeasured*	--	--	--	*Unmeasured*	--	--	--
Main Stem	R7	--	2,577	(+) 1,517	(+) 143%	--	6,149	(-) 1,803	(-) 23%
Total Mass Balance (Total Input)				**(-) 821**	**(-) 24%**	**Total Mass Balance (Total Input)**		**(-) 29,015**	**(-) 83%**
Mass Balance from Peak Load (*)				**(-) 1,349**	**(-) 34%**	**Mass Balance from Peak Load (*)**		**(-) 36,146**	**(-) 85%**

Figure 26. Gemfibrozil mass balance flow diagram for Gradient Study Area 1.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	ND
Event 2	ND

EFF	Load (ng/s)
Event 1	3,398
Event 2	35,164

R4	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,925	+527	16%
Event 2	42,295	+7,131	20%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,187	-738	-19%
Event 2	22,906	-19,389	-46%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,602	-585	-18%
Event 2	13,226	-9,680	-42%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	1,060	-1,543	-59%
Event 2	7,951	-5,274	-40%

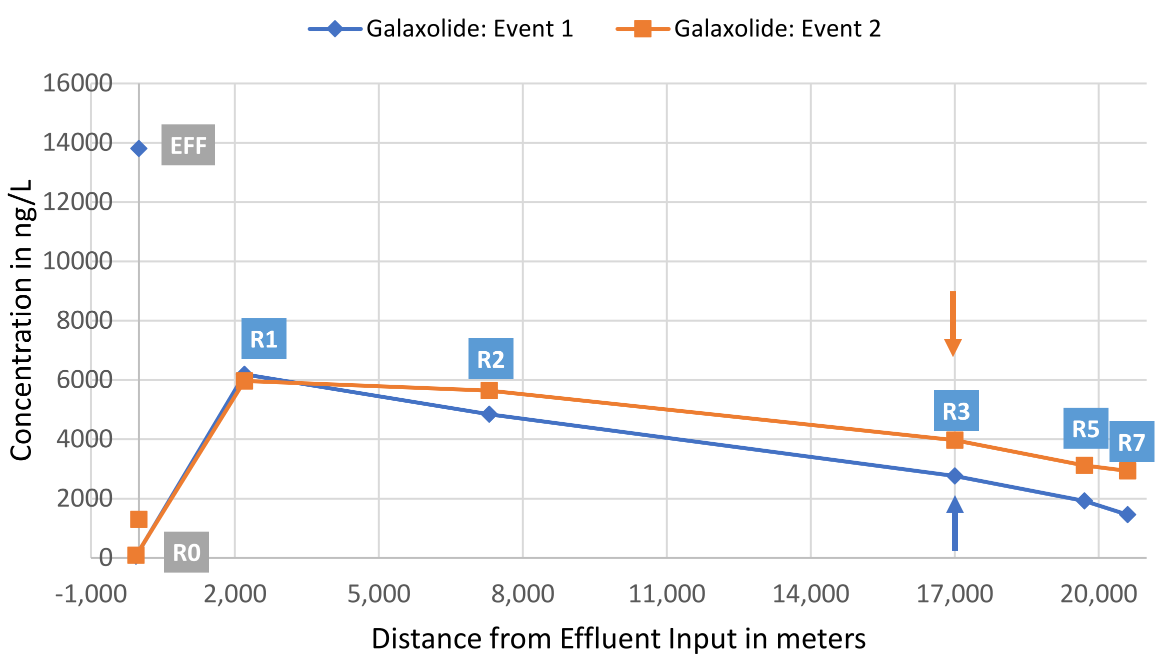
R7	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,577	+1,517	143%
Event 2	6,149	-1,803	-23%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Galaxolide

Galaxolide (synthetic musk found in fragrances) was detected above the RL at all sample locations for both events in Gradient Study Area 1. Concentrations were comparatively higher in the Effluent samples compared to R0, though the concentration in samples from the Effluent location in Event 1 was an order of magnitude higher than the concentration in samples collected in Event 2 (**Table 33**). Galaxolide concentrations were similar in the R1 sample for both events and decreased at consistent rates along the subsequent sites for both sampling events (**Figure 27**).

Figure 27. Galaxolide concentrations (ng/L) for Gradient Study Area 1.
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow.



Galaxolide results by mass load show a different pattern in the input and immediate sample locations, though a similar gradual decrease in the downstream sites as is seen with concentration (**Figure 28**). Notably, the higher concentration in samples from the Effluent location for Event 1 is still higher than the subsequent R1 measurement, though less than the overall load observed at R1 for Event 2. For Event 1, there is a slight increase in load from R5 to R7 (**Table 38**, **Figure 28**).

Galaxolide load peaks at R1 for Event 2 and steadily decreases downstream (**Table 38**, **Figure 28**). Mass balance showed a substantial decrease of 89% of the original input load for Event 1, but an overall increase in loading for Event 2. The mass balance of Galaxolide along the Gradient Study Area 1 flow path is shown in **Figure 29**.

Figure 28. Galaxolide instantaneous mass loads (µg/s) for Gradient Study Area 1.

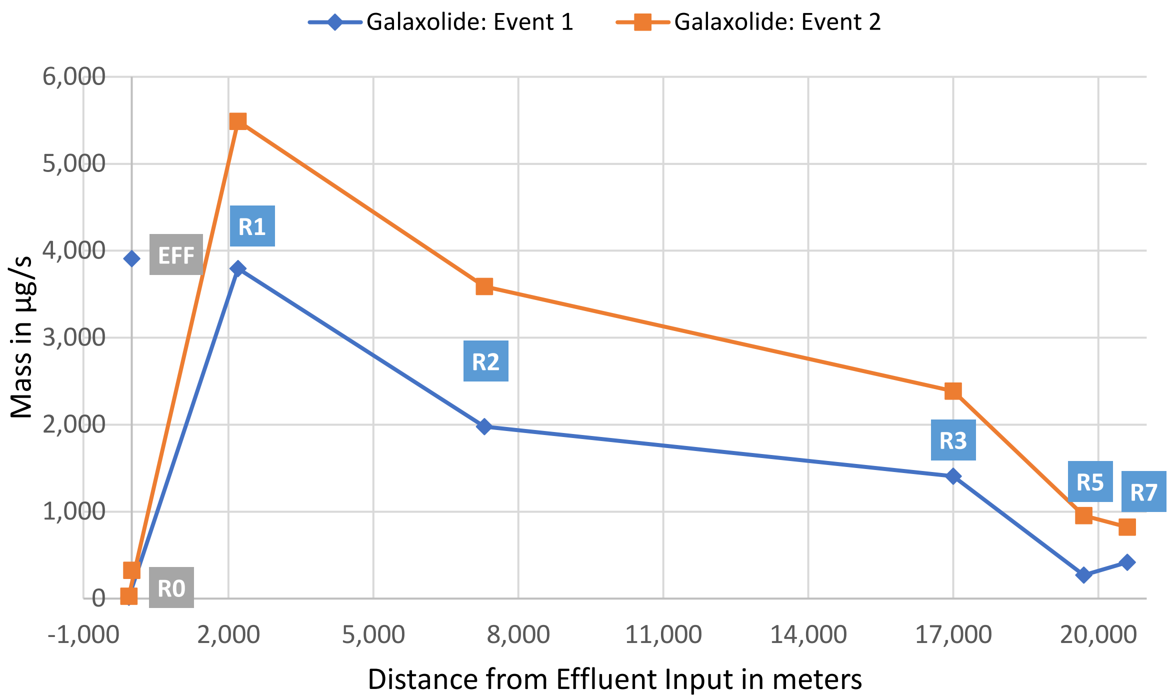


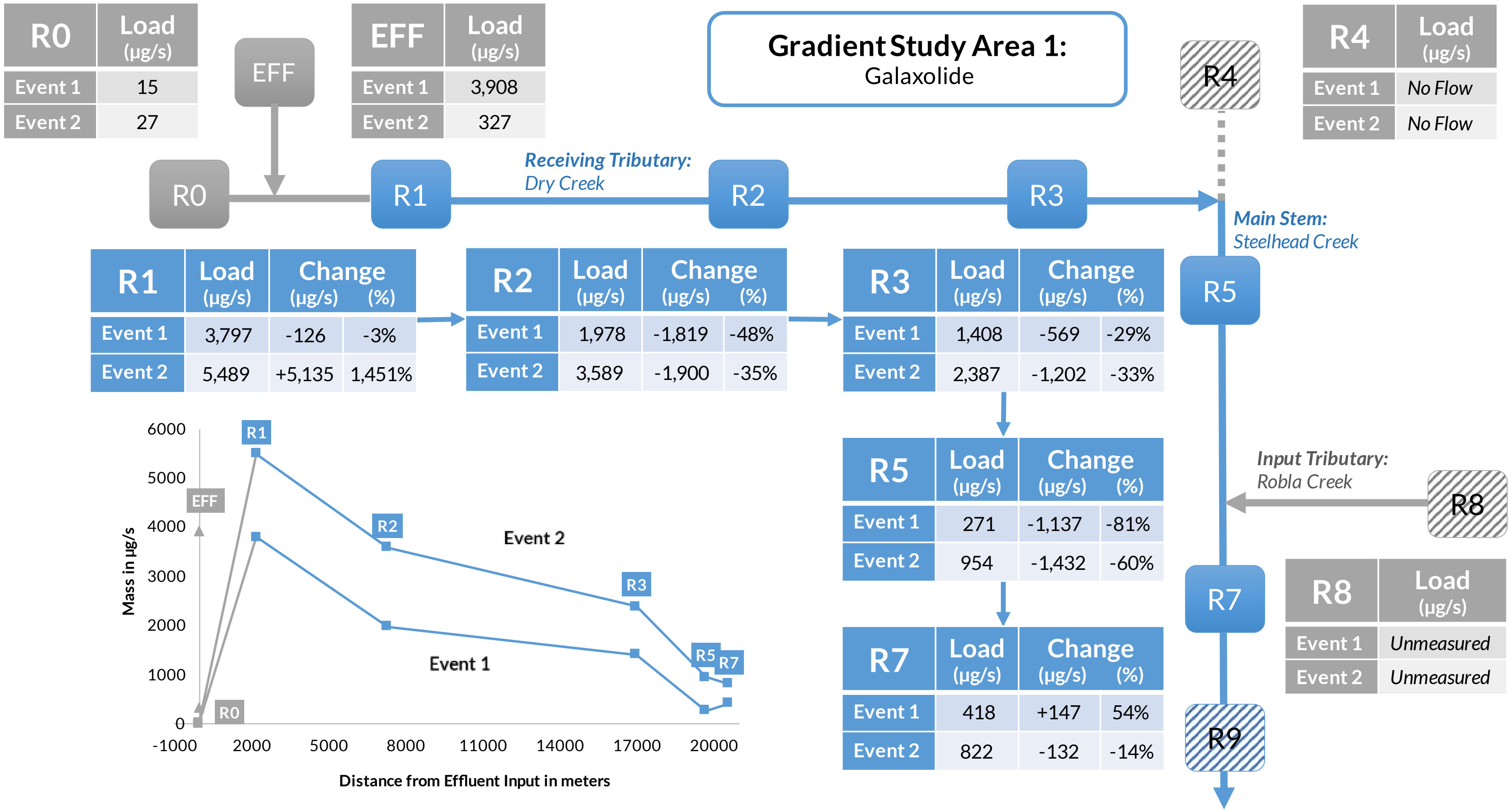
Table 38. Galaxolide mass balances for Gradient Study Area 1.

Total mass balance determined by the difference between the total receiving tributary input value and the final R7 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R8 and R9 were not sampled due to total sites reached. No R6 site exists for Gradient Study Area 1. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (µg/s)	Flow Path Load (µg/s)	Change from Previous (µg/s)	Change from Previous	Input Load (µg/s)	Flow Path Load (µg/s)	Change from Previous (µg/s)	Change from Previous
Receiving Tributary	R0	15	--	--	--	27	--	--	--
Effluent	EFF	3,908	--	--	--	327	--	--	--
Total Receiving Tributary Input		3,923				Total Input	354		
Receiving Tributary	R1	--	3,797*	(-) 126	(-) 3%	--	5,489*	(+) 5,135	(+) 1,451%
	R2	--	1,978	(-) 1,819	(-) 48%	--	3,589	(-) 1,900	(-) 35%
	R3	--	1,408	(-) 569	(-) 29%	--	2,387	(-) 1,202	(-) 33%
Main Stem	R5	--	271	(-) 1,137	(-) 81%	--	954	(-) 1,432	(-) 60%
Input Tributary	R8	*Unmeasured*	--	--	--	*Unmeasured*	--	--	--
Main Stem	R7	--	418	(+) 147	(+) 54%	--	822	(-) 132	(-) 14%
Total Mass Balance (Total Input)				**(-) 3,505**	**(-) 89%**	**Total Mass Balance (Total Input)**		**(+) 468**	**(+) 132%**
Mass Balance from Peak Load (*)				**(-) 3,379**	**(-) 89%**	**Mass Balance from Peak Load (*)**		**(-) 4,667**	**(-) 85%**

Figure 29. Galaxolide mass balance flow diagram for Gradient Study Area 1.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (µg/s)
Event 1	15
Event 2	27

EFF	Load (µg/s)
Event 1	3,908
Event 2	327

R4	Load (µg/s)
Event 1	*No Flow*
Event 2	*No Flow*

R1	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	3,797	-126	-3%
Event 2	5,489	+5,135	1,451%

R2	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	1,978	-1,819	-48%
Event 2	3,589	-1,900	-35%

R3	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	1,408	-569	-29%
Event 2	2,387	-1,202	-33%

R5	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	271	-1,137	-81%
Event 2	954	-1,432	-60%

R7	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	418	+147	54%
Event 2	822	-132	-14%

R8	Load (µg/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

PPCP Results for Gradient Study Area 2

Five of the 15 PPCP analytes were detected at Gradient Study Area 2 sites during the two sampling events, though the specific analytes differed from those detected in Gradient Study Area 1 (**Table 28**). Similar to Gradient Study Area 1, galaxolide was detected consistently during both events. For Gradient Study Area 2, salicylic acid was also detected during both events, though it was not detected at all in Gradient Study Area 1. Diclofenac and ibuprofen were also detected during both events, as opposed to a single event in Gradient Study Area 1. In addition, triclosan was detected only in Gradient Study Area 2, though only for a single event (**Table 28**).

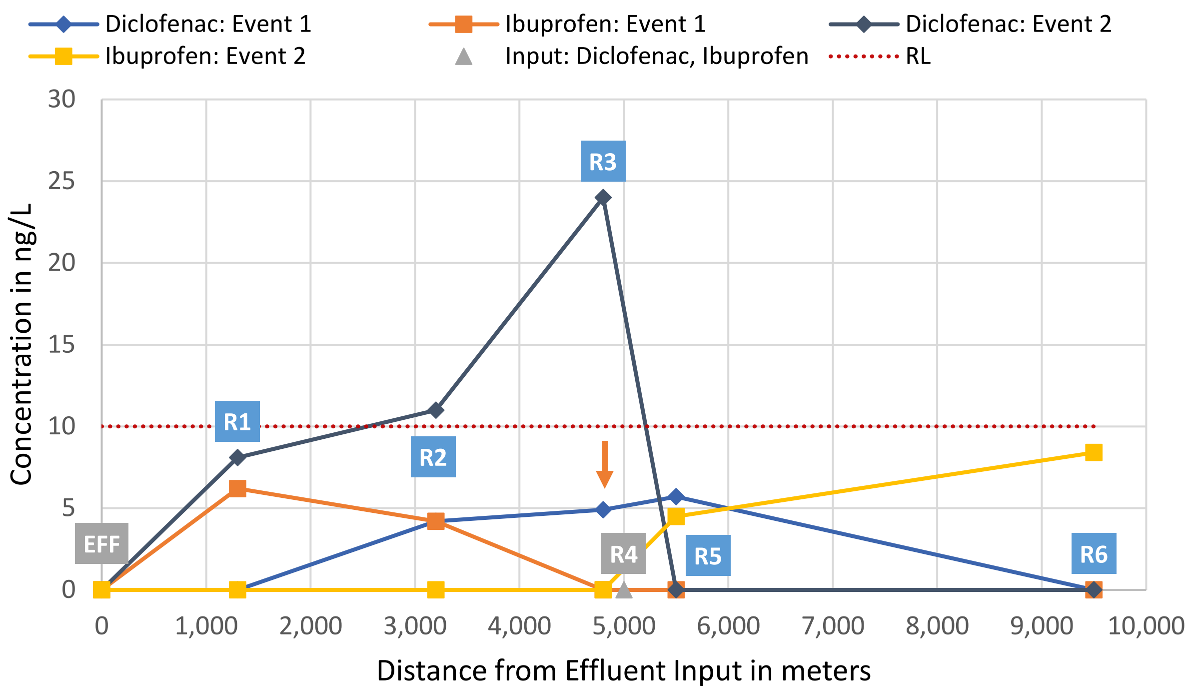
Diclofenac and Ibuprofen

Diclofenac and ibuprofen were detected at Gradient Study Area 2 sites during both Event 1 and 2. All detections were below the RL with the exception of two diclofenac concentrations in samples from Event 2 (**Figure 30**). Neither constituent was detected in the Effluent location or R4 input locations for either event, though detections occurred in subsequent flow path samples (**Figure 30)**.

Diclofenac concentrations were generally higher for Event 2, with the highest concentration measured at the R3 receiving tributary site prior to the outlet into the main stem. For this event, diclofenac concentrations rose at each subsequent site along the receiving tributary (R1-R3) but was not detected in any sites along the main stem. For Event 1, diclofenac was only detected at the R2 and R3 sites along the receiving tributary and rose slightly at the R5 site downstream of the confluence with the main stem; diclofenac was not detected at the subsequent downstream main stem site (R6).

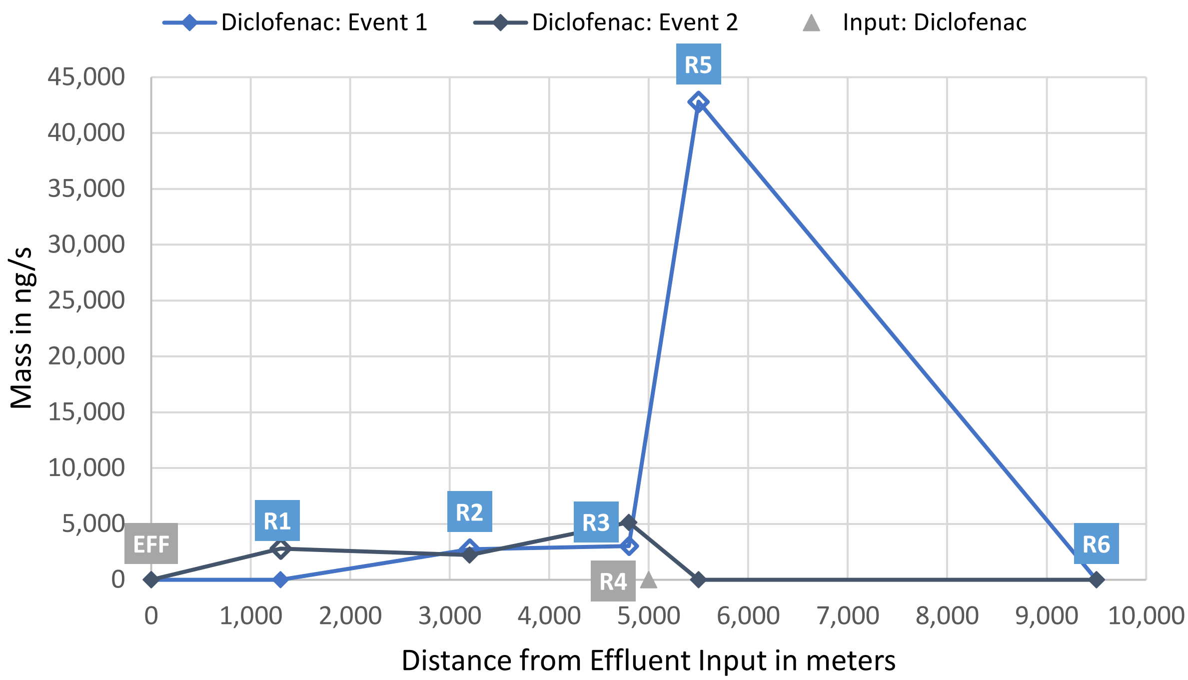
Ibuprofen was also detected in the receiving tributary in Event 1, though the samples were non-detect beginning at R3 and remained so for all downstream sites. For Event 2, however, ibuprofen was not detected until the main stem R5 and R6 sites, with the downstream R6 site representing the peak concentration observed (**Figure 30**).

Figure 30. Diclofenac and ibuprofen concentrations (ng/L) for Gradient Study Area 2. The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow; attenuation was not observed for diclofenac (Events 1 and 2) and ibuprofen (Event 2).



In terms of instantaneous mass loads, the Event 1 diclofenac load at R5 is the maximum load observed at 42,813 ng/s which is a 717% increase from R3 (**Table 39, Figure 31**). However, it should be noted that the magnitude of this result is likely influenced by the high discharge estimate obtained by the float method, as well as the uncertainty associated with measurements reported below the laboratory RL. Nevertheless, when accounting for discharge, the loading associated with the peak diclofenac concentration at R3 during Event 2 is within a similar range as the load at the same site for Event 1 (**Table 39**). The overall mass balance for diclofenac for both sampling events was zero, with the effluent source water non-detect for diclofenac. Load estimates peaked at R5 for Event 1 and R3 for Event 2 with the final R6 site non-detect for diclofenac for both events (**Table 39, Figure 31**).

Figure 31. Diclofenac instantaneous mass loads (ng/s) for Gradient Study Area 2.
Open datapoints represent mass loads based on a concentration detected below the RL.



For ibuprofen, the flux in concentrations along the flow path were generally reversed when comparing to the flux in instantaneous loads, with the R2 site having a slightly higher load than the R1 site for Event 1 and the R5 site having a higher load than R6 for Event 2 (**Figure 32**). The overall mass balance for ibuprofen during Event 1 was zero, with the effluent source water and final R6 site both non-detect for ibuprofen while the peak load was observed at R2 (**Table 40**). For Event 2, there was a net increase in ibuprofen loads, with the R6 location representing a net gain of 2,302 ng/s compared to the effluent. Nevertheless, the R6 loading represented an overall decrease of 48% from the peak observed at R5. Mass balances for ibuprofen along the Gradient Study Area 2 flow path are shown in **Figure 34**.

Figure 32. Ibuprofen instantaneous mass loads (ng/s) for Gradient Study Area 2.
Open datapoints represent mass loads based on a concentration detected below the RL.

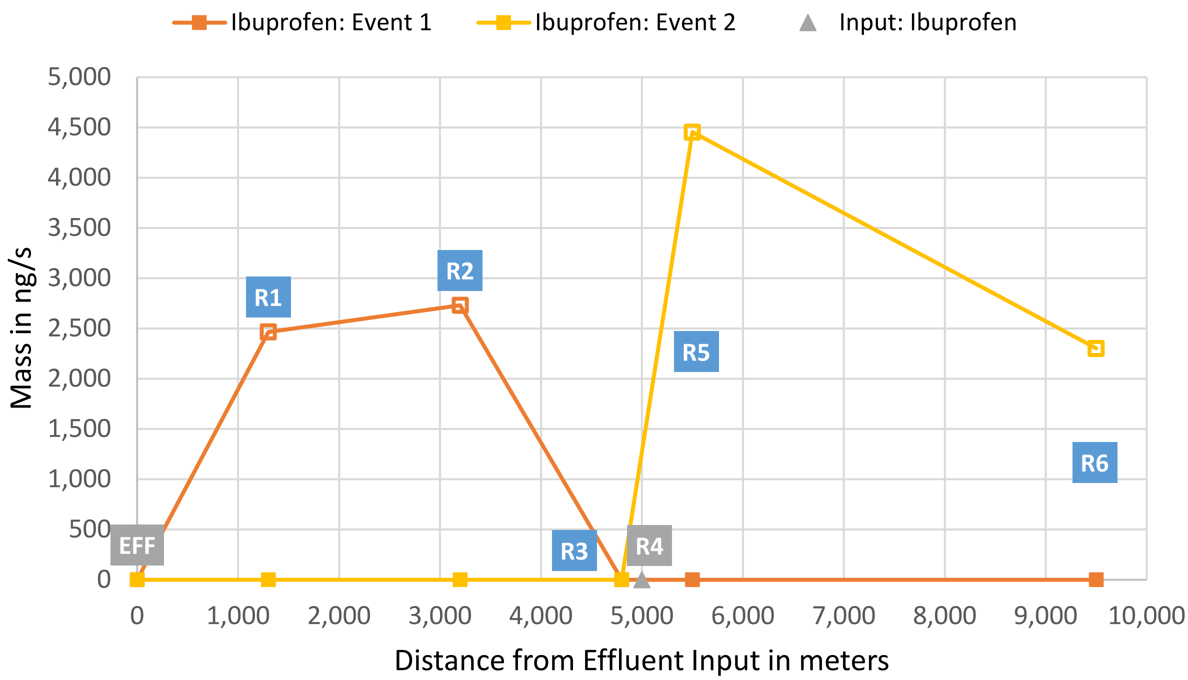


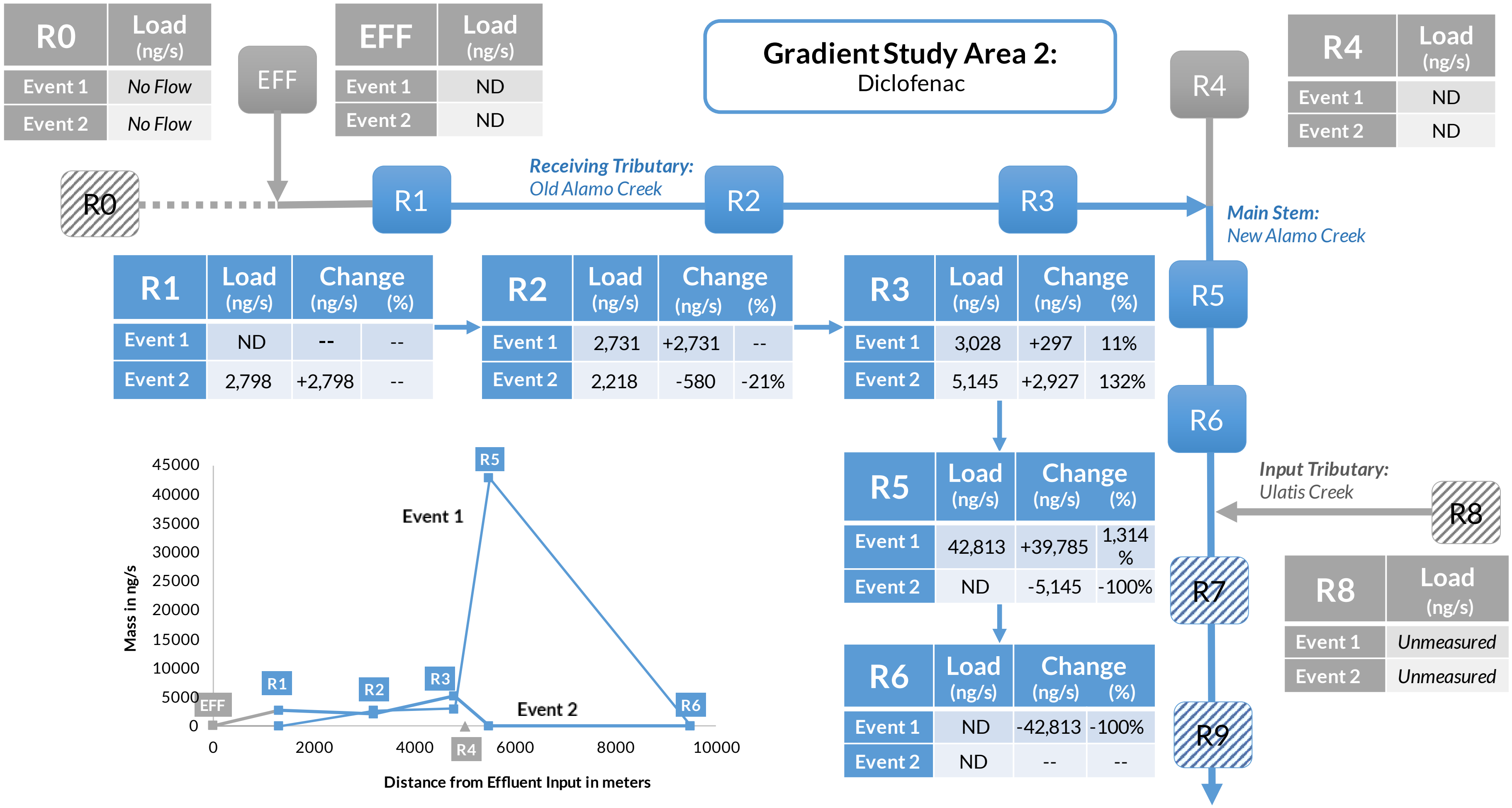
Table 39. Diclofenac mass balances for Gradient Study Area 2.

Total mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	ND	--	--	--	ND	--	--	--
Receiving Tributary	R1	--	ND	--	--	--	2,798	(+) 2,798	--
	R2	--	2,731	(+) 2,731	--	--	2,218	(-) 580	(-) 21%
	R3	--	3,028	(+)297	(+)11%	--	5,145*	(+) 2,927	(+) 132%
Input Tributary	R4	ND	--	--	--	ND	--	--	--
Total Main Stem Input			**3,028**			**Total Input**	**5,145**		
Main Stem	R5	--	42,813*	(+)39,785	(+)1,314%	--	ND	(-) 5,145	(-) 100%
	R6	--	ND	(-) 42,813	(-) 100%	--	ND	--	--
Total Mass Balance (Effluent)				**--**	**--**	**Total Mass Balance (Effluent)**		**--**	**--**
Mass Balance from Peak Load (*)				**(-) 42,813**	**(-) 100%**	**Mass Balance from Peak Load (*)**		**(-) 5,145**	**(-) 100%**

Figure 33. Diclofenac mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	ND
Event 2	ND

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	2,798	+2,798	--

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,731	+2,731	--
Event 2	2,218	-580	-21%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	3,028	+297	11%
Event 2	5,145	+2,927	132%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	42,813	+39,785	1,314 %
Event 2	ND	-5,145	-100%

R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	-42,813	-100%
Event 2	ND	--	--

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

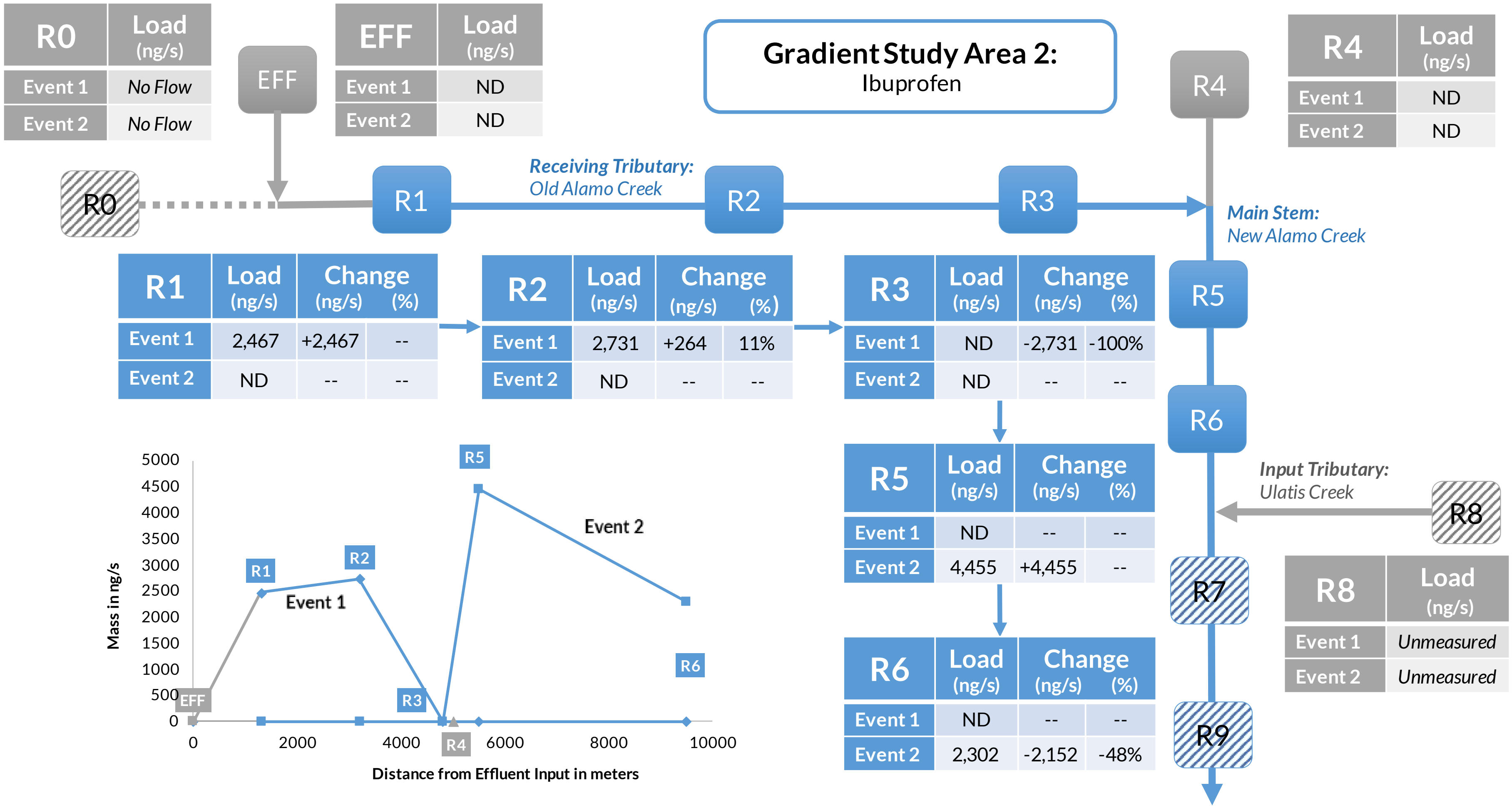
Table 40. Ibuprofen mass balances for Gradient Study Area 2.

Total mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	ND	--	--	--	ND	--	--	--
Receiving Tributary	R1	--	2,467	(+) 2,467	--	--	ND	--	--
	R2	--	2,731*	(+) 264	(+) 11%	--	ND	--	--
	R3	--	ND	(-) 2,731	(-) 100%	--	ND	--	--
Input Tributary	R4	ND	--	--	--	ND	--	--	--
Total Main Stem Input			**--**			**Total Input**	**--**		
Main Stem	R5	--	ND	--	--	--	4,455*	(+) 4,455	--
	R6	--	ND	--	--	--	2,302	(-) 2,152	(-) 48%
Total Mass Balance (Effluent)				**--**	**--**	**Total Mass Balance (Effluent)**		**2,302**	**--**
Mass Balance from Peak Load (*)				**(-) 2,731**	**(-) 100%**	**Mass Balance from Peak Load (*)**		**(-) 2,152**	**(-) 48%**

Figure 34. Ibuprofen mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	ND
Event 2	ND

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,467	+2,467	--
Event 2	ND	--	--

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	2,731	+264	11%
Event 2	ND	--	--

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	-2,731	-100%
Event 2	ND	--	--

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	4,455	+4,455	--

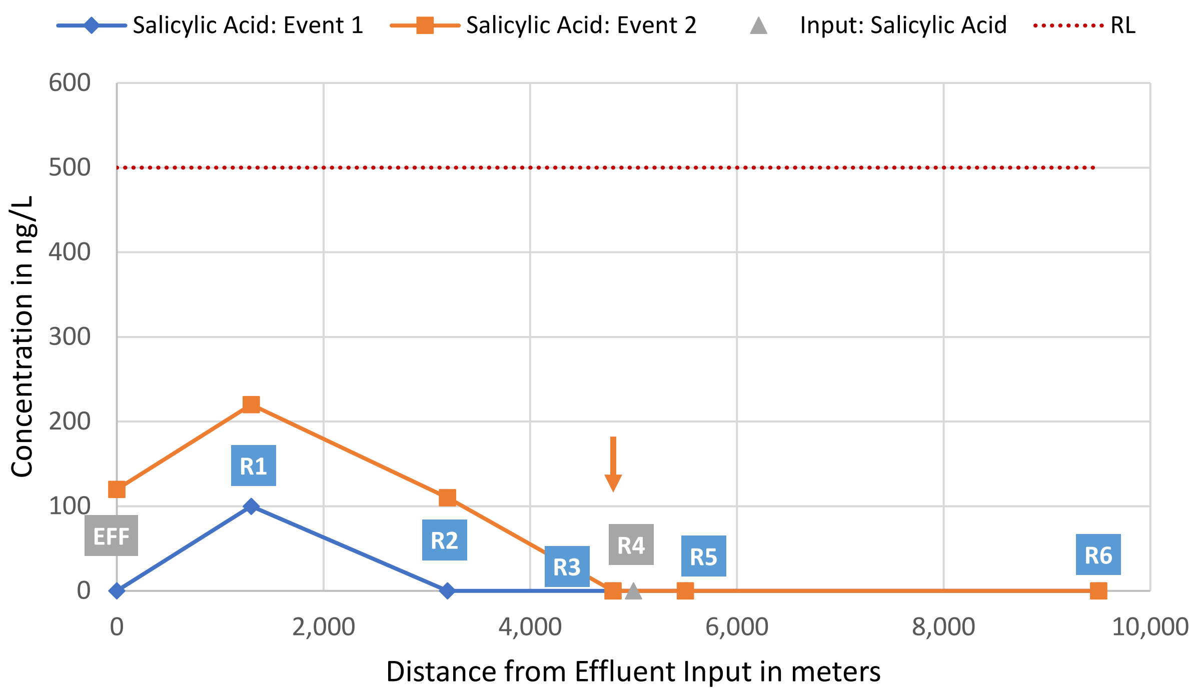
R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	2,302	-2,152	-48%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Salicylic Acid

Salicylic acid is an organic compound with anti-inflammatory properties used in skin care products and was detected at sites in Gradient Study Area 2 below the RL (estimated values). During Event 1, salicylic acid was detected in Gradient Study Area 2 at R1 only. During Event 2, salicylic acid was detected at the Effluent location, R1, and R2. Concentrations were non-detect in both events at R4, R5, and R6 (**Table 33**, **Figure 35**).

Figure 35. Salicylic acid concentrations (ng/L) for Gradient Study Area 2.
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow.



When evaluating instantaneous mass loads, during Event 1 the total mass balance was zero since salicylic acid was detected at only one location in the receiving tributary and was non-detect at the next receiving tributary location (R3); there was no load observed in the main stem (R5 or R6; **Table 16, Figure 36**). Event 2 loads had a similar pattern as the concentrations for salicylic acid with the highest load at R1 followed by a decrease in load at R2 and no load at R3 in the receiving tributary and no loads detected in the main stem (**Table 16, Figure 36).** All mass loads should be considered estimates since all concentrations are below the RL. The mass balance of salicylic acid along the Gradient Study Area 2 flow path is shown in **Figure 37**.

Figure 36. Salicylic acid instantaneous mass loads (ng/s) for Gradient Study Area 2.
Open datapoints represent mass loads based on a concentration detected below the RL.

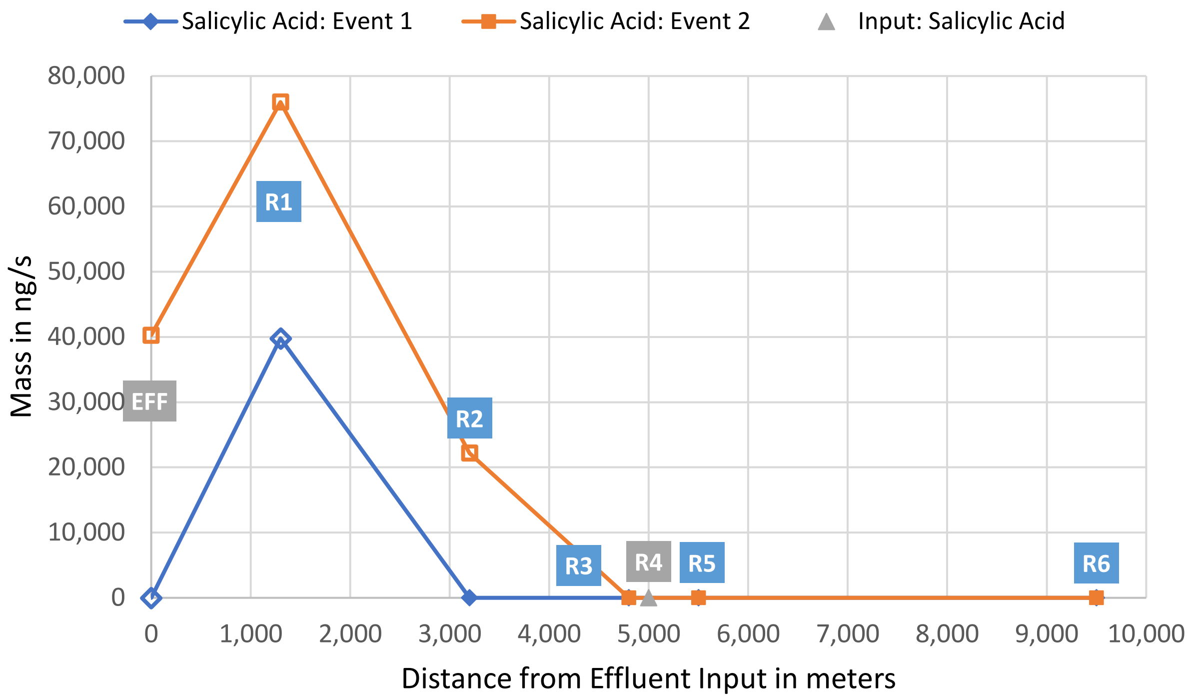


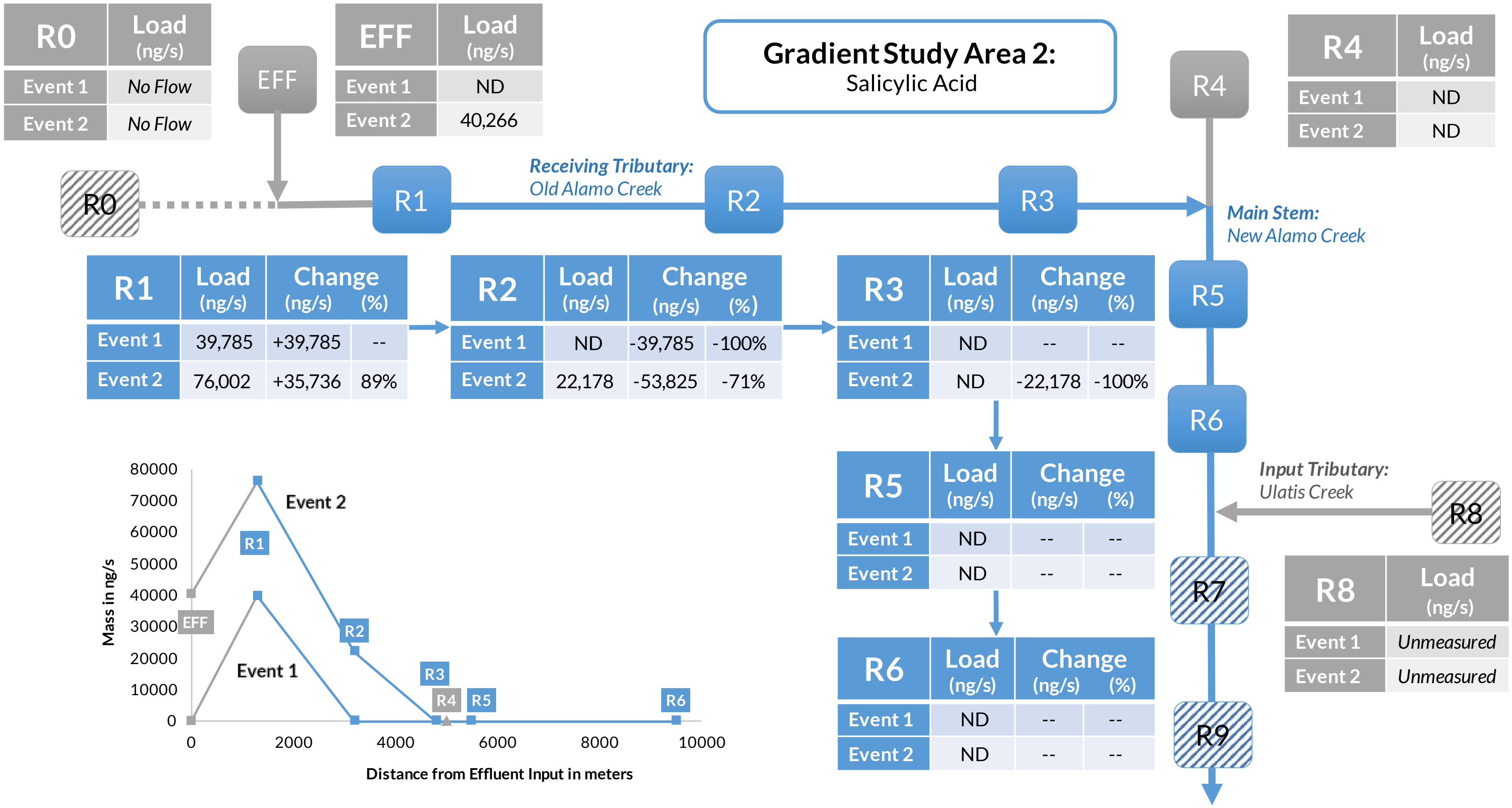
Table 41. Salicylic Acid mass balances for Gradient Study Area 2.

Total mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R4 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous	Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	ND	--	--	--	40,266	--	--	--
Receiving Tributary	R1	--	39,785*	(+) 39,785	--	--	76,002*	(+) 35,736	(+) 89%
	R2	--	ND	(-) 39,785	(-)100%	--	22,178	(-) 53,825	(-) 71%
	R3	--	ND	--	--	--	ND	(-) 22,178	(-) 100%
Input Tributary	R4	ND	--	--	--	ND	--	--	--
Total Main Stem Input			--			**Total Input**	--		
Main Stem	R5	--	ND	--	--	--	ND	--	--
	R6	--	ND	--	--	--	ND	--	--
Total Mass Balance (Effluent)				**--**	**--**	**Total Mass Balance (Effluent)**		**(-) 40,266**	**(-) 100%**
Mass Balance from Peak Load (*)				**(-) 39,785**	**(-) 100%**	**Mass Balance from Peak Load (*)**		**(-) 76,002**	**(-) 100%**

Figure 37. Salicylic acid mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	ND
Event 2	40,266

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	39,785	+39,785	--
Event 2	76,002	+35,736	89%

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	-39,785	-100%
Event 2	22,178	-53,825	-71%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	ND	-22,178	-100%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	ND	--	--

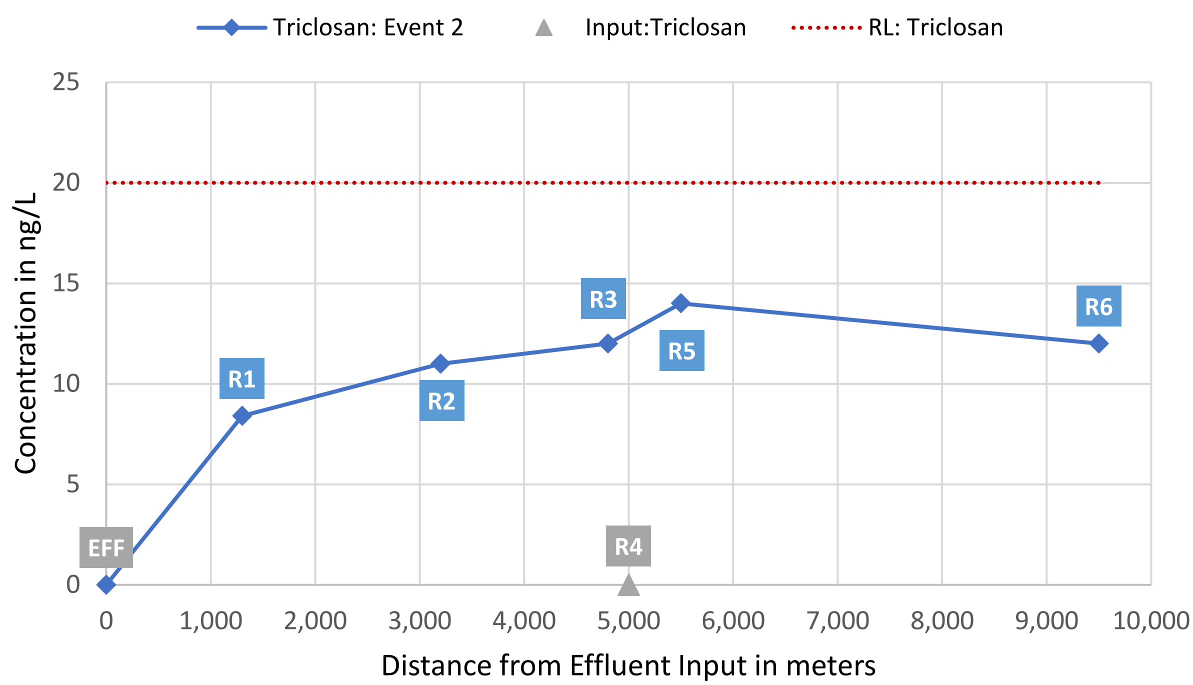
R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	ND	--	--

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Triclosan

Triclosan, an antibacterial and antifungal agent, was detected at Gradient Study Area 2 sites during Event 2 only. All triclosan detections were below the RL of 20 ng/L and are flagged as estimated values (MDL for triclosan is 8 ng/L). Triclosan was not detected at R0 or the Effluent location; the first detection occurred at R1 and continued to be detected along the flow path but not in samples collected at the R4 site, upstream of the main stem confluence (**Figure 38**).

Figure 38. Triclosan concentrations (ng/L) for Gradient Study Area 2 (Event 2).
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow; attenuation was not observed for triclosan (Event 2).



When evaluating instantaneous mass loads, the highest load is at R5 which is consistent with the location with the highest concentration. By R6, both the load and the concentration are reduced (**Figure 39**). All mass loads should be considered estimates since all concentrations are below the RL. The mass balance of triclosan along the Gradient Study Area 2 flow path is shown in **Figure 39.**

Figure 39. Triclosan instantaneous mass loads (ng/s) for Gradient Study Area 2.
Open datapoints represent mass loads based on a concentration detected below the RL.

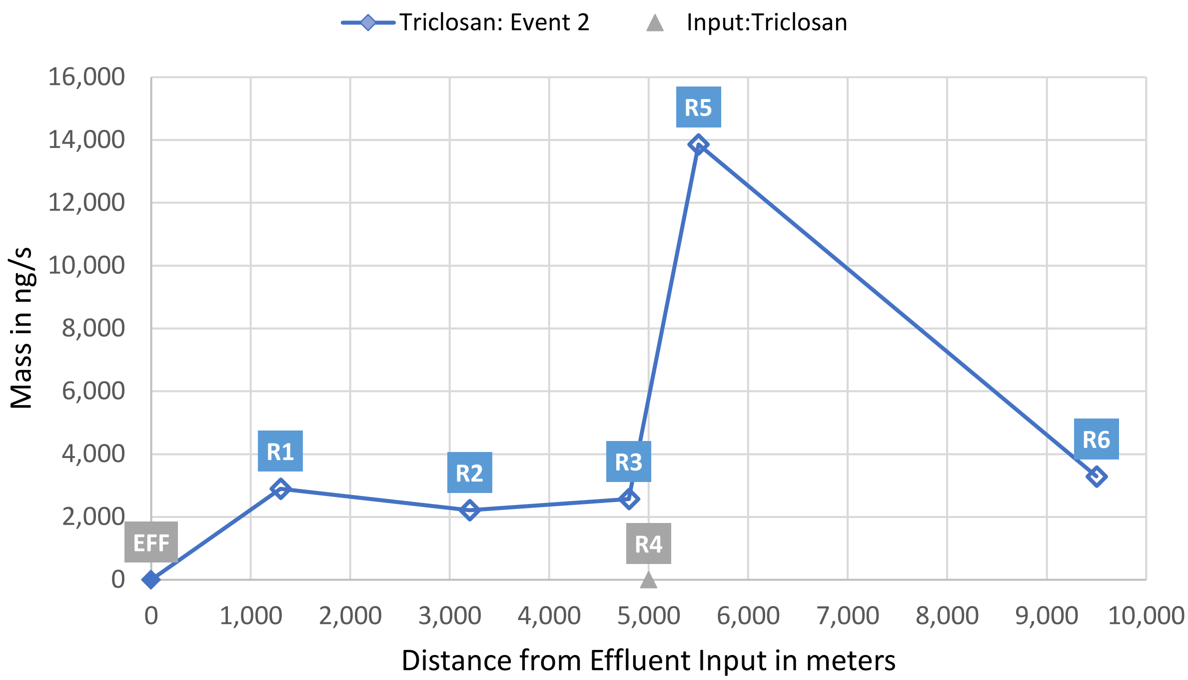
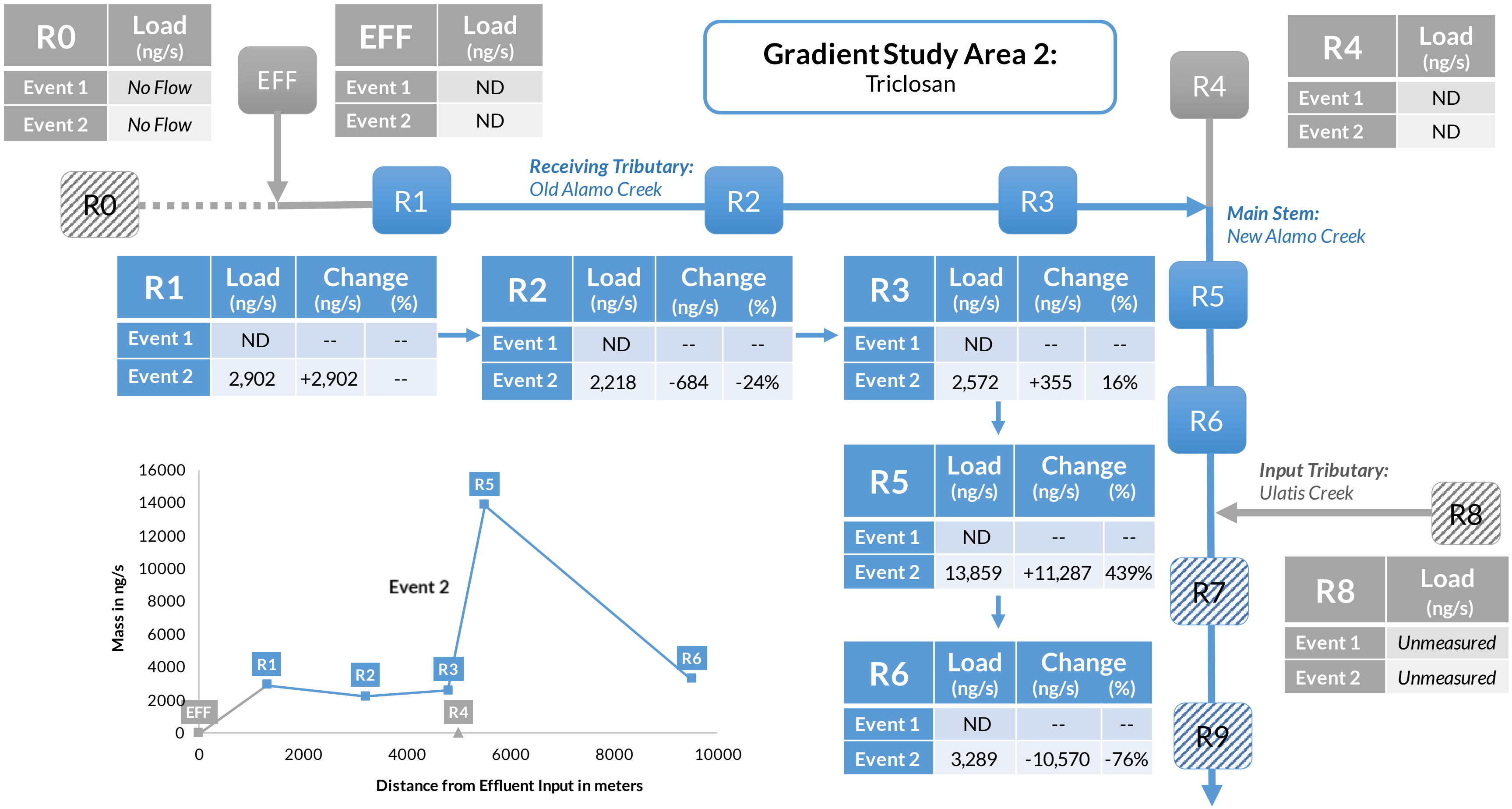


Table 42. Triclosan mass balances for Gradient Study Area 2.
Total mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

WATERBODY TYPE	SITE	EVENT 2			
		Input Load (ng/s)	Flow Path Load (ng/s)	Change from Previous (ng/s)	Change from Previous
Effluent	EFF	ND	--	--	--
Receiving Tributary	R1	--	2,902	(+) 2,902	--
	R2	--	2,218	(-) 684	(-) 24%
	R3	--	2,572	(+) 355	(+) 16%
Input Tributary	R4	ND	--	--	--
Total Main Stem Input			**2,572**		
Main Stem	R5	--	13,859*	(+) 11,287	(+) 439%
	R6	--	3,289	(-) 10,570	(-) 76%
Total Mass Balance (Effluent)				**(+) 3,289**	--
Mass Balance from Peak Load (*)				**(-) 10,570**	**(-) 76%**

Figure 40. Triclosan mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (ng/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (ng/s)
Event 1	ND
Event 2	ND

R4	Load (ng/s)
Event 1	ND
Event 2	ND

R1	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	2,902	+2,902	--

R2	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	2,218	-684	-24%

R3	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	2,572	+355	16%

R5	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	13,859	+11,287	439%

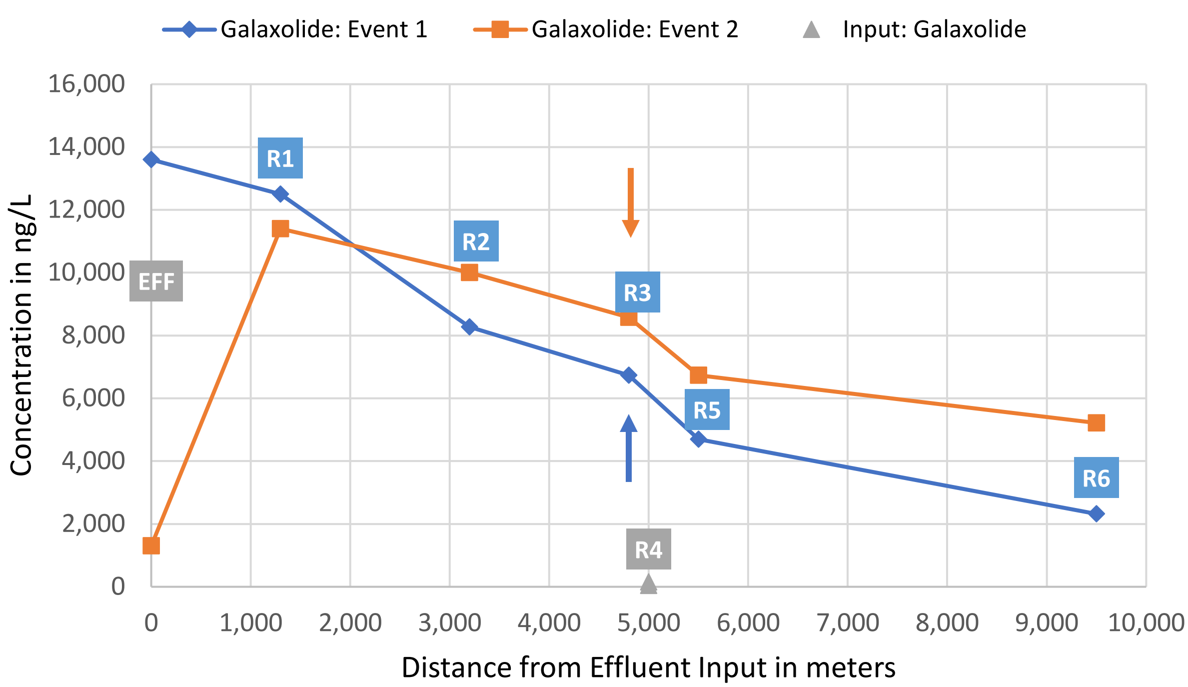
R6	Load (ng/s)	Change (ng/s)	Change (%)
Event 1	ND	--	--
Event 2	3,289	-10,570	-76%

R8	Load (ng/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

Galaxolide

Similar to Gradient Study Area 1, galaxolide was detected above the RL at all sample locations for both events in Gradient Study Area 2. In Event 1, the concentration of galaxolide at the Effluent location was the highest concentration within Gradient Study Area 2; however, in Event 2, the detection was significantly lower at the Effluent location than Event 1; the highest concentration was observed at R1, 1,300 meters downstream of the Effluent location (**Table 33**). Galaxolide concentrations were similar in the R1 sample for both events and decreased at consistent rates along the subsequent sites for both sampling events (**Figure 41**).

Figure 41. Galaxolide concentrations (ng/L) for Gradient Study Area 2.
The point of attenuation (defined as negative change is observed from the previous two monitoring locations) is indicated on the figure with an arrow.



Instantaneous mass loads for galaxolide in Gradient Study Area 2 are consistent from the first detection (the Effluent location for Event 1 and R1 for Event 2) and show an increase at R5 for both Event 1 and Event 2, with Event 1 having the largest increase in mass loading at R5 (390% increase; **Table 43 and Figure 42**). The mass balance of galaxolide along the Gradient Study Area 2 flow path is shown in **Figure 43**.

Figure 42. Galaxolide instantaneous mass loads (ng/s) for Gradient Study Area 2.

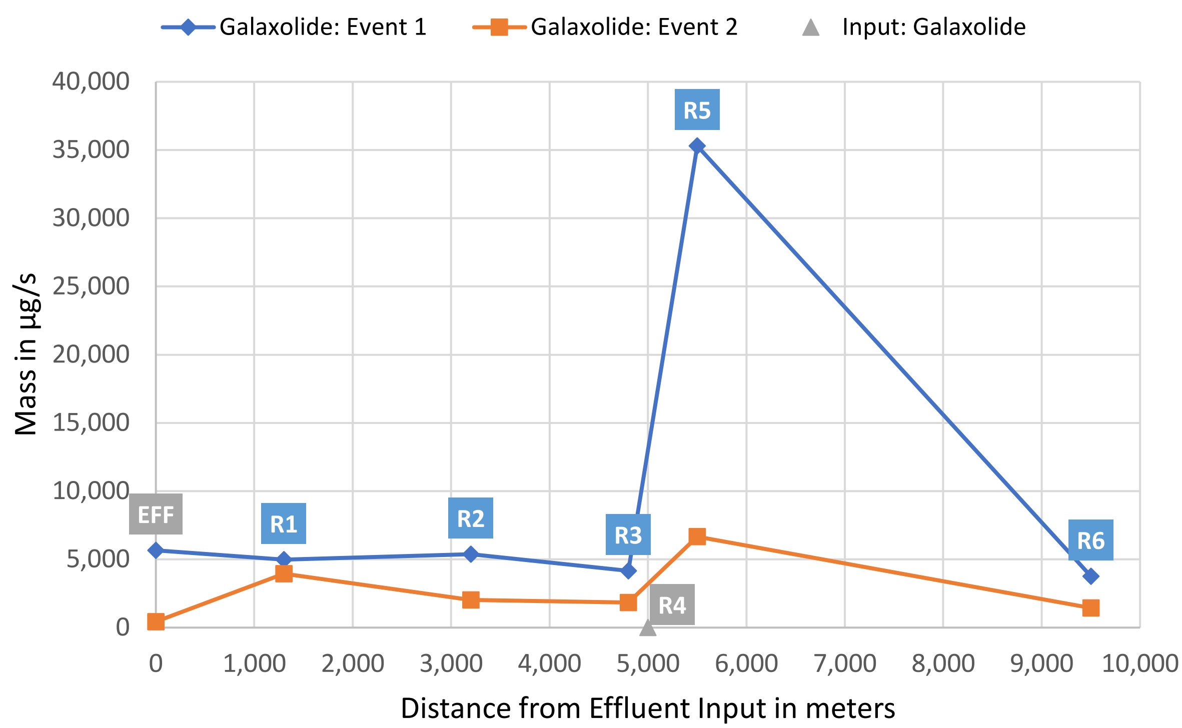


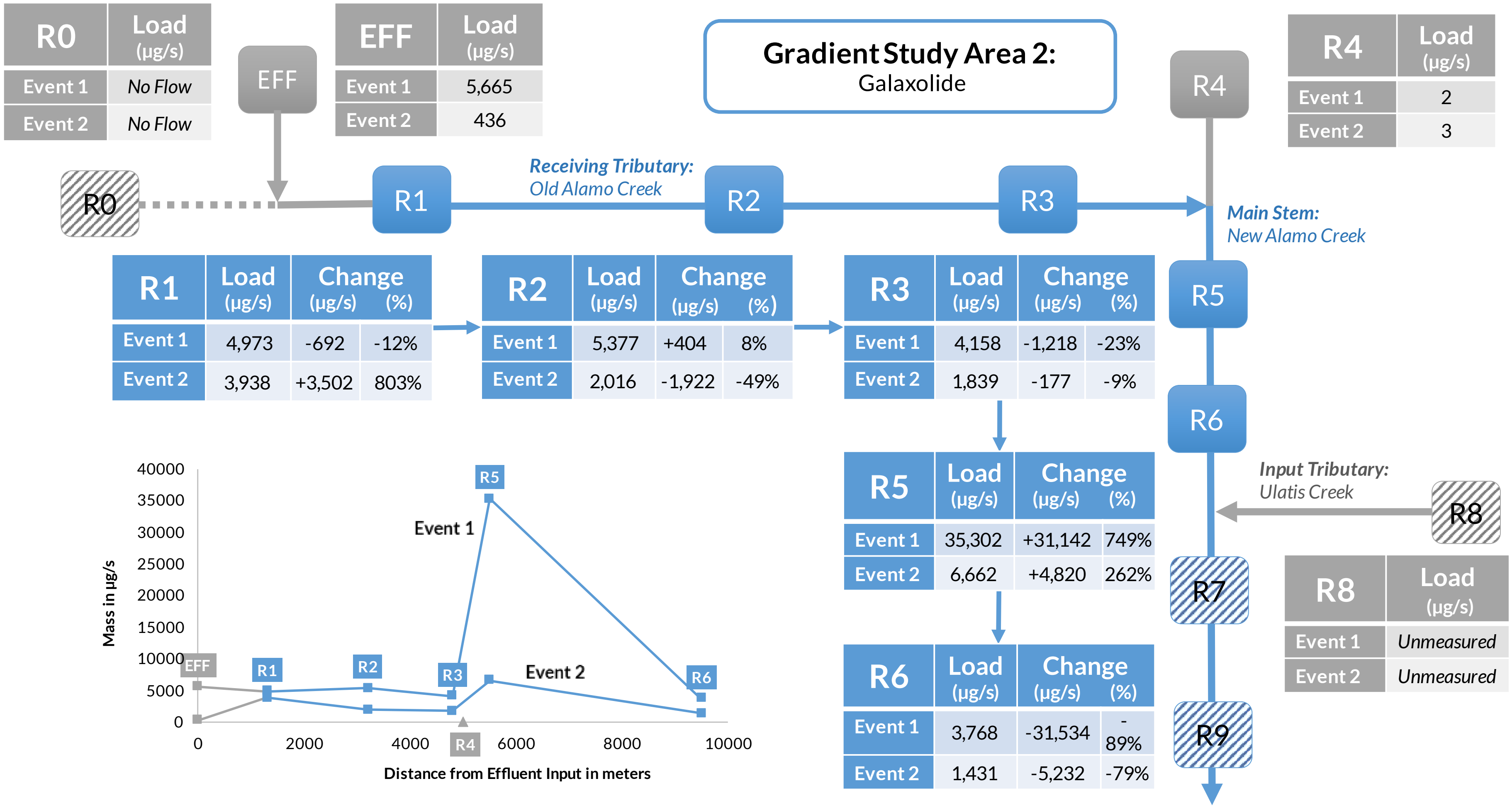
Table 43. Galaxolide mass balances for Gradient Study Area 2.

Total mass balance determined by the difference between effluent input value and the final R6 main stem value. Site R0 was not sampled due to no input flow, and it is therefore not included. R7, R8 and R9 were not sampled due to total sites reached. Peak loading values are indicated with an asterisk (*).

Waterbody Type	Site	Event 1				Event 2			
		Input Load (µg/s)	Flow Path Load (µg/s)	Change from Previous (µg/s)	Change from Previous	Input Load (µg/s)	Flow Path Load (µg/s)	Change from Previous (µg/s)	Change from Previous
Effluent	EFF	5,665	--	--	--	436	--	--	--
Receiving Tributary	R1	--	4,973	(-) 692	(-) 12%	--	3,938	(+) 3,502	(+) 803%
	R2	--	5,377	(+) 404	(+) 8%	--	2,016	(-) 1,922	(-) 49%
	R3	--	4,158	(-) 1,218	(-) 23%	--	1,839	(-) 177	(-) 9%
Input Tributary	R4	2	--	--	--	3	--	--	--
Total Main Stem Input		**4,160**				**Total Input**	**1,842**		
Main Stem	R5	--	35,302*	(+) 31,142	(+) 749%	--	6,662*	(+) 4,820	(+) 262%
	R6	--	3,768	(-) 31,534	(-) 89%	--	1,431	(-) 5,232	(-) 79%
Total Mass Balance (Effluent)				**(-) 1,897**	**(-) 33%**	**Total Mass Balance (Effluent)**		**(+) 995**	**(+) 228%**
Mass Balance from Peak Load (*)				**(-) 31,534**	**(-) 89%**	**Mass Balance from Peak Load (*)**		**(-) 5,232**	**(-) 79%**

Figure 43. Galaxolide mass balance flow diagram for Gradient Study Area 2.

Flow path sites are indicated in blue, input sources indicated in gray. Site IDs that were not sampled are indicated with stripes.



R0	Load (µg/s)
Event 1	*No Flow*
Event 2	*No Flow*

EFF	Load (µg/s)
Event 1	5,665
Event 2	436

R4	Load (µg/s)
Event 1	2
Event 2	3

R1	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	4,973	-692	-12%
Event 2	3,938	+3,502	803%

R2	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	5,377	+404	8%
Event 2	2,016	-1,922	-49%

R3	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	4,158	-1,218	-23%
Event 2	1,839	-177	-9%

R5	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	35,302	+31,142	749%
Event 2	6,662	+4,820	262%

R6	Load (µg/s)	Change (µg/s)	Change (%)
Event 1	3,768	-31,534	-89%
Event 2	1,431	-5,232	-79%

R8	Load (µg/s)
Event 1	*Unmeasured*
Event 2	*Unmeasured*

SUMMARY OF GRADIENT STUDY AREA RESULTS

The Stakeholder Work Plan outlines the following objectives for the Year 3 gradient study design:

1. For each of the CEC constituents, what is the attenuation at distances downstream from the POTW discharge?
2. For each of the CEC constituents, can the relative magnitude of the type of attenuation (hydraulic or degradation/inputs) be quantified based on a simple mass balance with available flow, travel time, and concentration measurements or estimates?

The following sections include an evaluation of attenuation, hydraulic dilution, and unmeasured variables that were observed in the field and/or potential conditions that may influence attenuation.

Attenuation

The Workplan defines two metrics that can be used to identify attenuation: a) where receiving water concentrations return to background concentrations or b) where a negative change in concentration is observed from the previous monitoring locations.

Attenuation due to negative change can further be assessed in two ways, either as the first observation of a reduction from one site to another (as indicated in the Stakeholder Work Plan), or where negative change is observed from the previous two monitoring locations (as indicated in the QAPP). Both criteria are assessed below for each Gradient Study Area. In addition, mass fluctuation estimates are used in conjunction with concentration to assess negative change. The impact of dilution can be assessed by comparing changes in mass flux (i.e., instantaneous mass load) relative to changes in concentrations.

A summary of the sites identified as the point of attenuation according to all criteria is provided in **Table 44.**

Attenuation as Negative Change

All detected constituents across both study areas and both monitoring events showed at least one instance of attenuation as negative change in instantaneous mass loads between one or more sites. Nevertheless, the locations and magnitude of these changes varied across the two gradient study areas.

GRADIENT STUDY AREA 1

Patterns of potential attenuation were relatively consistent for the analytes detected in Gradient Study Area 1 and are summarized in **Figure 44** and **Figure 45**. Though not all analytes were detected for both events (i.e., diclofenac, ibuprofen, and naproxen were each only detected during a single event), when they were present all analytes showed a peak instantaneous mass loading at the R1 location, followed by a reduction observed at the R2. All analytes also showed an overall reduction between the peak load at R1, and the final loading observed at R7.

Of the two metrics for evaluating negative change, all analytes detected at Gradient Study Area 1 showed a negative change from the peak load at R1 to the next downstream site at R2 (**Figure 44**). The percent change between these two sites for all analytes and events ranged from 19% to 53%, with gemfibrozil in Event 1 showing the least change and PFOS in Event 1 showing the most change. It should be noted that the two lowest percent change values for gemfibrozil (19%) and ibuprofen (23%) were both calculated with estimated concentrations below the RL and are therefore associated with increased uncertainty when comparing the loads between sites.

When negative change is evaluated as an observed decrease from the previous two monitoring locations, the attenuation for Gradient Study Area 1 is consistent for the PPCP analytes, but not PFAS (**Figure 44**). Instantaneous mass loading for PFAS constituents fluctuated along the flow path sites. Therefore, no two sites with consecutive negative change in loading occurred for either constituent or monitoring event. Conversely, all PPCP analytes detected showed a subsequent change from the R2 to R3 sites, indicating the R3 locations as the point of attenuation according to this criterion. Nevertheless, the secondary reductions were variable, with diclofenac only marginally reduced (1%) while the other constituents ranged from 18% to 43% reductions. For all constituents but diclofenac, the secondary reductions from R2 to R3 were within the same range of magnitude as those observed between R1 and R2, suggesting a relatively consistent rate of attenuation from the first observation of negative change to the second.

Figure 44. Negative percent change in mass loading value for constituents detected in Gradient Study Area 1 for Year 3 CEC monitoring.

Data labels indicate the reach in which the mass load reduction was observed.

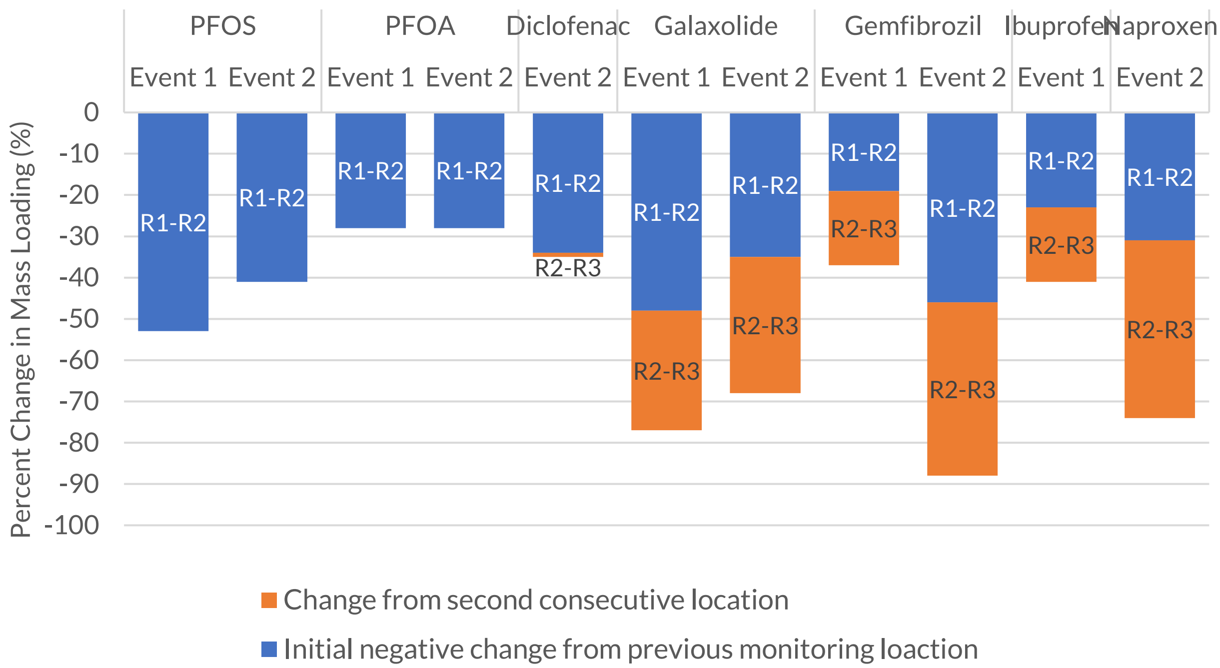
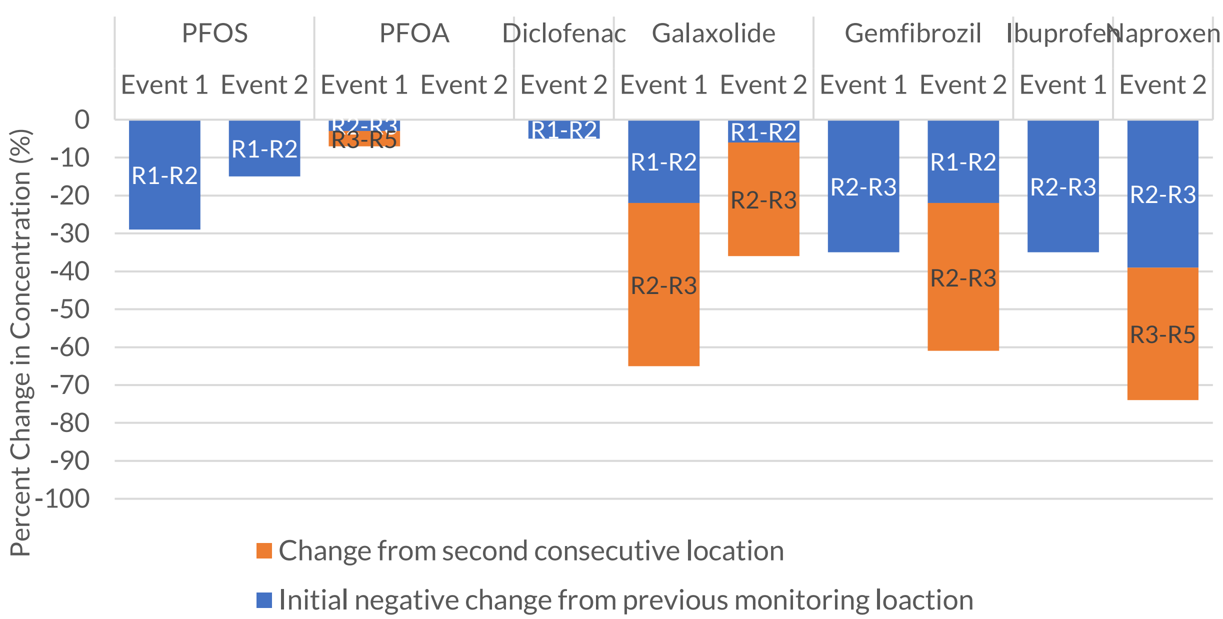


Figure 45. Negative percent change in concentration for constituents detected in Gradient Study Area 1 for Year 3 CEC monitoring.

Data labels indicate the reach in which the concentration reduction was observed.



GRADIENT STUDY AREA 2

Results between sites for Gradient Study Area 2 were generally more variable than those observed in Gradient Study Area 1. Consequently, there was less consistency in Gradient Study Area 2 in the locations where potential attenuation occurred, as shown in **Figure 46** and **Figure 47**.

All analytes detected in Gradient Study Area 2 showed at least one instance of negative change in instantaneous mass loading between sites; however, the locations at which these changes occurred varied by analyte and event. Similar to Gradient Study Area 1, PFOS for Event 2, PFOA for both events, diclofenac for Event 2, galaxolide for Event 2, salicylic acid for both events, and triclosan for Event 2 all showed an initial negative change from the R1 to the R2 site. Nevertheless, unlike Gradient Study Area 1, the R1 site did not represent the peak loading location for any of these analytes except for salicylic acid. This suggests that some initial attenuation may have occurred along the receiving tributary, but unknown variables may have affected the downstream results (see **Unmeasured Variables**). PFOS, galaxolide, and ibuprofen for Event 1 all show the first negative change between the R2 and R3 sites along the receiving water tributary. For ibuprofen, the R2 was also the peak loading location. Finally, diclofenac for Event 1 and ibuprofen for Event 2 did not show negative change in loads until the final reach between the R5 and R6 locations. In both cases, the R5 site was the location of the peak loading, and for ibuprofen, no detections occurred in the effluent or receiving tributary sites prior to the R5 along the main stem.

For Gradient Study Area 2 sites, only four instances of a second consecutive reduction in load was observed: PFOS for Events 1 and 2, galaxolide for Event 2, and salicylic acid for Event 2 (**Figure 46**). Even so, the magnitudes of these secondary reductions were variable, with PFOS for Event 1 and salicylic acid for Event 2 both reaching non-detect (i.e., 100% reduction) while PFOS for Event 2 showed a reduction of 1 ng/s (approximately 0.1% change) that is likely insignificant considering the uncertainty in the calculations. Galaxolide also showed a minimal secondary reduction of 9% from the R2 to R3 sites. It is possible sorption and/or degradation were also contributing to lower concentrations.

Figure 46. Negative percent change in mass loading value for constituents detected in Gradient Study Area 2 for Year 3 CEC monitoring.

Data labels indicate the reach in which the mass load reduction was observed.

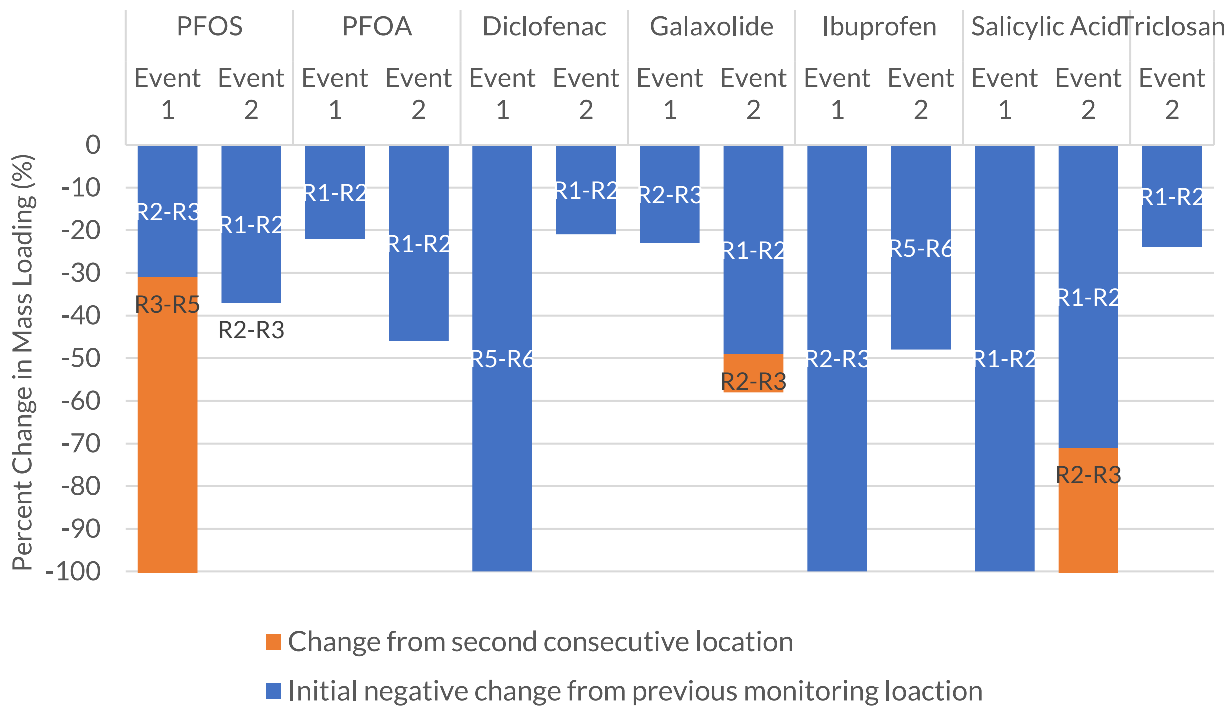
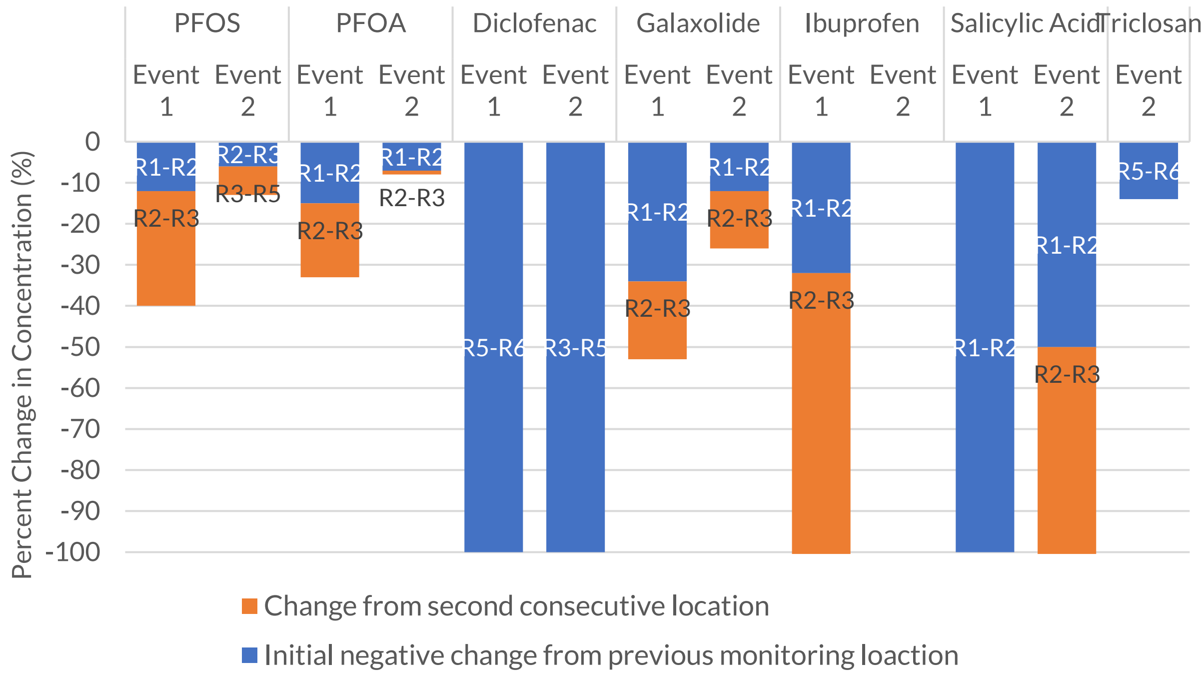


Figure 47. Negative percent change in concentration for constituents detected in Gradient Study Area 2 for Year 3 CEC monitoring.

Data labels indicate the reach in which the concentration reduction was observed.



Attenuation as Return to Background

For Gradient Study Area 1, the R0 site upstream of the effluent input represented the background levels of CEC constituents for all sites along the waterbodies. Both of the PFAS analytes were detected in the R0 samples for both events, indicating that the effluent input was not the only potential source present in the waterbody. The PPCP analytes were not detected in the R0 site samples, with the exception of galaxolide. It should be noted, however, that the low level of galaxolide detections at R0 compared to the input concentrations observed indicate that the background levels of galaxolide were relatively insignificant. Additionally, the R0 detections were within the range of associated field blank contamination, indicating they are also associated with potential uncertainty introduced by field measurement bias.

Of the analytes detected in Gradient Study Area 1, diclofenac was the only analyte that returned to the background level of non-detect by the mainstem (R5) and remained so at the subsequent R7 site. Concentrations for PFOS also returned to levels at or below the R0 concentrations at R1 for Event 1 and R5 for Event 2; however, in both cases increases in concentrations at subsequent downstream sites once again exceeded the R0 site results. Similarly, the mass loading for PFOS returned to a level commensurate with the original R0 loading at R5 for both events, though it increased once again at the final R7 site. All other constituents (PFOA, galaxolide, gemfibrozil, ibuprofen, and naproxen) had a net decrease from the peak concentrations and loads observed but did not return to the levels measured at the R0 site.

Background levels for Gradient Study Area 2 cannot be as readily assessed for the entire waterway, as there was no upstream flow in the receiving water tributary for either event, and therefore no background concentrations outside of the effluent input. While no upstream observations could be taken for the receiving water, the R4 site was sampled for both events and can be considered the background concentration for the main stem sites (i.e., R5 and R6). No Year 3 CEC constituents were detected in the R4 samples from either event with the exception of galaxolide; therefore, the background concentration for most constituents in the main stem waterbody can be considered non-detect. Similar to R0 in Gradient Study Area 1, galaxolide was detected in the R4 samples at levels far lower than the downstream sites and in concentrations within a similar range and possibly attributable to associated field blank contamination. Of the constituents detected at Gradient Study Area 2, only PFOS for Event 1 and diclofenac for both events returned to non-detect in the main stem samples (excluding analytes which were not detected in the receiving water tributary sites prior to the confluence).

Hydraulic Dilution

Any attenuation observed in the gradient study areas has the potential to be caused by both degradation and/or hydraulic dilution. As noted in the assessment of velocity, the areas sampled likely represent different parcels of water than the originally measured input. Hydraulic dilution can be assessed regardless of parcel tracking in situations where all inputs are characterized. Nevertheless, the areas sampled downstream of additional flow input sources present observations of increased attenuation due to dilution.

In Gradient Study Area 1, at the time of sampling, effluent discharged to the receiving tributary was diluted by upstream flows (R0) and by Robla Creek (which is also a potential source of CECs), upstream of R7. The sum of R0 flow and the Effluent flow were less than what was measured at the R1 site (**Figure 5**) during both Year 3 monitoring events. As described above, there is uncertainty in both the calculation of flow that could attribute to the difference and the potential that there are sources of flow not identified during this study. These uncertainties should be considered when evaluating change in concentrations and instantaneous mass loads. All analytes except for PFOS and galaxolide in Event 2 (i.e., PFOA, diclofenac, gemfibrozil, ibuprofen, naproxen, and galaxolide for Event 1) decreased in concentration from the effluent input to R1, consistent with a potential dilutionary effect of the receiving water. Regardless of the uncertainty of the inputs to R1, the R1 site was associated with peak loading for all constituents detected in Gradient Study Area 1. All analytes except for PFOS and galaxolide in Event 2 (i.e., PFOA, diclofenac, gemfibrozil, ibuprofen, naproxen, and galaxolide for Event 1) decreased in concentration from the effluent input to R1, consistent with a potential dilutionary effect of the receiving water. Taking into account the uncertainty of the inputs to R1, the R1 site is associated with peak loading for all constituents detected in Gradient Study Area 1.

Likewise, the downstream R7 location also had the potential additional input from Robla Creek, with the confluence of the main stem waterbody and this additional input tributary directly upstream of the sample location. During Event 1, the discharge measured at the R7 site (0.29 m^3/s) was approximately double that measured at the R5 site (0.14 m^3/s), indicating Robla Creek was likely flowing into the main stem. Concentrations of inputs from Robla Creek are unknown. Nevertheless, the concentrations for PFOS, PFOA, and gemfibrozil increased from R5 to R7, indicating dilution was likely not influencing the results. Ibuprofen and galaxolide both decreased in concentration; however, all detected constituents increased slightly in mass loading from R5 to R7 during Event 1. Dilution from Robla Creek did not appear to contribute to attenuation during Event 1. Discharge did not increase from R5 (0.31 m^3/s) to R7 (0.28 m^3/s) during Event 2, and Robla Creek likely had little additional input flow to the main stem waterbody.

A final potential source of dilution for Gradient Study Area 1 is the rain event that occurred between the sampling events that may have contributed to unknown inputs; however, this is unlikely since antecedent dry conditions outlined in the CEC QAPP (v3) were met (**Table 5**). The discharge values generally increased from Event 1 to Event 2, indicating there was likely a higher volume of water in the tributaries during Event 2. Nevertheless, measured concentrations also generally increase for analytes detected during both events, indicating any increased water volume in Event 2 also did not appear to have a dilutionary effect on the CECs detected.

For Gradient Study Area 2, the R4 main stem flow was the primary source of potential dilution as no flow upstream of the effluent input in the receiving tributary was present during either Year 3 monitoring event. In fact, for both events there was a substantial increase in discharge values from the R3 to R5 sites, with an especially large increase observed during Event 1. Nevertheless, concentration values remained consistent, and the mass loads therefore also generally increased from the R3 to R5 sites for most analytes detected. Such a change in loading at the R5 site is consistent with potential inputs from unmeasured sources rather than with hydraulic dilution from the main stem. As noted, the R5 site represented the peak loading for multiple constituents, rather than the reduction that may indicate hydraulic dilution. It should be noted that the higher discharge measurements at the R5 sites were collected using the float method, and therefore are less precise measurements than those collected by the wading method at R3. Even so, the PFOS (during Event 1) and diclofenac (during Event 2) were detected in the R3 site and not the R5. These two analytes are the most likely to have been influenced by dilution in the main stem as a contributing factor to the attenuation observed.

In addition to the main stem flow input, field crews noted additional input from agricultural canals present directly upstream of the Gradient Study Area 2 R2 sample location during Event 1. An associated increase in discharge was also observed from the R1 (0.40 m^3/s) to the R2 (0.65 m^3/s) sites. A decrease in concentrations from the R1 to R2 site was also observed for PFOS, PFOA, ibuprofen, salicylic acid, and galaxolide at this site. Of these analytes, salicylic acid showed a 100% reduction from the peak at R1 to non-detect at R2, indicating it was potentially influenced by dilution from this additional input. It is possible sorption and/or degradation were also contributing to lower concentrations. However, R2 represented the first detection of diclofenac along the receiving tributary for this event.

Unmeasured Variables

Potential unmeasured variables can be evaluated as locations where the CEC constituent instantaneous mass loading increased rather than decreased along the course of the gradient study area waterbodies. **Table 44** summarizes the sites with potential unmeasured variables as any location in which loads increased along the flow path. Common locations for observed increases in load included the R7 for Gradient study Area 1; a slight increase was also observed at the R3 for both PFAS analytes in the same study area. Locations for increase in loading for Gradient Study Area 2 included the R2, R3, R5, and R6 sites, with the R5 site as the most commonly observed location with an increase in mass loading. While some of these locations are associated with known inputs to the waterbodies, some of these increases must also be considered in terms of the uncertainties associated with the study design and results, such as the increases observed at R3 sites as no known inputs were observed or suspected upstream of the R3 site for either gradient study area. Changes that are less than the analyte-specific measurement variability (as defined by the analytical QC data) should also be interpreted with caution.

As discussed in the **Mean Flow Rates and Sample Timing** section, the timing of sample collections likely did not align with the original pulse of effluent measured at the beginning of each gradient study area monitoring event, especially for the furthest downstream sites (**Figure 7** through **Figure 10**). Velocity estimates indicate that samples for the R1 site may have been collected at roughly the same time as the expected trajectory of the effluent input, especially for Gradient Study Area 1, Event 2 (**Figure 8**) and Gradient Study Area 2, Event 1 (**Figure 9**). From that point, however, sample times are estimated to be more than an hour in difference for the R2 sites, with the gap increasing for each subsequent site. This discrepancy means that the samples collected were likely from varying effluent sources discharged at different times of day. Regular diurnal swings in the amount of POTW effluent and concentrations of CECs are therefore likely influencing the results comparisons presented here, though the extent to which cannot be quantified without the collection of more data. Even so, the fact that there were constituents detected for only a single event indicates some temporal fluctuation in the constituents present which may also confound the assessments of potential attenuation rates.

Potential diurnal swings in effluent characteristics, differing CEC concentrations in the effluent, differing effluent flow rates, and differing stream flow rates may also explain the differing patterns of results across the two gradient study areas. The primary physical differences between the two areas were the distance of the waterbodies and the receiving waters. The final collection site Gradient Study Area 1 was over twice as far from the original effluent source than that of Gradient Study Area 2, and the Gradient Study Area 1 effluent flowed into an existing waterbody while the receiving water for Gradient Study Area 2 consists entirely of the effluent source water.

These differences may contribute to the fact that the peak loading location, observations of load reductions, and overall rates of attenuation are generally consistent for all constituents and both events for Gradient Study Area 1 (**Figure 44**). Contrasted to the more variable data obtained from Gradient Study Area 2, these results may suggest that the samples taken a shorter distance from the source in receiving waters primarily influenced by the effluent may be more subject to these diurnal swings; a more intensive Lagrangian sample design may be more critical for general assessments if similar waterbodies.

Another confounding factor centers around the discharge measurements used to convert concentration to instantaneous mass loads. The highest discharge values were those measured using the float method (both taken at the R5 location for Gradient Study Area 2). While discharge was likely higher, as evidenced by the fact that the stream was not wadable, the accuracy of these values, especially the R5 discharge for Event 1, is difficult to assess. In addition, as described in the **Sampling Methods** section, recent studies indicate that the float method likely overestimates discharge in small streams. Another example is in Gradient Area 1, where the R1 discharge was greater than the sum of the two measured inputs (R0 and Effluent), which may be the result of uncertainty in the measurements and potential unknown inputs. This, along with additional uncertainty regarding some of the deviations from the wading method protocols (Deviation **2023-19**) indicate that the uncertainty around discharge may be something to address in future studies. This may include more precise calculations using the wading method (e.g., more intervals taken within the cross section), or gathering enough data to use additional methods in place of the float method, such as establishing a stage-discharge curve.

Additional uncertainty regarding the loading calculations may also come from low level concentrations detected below the laboratory’s RL. These values are not within the quantifiable range, therefore, while they are informative regarding the presence of the constituent, the concentration values and associated loading estimates must be considered estimates. The mass balance and relative change comparisons that used estimated results for diclofenac, gemfibrozil, ibuprofen, salicylic acid, and triclosan should be considered estimated as well. Any associated increases or decreases in loading values between estimated results should also be considered uncertain, especially where the percent change between the two is low and possibly insignificant. To avoid such uncertainty, future studies may benefit from higher resolution analytical methods, if available.

The greatest potential for unmeasured variables across both monitoring events occurred at the R7 site for Gradient Study Area 1 and the R5 site for Gradient Study Area 2. Concentrations and instantaneous mass load generally increased from R5 to R7 for Gradient Study Area 1, potentially due to unmeasured inputs from the Robla Creek confluence directly upstream of the R7 site. In addition, field crews noted increased human activities and adjacent unhoused encampments downstream of the sample sites along the main stem waterbody. This activity presents another potential unmeasured source of CEC constituents outside of the POTW effluent.

For Gradient Study Area 2, the R5 site results were consistent with increased input as discussed above in **Hydraulic Dilution**; however, the R4 site was non-detect for all analytes except for galaxolide, which was present in low concentrations compared to the other sample results. While the R4 site presents an opportunity for additional inputs of CEC analytes that could contribute to the peak loading values observed at the R5 site, the consistent lack of detections suggests the R5 results are likely due to other uncertainty, namely, the temporal differences between the sample time and associated upstream results and the imprecision of the discharge measurement potentially contributing to an overestimate of the mass loading.

The additional flow input observed upstream of the R2 site at Gradient Study Area 2 during Event 1 also presents a potential unmeasured input of CECs. The samples collected from this site did show increases in several PFAS and PPCP analytes compared to the R1 site, including the initial detection of diclofenac for that event. Nevertheless, given the variability in detections of these constituents along the Gradient Study Area 2 receiving tributary, it is difficult to attribute these increases to the observed input, especially considering the source is likely agricultural and less likely to contain the CEC analytes in question.

Table 44. Summary of locations and amounts of attenuation and potential unmeasured inputs for Year 3 CEC monitoring.

Location	Analyte	Event	Peak Load Site	Initial Negative Change Site	Initial Negative Change	Second Consecutive Negative Change Site	Second Consecutive Negative Change	Return to Background	Potential Unmeasured Variables
Gradient Study Area 1	PFOS	Event 1	R1	R2	-53%	None	--	R2	R3, R7
		Event 2	R1	R2	-41%	None	--	R5	R3, R7
	PFOA	Event 1	R1	R2	-28%	None	--	None	R3, R7
		Event 2	R1	R2	-28%	None	--	None	R3, R7
	Diclofenac	Event 2	R1	R2	-34%	R3	-1%	R5	None
	Galaxolide	Event 1	R1	R2	-48%	R3	-29%	None	R7
		Event 2	R1	R2	-35%	R3	-33%	None	None
	Gemfibrozil	Event 1	R1	R2	-19%	R3	-18%	None	R7
		Event 2	R1	R2	-46%	R3	-42%	None	None
	Ibuprofen	Event 1	R1	R2	-23%	R3	-18%	None	R7
	Naproxen	Event 2	R1	R2	-31%	R3	--	None	R7
Gradient Study Area 2	PFOS	Event 1	R6	R3	-31%	R5	-100%	R5	R2, R6
		Event 2	R5	R2	-37%	R3	-0.1%	None	R5
	PFOA	Event 1	R5	R2	-22%	None	--	None	R2, R5
		Event 2	R5	R2	-46%	None	--	None	R3, R5
	Diclofenac	Event 1	R5	R6	-100%	None	--	R6	R3, R5
		Event 2	R3	R2	-21%	None	--	R5	R3
	Galaxolide	Event 1	R5	R2	-23%	None	--	None	R3, R5
		Event 2	R5	R3	-49%	R3	-9%	None	R5
	Ibuprofen	Event 1	R2	R3	-100%	None	--	None	R2
		Event 2	R5	R6	-48%	None	--	None	R5
	Salicylic Acid	Event 1	R1	R2	-100%	None	--	None	None
		Event 2	R1	R2	-71%	R3	-100%	None	None
	Triclosan	Event 2	R5	R2	-24%	None	--	None	R3, R5

DATA USABILITY

DATA AVAILABILITY

CEC Year 3 data will be published to CEDEN for ambient locations and can be accessed through the Advance Query Tool (https://ceden.waterboards.ca.gov/AdvancedQueryTool) under the project name "2023 Delta RMP Constituents of Emerging Concern" (23DRMP5CEC).

Table 45. CEC Years 1-3 station names and associated sample matrices available on CEDEN.

Station Name	Station Code	CEDEN Project Code	Matrix
American River at Discovery Park	519AMNDVY	20DRMP5CEC	Water, Bivalves, Sediment
		21DRMP5CEC	Water, Bivalves, Sediment
Dry Creek at Cook Riolo Rd bridge	519DRYCRB	23DRMP5CEC	Water
Dry Creek at Watt Ave bridge	519DRYWAB	23DRMP5CEC	Water
Dry Creek at Roseville WWTP	519DRYCRK	20DRMP5CEC	Water, Sediment
		21DRMP5CEC	Water, Sediment
		23DRMP5CEC	Water
New Alamo Creek downstream of confluence between New and Old Alamo Creeks	511NACDOA	23DRMP5CEC	Water
New Alamo Creek upstream of confluence with Old Alamo Creek	511NACUOA	23DRMP5CEC	Water
Old Alamo Creek at Chicorp Ln.	511OACCLN	23DRMP5CEC	Water
Old Alamo Creek at Lewis Road	511SOL011	20DRMP5CEC	Water, Sediment
		21DRMP5CEC	Water, Sediment
Old Alamo Creek at Sunnybrook Ln.	511OACSBL	23DRMP5CEC	Water
POTW Source 1*	519POTW01	21DRMP5CEC	Water
		23DRMP5CEC	Water
POTW Source 2*	511POTW02	21DRMP5CEC	Water
		23DRMP5CEC	Water
Roseville Urban Runoff*	519PGC010	21DRMP5CEC	Water
		23DRMP5CEC	Water
Sacramento River at Elkhorn Boat Launch Facility	519SUT108	20DRMP5CEC	Water, Bivalves
		21DRMP5CEC	Water, Bivalves
Sacramento River at Freeport, CA-510ST1301	510ST1301	20DRMP5CEC	Water, Bivalves
		21DRMP5CEC	Water, Bivalves

Station Name	Station Code	CEDEN Project Code	Matrix
Sacramento River at Hood Monitoring Station Platform	510SACC3A	20DRMP5CEC	Water, Bivalves
		21DRMP5CEC	Water, Bivalves
Sacramento River at Veterans Bridge-03SWSBIO-519ST1309	519ST1309	20DRMP5CEC	Fish
		21DRMP5CEC	Fish
Sacramento River/Freeport-510ST1317	510ST1317	20DRMP5CEC	Fish
		21DRMP5CEC	Fish
Sacramento Urban Runoff 3; Sump 111*	519SACUR3	21DRMP5CEC	Water
		23DRMP5CEC	Water
San Joaquin R at Buckley Cove	544LSAC13	20DRMP5CEC	Fish
		21DRMP5CEC	Fish
San Joaquin River at Airport Way near Vernalis	541SJC501	20DRMP5CEC	Water, Fish
		21DRMP5CEC	Water, Bivalves, Fish
San Joaquin River near Buckley Cove	544SJRNBC	20DRMP5CEC	Water, Bivalves
		21DRMP5CEC	Water, Bivalves
Steelhead Creek main stem downstream of confluence with Dry Creek	519SHCDDC	23DRMP5CEC	Water
Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	519SHCDRC	23DRMP5CEC	Water
Terminus of Dry Creek at Rio Linda Blvd	519DRYRLB	23DRMP5CEC	Water
Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	511NACARD	23DRMP5CEC	Water
Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	511OACUNA	23DRMP5CEC	Water

*Results associated with these Station Codes will remain in CV RDC and not be transferred to CEDEN.

DATA LIMITATIONS

Deviations and Corrective Actions

Relevant DRMP QAPP deviations are outlined in **Table 46** and a summary for each is provided below. These specific deviations are either finalized or waiting on review and/or signatures from the CVRWQCB staff and are included in **Appendix D**.

2023-01: CEC Year 3 Event 1 Roseville Turbidity Measures Recorded with Probe

The deviation that occurred on October 19, 2023, was related to Year 3 Event 1 CEC monitoring conducted on October 16, 18, and 19, 2023 (deviation **2023-01**). At the POTW 1 sites sampled on October 19, 2023, turbidity was measured in the field instead of collecting water samples for a laboratory analysis. At these sites, turbidity was measured using a Hanna Turbidity Meter following method EPA 180.1, instead of submitting samples to Physis Laboratories for analysis by method EPA 180.1, as outlined in the approved QAPP. MLJ field crews collected turbidity as a field measurement in lieu of a laboratory analysis for the POTW 1 samples to avoid holding time violations for that analyte given potential shipping and delivery errors that could have compromised the analyte sample handling requirements. While not defined in the current version of the QAPP, previous years of the CEC Pilot Study obtained turbidity results as field measurements; therefore, turbidity field results are consistent with previous project data. In addition, turbidity is an ancillary measurement, not one of the targeted CECs to be monitored, and the resolution of the field instrument (0.1 NTU) is comparable to the laboratory reporting limit (0.5 NTU). The field turbidity measurements obtained on October 19, 2023, will meet the project needs for interpreting associated CEC data. The deviation has been finalized, approved, and signed by all required parties.

2023-02: CEC Year 3 Event 2 Enthalpy Missing Laboratory Control Sample Duplicate

On November 27, 2023, a deviation (**2023-02**) occurred relating to missing laboratory control sample duplicates for CEC Year 3 Event 2 monitoring. Enthalpy Analytics was contracted to run Per-, Poly- Fluoroalkyl Substances (PFAS) constituents testing and analysis. The CEC QAPP (v3) requires that a laboratory duplicate be analyzed on a per batch basis. A laboratory control sample duplicate (LCSD) is used by Enthalpy to meet this requirement. On November 27, 2023, the Enthalpy Project Manager, Rajwinder Kaur, informed the DRMP Program Manager, Melissa Turner, that the laboratory missed analyzing the LCSD during the analysis of the samples associated with Event 2. The reason for this error was laboratory oversight. The Lab Batch will be flagged following the DRMP Data Management SOP where the Lab Submission Code is updated to “QI” to indicate incomplete QC. A Lab Batch Comment will be added to indicate which batch QC frequency was not met and why. The deviation has been finalized, approved, and signed by all required parties.

2023-04: CEC Event1 Missed Physis Reporting Deadline and Extraction Hold Time Exceedance.

Deviation **2023-04** occurred on December 28, 2023, and was related to CEC Event 1 monitoring reporting deadlines and sample extraction hold time requirements. Physis Environmental Laboratories (Physis) reported Event 1 EDDs to MLJ on December 21, 2023, for all results (turbidity and PPCPs). It was noted that eight samples collected on October 18, 2023, had a turbidity analysis date of October 20, 2023, and the resolution preliminary reporting deadline (60 days from the analysis date) was missed by seven days for these results. This aspect of the deviation only affects the timing for when preliminary results were received and there were no hold time violations associated with the turbidity analysis results. Therefore, it was concluded that this portion of the deviation had no impact on the findings of the results. The second part of the deviation occurred during a cursory review of the Physis results, when it was noted that the two samples (519PGC010 and 519SACUR3) collected on October 16, 2023 (and extracted on October 25, 2023) missed the seven-day extraction hold time by two days. Physis was contacted and confirmed the hold time exceedance. Corrective actions for deviation included: 1) the laboratory has reminded staff about requirement to report results within 60 days of the analysis date, 2) the laboratory reviewed the error with staff and reminded them to confirm analysis dates of all samples when scheduling extractions to ensure hold times are not missed, and 3) the affected data will be flagged with a "H" QA Code flag and a batch comment will be added indicating there was a two-day extraction hold time violation on two samples in the batch. The deviation has been finalized, approved, and signed by all required parties.

2023-05: CEC Events 1 and 2 Weck Missed Preliminary Reporting Deadline

Deviation (**2023-05**) occurred on January 10, 2024, and was related to missed preliminary reporting deadlines for CEC Events 1 and 2. As per Resolution R5-2021-0054, preliminary raw data and monitoring results shall be provided to the CVRWQB within sixty calendar days from the date of sample analysis. MLJ Environmental collected samples for CEC Year 3 Event 1 on October 16, 18, and 19, 2023. Event 2 samples were collected on October 30 and November 1, 2023. On January 4, 2024, Weck Laboratories sent Event 1 PPCP lab reports and EDDs for samples collected on October 16, 2023 (3J20079) and October 18, 2023 (3J20081) to the Data Management Team, with an acknowledgement that results for samples collected on October 19, 2023, as well as all results from Event 2, were still pending. On January 10, 2024, Weck sent the PPCP Lab Report and EDD for sample date October 19, 2023 (3J24067) to the Data Management Team, with a further acknowledgement the Data Management Team had requested Event 2 results from Weck. Once all results for Event 1 were reported (January 10, 2024), the DRMP Data Manager assessed whether preliminary reporting deadlines were missed. On January 11, 2024, the DRMP Data Manager sent an email to Selina Cole (QA Representative, CVRWQCB) to provide notification that the CEC Event 1 PPCP preliminary reporting deadline was missed for the Event 1 collections. Specifically, the samples collected on October 16 and 18, 2023 were analyzed on October 26, 2023, and reported on January 4, 2024 (10 days past deadline). The samples collected on October 19, 2023, were analyzed on November 4, 2023, and reported on January 10, 2024 (7 days past deadline). Additionally, Selina Cole was notified that the analysis dates for Event 2 samples were currently unknown, and it was anticipated that those results might also be received by the Data Management Team outside the 60 days reporting timeline. On January 17, 2024, the DRMP Data Manager sent an additional reminder to Weck requesting data for Event 2.

On January 17, 2024, Weck sent Event 2 sample dates October 19, 2023 (3K03096) and November 1, 2023 (3K03096, 3K03103) lab reports and EDDs to the Data Management Team. On January 18, 2024, the DRMP Data Manager sent an email to Selina Cole with a notification that Event 2 Weck files were received on January 17, 2024, and the analysis was done on November 15, 2023. The preliminary reporting timeline was missed by three days for Event 2 PPCP results. The deviation only affected the timing for when preliminary results were received and there were no hold time violations associated with these results. Accordingly, this deviation had no impact on the results themselves. The corrective action was for future DRMP projects with Weck, the 60-day reporting timeline will be discussed in a kickoff meeting with the laboratory in addition to noting this requirement in contract language and analysis quote requests. The deviation has been finalized, approved, and signed by all required parties.

2023-08: CEC Events 1 and 2 Physis Field Contamination

Deviation **2023-08** occurred on December 20, 2023 (CEC Events 1 and 2, WY 2024). Physis Environmental Laboratories, Inc. (Physis) reported Event 1 and Event 2 EDDs to the Data Management Team on December 20, 2023, for all results (turbidity and PPCPs). It was noted by the Data Management Team upon review of the EDD data (submitted on December 20, 2023) that there was field contamination for galaxolide and turbidity (MQO for field blank is < Reporting Limit (RL)) in field and equipment blanks for Event 1 and Event 2 sampling performed on October 18, October 19, and November 1, 2023 and appropriate flags were applied following the Data Management SOP. While it was noted that all laboratory blanks analyzed with samples from these sampling events were non-detect (ND) for all parameters, the laboratory indicated it is not uncommon to see turbidity detections in laboratory blanks. Specifically, the samples affected were the following: 1) October 18, 2023 (sample ID # 511NACDOA-EB), 2) October 19, 2023 (sample ID # 519POTW01-EB and 519DRYRLB-FB), and 3) November 1, 2023 (sample ID # 511NACDOA-EB, 511OACCLN-FB, and 519POTW01-EB). A majority of the samples with field contamination were associated with equipment blanks where the blank water supplied by the laboratory is processed through the sampling equipment prior to the laboratory bottle (same process as collecting an environmental sample), whereas a field blank is created by pouring blank water directly into the bottle. MLJ field sampling staff confirmed that Physis supplied the blank water used by MLJ staff during CEC Event 1 and Event 2 field sampling and that the blank water was received and handled according to the DRMP CEC Field Sampling SOP. Galaxolide is present in most materials, and it can be difficult to avoid contamination. The laboratory is unsure of the source of contamination; it may be found in solvents utilized by the laboratory. On January 30, 2024, CVRWQCB QA Representative, Selina Cole, was contacted to determine if this constituted a deviation since the samples were correctly flagged. Selina Cole noted that field contamination(s) that will impact data quality should be documented in a deviation form that identifies corrective actions to hopefully prevent similar issues in future monitoring events. Field samplers went through extensive training prior to CEC Year 3 sampling with special attention paid to field contamination. Staff were reminded about sampling procedures to reduce contamination, and the laboratory was also communicated with regarding contamination concerns. A QA Code was added to records where the result is greater than the Reporting Limit with a QA Code of IP [Analyte detected in field or lab generated blank]. Furthermore, it is recommended that additional blank samples be added to future CEC projects to assess possible sources of contamination in both the field and laboratory. The deviation is currently under review by CVRWQCB staff.

2023-09: CEC Events 1 and 2 Physis Missing LCS samples for Turbidity

Deviation **2023-09** occurred on January 30, 2024 (CEC Events 1 and 2, WY 2024). On January 30, 2024, the Data Management Team reviewed the Physis EDDs for Events 1 and 2 (CEC Year 3) and noted that a turbidity laboratory control spike (LCS), as required per batch in QAPP Table 6, was not performed by the laboratory for two batches. Samples were collected on October 16, 18, and 19, 2023 for Event 1 and October 30 and November 1, 2023, for Event 2. Electronic data deliverables (EDDs) were received by the Data Management Team on January 17, 2024. Cassandra Lamerdin (DRMP Data Manager) contacted Physis Laboratories on January 30, 2024, to inquire about missing LCS for turbidity in the following lab batches: 1) Physis_DRMP_CEC_C-74082_W_TURB and 2) Physis_DRMP_CEC_C-74089_W_TURB. Rachael Hansen at Physis responded on January 30, 2024, and indicated Physis did not perform an LCS for turbidity. Rich Gossett at Physis further responded on January 30, 2024, and indicated Physis only performed lab blanks and lab duplicates for quality assurance and quality control (QAQC) purposes in relation to turbidity. Despite these missing LCS results, it is anticipated that the completeness requirement of 90% or more of analytes meeting MQOs for accuracy will still be met for the project. Physis confirmed that all other required QC were performed including a mid-level calibration check, laboratory blanks, and laboratory duplicates for all turbidity batches. The corrective actions for this deviation included: 1) all batches missing the required QC were flagged with a QA Code of "QI" and a lab batch comment will be added to indicate which batch QC frequency was not met and why, 2) future kickoff meetings will be clear about batch QC requirements including references to QAPP tables. The deviation has been finalized, approved, and signed by all required parties.

2023-19: CEC Events 1 and 2 MLJ Environmental Discharge Measurement and Data Entry Error

The final CEC deviation (Deviation **2023-19**: CEC Events 1 and 2 MLJ Environmental Discharge Measurement and Data Entry Error) occurred on August 2, 2024 (CEC Events 1 and 2, WY 2024). On August 2, 2024, MLJ staff reviewing field measurement datasheets and flow discharge calculations for Events 1 and 2 (CEC Year 3) noted two data entry errors and two field protocol measurement errors which resulted in erroneous flow discharge estimates across Event 1 and Event 2 sampling involving the following station locations: 511OACUNA (Event 1, October 18, 2023), 511NACDOA (Event-2, November 1, 2023), 519DRYWAB (Event1, October 19, 2023) and 511NACUOA (Event1, October 18, 2023). Melissa Turner (DRMP Program Manager) was notified and briefed on the deviation during an in-person meeting on August 5, 2024, and Ryan Brown at the CVRWQCB was sent notification of the Deviation on August 9, 2024. For the 511OACUNA (Event 1) and 511NACDOA (Event-2) field data entry errors, the spreadsheet data entry was corrected and revised estimates for total discharge were calculated. Corrected values were updated in ancillary datasets and any published public data products. For the 519DRYWAB and 511NACUOA (Event 1) measurement protocol errors, a QA Code of MN [Method procedures not followed] was applied to the discharge results, and the compliance codes were updated to “Qual” and a comment was added to the results. Finally, additional training for field crew staff on the correct sampling protocol was undertaken. The deviation is currently under internal review by MLJ Environmental staff.

Table 46. Referenced deviations from the DRMP CEC QAPP.

Deviation Number	Status	Date	QAPP Name	Title	Description	Corrective Action	Resolution
2023-01	Final	10/19/2023	DRMP CEC QAPP v3.3	CEC Year 3 Roseville Turbidity Measures Recorded with Probe	Turbidity was measured in the field instead of collecting water for a laboratory analysis at the POTW 1 sites sampled on October 19, 2023. Turbidity was measured using a Hanna Turbidity Meter following method EPA 180.1, instead of submitting samples to Physis Laboratories, as outlined in the approved QAPP.	None	NA
2023-02	Final	11/27/2023	DRMP CEC QAPP v3.3	CEC Year 3 Event 2 Enthalpy Missing Laboratory Control Sample Duplicate	On 11/27/2023, Enthalpy informed the DRMP that the laboratory missed analyzing the LCSD during the analysis of the samples associated with Event 2; PFAS samples were analyzed without a laboratory duplicate as is required by the QAPP.	None	NA
2023-04	Final	12/28/2023	DRMP CEC QAPP v3.3	CEC Event1 Missed Physis Reporting Deadline and Extraction Hold Time Exceedance.	1) Physis reported Event 1 EDDs for turbidity past the resolution preliminary reporting deadline (60 days from the analysis date) by 7 days for these results. 2) Two samples collected on 10/16/2023 and extracted on 10/25/2023 missed the 7-day extraction hold time by 2 days.	1) Lab reminded staff about reporting requirements 2) Lab reviewed hold time error with staff 3) Data flagged with appropriate QA Code (H) and comment.	Future reports provided within requirements. Data flagged according to the Data Management SOP

Deviation Number	Status	Date	QAPP Name	Title	Description	Corrective Action	Resolution
2023-05	Final	01/11/2024	DRMP CEC QAPP v3.3	CEC Events 1 and 2 Weck Missed Preliminary Reporting Deadline	Event 1 PPCP preliminary reporting deadline (60 days) was missed by Weck. Samples collected on 10/16/2023 and 10/18/2023 were reported 10 days past deadline; samples collected on 10/19/2023 were reported seven days past deadline. In addition, Event 2 Weck files were received three days past the preliminary reporting timeline.	For future DRMP projects with Weck, the 60-day reporting timeline will be discussed in a kickoff meeting with the laboratory in addition to noting this requirement in contract language and analysis quote requests.	No further sampling events for Year 3 CEC Monitoring.
2023-08	Out for Regional Board Review	12/20/2023	DRMP CEC QAPP v3.3	CEC Events 1 and 2 Physis Field Contamination	Physis results were reported with contamination for galaxolide and turbidity in field and equipment blanks for Events 1 and 2.	1) Field staff were reminded about sampling procedures to reduce contamination, and the lab was also communicated with regarding contamination concerns, 2) QA Code was added to records where the result is greater than the RL (IP: Analyte detected in field or lab generated blank).	Data flagged according to the Data Management SOP.
2023-09	Final	01/30/2024	DRMP CEC QAPP v3.3	CEC Events 1 and 2 Physis Missing LCS samples for Turbidity	A turbidity LCS was not performed by Physis for two batches. Lab staff indicated that Physis only performs lab blanks and lab duplicates for turbidity QC.	1) all batches missing the required QC were flagged with a QA Code of QI with an appropriate lab batch 2) future kickoff meetings will be clear about batch QC requirements including references to QAPP tables.	No further sampling events for Year 3 CEC Monitoring.

Deviation Number	Status	Date	QAPP Name	Title	Description	Corrective Action	Resolution
2023-19	Under Internal MLJ Review	08/02/2024	DRMP CEC QAPP v3.3	CEC Events 1 and 2 MLJ Environ. Discharge Measurement and Data Entry Error	On August 2, 2024, MLJ staff reviewing field measurement datasheets and flow discharge calculations for Events 1 and 2 (CEC Year 3) noted two data entry errors and two field protocol measurement errors which resulted in erroneous flow discharge estimates across Event 1 and Event 2 sampling efforts	For the 511OACUNA (Event 1) and 511NACDOA (Event-2) field data entry errors, the spreadsheet data entry was corrected and revised estimates for total discharge were calculated. For the 519DRYWAB and 511NACUOA (Event 1) protocol errors, a QA Code of MN [Method procedures not followed] was applied to the discharge results, the compliance codes were updated to "Qual" and a comment was added to the result.	Corrected values were updated in ancillary datasets and any published public data products. Additional training for field crew staff on the correct sampling protocol was taken.

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Appendix A. Field Reports for Year 3 Monitoring for Constituents of Emerging Concern

Event 1 – October 16, 18 and 19, 2023

MLJ Field Report – Event 1 Urban Source and Year 3 Gradient Study Area Monitoring

Field Report

Delta RMP CEC Year 3 Monitoring
Event 1 – Urban Source and Gradient Study Areas

Version 1.0

Prepared October 27, 2023

MLJ ENVIRONMENTAL

SAMPLE EVENT INFORMATION

Dates Sampling Occurred: 10/16/2023 through 10/19/2023

This field report summarizes the sampling activities that occurred for the Year 3 of the Delta Regional Monitoring Program (RMP) Monitoring for Constituents of Emerging Concern (CECs). Sampling was conducted by MLJ Environmental field crews on 16th, 18th, and 19th of October 2023. This event was the first of two planned for Year 3 monitoring to collect water quality samples from two urban runoff locations and 14 POTW gradient study locations. The schedule of sampling event activities by MLJ staff is summarized in **Table 1**.

Sampling activities for the urban source and POTW 2 study area locations were completed according to the anticipated schedule. Sample collection of the POTW 1 gradient study area sites was postponed one day due to pumping that was observed upstream of the R5 monitoring location (see **Event Comments** for further details). All field activities were conducted in accordance with the requirements outlined in the approved Quality Assurance Project Plan for CEC Monitoring, version 3.3 (CEC QAPP v3.3), with the exception of the collection of turbidity samples for the POTW 1 samples collected on October 19, 2023 (see **Quality Assurance**).

Table 1. Monitoring event schedule summary.

Date	Field Prep/Cleanup	Urban Site Monitoring	POTW 1 Area Monitoring	POTW 2 Area Monitoring
Monday, 10/16/2023	Equipment/materials preparation	**Sample Collection**	Site Reconnaissance	Site Reconnaissance
Tuesday, 10/17/2023	Reconnaissance report submitted to DRMP and CVRWQCB. Equipment/materials preparation	**--**	R5 Site Visit	--
Wednesday, 10/18/2023	Equipment/materials preparation	**--**	R5 Site Visit	**Sample Collection**
Thursday, 10/19/2023	--	PPCP sample shipment	**Sample Collection**	PPCP sample shipment
Friday, 10/20/2023	Post-calibration and equipment cleaning.	PFAS sample delivery	PFAS sample delivery	PFAS sample delivery
Monday, 10/23/2023	Field data entry	--	PPCP sample shipment	--

EVENT COMMENTS

Sampling Event 1 for CEC monitoring was scheduled to occur from October 16th through October 18th. Per the CEC QAPP v3.3, monitoring was planned to occur over three days as follows:

- Monday: urban runoff sample collection, gradient area site reconnaissance;
- Tuesday: gradient sample plan submission and equipment preparation;
- Wednesday: gradient sampling for POTW 1 and POTW 2 study areas.

All activities were completed as planned with the exception of postponing the POTW 1 study area sample collection by one day, to be collected on Thursday, October 19th. The conditions leading to this decision are provided below.

MLJ field crews successfully collected the urban runoff samples and completed gradient field reconnaissance on Monday, October 16th. MLJ staff developed a gradient Sample Plan based on the observed conditions, which was submitted to the Delta RMP Program Manager and CVRWQCB QA Representative on the morning of Tuesday, October 17th. The Event 1 Sample Plan is provided in **Attachment 1. Sample Plan**.

During the site reconnaissance for the POTW 1 study area field crews noted that Sacramento County staff were in the process of pumping water out of the area of Steelhead Creek upstream of the flow control structure into the confluence area with Dry Creek near the sample area at R5. MLJ staff spoke with the personnel operating the pump, who indicated that their activities would be completed by the end of the day Monday. MLJ field crews visited the site again on Tuesday to verify no activity was occurring, as well as prior to beginning the gradient sampling on Wednesday, October 18th. No activity was observed on Tuesday; however, during the Wednesday site visit, pumping crews were again present and operating the pump. As a result, MLJ field crews were instructed not to begin the POTW 1 sampling that day.

MLJ field crews remained in contact with the pump operators and confirmed that pumping ceased on Wednesday the 18th. Field crews were instructed to resume sampling as scheduled on Thursday, October 19th after verifying that no pumping activity was occurring or planned upstream of R5. No other anomalies of note occurred during the POTW 1 area sampling.

Sampling for the POTW 2 study area was completed as scheduled on October 18, 2023. Sampling crews noted that discharge into Old Alamo Creek was occurring from adjacent irrigation canals at the R2 location. No other anomalies of note occurred during the POTW 2 area sampling. Field sheets for the samples collected during Event 1 are provided in **Attachment 2. Fieldsheets**.

SAMPLING SITES

The sample sites for Event 1 are provided in **Table 2**. Urban runoff locations were collected according to the schedule required by the CEC QAPP v3.3. The POTW 1 and 2 gradient study area locations were scheduled according to the site reconnaissance conducted on October 16, 2023 and outlined in the Sample Plan submitted the Delta RMP Program Manager and the Central Valley Regional Water Quality Control Board (CVRWQCB) QA Representative on October 17,2023.

Table 2. Locations at which monitoring was conducted for CEC Event 1.
An "X" indicates a scheduled measurement or sample that was successfully collected. A "—" indicates not collected. Discharge is not required at the urban runoff sites and POTW 1; turbidity is not required at urban runoff locations.

Area	Type	Staton Code	Sample Date	Time	Collected					
					Field	Discharge	Turbidity	SSC	PPCPs	PFAS
Urban	MS4	519SACUR3	10/16/2023	0930	X	--	--	X	X	X
Urban	MS4	519PGC010	10/16/2023	1050	X	--	--	X	X	X
POTW2	EFF	511POTW02	10/18/2023	0900	X	X	X	X	X	X
POTW2	R1	511OACCLN	10/18/2023	1030	X	X	X	X	X	X
POTW2	R2	511OACSBL	10/18/2023	1110	X	X	X	X	X	X
POTW2	R3	5110ACUNA	10/18/2023	1200	X	X	X	X	X	X
POTW2	R4	511NACUOA	10/18/2023	1230	X	X	X	X	X	X
POTW2	R5	511NACDOA	10/18/2023	1330	X	X	X	X	X	X
POTW2	R6	511NACARD	10/18/2023	1430	X	X	X	X	X	X
POTW1	R0	519DRYCRK	10/19/2023	0830	X	X	X*	X	X	X
POTW1	EFF	519POTW01	10/19/2023	0930	X	--	X*	X	X	X
POTW1	R1	519DRYCRB	10/19/2023	1050	X	X	X*	X	X	X
POTW1	R2	519DRYWAB	10/19/2023	1150	X	X	X*	X	X	X
POTW1	R3	519DRYRLB	10/19/2023	1330	X	X	X*	X	X	X
POTW1	R5	519SHCDDC	10/19/2023	1500	X	X	X*	X	X	X
POTW1	R7	519SHCDRC	10/19/2023	1600	X	X	X*	X	X	X

* Turbidity collected as a field measurement, not submitted to the laboratory for analysis (see **Deviations**).

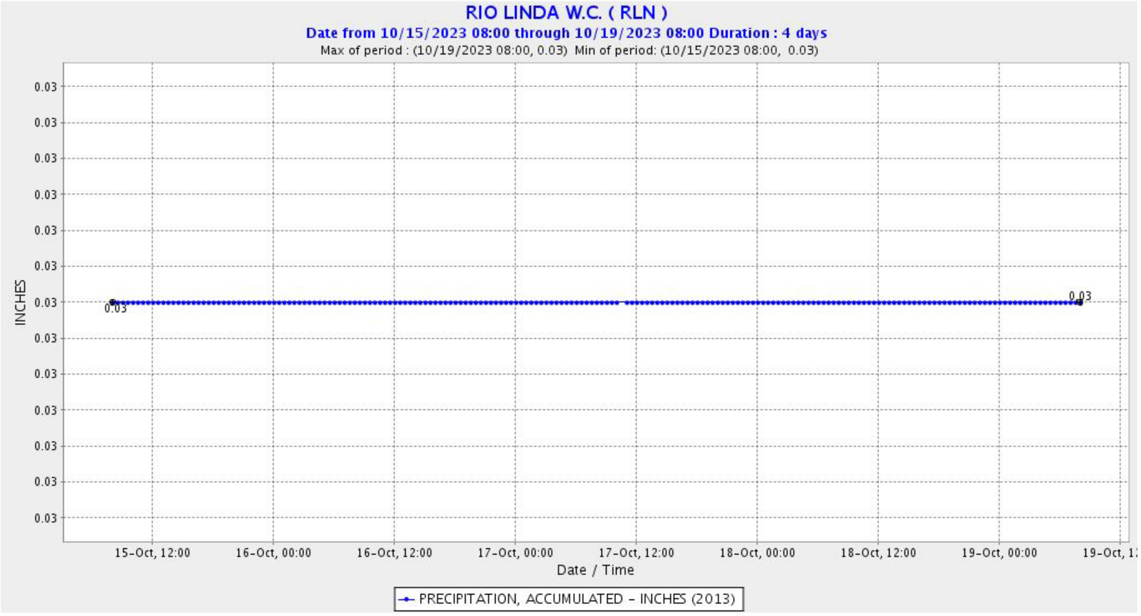
SAMPLING CONDITONS

Gradient study area monitoring was targeted for dates with antecedent dry conditions (i.e., rainfall ≤ 0.1 inches) of at least 72 hours (CEC QAPP v3.3). No prior rainfall was recorded at either gradient study area prior to sample collection on October 18th and 19th.

POTW 1 STUDY AREA PRECIPITATION DATA

Antecedent precipitation information for the POTW 1 study area is provided in **Figure 1**. The POTW 1 precipitation data is obtained from DWR CDEC precipitation gauge RLN.

Figure 1. POTW 1 precipitation data from station RLN prior to 10/19/2023.



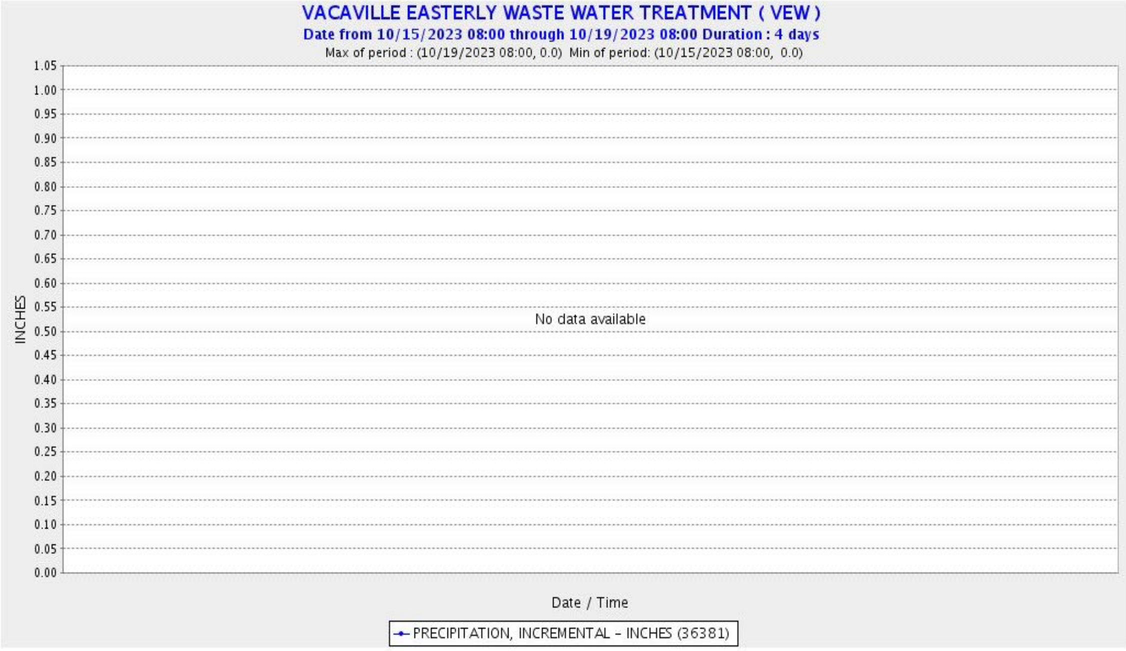
POTW SOURCE 2 PRECIPITATION DATA

Antecedent precipitation information for the POTW 2 study area is provided in **Table 4**. The preferred source for POTW 2 precipitation data is DWR CDEC precipitation gauge VEW; however, no records are available for this gauge during the required time period (**Figure 2**). Instead, POTW 2 precipitation data was obtained from the gauges located at Travis Air Force Base, located approximately five miles from the study area.

Table 3. POTW 2 precipitation data from Travis Air Force Base prior to 10/18/2023.

Date	Precipitation Station ID	Precipitation in inches (24 -our total)
10/15/2023	KCATRAVI7 (Travis AFB)	0.00
10/16/2023	KCATRAVI7 (Travis AFB)	0.00
10/17/2023	KCATRAVI7 (Travis AFB)	0.00
10/18/2023	KCATRAVI7 (Travis AFB)	0.00

Figure 2. POTW 2 precipitation data from station VEW prior to 10/18/2023.



QUALITY ASSURANCE

QUALITY CONTROL SAMPLES

Quality control (QC) samples were collected as outlined in **Table 3**. All scheduled QC samples were successfully collected as required by the CEC QAPP v3.3.

Table 4. Quality control sample summary.

QC Sample Location	Sample Date	QC Type	Analytes	Scheduled/ Alternate
POTW 2, R4: 511NACUOA	10/18/2023	Equipment Blank – Conbar Dipper	SSC, PPCPs, Turbidity, PFAS	Scheduled
POTW 1, EFF: 519POTW01	10/19/2023	Equipment Blank - Bailer	SSC, PPCPs, PFAS	Scheduled
POTW 1, R3: 519DRYRLB	10/19/2023	Field Blank, Field Duplicate	SSC, PPCPs, PFAS	Scheduled

DEVIATIONS

Per the requirements of the CEC QAPP v3.3, any deviations from the requirements outlined in that document must be approved by the CVRWQCB QA Representative prior to implementation and documented in a Delta RMP QAPP Deviation Form.

One deviation from the QAPP was identified during the Year 3 Event 1 field monitoring regarding the collection of turbidity for the POTW 1 study area. Due to concerns regarding pumping occurring upstream of the R5 monitoring location on the originally scheduled sample date (October 18th), field crews were directed to postpone the sample collection to the following day, October 19th. The additional sample collection day raised concerns regarding the ability to ship sample to labs located in Southern California prior to the weekend, when there is elevated risk of shipping delays or sample receiving errors. To alleviate these concerns, MLJ staff recommended retaining custody of these samples over the weekend and shipping them in the morning of Monday, October 23rd. Of the samples scheduled for the later shipping date, the holding time for turbidity (48 hours) was such that it would not be received by the laboratory in time to meet the analysis requirements. Therefore, MLJ field crews opted to collect turbidity as a field measurement on October 19th in lieu of the laboratory analysis outlined in the QAPP. The CVRWQCB was notified of this decision on October 18th. A deviation form (2023-01_CECv3.3_Dev_Event1_MLJ_RosevilleTurbidityProbe) is being drafted to record this anomaly and will be submitted to the CVRWQCB QA Representative for signature. No other deviations were identified during Event 1 sampling.

URBAN RUNOFF SITE COLLECTION

Urban runoff site collection occurred on October 16, 2023 according to the schedule outline in the CEC QAPP v3.3. Recorded collection locations are shown in **Figure 3**.

MS4 SITE 1: 519SACUR3

Station Type:	MS4
Station Code:	519SACUR3
Station Name:	Sacramento Urban Runoff 3; Sump 111
Target Coordinates:	38.60127, -121.49296
Recorded Coordinates:	38.60130, -121.492993
Distance from Target:	5 m

Site Photos

Sump Interior

Sump Exterior

Sample Collection

Sample Date:	10/16/2023
Sample Time:	09:30
Observed Flow:	No Observed Flow
Sample Type:	Grab
Collection Method:	Bailer
Discharge Method:	Not Applicable
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

MS4 SITE 2: 519PGC010

Station Type:	MS4
Station Code:	519PGC010
Station Name:	Roseville Urban Runoff
Target Coordinates:	38.80477, -121.32733
Recorded Coordinates:	38.80475, -121.327398
Distance from Target:	6 m

Site Photos


Sample Location


Downstream

Sample Collection

Sample Date:	10/16/2023
Sample Time:	10:50
Observed Flow:	No Observed Flow
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Not Applicable
QC Site:	No

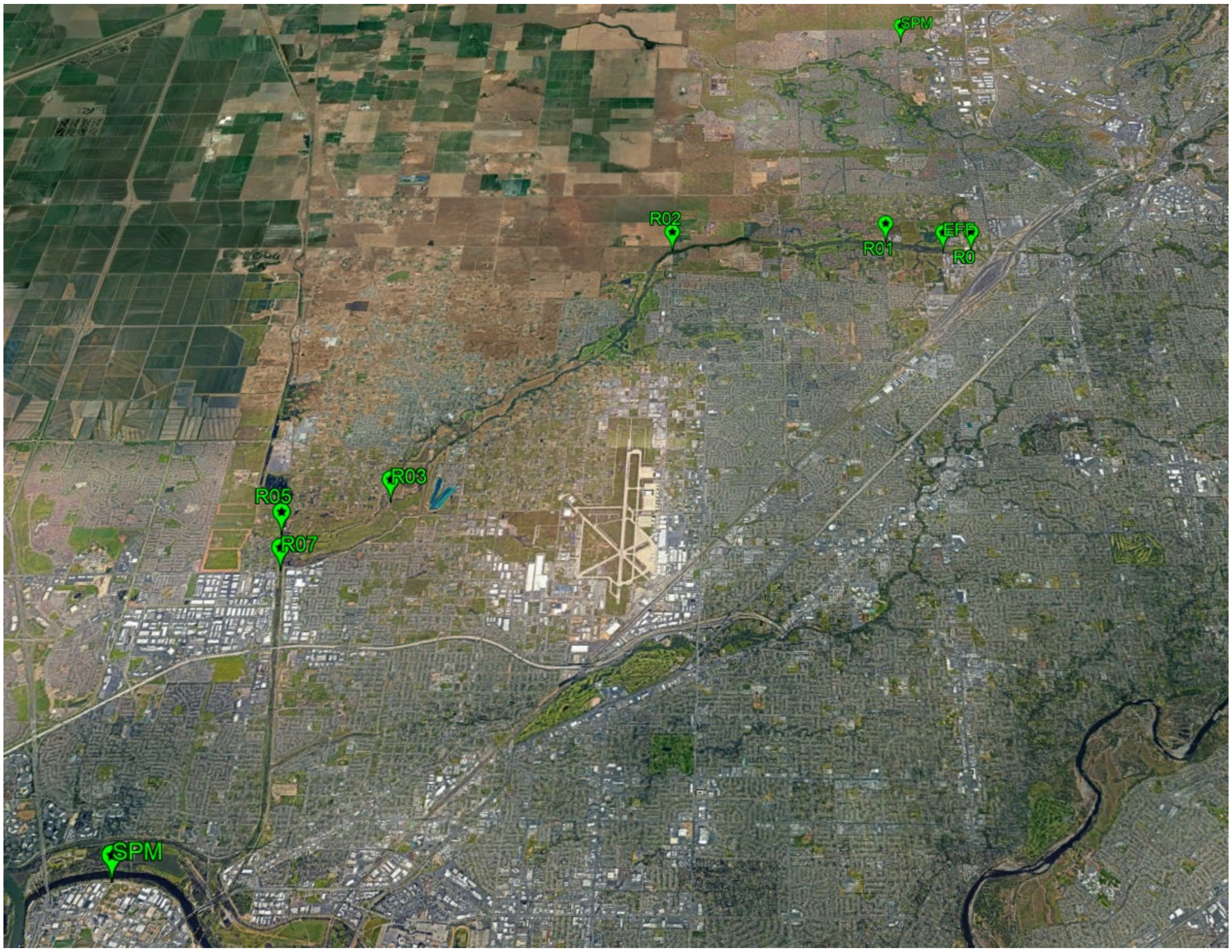
☒ Samples collected without issues with no additional information.

Site Comments: None

POTW 1 GRADIENT AREA COLLECTION

Field crews collected samples from seven POTW 1 gradient study area locations on October 19, 2023, as shown in **Figure 3**.

Figure 3. Recorded POTW 1 and urban runoff locations sampled 10/16/2023-10/19/2023.



SITE 1: 519DRYCRK

Station Type:	R0
Station Code:	519DRYCRK
Station Name:	Dry Creek before POTW Source 1
Target Coordinates:	38.7341, -121.31444
Recorded Coordinates:	38.73408, -121.31459
Distance from Target:	13 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	08:30
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 2: 519POTW01

Station Type:	EFF
Station Code:	519POTW01
Station Name:	POTW Source 1 effluent discharge to Dry Creek
Target Coordinates:	38.73402, -121.32185
Recorded Coordinates:	38.73412, -121.32187
Distance from Target:	11 m

Site Photos

Effluent Discharge

Samling Port

Sample Collection

Sample Date:	10/19/2023
Sample Time:	09:30
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	Bailer
Discharge Method:	Not Applicable
QC Site:	Equipment Blank - Bailer

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 3: 519DRYCRB

Station Type:	R1
Station Code:	519DRYCRB
Station Name:	Dry Creek at Cook Riolo Rd bridge
Target Coordinates:	38.73672, -121.33670
Recorded Coordinates:	38.73695, -121.33678
Distance from Target:	27 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	10:50
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 4: 519DRYWAB

Station Type:	R2
Station Code:	519DRYWAB
Station Name:	Dry Creek at Watt Ave bridge
Target Coordinates:	38.73456, -121.39290
Recorded Coordinates:	38.73450, -121.39288
Distance from Target:	7 m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	11:50
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

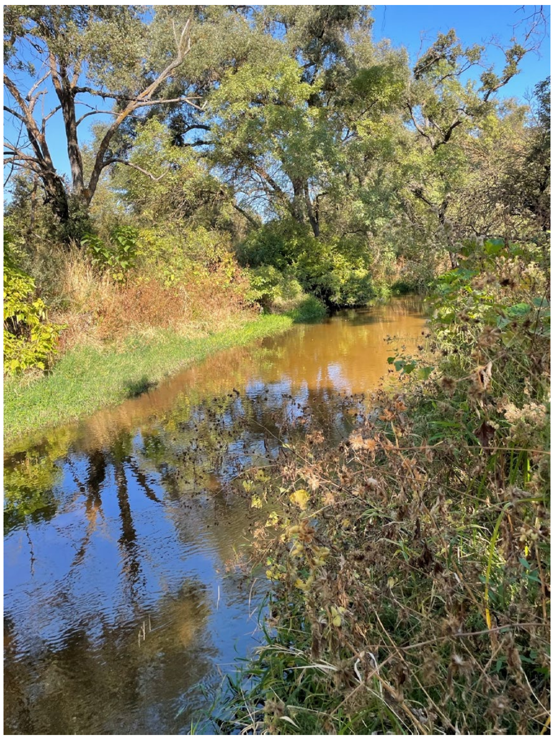
☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 5: 519DRYRLB

Station Type:	R3
Station Code:	519DRYRLB
Station Name:	Terminus of Dry Creek at Rio Linda Blvd
Target Coordinates:	38.67109, -121.45415
Recorded Coordinates:	38.67106, -121.45415
Distance from Target:	3 m

Site Photos



Upstream

Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	13:30
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	Yes – Duplicates, MS/MSD, Field blanks

☒ Samples collected without issues with no additional information.

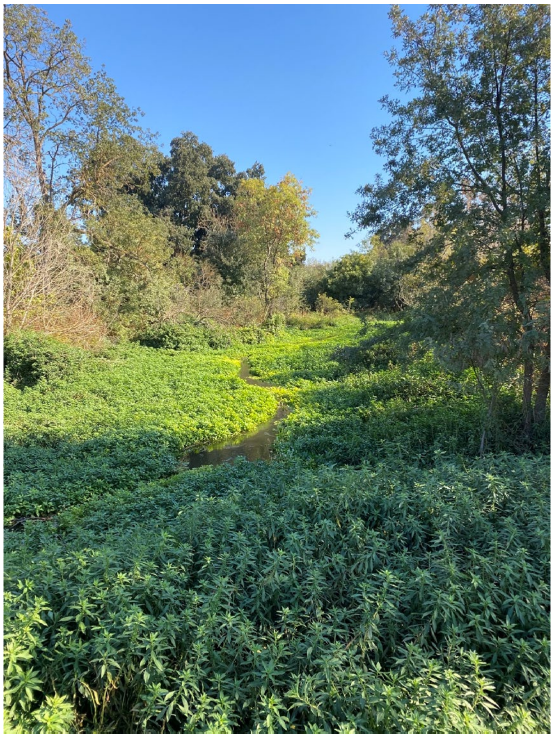
Site Comments: None

SITE 6: 519SHCDDC

Station Type:	R5
Station Code:	519SHCDDC
Station Name:	Steelhead Creek main stem Downstream of confluence with Dry Creek
Target Coordinates:	38.66407, -121.47720
Recorded Coordinates:	38.66408, -121.47720
Distance from Target:	1 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	15:00
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 7: 519SHCDRC

Station Type:	R7
Station Code:	519SHCDRC
Station Name:	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence
Target Coordinates:	38.65650, -121.475453
Recorded Coordinates:	38.65645, -121.47554
Distance from Target:	9 m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	10/19/2023
Sample Time:	16:00
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

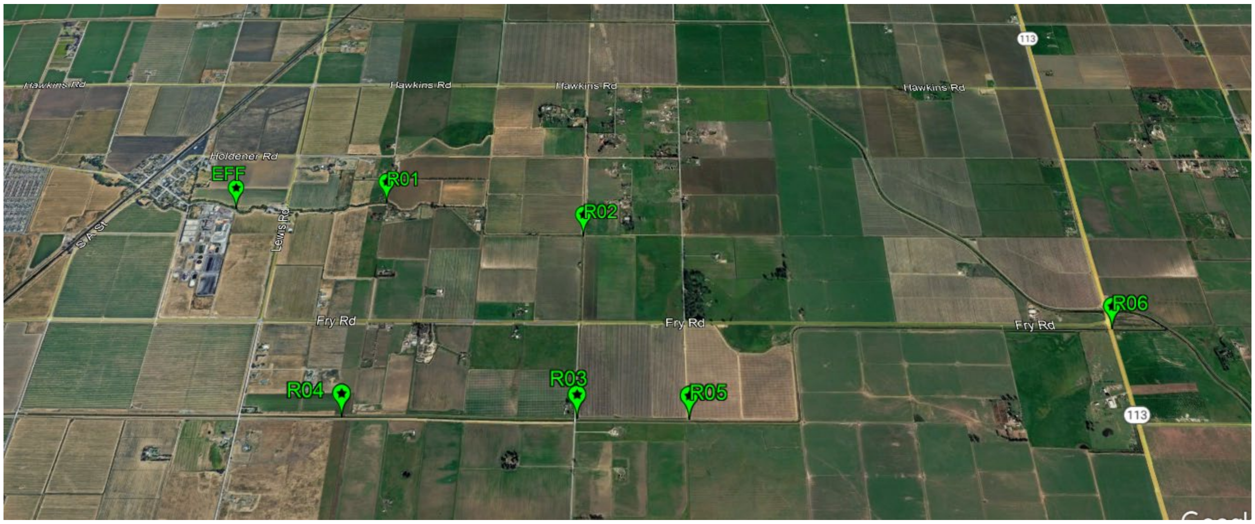
☒ Samples collected without issues with no additional information.

Site Comments: None

POTW 2 GRADIENT AREA COLLECTION

Field crews collected samples from seven POTW 2 gradient study area locations as shown in **Figure 4**.

Figure 4. Recorded POTW 2 locations sampled 10/18/2023.



SITE 1: 511POTW02

Station Type:	EFF
Station Code:	511POTW02
Station Name:	POTW Source 2 effluent discharge to Old Alamo Creek
Target Coordinates:	38.34664, -121.90156
Recorded Coordinates:	38.34660, -121.90157
Distance from Target:	4 m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	09:00
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 2: 511OACCLN

Station Type:	R1
Station Code:	511OACCLN
Station Name:	Old Alamo Creek at Chicorp Ln.
Target Coordinates:	38.347147, -121.887617
Recorded Coordinates:	38.34723, -121.88750
Distance from Target:	14 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	10:30
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 3: 511OACSBL

Station Type:	R2
Station Code:	511OACSBL
Station Name:	Old Alamo Creek at Sunnybrook Ln.
Target Coordinates:	38.344197, -121.869089
Recorded Coordinates:	38.34399, -121.86900
Distance from Target:	24 m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	11:10
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments:

- Culverts upstream were open and discharging water into the waterbody at a slow rate. No turbid water or disturbance was visible.
- Pipe downstream discharging water. Samples were collected downstream where water was homogenized.

SITE 4: 5110ACUNA

Station Type:	R3
Station Code:	5110ACUNA
Station Name:	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek
Target Coordinates:	38.329869, -121.869231
Recorded Coordinates:	38.32991, -121.86917
Distance from Target:	7 m

Site Photos

Downstream (confluence/culvert outlet)

Upstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	12:00
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 5: 511NACUOA

Station Type:	R4
Station Code:	511NACUOA
Station Name:	New Alamo Creek upstream of confluence with Old Alamo Creek
Target Coordinates:	38.329939, -121.888569
Recorded Coordinates:	38.32989, -121.88869
Distance from Target:	12 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	12:30
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: Low flow upstream of grade control structure. Downstream below grade control flow was stronger.

SITE 6: 511NACDOA

Station Type:	R5
Station Code:	511NACDOA
Station Name:	New Alamo Creek downstream of confluence between New and Old Alamo Creeks
Target Coordinates:	38.329789, -121.860019
Recorded Coordinates:	38.32983, -121.85997
Distance from Target:	6 m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	13:30
Observed Flow:	>200cfs
Sample Type:	Grab
Collection Method:	Conbar dipper
Discharge Method:	Float method
QC Site:	Equipment Blank – Conbar Dipper

☒ Samples collected without issues with no additional information.

Site Comments: Unable to collect composite sample due to field crew safety. Water depth and flow unsafe for wading.

SITE 7: 511NACARD

Station Type:	R6
Station Code:	511NACARD
Station Name:	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek
Target Coordinates:	38.336511, -121.823136
Recorded Coordinates:	38.336533, -121.82296
Distance from Target:	16 m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	10/18/2023
Sample Time:	14:30
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	Conbar dipper
Discharge Method:	Float method
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SAMPLE SHIPMENT INFORMATION

All samples were successfully delivered to the laboratories within the required time limits. Sample transfer delivery information is provided in **Table 5**. Samples were transported to MLJ offices and to laboratories in coolers with double bagged wet ice. Samples held in MLJ custody for an extended period of time were maintained within the required temperature ranges in a secured refrigerator until time of shipping.

Table 5. Sample transfer and delivery information.

Date/Time Samples Shipped	Laboratory	Shipping Company	Comments
10/19/23 – 11:00	Weck and Physis	FedEX	First shipment from samples collected on 10/16 and 10/18.
10/20/23 – 15:00	Enthalpy (Vista)	Direct delivery to lab by MLJ staff	PFAS samples from 10/16, 10/18, and 10/19 delivered directly to Enthalpy (Vista)
10/23/23 – 11:00	Weck and Physis	FedEX	Second shipment from samples collected on 10/19.

FIELD RESULT DATA

Table 6. Field result data.

Station Code	Sample Date	Collection Time	Discharge (cfs)	DO (mg/L)	DO (%)	pH	SC (uS/cm)	Temperature (Deg C)	Turbidity (NTU)
519SACUR3	10/16/23	9:30	0	1.43	15.3	6.94	206.1	19.4	--
519PGC010	10/16/23	10:50	0	1.07	11.3	6.82	99.1	20.8	--
511POTW02	10/18/23	9:00	14.71	4.78	58.9	7.11	890	25.0	--
511OACCLN	10/18/23	10:30	14.05	5.10	59.4	7.22	605	24.5	--
511OACSBL	10/18/23	11:10	22.96	6.37	73.4	7.61	723	22.2	--
511OACUNA	10/18/23	12:00	37.79	7.59	83.0	7.65	763	21.5	--
511NACUOA	10/18/23	12:30	1.57	11.20	114.7	7.56	723	18.5	--
511NACDOA	10/18/23	13:30	265.25	7.23	84.0	7.65	663	21.5	--
511NACARD	10/18/23	14:30	57.36	5.01	57.0	7.50	640	20.1	--
519DRYCRK	10/19/23	8:30	8.66	8.21	84.5	7.28	151.1	16.4	5.41
519POTW01	10/19/23	9:30	--	7.18	86.2	7.35	506	24.9	1.38
519DRYCRB	10/19/23	10:50	21.66	7.82	88.1	7.46	308.5	19.7	7.17
519DRYWAB	10/19/23	11:50	14.43	7.98	87.3	7.41	356.8	19.7	3.81
519DRYRLB	10/19/23	13:30	18.02	9.13	99.8	7.63	829.4	19.7	4.55
519SHCDDC	10/19/23	15:00	4.99	8.77	95.8	7.53	333.9	19.6	14.2
519SHCDRC	10/19/23	16:00	10.11	5.29	56.8	6.98	312.0	18.9	14.3

ATTACHMENT 1. SAMPLE PLAN

CEC Gradient Sample Plan

Year 3 Sampling Event: Event 1
Site Reconnaissance Date: October 16, 2023
Gradient Sample Date: October 18, 2023

MLJ field crews conducted site reconnaissance on Monday, October 16. The anticipated site locations for the gradient sampling event planned for Wednesday, October 18 are provided below (**Table 1** and **Table 2**) for approval by the Delta RMP Program Manager and Central Valley Regional Water Quality Control Board QA Representative.

POTW 1 GRADIENT STUDY AREA

Staff: Matt Bundock
Reconnaissance Time: 10:00 – 15:30

Reconnaissance Summary:

Sample conditions and site accessibility were generally as expected based on previous scouting trips. Unhoused presence was observed near the downstream R7, R8, R9, and R10 sites.

The flow control structure at R4 was closed, indicating no upstream sample should be collected from Steelhead Creek; however, at the time of the pre-sampling visit Sacramento County field crews were present and actively pumping water from the area upstream of the structure into the Dry Creek confluence. The crew lead informed MLJ staff that pumping would be completed by the end of the day on the 10/16 and no further pumping would be taking place on the scheduled sampling date (10/18). Should pumping be observed during sampling, field crews will contact the Delta RMP Program Manager and the CVRWQCB QA Representative.

Table 1. POTW 1 planned gradient sample locations.

Site Order	Station Type	Station Name	Station Code	Site Condition Comments
1	R0	Dry Creek before POTW Source 1	519DRYCRK	None
2	EFF	POTW Source 1 effluent discharge to Dry Creek	519POTW01	None
3	R1	Dry Creek at Cook Riolo Rd bridge	519DRYCRB	None

Site Order	Station Type	Station Name	Station Code	Site Condition Comments
4	R2	Dry Creek at Watt Ave bridge	519DRYWAB	None
5	R3	Terminus of Dry Creek at Rio Linda Blvd	519DRYRLB	Trash downstream of sample location
6	R5	Steelhead Creek main stem Downstream of confluence with Dry Creek	519SHCDDC	Pumping occurring from Steelhead Creek upstream of sample location due to channel maintenance. Flow structure gate closed.
7	R7	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	519SHCDRC	Grab sample anticipated; Robla Creek stagnant.

POTW 2 GRADIENT STUDY AREA

Staff: Isabell D'Este
Reconnaissance Time: 09:00 – 16:00

Reconnaissance Summary:

Sample conditions and site accessibility were generally as expected based on previous scouting trips, though downstream water levels were generally higher. The R0 site was not contiguous and is not planned for sample collection. Sites R5, R6, R7, and R8 were deep with swift currents and cannot be waded across safely. Site R9 may be wadeable in certain locations near the sample area, though may still not be suitable for cross section discharge measurements due to the influence of the overlying bridge. No agricultural discharges into waterbodies were observed.

Table 2. POTW 2 planned gradient sample locations.

Site Order	Station Type	Station Name	Station Code	Site Condition Comments
1	EFF	POTW Source 2 effluent discharge to Old Alamo Creek	511POTW02	None
2	R1	Old Alamo Creek at Chicorp Ln.	511OACCLN	None

Site Order	Station Type	Station Name	Station Code	Site Condition Comments
3	R2	Old Alamo Creek at Sunnybrook Ln.	511OACSBL	No visible discharge from culverts/adjacent irrigation ditches.
4	R3	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	511OACUNA	Water flowing into culvert at confluence.
5	R4	New Alamo Creek upstream of confluence with Old Alamo Creek	511NACUOA	None
6	R5	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	511NACDOA	Composite sample anticipated.
7	R6	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	511NACARD	None

POTW 1 Reconnaissance Photos – 10/16/2023

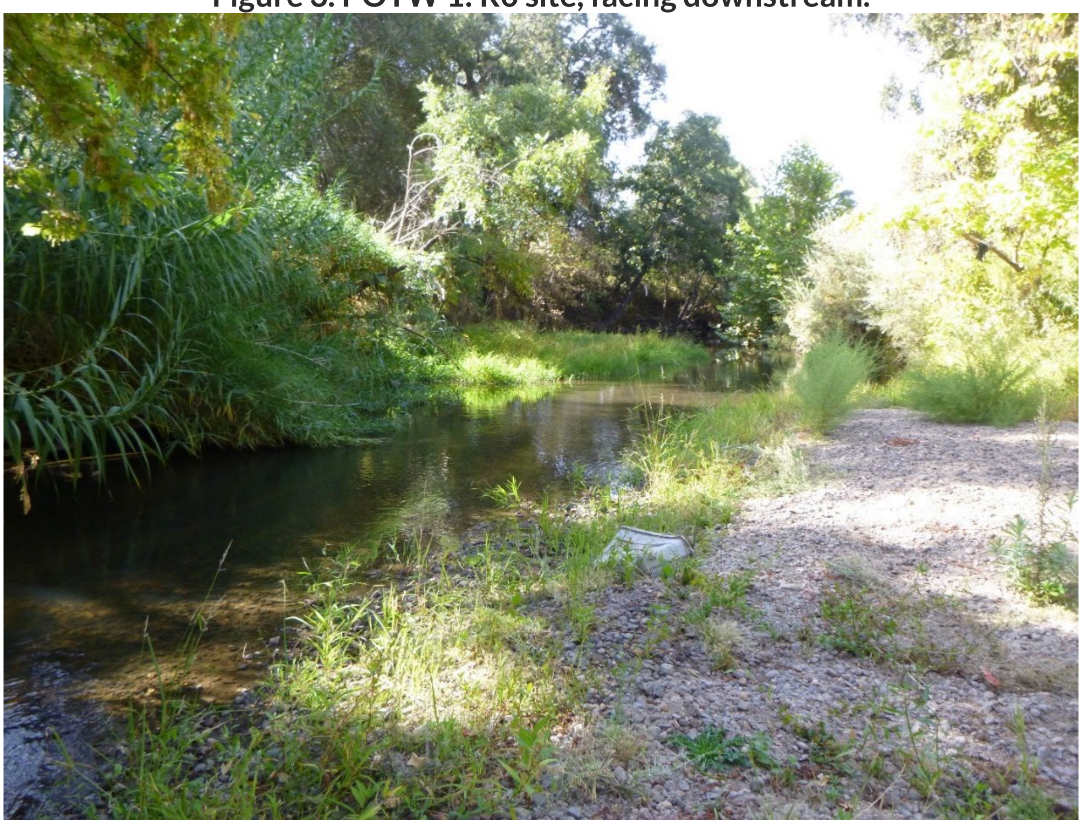
Effluent: Planned for Sample Collection

Figure 1. POTW 1 effluent site.

R0: Planned for Sample Collection

Figure 2. POTW 1: R0 site, facing upstream.

Figure 3. POTW 1: R0 site, facing downstream.



R1: Planned for Sample Collection

Figure 4. POTW 1: R1 site, facing upstream.

Figure 5. POTW 1: R1 site, facing downstream.

R2: Planned for Sample Collection

Figure 6. POTW 1: R2 site, facing upstream.

Figure 7. POTW1: R2 site, facing downstream.

.

R3: Planned for Sample Collection

Figure 8. POTW 1: R3, facing upstream.

Figure 9. POTW 1: R3, facing downstream.

R4: Not Planned for Sample Collection

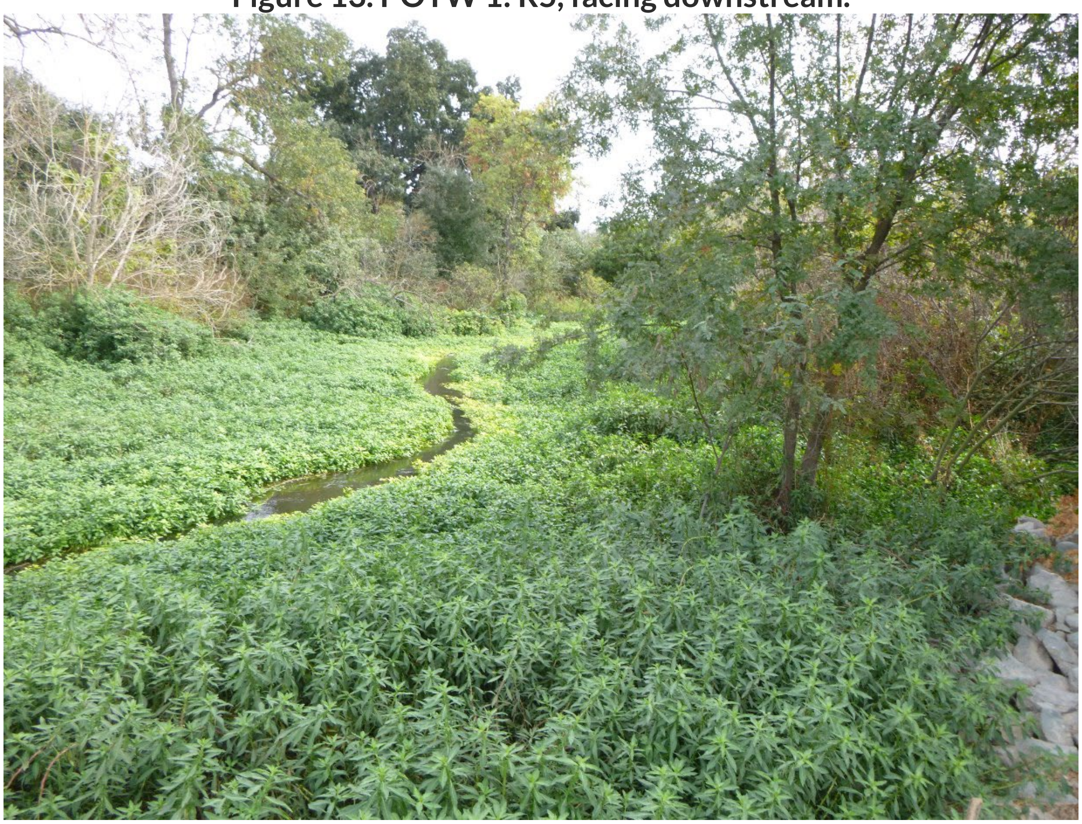
Figure 10. POTW 1: R4, facing upstream.

Figure 11. POTW 1: R4, facing downstream.

R5: Planned for Sample Collection

Figure 12. POTW 1: R5, facing upstream.

Figure 13. POTW 1: R5, facing downstream.



R7: Planned for Sample Collection

Figure 14. POTW 1: R7, facing upstream.

Figure 15. POTW 1: R7, facing downstream.

R8: Not Planned for Sample Collection

Figure 16. POTW 1: R8, facing upstream.

Figure 17. POTW 1: R8, facing downstream.

R9: Not Planned for Sample Collection

Figure 18. POTW 1: R9, facing upstream.

Figure 19. POTW 1: R9, facing downstream.

R10: Not Planned for Sample Collection

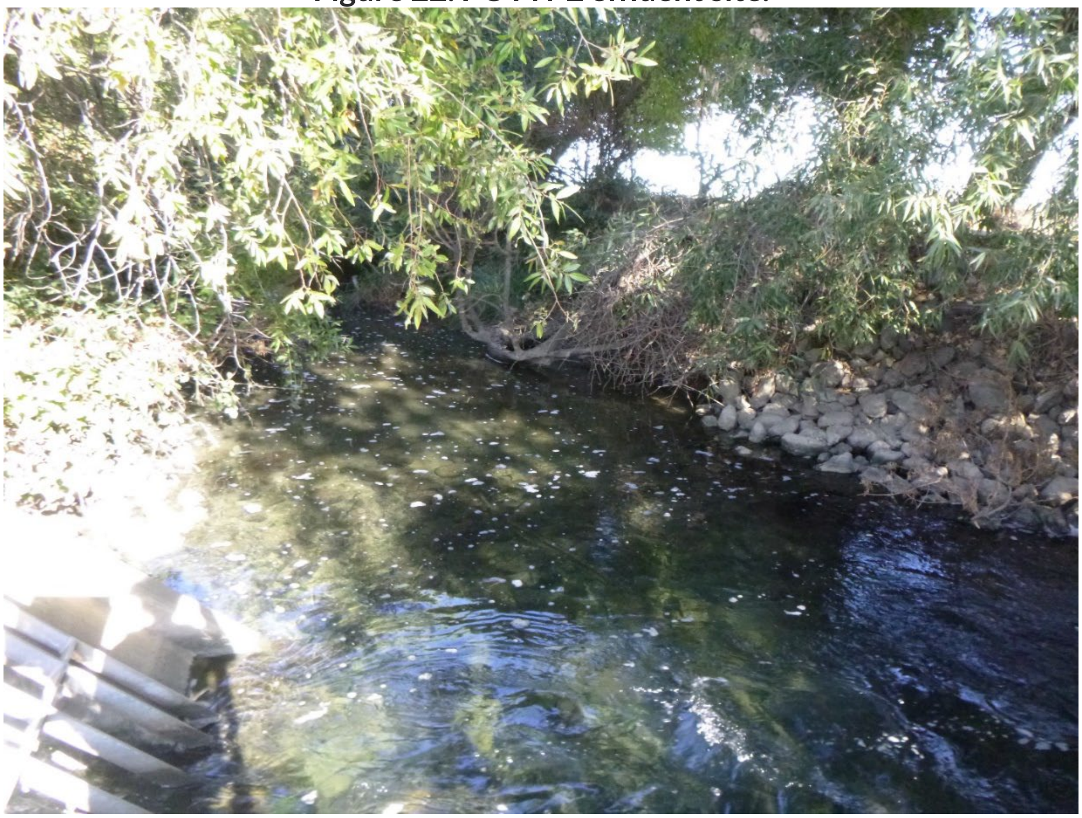
Figure 20. POTW 1: R10, facing upstream.

Figure 21. POTW 1: R10, facing downstream.

POTW 2 Reconnaissance Photos

Effluent: Planned for Sample Collection

Figure 22. POTW 2 effluent site.



R0: Not Planned for Sample Collection

Figure 23. POTW 2: R0 site, facing upstream.

Figure 24. POTW 2: R0 site, facing downstream.

R1: Planned for Sample Collection

Figure 25. POTW 2: R1 site, facing upstream.

Figure 26. POTW 2: R1 site, facing downstream.

R2: Planned for Sample Collection

Figure 27. POTW 2: R2 site, facing upstream.

Figure 28. POTW2: R2 site, facing downstream.

R3: Planned for Sample Collection

Figure 29. POTW 2: R3, facing upstream.

Figure 30. POTW 2: R3, discharge at confluence.

R4: Planned for Sample Collection

Figure 31. POTW 2: R4, facing upstream.

Figure 32. POTW 2: R4, facing downstream.

R5: Planned for Sample Collection

Figure 33. POTW 2: R5, facing upstream.

Figure 34. POTW 2: R5, facing downstream.

R6: Planned for Sample Collection

Figure 35. POTW 2: R6, facing upstream.

Figure 36. POTW 2: R6, facing downstream.

R7: Not Planned for Sample Collection

Figure 37. POTW 2: R7, facing upstream.

Figure 38. POTW 2: R7, facing downstream.

R8: Not Planned for Sample Collection

Figure 39. POTW 1: R8, facing upstream.

Figure 40. POTW 1: R8, facing downstream.

R9: Not Planned for Sample Collection

Figure 41. POTW 1: R9, facing upstream.

Figure 42. POTW 1: R9, facing downstream.

Event 2 – October 30 and November 1, 2023

MLJ Field Report – Event 2 Urban Source and Year 3 Gradient Study Area Monitoring

Field Report

Delta RMP CEC Year 3 Monitoring

Event 2 – Urban Source and Gradient Study Areas

Version 1.0

Prepared November 9, 2023

MLJ ENVIRONMENTAL

SAMPLE EVENT INFORMATION

Dates Sampling Occurred: 10/30/2023 through 11/1/2023

This field report summarizes the sampling activities that occurred for the Year 3 of the Delta Regional Monitoring Program (RMP) Monitoring for Constituents of Emerging Concern (CECs). Sampling was conducted by MLJ Environmental field crews on October 30, 2023 and November 1, 2023. This event was the second of two planned for Year 3 monitoring to collect water quality samples from two urban runoff locations and 14 POTW gradient study locations. The schedule of sampling event activities by MLJ staff is summarized in **Table 1**.

All sampling activities for the urban source and gradient study areas was completed according to the anticipated schedule. All field activities were conducted in accordance with the requirements outlined in the approved Quality Assurance Project Plan for CEC Monitoring, version 3.3 (CEC QAPP v3.3).

Table 1. Monitoring event schedule summary.

Date	Field Prep/Cleanup	Urban Site Monitoring	POTW 1 Area Monitoring	POTW 2 Area Monitoring
Monday, 10/30/2023	Equipment/materials preparation	**Sample Collection**	Site Reconnaissance	Site Reconnaissance
Monday, 10/30/2023	Reconnaissance report submitted to DRMP and CVRWQCB. Equipment/materials preparation	**--**	--	--
Wednesday, 11/1/2023	Equipment/materials preparation	**--**	**Sample Collection**	**Sample Collection**
Thursday, 11/2/2023	Post-calibration and equipment cleaning.	Sample Shipment	Sample Shipment	Sample Shipment
Friday, 11/3/2023	Field data entry	--	--	--

EVENT COMMENTS

Sampling Event 2 for CEC monitoring was scheduled to occur from October 30th through November 1st. Per the CEC QAPP v3.3, monitoring was planned to occur over three days as follows:

- Monday: urban runoff sample collection, gradient area site reconnaissance;
- Tuesday: gradient sample plan submission and equipment preparation;
- Wednesday: gradient sampling for POTW 1 and POTW 2 study areas.

All activities were completed as planned for Event 2. MLJ field crews successfully collected the urban runoff samples and completed gradient field reconnaissance on Monday, October 30th. MLJ staff developed a gradient Sample Plan based on the observed conditions, which was submitted to the Delta RMP Program Manager and CVRWQCB QA Representative on the evening of Monday, October 30th. The Event 2 Sample Plan is provided in **Attachment 1. Sample Plan**.

Sampling for the POTW 1 and 2 study areas were completed as scheduled on November 1, 2023. For the POTW 1 study area, sampling crews observed that the wet well area at the structure upstream of the R5 site from which pumping was occurring prior to Event 1 was completely dry, indicating no pumping occurred during Event 2. Likewise, for the POTW 2 area sampling crews noted that discharge into Old Alamo Creek was not occurring from adjacent irrigation canals at the R2 location as the adjacent channels were dry.

Though all antecedent precipitation requirements were met for each study area there was a minor storm that occurred in the region the Saturday prior to sampling (see **Sampling Conditions**). In general, discharge measurements were slightly higher at the POTW 1 sites for Event 2 compared to Event 1, which may have been influenced by this antecedent storm. In contrast, measured and observed flows in the POTW 2 study area were generally lower during Event 2. Discharge measurements for Event 2 are provided in **Field Result Data**. No other anomalies of note occurred during Event 2 sampling. Field sheets for the samples collected during Event 2 are provided in **Attachment 2. Fieldsheets**.

SAMPLING SITES

The sample sites for Event 2 are provided in **Table 2**. Urban runoff locations were collected according to the schedule required by the CEC QAPP v3.3. The POTW 1 and 2 gradient study area locations were scheduled according to the site reconnaissance conducted on October 30, 2023 and outlined in the Sample Plan submitted the Delta RMP Program Manager and the Central Valley Regional Water Quality Control Board (CVRWQCB) QA Representative on October 30,2023.

Table 2. Locations at which monitoring was conducted for CEC Event 2.
An "X" indicates a scheduled measurement or sample that was successfully collected. A "--" indicates not collected. Discharge is not required at the urban runoff sites and POTW 1; turbidity is not required at urban runoff locations.

Area	Type	Staton Code	Sample Date	Time	Collected					
					Field	Discharge	Turbidity	SSC	PPCPs	PFAS
Urban	MS4	519SACUR3	10/30/2023	0850	X	--	--	X	X	X
Urban	MS4	519PGC010	10/30/2023	1010	X	--	--	X	X	X
POTW1	R0	519DRYCRK	11/1/2023	0850	X	X	X	X	X	X
POTW1	EFF	519POTW01	11/1/2023	0920	X	--	X	X	X	X
POTW1	R1	519DRYCRB	11/1/2023	1130	X	X	X	X	X	X
POTW1	R2	519DRYWAB	11/1/2023	1230	X	X	X	X	X	X
POTW1	R3	519DRYRLB	11/1/2023	1330	X	X	X	X	X	X
POTW1	R5	519SHCDDC	11/1/2023	1440	X	X	X	X	X	X
POTW1	R7	519SHCDRC	11/1/2023	1530	X	X	X	X	X	X
POTW2	EFF	511POTW02	11/1/2023	0910	X	X	X	X	X	X
POTW2	R1	511OACCLN	11/1/2023	1020	X	X	X	X	X	X
POTW2	R2	511OACSBL	11/1/2023	1140	X	X	X	X	X	X
POTW2	R3	5110ACUNA	11/1/2023	1240	X	X	X	X	X	X
POTW2	R4	511NACUOA	11/1/2023	1350	X	X	X	X	X	X
POTW2	R5	511NACDOA	11/1/2023	1430	X	X	X	X	X	X
POTW2	R6	511NACARD	11/1/2023	1600	X	X	X	X	X	X

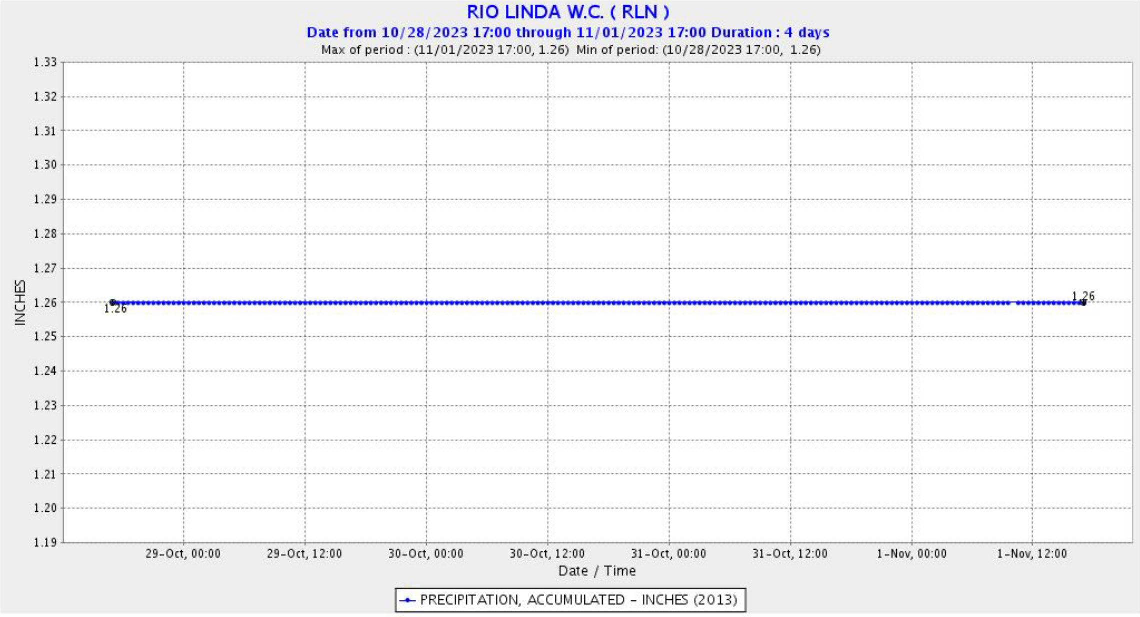
SAMPLING CONDITIONS

Gradient study area monitoring was targeted for dates with antecedent dry conditions (i.e., rainfall ≤ 0.1 inches) of at least 72 hours (CEC QAPP v3.3). No prior rainfall was recorded at either gradient study area prior to sample collection on November 1, 2023.

POTW 1 STUDY AREA PRECIPITATION DATA

Antecedent precipitation information for the POTW 1 study area is provided in **Figure 1.** The POTW 1 precipitation data is obtained from DWR CDEC precipitation gauge RLN.

Figure 1. POTW 1 accumulated precipitation data from station RLN prior to 11/1/2023.



POTW SOURCE 2 PRECIPITATION DATA

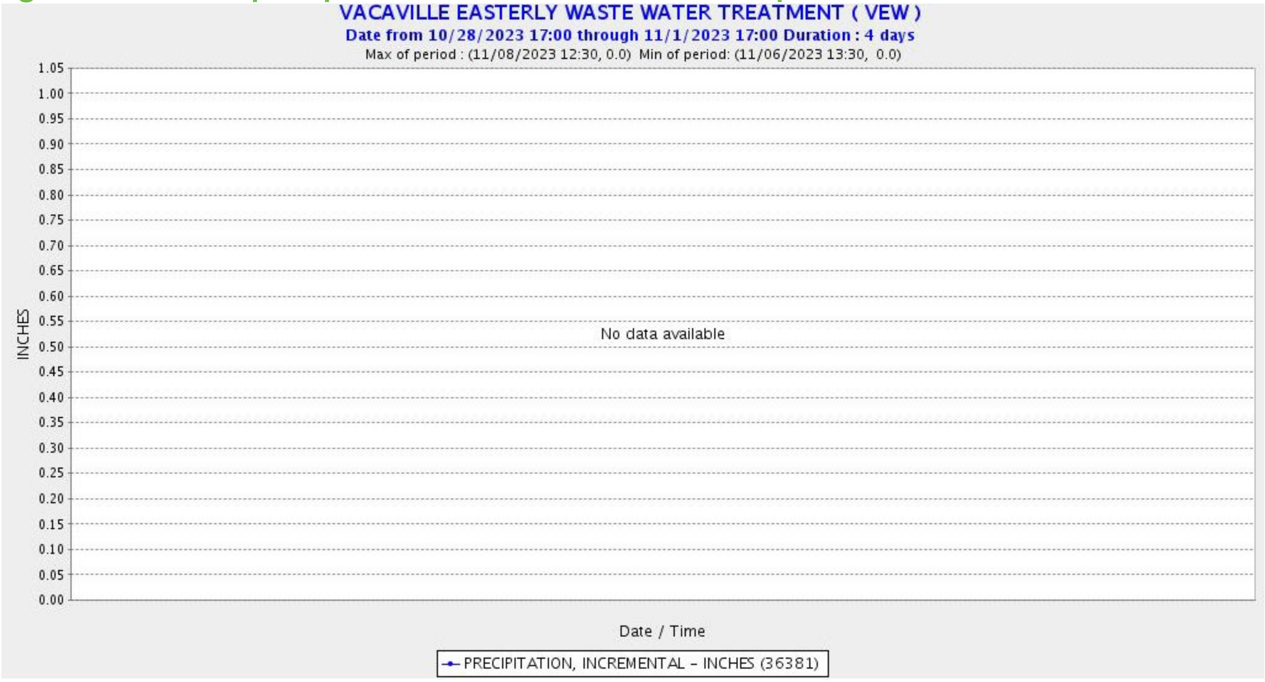
Antecedent precipitation information for the POTW 2 study area is provided in **Table 3**. The preferred source for POTW 2 precipitation data is DWR CDEC precipitation gauge VEW; however, no records are available for this gauge during the required time period (**Figure 2**). Instead, POTW 2 precipitation data was obtained from the gauges located at Travis Air Force Base, located approximately five miles from the study area.

Table 3. POTW 2 precipitation data from Travis Air Force Base prior to 11/1/2023.

Date	Precipitation Station ID	Precipitation in inches (24 -our total)
10/29/2023	KCATRAVI7 (Travis AFB)	0.00

Date	Precipitation Station ID	Precipitation in inches (24 -our total)
10/30/2023	KCATRAVI7 (Travis AFB)	0.00
10/31/2023	KCATRAVI7 (Travis AFB)	0.00
11/1/2023	KCATRAVI7 (Travis AFB)	0.00

Figure 2. POTW 2 precipitation data from station VEW prior to 11/1/2023.



QUALITY ASSURANCE

QUALITY CONTROL SAMPLES

Quality control (QC) samples were collected as outlined in **Table 4**. All scheduled QC samples were successfully collected as required by the CEC QAPP v3.3.

Table 4. Quality control sample summary.

QC Sample Location	Sample Date	QC Type	Analytes	Scheduled/ Alternate
POTW 2, R4: 511NACDOA	11/1/2023	Equipment Blank – Conbar Dipper	SSC, PPCPs, Turbidity, PFAS	Scheduled
POTW 1, EFF: 519POTW01	11/1/2023	Equipment Blank - Bailer	SSC, PPCPs, Turbidity, PFAS	Scheduled
POTW 2, R1: 511OACCLN	11/1/2023	Field Blank, Field Duplicate	SSC, PPCPs, Turbidity, PFAS	Scheduled

DEVIATIONS

Per the requirements of the CEC QAPP v3.3, any deviations from the requirements outlined in that document must be approved by the CVRWQCB QA Representative prior to implementation and documented in a Delta RMP QAPP Deviation Form. No deviations were identified during Event 2 sample collection or field data processing.

URBAN RUNOFF SITE COLLECTION

MS4 SITE 1: 519SACUR3

Station Type:	MS4
Station Code:	519SACUR3
Station Name:	Sacramento Urban Runoff 3; Sump 111
Target Coordinates:	38.60127, -121.49296
Recorded Coordinates:	38.60134, -121.49308
Distance from Target:	13m

Site Photos

Sump Interior

Sump Exterior

Sample Collection

Sample Date:	10/30/2023
Sample Time:	08:50
Observed Flow:	No Observed Flow
Sample Type:	Grab
Collection Method:	Bailer
Discharge Method:	Not Applicable
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

MS4 SITE 2: 519PGC010

Station Type:	MS4
Station Code:	519PGC010
Station Name:	Roseville Urban Runoff
Target Coordinates:	38.80477, -121.32733
Recorded Coordinates:	38.80475, -121.32734
Distance from Target:	2m

Site Photos


Sample Location


Downstream

Sample Collection

Sample Date:	10/30/2023
Sample Time:	10:10
Observed Flow:	No Observed Flow
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Not Applicable
QC Site:	No

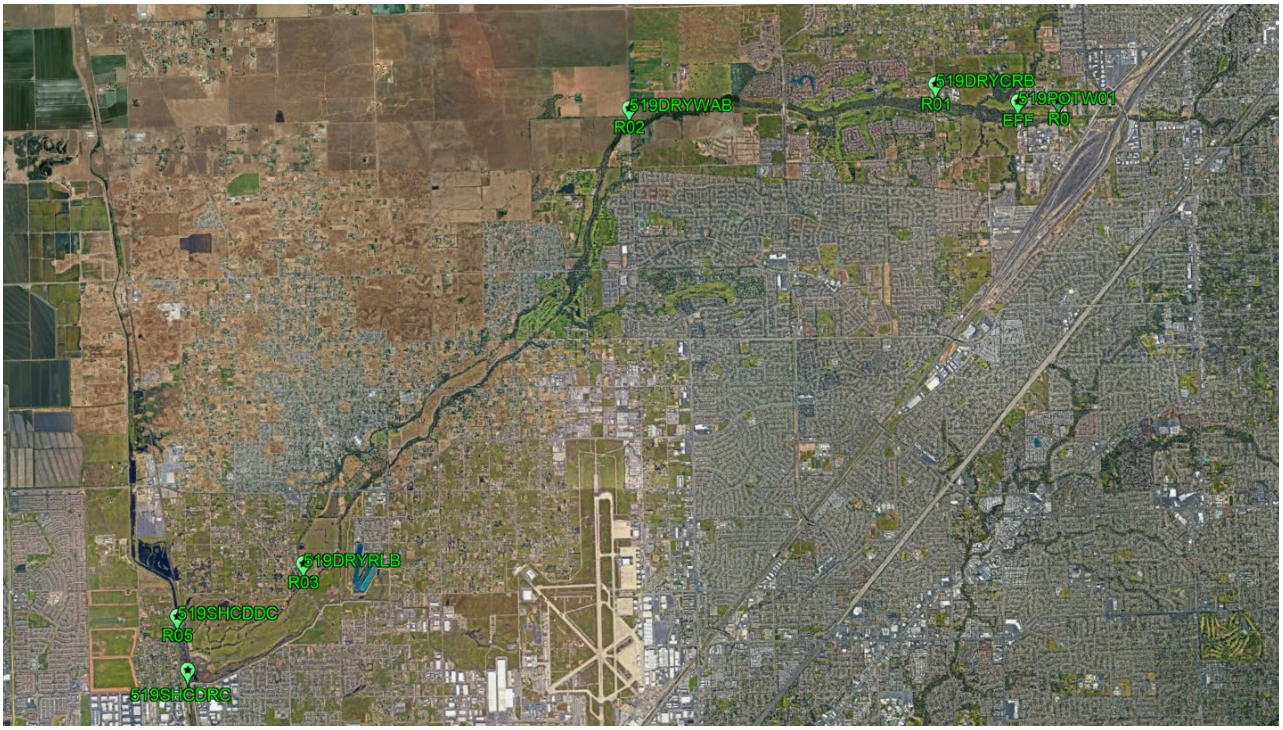
☒ Samples collected without issues with no additional information.

Site Comments: None

POTW 1 GRADIENT AREA COLLECTION

Field crews collected samples from seven POTW 1 gradient study area locations on November 1, 2023, as shown in **Figure 3**.

Figure 3. Recorded POTW 1 and urban runoff locations sampled 10/16/2023-10/19/2023.



SITE 1: 519DRYCRK

Station Type:	R0
Station Code:	519DRYCRK
Station Name:	Dry Creek before POTW Source 1
Target Coordinates:	38.7341, -121.31444
Recorded Coordinates:	38.73401, -121.31449
Distance from Target:	11m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	08:50
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 2: 519POTW01

Station Type:	EFF
Station Code:	519POTW01
Station Name:	POTW Source 1 effluent discharge to Dry Creek
Target Coordinates:	38.73402, -121.32185
Recorded Coordinates:	38.73404, -121.32188
Distance from Target:	3m

Site Photos

Effluent Discharge

Sampling Port

Sample Collection

Sample Date:	11/1/2023
Sample Time:	09:20
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	Bailer
Discharge Method:	Not Applicable
QC Site:	Equipment Blank - Bailer

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 3: 519DRYCRB

Station Type:	R1
Station Code:	519DRYCRB
Station Name:	Dry Creek at Cook Riolo Rd bridge
Target Coordinates:	38.73672, -121.33670
Recorded Coordinates:	38.73688, -121.33682
Distance from Target:	21m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	11:30
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 4: 519DRYWAB

Station Type:	R2
Station Code:	519DRYWAB
Station Name:	Dry Creek at Watt Ave bridge
Target Coordinates:	38.73456, -121.39290
Recorded Coordinates:	38.73455, -121.39294
Distance from Target:	4m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	12:30
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 5: 519DRYRLB

Station Type:	R3
Station Code:	519DRYRLB
Station Name:	Terminus of Dry Creek at Rio Linda Blvd
Target Coordinates:	38.67109, -121.45415
Recorded Coordinates:	38.67105, -121.45419
Distance from Target:	6m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	13:30
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 6: 519SHCDDC

Station Type:	R5
Station Code:	519SHCDDC
Station Name:	Steelhead Creek main stem Downstream of confluence with Dry Creek
Target Coordinates:	38.66407, -121.47720
Recorded Coordinates:	38.66405, -121.47723
Distance from Target:	3m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	14:40
Observed Flow:	0.1-1cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 7: 519SHCDRC

Station Type:	R7
Station Code:	519SHCDRC
Station Name:	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence
Target Coordinates:	38.65650, -121.475453
Recorded Coordinates:	38.65646, -121.47552
Distance from Target:	7m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	15:30
Observed Flow:	0.1-1cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

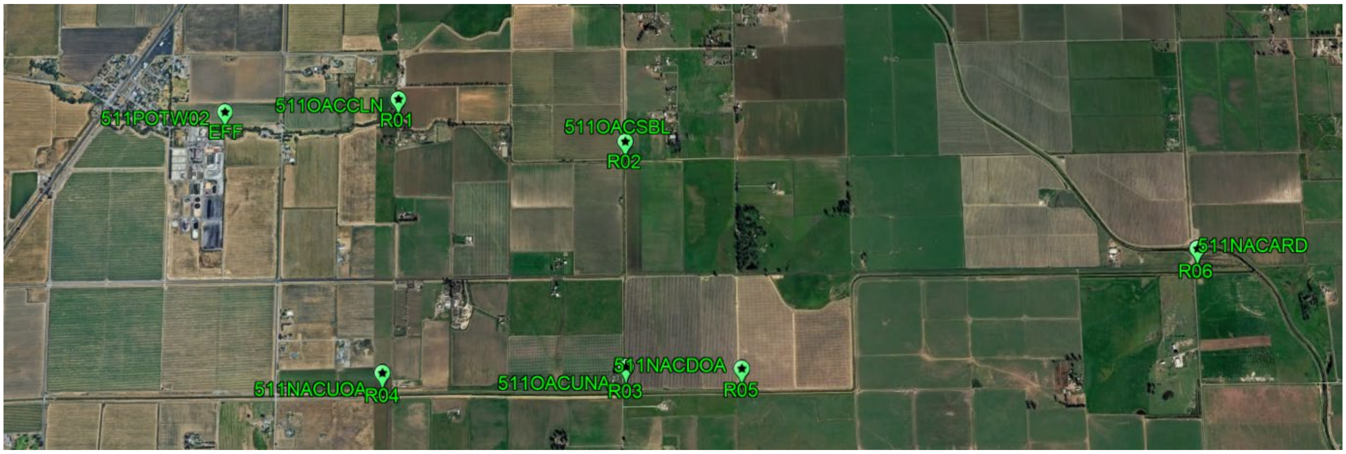
☒ Samples collected without issues with no additional information.

Site Comments: None

POTW 2 GRADIENT AREA COLLECTION

Field crews collected samples from seven POTW 2 gradient study area locations as shown in **Figure 4**.

Figure 4. Recorded POTW 2 locations sampled 11/1/2023.



SITE 1: 511POTW02

Station Type:	EFF
Station Code:	511POTW02
Station Name:	POTW Source 2 effluent discharge to Old Alamo Creek
Target Coordinates:	38.34664, -121.90156
Recorded Coordinates:	38.346551, -121.901645
Distance from Target:	9m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	09:10
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 2: 511OACCLN

Station Type:	R1
Station Code:	511OACCLN
Station Name:	Old Alamo Creek at Chicorp Ln.
Target Coordinates:	38.347147, -121.887617
Recorded Coordinates:	38.347146, -121.88748
Distance from Target:	12m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	10:20
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	Yes – Field duplicates and Field blanks.

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 3: 511OACSBL

Station Type:	R2
Station Code:	511OACSBL
Station Name:	Old Alamo Creek at Sunnybrook Ln.
Target Coordinates:	38.344197, -121.869089
Recorded Coordinates:	38.34413, -121.868983
Distance from Target:	12m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	11:40
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments:

- Culverts upstream were open but were not discharging water.
- Irrigation ditches adjacent to waterbody were dry. No influence reported from culverts or pipes.

SITE 4: 511OACUNA

Station Type:	R3
Station Code:	511OACUNA
Station Name:	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek
Target Coordinates:	38.329869, -121.869231
Recorded Coordinates:	38.330039, -121.869159
Distance from Target:	20m

Site Photos


Upstream


Downstream (confluence/culvert outlet)

Sample Collection

Sample Date:	11/1/2023
Sample Time:	12:40
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SITE 5: 511NACUOA

Station Type:	R4
Station Code:	511NACUOA
Station Name:	New Alamo Creek upstream of confluence with Old Alamo Creek
Target Coordinates:	38.329939, -121.888569
Recorded Coordinates:	38.329987, -121.888532
Distance from Target:	6m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	13:50
Observed Flow:	1-5cfs
Sample Type:	Grab
Collection Method:	By hand
Discharge Method:	Wading/cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: Low flow upstream of grade control structure. Downstream below grade control flow was stronger.

SITE 6: 511NACDOA

Station Type:	R5
Station Code:	511NACDOA
Station Name:	New Alamo Creek downstream of confluence between New and Old Alamo Creeks
Target Coordinates:	38.329789, -121.860019
Recorded Coordinates:	38.329785, -121.859936
Distance from Target:	7m

Site Photos

Upstream

Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	14:30
Observed Flow:	20-50cfs
Sample Type:	Grab
Collection Method:	Conbar dipper
Discharge Method:	Float method
QC Site:	Equipment Blank – Conbar Dipper

☒ Samples collected without issues with no additional information.

Site Comments: Unable to collect composite sample due to field crew safety. Water depth and flow unsafe for wading.

SITE 7: 511NACARD

Station Type:	R6
Station Code:	511NACARD
Station Name:	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek
Target Coordinates:	38.336511, -121.823136
Recorded Coordinates:	38.336579, -121.822949
Distance from Target:	18m

Site Photos


Upstream


Downstream

Sample Collection

Sample Date:	11/1/2023
Sample Time:	16:00
Observed Flow:	5-20cfs
Sample Type:	Grab
Collection Method:	By Hand
Discharge Method:	Wading/Cross section
QC Site:	No

☒ Samples collected without issues with no additional information.

Site Comments: None

SAMPLE SHIPMENT INFORMATION

All samples were successfully delivered to the laboratories within the required time limits. Sample transfer delivery information is provided in **Table 4**. Samples were transported to MLJ offices and to laboratories in coolers with double bagged wet ice. Samples held in MLJ custody for an extended period of time were maintained within the required temperature ranges in a secured refrigerator until time of shipping.

Table 5. Sample transfer and delivery information.

Date/Time Samples Shipped	Laboratory	Shipping Company	Comments
11/2/23 – 11:30	Weck and Physis	FedEX	Samples collected on 10/30 and 11/1.
11/2/23 – 15:30	Enthalpy (Vista)	Direct delivery to lab by MLJ staff	PFAS samples from 10/30 and 11/1, delivered directly to Enthalpy (Vista)

FIELD RESULT DATA

Table 6. Field result data.

Station Code	Sample Date	Collection Time	Discharge (cfs)	DO (mg/L)	DO (%)	pH	SC (uS/cm)	Water Temperature (Deg C)
519SACUR3	10/30/2023	8:50	0	1.37	13.6	6.77	178.2	15.2
519PGC010	10/30/2023	10:10	0	2.02	21.4	6.74	136.7	16.5
511POTW02	11/1/2023	9:10	11.85	5.62	57.7	7.24	807	23.5
511OACCLN	11/1/2023	10:20	12.20	5.33	52.7	7.43	812	21.7
511OACSBL	11/1/2023	11:40	7.12	5.32	57.9	7.63	813	19.4
511OACUNA	11/1/2023	12:40	7.57	7.19	77.1	7.74	805	18.7
511NACUOA	11/1/2023	13:50	0.69	11.63	108.9	7.89	731	12.4
511NACDOA	11/1/2023	14:30	32.90	9.03	98.21	8.06	821	19.4
511NACARD	11/1/2023	16:00	9.68	8.98	97.86	8.04	864	19.5
519DRYCRK	11/1/2023	8:50	11.41	10.53	93.9	7.36	141.0	10.3
519POTW01	11/1/2023	9:20	--	7.45	86.1	7.43	456.6	22.6
519DRYCRB	11/1/2023	11:30	32.47	9.33	91.6	7.51	281.7	14.9
519DRYWAB	11/1/2023	12:30	22.47	9.36	91.5	7.73	309.5	14.8
519DRYRLB	11/1/2023	13:30	21.23	9.11	90.2	7.83	314.2	14.1
519SHCDDC	11/1/2023	14:40	10.80	9.36	90.9	7.69	306.3	14.0
519SHCDRC	11/1/2023	15:30	9.87	8.04	77.1	7.43	292.1	13.1

ATTACHMENT 1. SAMPLE PLAN

CEC Gradient Sample Plan

Year 3 Sampling Event: Event 2
Site Reconnaissance Date: October 30, 2023
Gradient Sample Date: November 1, 2023

MLJ field crews conducted site reconnaissance on Monday, October 30. The anticipated site locations for the gradient sampling event planned for Wednesday, November 1 are provided below (**Table 1** and **Table 2**) for approval by the Delta RMP Program Manager and Central Valley Regional Water Quality Control Board QA Representative.

POTW 1 GRADIENT STUDY AREA

Staff: Matt Bundock
Reconnaissance Time: 09:00 – 15:30

Reconnaissance Summary:

Sample conditions and site accessibility were generally as expected based on previous scouting and Event 1 sample collection. Unhoused presence increased near the downstream R7, R8, R9, and R10 sites since last sample event. Police patrolling the area spoke with the field crew regarding reported aggression at R10 location.

The flow control structure at R4 was closed, indicating no upstream sample should be collected from Steelhead Creek. The wet well/sump upstream of the flow control structure at R4 is dry; based on correspondence with Sacramento County, this indicates no pumping will occur into Dry Creek. Pumping will only occur if water trickles into wet well, but water levels are 1' below the concrete sump barrier, indicating overflow is unlikely.

Table 1. POTW 1 planned gradient sample locations.

Site Order	Station Type	Station Name	Station Code	Reconnaissance Site Condition Comments
1	R0	Dry Creek before POTW Source 1	519DRYCRK	None
2	EFF	POTW Source 1 effluent discharge to Dry Creek	519POTW01	None
3	R1	Dry Creek at Cook Riolo Rd bridge	519DRYCRB	None
4	R2	Dry Creek at Watt Ave bridge	519DRYWAB	None

Site Order	Station Type	Station Name	Station Code	Reconnaissance Site Condition Comments
5	R3	Terminus of Dry Creek at Rio Linda Blvd	519DRYRLB	Trash removed from waterbody and banks, accumulated since Event 1.
6	R5	Steelhead Creek main stem Downstream of confluence with Dry Creek	519SHCDDC	No pumping occurring from R4 location into Dry Creek. Wet well dry at R4 and gate closed upstream.
7	R7	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	519SHCDRC	Robla creek stagnant. Multiple areas upstream and downstream scouted to confirm no flow. Grab sample anticipated.

POTW 2 GRADIENT STUDY AREA

Staff: Isabell D'Este
Reconnaissance Time: 09:00 – 13:00

Reconnaissance Summary:

Sample conditions and site accessibility were generally as expected based on previous collection for Event 1, though downstream water levels were lower at some sites. The R0 site was not contiguous and is not planned for sample collection. Sites R5 and R6 were significantly lower and may be wadeable if conditions are the same during collection. Sites R7 and R8 were still deep with swift currents and therefore unwedable. No agricultural discharge into the waterbody was observed at R2, as adjacent irrigation ditches were dry.

Table 2. POTW 2 planned gradient sample locations.

Site Order	Station Type	Station Name	Station Code	Reconnaissance Site Condition Comments
1	EFF	POTW Source 2 effluent discharge to Old Alamo Creek	511POTW02	None
2	R1	Old Alamo Creek at Chicorp Ln.	511OACCLN	None
3	R2	Old Alamo Creek at Sunnybrook Ln.	511OACSBL	Irrigation channels are dry and not discharging into waterbody.

Site Order	Station Type	Station Name	Station Code	Reconnaissance Site Condition Comments
4	R3	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	511OACUNA	Water flowing into culvert at confluence.
5	R4	New Alamo Creek upstream of confluence with Old Alamo Creek	511NACUOA	None
6	R5	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	511NACDOA	Water level significantly lower; Composite sample anticipated if wadeable.
7	R6	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	511NACARD	Water level significantly lower.

POTW 1 Reconnaissance Photos – 10/30/2023

Effluent: Planned for Sample Collection

Figure 1. POTW 1 effluent site.

R0: Planned for Sample Collection

Figure 2. POTW 1: R0 site, facing upstream.

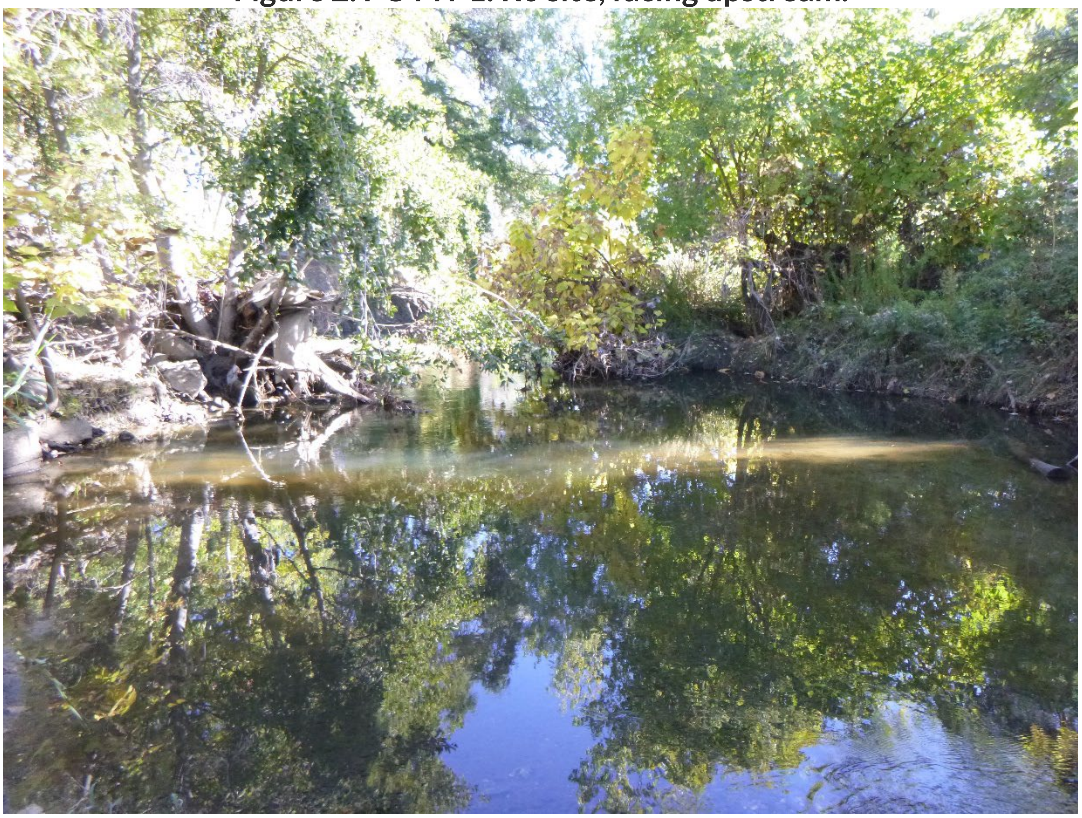


Figure 3. POTW 1: R0 site, facing downstream.

R1: Planned for Sample Collection

Figure 4. POTW 1: R1 site, facing upstream.

Figure 5. POTW 1: R1 site, facing downstream.

R2: Planned for Sample Collection

Figure 6. POTW 1: R2 site, facing upstream.

Figure 7. POTW1: R2 site, facing downstream.

R3: Planned for Sample Collection

Figure 8. POTW 1: R3, facing upstream.

Figure 9. POTW 1: R3, facing downstream.

R4: Not Planned for Sample Collection

Figure 10. POTW 1: R4, facing upstream.

Figure 11. POTW 1: R4, facing downstream.

Figure 12. POTW 1: R4, dry sump area.

R5: Planned for Sample Collection

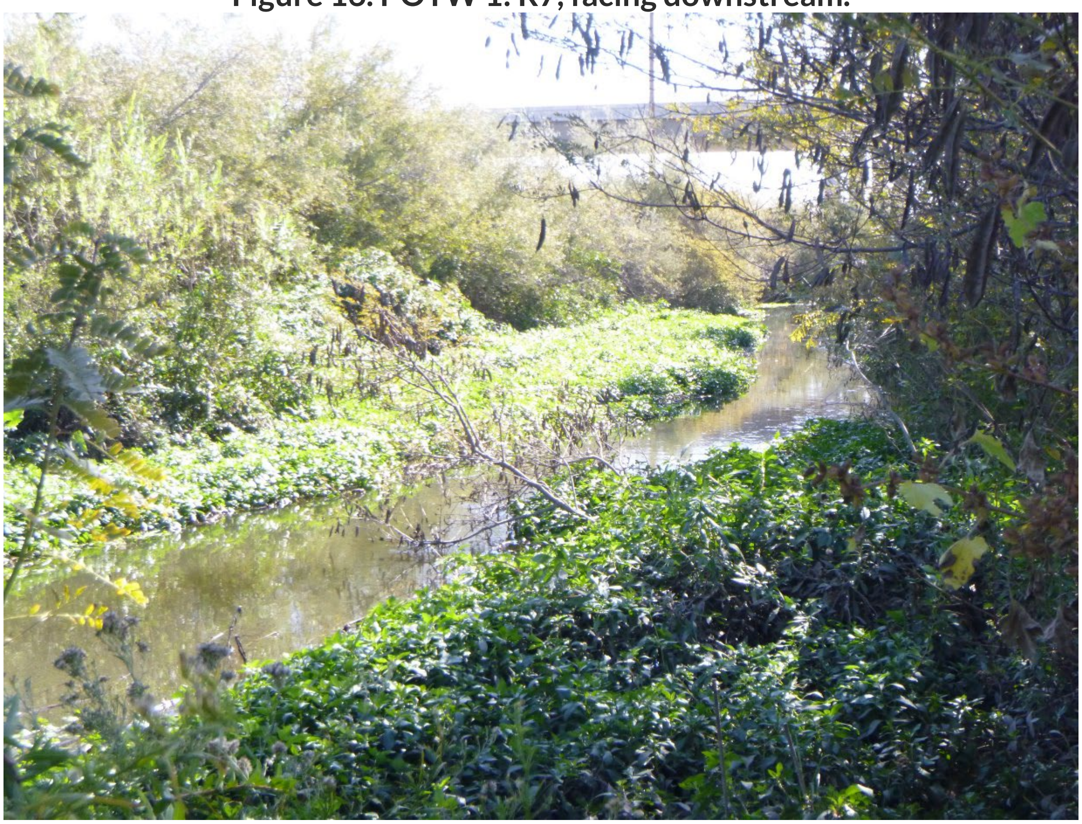
Figure 13. POTW 1: R5, facing upstream.

Figure 14. POTW 1: R5, facing downstream.

R7: Planned for Sample Collection

Figure 15. POTW 1: R7, facing upstream.

Figure 16. POTW 1: R7, facing downstream.



R8: Not Planned for Sample Collection

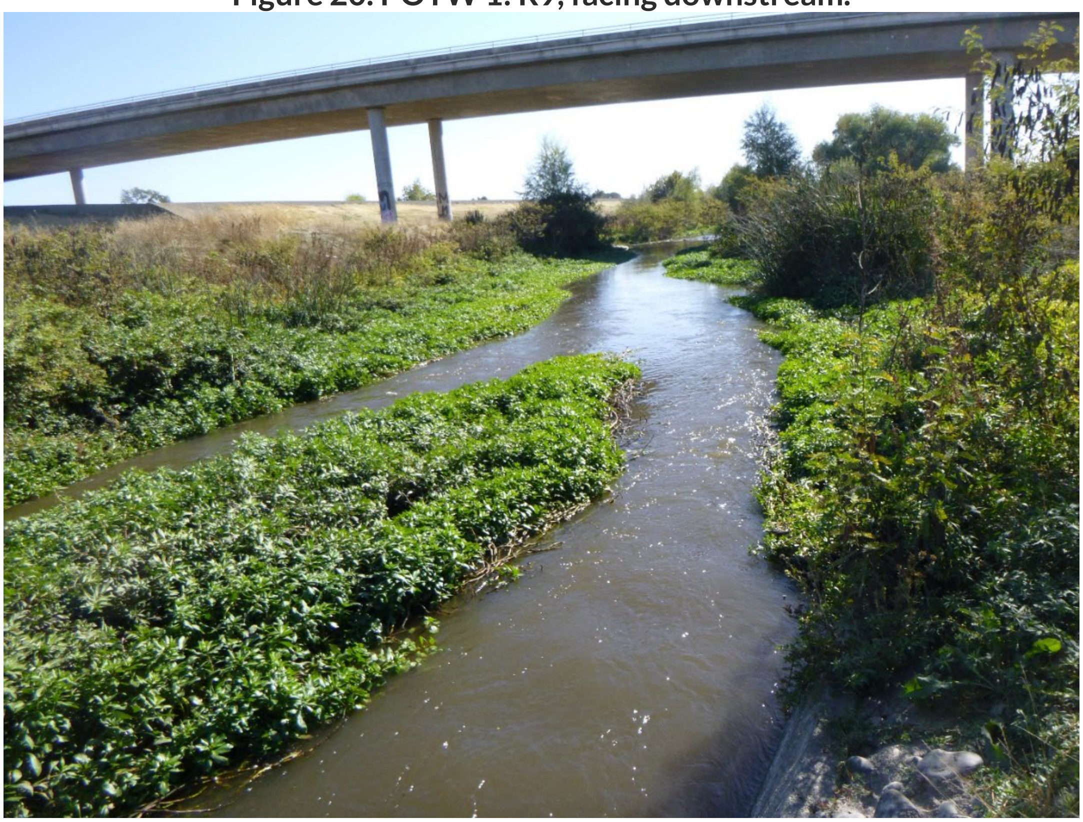
Figure 17. POTW 1: R8, facing upstream.

Figure 18. POTW 1: R8, facing downstream.

R9: Not Planned for Sample Collection

Figure 19. POTW 1: R9, facing upstream.

Figure 20. POTW 1: R9, facing downstream.



R10: Not Planned for Sample Collection

Figure 21. POTW 1: R10, facing upstream.

Figure 22. POTW 1: R10, facing downstream.

POTW 2 Reconnaissance Photos – 10/30/23

Effluent: Planned for Sample Collection

Figure 23. POTW 2 effluent site.

R0: Not Planned for Sample Collection

Figure 24. POTW 2: R0 site, facing upstream.

Figure 25. POTW 2: R0 site, facing downstream.

R1: Planned for Sample Collection

Figure 26. POTW 2: R1 site, facing upstream.

Figure 27. POTW 2: R1 site, facing downstream.

R2: Planned for Sample Collection

Figure 28. POTW 2: R2 site, facing upstream.

Figure 29. POTW2: R2 site, facing downstream.

R3: Planned for Sample Collection

Figure 30. POTW 2: R3, facing upstream.

Figure 31. POTW 2: R3 , facing downstream.

R4: Planned for Sample Collection

Figure 32. POTW 2: R4, facing upstream.

Figure 33. POTW 2: R4, facing downstream.

R5: Planned for Sample Collection

Figure 34. POTW 2: R5, facing upstream.

Figure 35. POTW 2: R5, facing downstream.

R6: Planned for Sample Collection

Figure 36. POTW 2: R6, facing upstream.

Figure 37. POTW 2: R6, facing downstream.

R7: Not Planned for Sample Collection

Figure 38. POTW 2: R7, facing upstream.

Figure 39. POTW 2: R7, facing downstream.

R8: Not Planned for Sample Collection

Figure 40. POTW 1: R8, facing upstream.

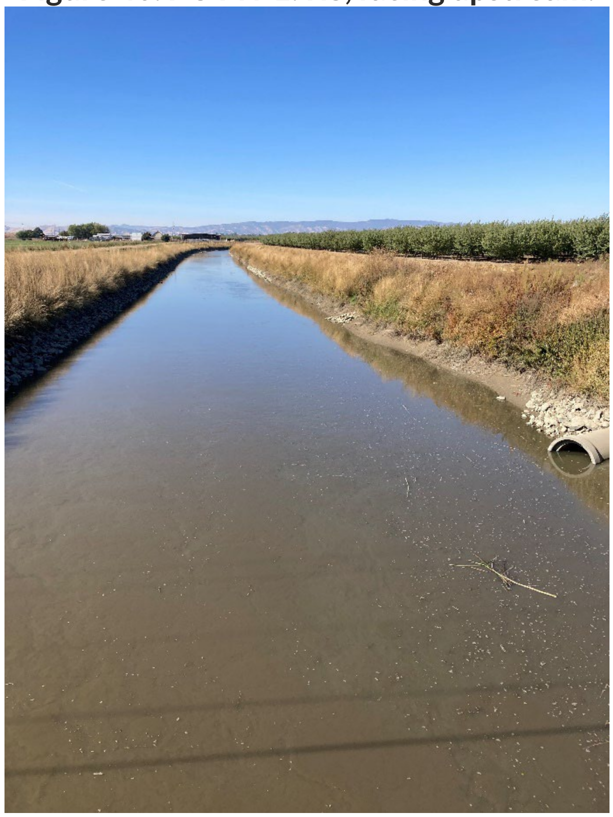


Figure 41. POTW 1: R8, facing downstream.

R9: Not Planned for Sample Collection

Figure 42. POTW 1: R9, facing upstream.

Figure 43. POTW 1: R9, facing downstream.

Velocity Measurements Taken at Gradient Study Area Locations

Table A.1. Watercourse width, interval midpoint depth, velocity, and total discharge for each station sampled during CEC Year 3 monitoring.

For depth and velocity, values are means (± 1.0 standard deviations) across n=5 interval measurements.

Event	CEDEN Station Code	CEDEN Station Name	Station Location	Width (m)	Mean Depth (ft)	Mean Velocity (m/s)	Total Discharge (m^3/s)
1	519SACUR3	Sacramento Urban Runoff 3; Sump 111	MSR4 - Runoff	--	--	--	--
1	519PGC010	Roseville Urban Runoff	MSR4 - Runoff	--	--	--	--
1	519DRYCRK	Dry Creek at Roseville WWTP	R0 - Gradient Study Area 1	7.5	1.06 (0.17)	0.12 (0.05)	0.25
1	519POTW01	POTW Source 1	Effluent	--	--	--	--
1	519DRYCRB	Dry Creek at Cook Riolo Rd bridge	R1 - Gradient Study Area 1	6.4	1.04 (0.46)	0.36 (0.11)	0.61
1	519DRYWAB	Dry Creek at Watt Ave bridge	R2 - Gradient Study Area 1	9.7	1.36 (0.21)	0.14 (0.02)	0.41
1	519DRYRLB	Terminus of Dry Creek at Rio Linda Blvd	R3 - Gradient Study Area 1	4.5	1.26 (0.24)	0.36 (0.05)	0.51
1	519SHCDDC	Steelhead Creek main stem downstream of confluence with Dry Creek	R5 - Gradient Study Area 1	0.8	3.0 (0.07)	0.23 (0.03)	0.14
1	519SHCDRC	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	R7 - Gradient Study Area 1	1.5	2.52 (0.11)	0.30 (0.02)	0.29
1	511POTW02	POTW Source 2	Effluent	4.6	2.18 (0.22)	0.16 (0.17)	0.42
1	511OACCLN	Old Alamo Creek at Chicorp Ln.	R1 - Gradient Study Area 2	4.7	1.16 (0.23)	0.29 (0.04)	0.40
1	511OACSBL	Old Alamo Creek at Sunnybrook Ln.	R2 - Gradient Study Area 2	4.2	1.88 (0.50)	0.30 (0.13)	0.65

Event	CEDEN Station Code	CEDEN Station Name	Station Location	Width (m)	Mean Depth (ft)	Mean Velocity (m/s)	Total Discharge (m^3/s)
1	5110ACUNA	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	R3 - Gradient Study Area 2	2.0	1.66 (0.11)	0.74 (0.25)	0.62
1	511NACUOA	New Alamo Creek upstream of confluence with Old Alamo Creek	R4 - Gradient Study Area 2	9.9	1.86 (0.23)	0.013 (0.01)	0.04
1	511NACDOA	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	R5 - Gradient Study Area 2	15.0	4.5 (Float)	0.46 (Float)	7.51
1	511NACARD	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	R6 - Gradient Study Area 2	15.0	4.5 (Float)	0.093 (Float)	1.62
2	519SACUR3	Sacramento Urban Runoff 3; Sump 111	MSR - Runoff	--	--	--	--
2	519PGC010	Roseville Urban Runoff	MSR - Runoff	--	--	--	--
2	519DRYCRK	Dry Creek at Roseville WWTP	R0 - Gradient Study Area 1	7.5	0.98 (0.24)	0.17 (0.03)	0.32
2	519POTW01	POTW Source 1	Effluent	--	--	--	--
2	519DRYCRB	Dry Creek at Cook Riolo Rd bridge	R1 - Gradient Study Area 1	6.8	1.24 (0.26)	0.44 (0.14)	0.92
2	519DRYWAB	Dry Creek at Watt Ave bridge	R2 - Gradient Study Area 1	10.1	1.18 (0.25)	0.21 (0.06)	0.64
2	519DRYRLB	Terminus of Dry Creek at Rio Linda Blvd	R3 - Gradient Study Area 1	5.5	1.5 (0.40)	0.29 (0.04)	0.60
2	519SHCDDC	Steelhead Creek main stem downstream of confluence with Dry Creek	R5 - Gradient Study Area 1	1.5	3.0 (0.0)	0.27 (0.06)	0.31
2	519SHCDRC	Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	R7 - Gradient Study Area 1	1.40	2.74 (0.05)	0.29 (0.03)	0.28
2	511POTW02	POTW Source 2	Effluent	4.2	2.22 (0.13)	0.14 (0.16)	0.34
2	511OACCLN	Old Alamo Creek at Chicorp Ln.	R1 - Gradient Study Area 2	7.4	1.06 (0.55)	0.17 (0.09)	0.35

EVENT	CEDEN STATION CODE	CEDEN STATION NAME	STATION LOCATION	WIDTH (m)	MEAN DEPTH (ft)	MEAN VELOCITY (m/s)	TOTAL DISCHARGE (m^3/s)
2	511OACSBL	Old Alamo Creek at Sunnybrook Ln.	R2 - Gradient Study Area 2	4.3	2.18 (0.66)	0.07 (0.07)	0.20
2	5110ACUNA	Terminus of Old Alamo Creek upstream of confluence with New Alamo Creek	R3 - Gradient Study Area 2	7.1	1.44 (0.25)	0.08 (0.06)	0.21
2	511NACUOA	New Alamo Creek upstream of confluence with Old Alamo Creek	R4 - Gradient Study Area 2	10.3	0.96 (0.34)	0.01 (0.01)	0.02
2	511NACDOA	New Alamo Creek downstream of confluence between New and Old Alamo Creeks	R5 - Gradient Study Area 2	8	3.2 (Float)	0.15 (Float)	0.99
2	511NACARD	Terminus of New Alamo Creek at Rio Dixon Rd before confluence with Ulatis Creek	R6 - Gradient Study Area 2	8.5	0.58 (0.33)	0.18 (0.09)	0.27

Table A.2. Discharge intervals (n=5 per watercourse width), interval width, interval midpoint depth, interval area, interval velocity, and interval discharge for each station sampled during CEC Year 3 Event 1 & 2 monitoring.

Event	CEDEN Station Code	Station Location	Discharge interval #	Interval midpoint Location (m)	Interval Width (m)	Interval Midpoint Depth (ft)	Interval Area (m^2)	Interval Velocity (m/s)	Interval discharge (m^3/s)
1	519SACUR3	MS4 - Runoff	--	--	--	--	--	--	--
1	519PGC010	MS4 - Runoff	--	--	--	--	--	--	--
1	519DRYCRK	R0 - Gradient Study Area 1	1	1.25	1.25	1.00	0.38	0.11	0.04
1	519DRYCRK	R0 - Gradient Study Area 1	2	2.50	1.25	1.20	0.46	0.07	0.03
1	519DRYCRK	R0 - Gradient Study Area 1	3	3.75	1.25	1.10	0.42	0.18	0.07
1	519DRYCRK	R0 - Gradient Study Area 1	4	5.00	1.25	1.20	0.46	0.17	0.08
1	519DRYCRK	R0 - Gradient Study Area 1	5	6.25	1.25	0.80	0.30	0.07	0.02
1	519POTW01	Effluent	--	--	--	--	--	--	--
1	519DRYCRB	R1 - Gradient Study Area 1	1	1.10	1.10	0.40	0.13	0.27	0.04
1	519DRYCRB	R1 - Gradient Study Area 1	2	2.20	1.10	0.80	0.27	0.47	0.13
1	519DRYCRB	R1 - Gradient Study Area 1	3	3.30	1.10	1.10	0.37	0.45	0.17
1	519DRYCRB	R1 - Gradient Study Area 1	4	4.40	1.10	1.60	0.54	0.36	0.19
1	519DRYCRB	R1 - Gradient Study Area 1	5	5.50	1.00	1.30	0.40	0.23	0.09
1	519DRYWAB	R2 - Gradient Study Area 1	1	1.60	1.25	1.20	0.46	0.11	0.05
1	519DRYWAB	R2 - Gradient Study Area 1	2	2.50	0.90	1.10	0.30	0.15	0.05
1	519DRYWAB	R2 - Gradient Study Area 1	3	3.40	0.90	1.60	0.44	0.15	0.07
1	519DRYWAB	R2 - Gradient Study Area 1	4	4.30	0.90	1.40	0.38	0.11	0.04
1	519DRYWAB	R2 - Gradient Study Area 1	5	5.20	2.70	1.50	1.23	0.16	0.20
1	519DRYRLB	R3 - Gradient Study Area 1	1	0.80	0.80	1.60	0.39	0.29	0.11
1	519DRYRLB	R3 - Gradient Study Area 1	2	1.60	0.75	1.40	0.32	0.39	0.12
1	519DRYRLB	R3 - Gradient Study Area 1	3	2.30	0.75	1.00	0.23	0.40	0.09
1	519DRYRLB	R3 - Gradient Study Area 1	4	3.10	0.75	1.10	0.25	0.38	0.10
1	519DRYRLB	R3 - Gradient Study Area 1	5	3.80	0.70	1.20	0.26	0.34	0.09
1	519SHCDDC	R5 - Gradient Study Area 1	1	0.13	0.13	2.90	0.11	0.20	0.02
1	519SHCDDC	R5 - Gradient Study Area 1	2	0.26	0.13	3.00	0.12	0.22	0.03
1	519SHCDDC	R5 - Gradient Study Area 1	3	0.39	0.13	3.00	0.12	0.23	0.03

Event	CEDEN Station Code	Station Location	Discharge interval #	Interval midpoint Location (m)	Interval Width (m)	Interval Midpoint Depth (ft)	Interval Area (m^2)	Interval Velocity (m/s)	Interval discharge (m^3/s)
1	519SHCDDC	R5 - Gradient Study Area 1	4	0.52	0.13	3.00	0.12	0.27	0.03
1	519SHCDDC	R5 - Gradient Study Area 1	5	0.65	0.14	3.10	0.13	0.24	0.03
1	519SHCDRC	R7 - Gradient Study Area 1	1	0.25	0.25	2.40	0.18	0.29	0.05
1	519SHCDRC	R7 - Gradient Study Area 1	2	0.50	0.25	2.60	0.20	0.28	0.06
1	519SHCDRC	R7 - Gradient Study Area 1	3	0.75	0.25	2.60	0.20	0.32	0.06
1	519SHCDRC	R7 - Gradient Study Area 1	4	1.00	0.25	2.60	0.20	0.28	0.06
1	519SHCDRC	R7 - Gradient Study Area 1	5	1.25	0.25	2.40	0.18	0.30	0.06
1	511POTW02	Effluent	1	0.76	0.76	1.80	0.42	0.05	0.02
1	511POTW02	Effluent	2	1.52	0.76	2.30	0.53	-0.02	-0.01
1	511POTW02	Effluent	3	2.28	0.76	2.30	0.53	0.09	0.05
1	511POTW02	Effluent	4	3.04	0.76	2.20	0.51	0.30	0.15
1	511POTW02	Effluent	5	3.80	0.78	2.30	0.55	0.37	0.21
1	511OACCLN	R1 - Gradient Study Area 2	1	0.76	0.76	1.20	0.28	0.24	0.07
1	511OACCLN	R1 - Gradient Study Area 2	2	1.52	0.76	1.40	0.32	0.31	0.10
1	511OACCLN	R1 - Gradient Study Area 2	3	2.28	0.76	1.30	0.30	0.34	0.10
1	511OACCLN	R1 - Gradient Study Area 2	4	3.04	0.76	1.10	0.25	0.28	0.07
1	511OACCLN	R1 - Gradient Study Area 2	5	3.80	0.83	0.80	0.20	0.27	0.05
1	511OACSBL	R2 - Gradient Study Area 2	1	0.70	0.70	1.00	0.21	0.09	0.02
1	511OACSBL	R2 - Gradient Study Area 2	2	1.40	0.70	2.00	0.43	0.34	0.14
1	511OACSBL	R2 - Gradient Study Area 2	3	2.10	0.70	2.10	0.45	0.39	0.17
1	511OACSBL	R2 - Gradient Study Area 2	4	2.80	0.70	2.10	0.45	0.39	0.17
1	511OACSBL	R2 - Gradient Study Area 2	5	3.50	0.70	2.20	0.47	0.29	0.14
1	5110ACUNA	R3 - Gradient Study Area 2	1	0.33	0.33	1.80	0.18	0.32	0.06
1	5110ACUNA	R3 - Gradient Study Area 2	2	0.66	0.33	1.70	0.17	0.71	0.12
1	5110ACUNA	R3 - Gradient Study Area 2	3	0.99	0.34	1.70	0.17	0.86	0.15
1	5110ACUNA	R3 - Gradient Study Area 2	4	1.33	0.34	1.60	0.16	0.93	0.15
1	5110ACUNA	R3 - Gradient Study Area 2	5	1.66	0.33	1.50	0.15	0.90	0.14
1	511NACUOA	R4 - Gradient Study Area 2	1	1.65	1.65	2.10	1.06	0.01	0.01

Event	CEDEN Station Code	Station Location	Discharge interval #	Interval midpoint Location (m)	Interval Width (m)	Interval Midpoint Depth (ft)	Interval Area (m^2)	Interval Velocity (m/s)	Interval discharge (m^3/s)
1	511NACUOA	R4 - Gradient Study Area 2	2	3.30	1.65	1.90	0.96	0.01	0.01
1	511NACUOA	R4 - Gradient Study Area 2	3	4.95	1.15	1.80	0.63	0.01	0.01
1	511NACUOA	R4 - Gradient Study Area 2	4	5.60	1.15	1.50	0.53	0.04	0.02
1	511NACUOA	R4 - Gradient Study Area 2	5	7.25	2.15	2.00	1.31	0.00	0.00
1	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	0.45	--
1	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	1.02	--
1	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	0.96	--
1	511NACARD	R6 – Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	0.10	--
1	511NACARD	R6 – Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	0.934	--
1	511NACARD	R6 – Gradient Study Area 2	Float	Midchannel	15	4.5	20.6	0.922	--
2	519SACUR3	MS4 - Runoff	--	--	--	--	--	--	--
2	519PGC010	MS4 - Runoff	--	--	--	--	--	--	--
2	519DRYCRK	R0 - Gradient Study Area 1	1	1.25	1.25	0.70	0.27	0.15	0.04
2	519DRYCRK	R0 - Gradient Study Area 1	2	2.50	1.25	1.10	0.42	0.20	0.09
2	519DRYCRK	R0 - Gradient Study Area 1	3	3.75	1.25	0.80	0.30	0.17	0.05
2	519DRYCRK	R0 - Gradient Study Area 1	4	5.00	1.25	1.30	0.50	0.20	0.10
2	519DRYCRK	R0 - Gradient Study Area 1	5	6.25	1.25	1.00	0.38	0.12	0.05
2	519POTW01	Effluent	--	--	--	--	--	--	--
2	519DRYCRB	R1 – Gradient Study Area 1	1	1.13	1.13	0.90	0.31	0.32	0.10
2	519DRYCRB	R1 – Gradient Study Area 1	2	2.26	1.13	1.10	0.38	0.62	0.24
2	519DRYCRB	R1 – Gradient Study Area 1	3	3.39	1.13	1.20	0.41	0.55	0.23
2	519DRYCRB	R1 – Gradient Study Area 1	4	4.52	1.13	1.50	0.52	0.30	0.16
2	519DRYCRB	R1 - Gradient Study Area 1	5	5.65	1.14	1.50	0.52	0.38	0.20
2	519DRYWAB	R2 - Gradient Study Area 1	1	1.68	1.68	1.60	0.82	0.16	0.13
2	519DRYWAB	R2 - Gradient Study Area 1	2	3.36	1.68	1.00	0.51	0.17	0.09
2	519DRYWAB	R2 - Gradient Study Area 1	3	5.04	1.68	1.10	0.56	0.18	0.10
2	519DRYWAB	R2 - Gradient Study Area 1	4	6.72	1.68	1.20	0.61	0.26	0.16

Event	CEDEN Station Code	Station Location	Discharge interval #	Interval midpoint Location (m)	Interval Width (m)	Interval Midpoint Depth (ft)	Interval Area (m^2)	Interval Velocity (m/s)	Interval discharge (m^3/s)
2	519DRYWAB	R2 - Gradient Study Area 1	5	8.40	1.69	1.00	0.52	0.30	0.16
2	519DRYRLB	R3 - Gradient Study Area 1	1	0.92	0.92	1.90	0.53	0.25	0.13
2	519DRYRLB	R3 - Gradient Study Area 1	2	1.84	0.92	1.90	0.53	0.27	0.15
2	519DRYRLB	R3 - Gradient Study Area 1	3	2.76	0.92	1.10	0.31	0.36	0.11
2	519DRYRLB	R3 - Gradient Study Area 1	4	3.68	0.92	1.10	0.31	0.29	0.09
2	519DRYRLB	R3 - Gradient Study Area 1	5	4.60	0.92	1.50	0.42	0.29	0.12
2	519SHCDDC	R5 - Gradient Study Area 1	1	0.25	0.25	3.00	0.23	0.26	0.06
2	519SHCDDC	R5 - Gradient Study Area 1	2	0.50	0.25	3.00	0.23	0.31	0.07
2	519SHCDDC	R5 - Gradient Study Area 1	3	0.75	0.25	3.00	0.23	0.31	0.07
2	519SHCDDC	R5 - Gradient Study Area 1	4	1.00	0.25	3.00	0.23	0.30	0.07
2	519SHCDDC	R5 - Gradient Study Area 1	5	1.25	0.25	3.00	0.23	0.16	0.04
2	519SHCDRC	R7 - Gradient Study Area 1	1	0.23	0.23	2.80	0.20	0.29	0.06
2	519SHCDRC	R7 - Gradient Study Area 1	2	0.46	0.23	2.80	0.20	0.30	0.06
2	519SHCDRC	R7 - Gradient Study Area 1	3	0.69	0.23	2.70	0.19	0.31	0.06
2	519SHCDRC	R7 - Gradient Study Area 1	4	0.92	0.23	2.70	0.19	0.30	0.06
2	519SHCDRC	R7 - Gradient Study Area 1	5	1.15	0.24	2.70	0.20	0.24	0.05
2	511POTW02	Effluent	1	0.70	0.70	2.30	0.49	0.28	0.14
2	511POTW02	Effluent	2	1.40	0.70	2.30	0.49	0.30	0.15
2	511POTW02	Effluent	3	2.10	0.70	2.00	0.43	0.17	0.07
2	511POTW02	Effluent	4	2.80	0.70	2.20	0.47	0.02	0.01
2	511POTW02	Effluent	5	3.50	0.70	2.30	0.49	-0.07	-0.03
2	511OACCLN	R1 - Gradient Study Area 2	1	1.23	1.23	0.80	0.30	0.03	0.01
2	511OACCLN	R1 - Gradient Study Area 2	2	2.46	1.23	1.70	0.64	0.13	0.09
2	511OACCLN	R1 - Gradient Study Area 2	3	3.69	1.23	1.60	0.60	0.27	0.16
2	511OACCLN	R1 - Gradient Study Area 2	4	4.92	1.23	0.70	0.26	0.21	0.06
2	511OACCLN	R1 - Gradient Study Area 2	5	6.15	1.24	0.50	0.19	0.18	0.03
2	511OACSBL	R2 - Gradient Study Area 2	1	0.70	0.70	1.20	0.26	0.01	0.00

Event	CEDEN Station Code	Station Location	Discharge interval #	Interval midpoint Location (m)	Interval Width (m)	Interval Midpoint Depth (ft)	Interval Area (m^2)	Interval Velocity (m/s)	Interval discharge (m^3/s)
2	511OACSBL	R2 - Gradient Study Area 2	2	1.40	0.70	2.00	0.43	0.01	0.00
2	511OACSBL	R2 - Gradient Study Area 2	3	2.10	0.70	2.20	0.47	0.05	0.02
2	511OACSBL	R2 - Gradient Study Area 2	4	2.80	0.70	2.50	0.53	0.16	0.08
2	511OACSBL	R2 - Gradient Study Area 2	5	3.50	0.75	3.00	0.69	0.14	0.09
2	5110ACUNA	R3 - Gradient Study Area 2	1	1.18	1.18	1.50	0.54	0.01	0.00
2	5110ACUNA	R3 - Gradient Study Area 2	2	2.36	1.18	1.00	0.36	0.03	0.01
2	5110ACUNA	R3 - Gradient Study Area 2	3	3.54	1.18	1.60	0.58	0.06	0.04
2	5110ACUNA	R3 - Gradient Study Area 2	4	4.72	1.18	1.60	0.58	0.15	0.09
2	5110ACUNA	R3 - Gradient Study Area 2	5	5.90	1.19	1.50	0.54	0.14	0.08
2	511NACUOA	R4 - Gradient Study Area 2	1	1.70	1.70	1.30	0.67	-0.01	0.00
2	511NACUOA	R4 - Gradient Study Area 2	2	3.40	1.70	1.30	0.67	0.01	0.01
2	511NACUOA	R4 - Gradient Study Area 2	3	5.10	1.70	0.80	0.41	0.02	0.01
2	511NACUOA	R4 - Gradient Study Area 2	4	6.80	1.70	0.90	0.47	0.02	0.01
2	511NACUOA	R4 - Gradient Study Area 2	5	8.50	1.75	0.50	0.27	0.00	0.00
2	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	8	3.2	7.8	0.15	--
2	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	8	3.2	7.8	0.79	--
2	511NACDOA	R5 - Gradient Study Area 2	Float	Midchannel	8	3.2	7.8	1.5	--
2	511NACARD	R6 - Gradient Study Area 2	1	1.40	1.40	0.30	0.13	0.06	0.01
2	511NACARD	R6 - Gradient Study Area 2	2	2.80	1.40	0.70	0.30	0.27	0.08
2	511NACARD	R6 - Gradient Study Area 2	3	4.20	1.40	1.00	0.43	0.27	0.11
2	511NACARD	R6 - Gradient Study Area 2	4	5.60	1.40	0.70	0.30	0.20	0.06
2	511NACARD	R6 - Gradient Study Area 2	5	7.00	1.45	0.20	0.09	0.12	0.01

Appendix B. List of all CEC Analytes Reported for Year 3 Monitoring

Constituents of Emerging Concern Analytes Reported

Table B.1. Year 3 DRMP constituents of emerging concern.

Analyte Category	Analyte	Analyte Alias	Agency	Method	Matrix	Unit
PFAS	Perfluorooctanoic acid	PFOA	Enthalpy	EPA 537M	Water	ng/L
PFAS	Perfluorooctanesulfonic acid	PFOS	Enthalpy	EPA 537M	Water	ng/L
PPCPs-Hormones	Estradiol, 17beta-	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Hormones	Estrone	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Bisphenol A	--	Physis, Weck	EPA 625.1M , EPA 1694M	Water	ng/L
PPCPs-Pharma	Diclofenac	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Ibuprofen	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Triclosan	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Triclocarban	--	Physis	EPA 625.1M_MRM	Water	ng/L
PPCPs-Pharma	Galaxolide	--	Physis	EPA 625.1M	Water	ng/L
PPCPs-Hormones	Ethynylestradiol, 17alpha-	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Hormones	Progesterone	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Hormones	Testosterone	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Gemfibrozil	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Iopromide	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Naproxen	--	Weck	EPA 1694M	Water	ng/L
PPCPs-Pharma	Salicylic Acid	--	Weck	EPA 1694M	Water	ng/L
Physical and Conventional Parameters	Turbidity	--	Physis	EPA 180.1	Water	NTU
Physical and Conventional Parameters	Suspended Sediment Concentration	--	Weck	ASTM D3977	Water	mg/L

Isotope Dilution Analogues and Associated Analytes

Table B.2. Year 3 DRMP constituents of emerging concern Isotope Dilution Analogue quantitation relationships.

ANALYTE CATEGORY	TARGET ANALYTE	QUANTIFIED WITH	QUANT. TYPE	AGENCY	METHOD	MATRIX
PFAS	Perfluorooctanesulfonic acid (PFOS)	Perfluorooctanesulfonic acid-$^{13}C_8$ (IsoDilAnalogue)	Direct Isotope	Enthalpy	EPA 537M	Water
PFAS	Perfluorooctanoic acid (PFOA)	Perfluorooctanoic acid-$^{13}C_2$ (IsoDilAnalogue)	Direct Isotope	Enthalpy	EPA 537M	Water
PPCPs-Hormones	Estradiol, 17beta-	Estradiol-d_3, 17beta- (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Hormones	Estrone	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	Indirect Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Bisphenol A	Bisphenol A-d_{16} (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Diclofenac	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	Indirect Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Ibuprofen	Ibuprofen-d_3 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Triclosan	Triclosan-d_3(IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Hormones	Ethynylestradiol, 17alpha-	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Hormones	Progesterone	Progesterone-d_9 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Hormones	Testosterone	Testosterone-d_3 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Gemfibrozil	Gemfibrozil-d_6 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Iopromide	Salicylic Acid-d_4 (IsoDilAnalogue); Iopromide-d_3 (IsoDilAnalogue)	Indirect Isotope, Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Naproxen	Naproxen-d_3 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water
PPCPs-Pharma	Salicylic Acid	Salicylic Acid-d_4 (IsoDilAnalogue)	Direct Isotope	Weck	EPA 1694M	Water

Appendix C. Summary of Completeness and Quality Control Sample Acceptability for Year 3 CEC Monitoring

The following sections outline the completeness and overall acceptability of each analysis completed for the Delta Regional Monitoring Program (RMP) Constituents of Emerging Concern (CEC) monitoring that occurred during Year 3.

All results for Year 3 CEC Monitoring were reviewed according to the CEC QAPP v3 and the DRMP Data Management Standard Operating Procedures (SOP) and were flagged with California Environmental Data Exchange Network (CEDEN) comparable QA Codes. All codes applied to the Year 3 CEC Monitoring are defined in **Table C.1**.

Table C.1. QA Codes Used in Year 3 CEC Dataset.

QA Code	QA Name
BB	Sample > 4x spike concentration
DB	QA results outside of acceptance limits due to matrix effects
DF	Reporting limits elevated due to matrix interferences
FLV	Velocity too low to be measured
FUD	Unable to deploy instrument
GB	Matrix spike recovery not within control limits
GIDA	Isotope Dilution Analogue recovery not within control limits
H	A holding time violation has occurred.
IDA	Isotope Dilution Analogue corrected
IL	RPD exceeds laboratory control limit
IP	Analyte detected in field or lab generated blank
M	A matrix effect is present
None	None - No QA Qualifier
QAX	When the native sample for the MS/MSD or DUP is not included in the batch reported

Summary of Completeness

Year 3 CEC monitoring samples were collected from ambient and source monitoring sites over two sampling events, per the Central Valley CEC Pilot Study Workplan (see **Sampling Overview**). An evaluation of field, transport, and analytical completeness, along with field quality control sample completeness are provided in tables.

Sample Completeness

Table C.2. Field and transport and analytical completeness for Year 3 CEC Monitoring.

Method	Lab	Matrix	Analyte	Env. Samples Scheduled	Env. Samples Collected	Field and Transport Completeness (%)	Total Samples Analyzed	Analytical Completeness (%)
ASTM D3977	Weck	Water	Suspended Sediment Concentration	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Ethynylestradiol, 17alpha-	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Gemfibrozil	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Iopromide	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Naproxen	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Progesterone	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Salicylic Acid	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Testosterone	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Bisphenol A	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Diclofenac	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Estradiol, 17beta-	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Estrone	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Ibuprofen	32	32	100.0	32	100.0
EPA 1694M	Weck	Water	Triclosan	32	32	100.0	32	100.0
EPA 180.1[1]	Physis	Water	Turbidity	21	21	100.0	21	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanesulfonic acid (PFOS)	32	32	100.0	32	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanoic acid (PFOA)	32	32	100.0	32	100.0
EPA 625.1M	Physis	Water	Galaxolide	32	32	100.0	32	100.0
EPA 625.1M	Physis	Water	Bisphenol A	32	32	100.0	32	100.0

Method	Lab	Matrix	Analyte	Env. Samples Scheduled	Env. Samples Collected	Field and Transport Completeness (%)	Total Samples Analyzed	Analytical Completeness (%)
EPA 625.1M_MRM	Physis	Water	Triclocarban	32	32	100.0	32	100.0
Total				**629**	**629**	**100.0**	**629**	**100.0**

[1] Turbidity was measured by field crews instead of the laboratory for seven sites in the POTW 1 Year 3 gradient study area during the first event for the study.

Field Measurement Completeness

Table C.3. Field measurement completeness counts for Year 3.

ANALYTE	SAMPLES SCHEDULED	INSTRUMENT FAILURE	MEASUREMENTS TAKEN	COMPLETENESS (%)
Discharge [1]	32	0	32	100.0
Dissolved Oxygen, mg/L	32	0	32	100.0
Oxygen Saturation (%)	32	0	32	100.0
pH	32	0	32	100.0
Specific Conductivity, µS/cm	32	0	32	100.0
Temperature, water, ºC	32	0	32	100.0
Temperature, air, ºC	32	0	32	100.0
Turbidity, NTU [2]	7	0	7	100.0
Total	**231**	**0**	**231**	**100.0**

[1] Discharge values for POTW 1 effluent are provided by POTW staff and not measured in the field.
[2] Turbidity was measured by field crews instead of the laboratory for seven sites in the POTW 1 Year 3 gradient study area during the first event for the study.

Field Quality Control Frequency

Table C.4. Field quality control sample completeness for Year 3 CEC Monitoring.

Method	Lab	Matrix	Analyte	Env. Samples	Field Duplicates	Field Blanks	Field Duplicate Completeness (%)	Field Blank Completeness (%)
ASTM D3977	Weck	Water	Suspended Sediment Concentration	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Bisphenol A	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Diclofenac	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Estradiol, 17beta-	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Estrone	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Ethynylestradiol, 17alpha-	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Gemfibrozil	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Ibuprofen	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Iopromide	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Naproxen	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Progesterone	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Salicylic Acid	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Testosterone	32	2	2	6.3	6.3
EPA 1694M	Weck	Water	Triclosan	32	2	2	6.3	6.3
EPA 180.1[1]	**Physis**	**Water**	**Turbidity**	**21**	**1**	**1**	**4.8**	**4.8**
EPA 537M	Enthalpy	Water	Perfluorooctanesulfonic acid (PFOS)	32	2	2	6.3	6.3
EPA 537M	Enthalpy	Water	Perfluorooctanoic acid (PFOA)	32	2	2	6.3	6.3
EPA 625.1M	Physis	Water	Bisphenol A	32	2	2	6.3	6.3
EPA 625.1M	Physis	Water	Galaxolide	32	2	2	6.3	6.3
EPA 625.1M_MRM	Physis	Water	Triclocarban	32	2	2	6.3	6.3
Total				**629**	**39**	**39**	**6.2**	**6.2**

[1] Turbidity was measured by field crews instead of analyzed by the laboratory for seven sites in the POTW 1 Year 3 gradient study area during the first event for the study.

Summary of Sample Handling Acceptability

Hold Time Evaluations

Table C.5. Sample hold time acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Analyte	Acceptability Criteria	Total Samples	Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Suspended Sediment Concentration	Analyze within 14 days	40	40	100.0
EPA 1694M	Weck	Water	Bisphenol A	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Bisphenol A-d_{16} (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Diclofenac	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Estradiol, 17beta-	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Estradiol-d_3, 17beta- (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Estrone	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Ethynylestradiol, 17alpha-	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Gemfibrozil	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Gemfibrozil-d_6 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Ibuprofen	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Ibuprofen-d_3 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Iopromide	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Iopromide-d_3 (IsoDilAnalogue)	Analyze within 30 days	21	21	100.0

Method	Lab	Matrix	Analyte	Acceptability Criteria	Total Samples	Samples in Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Naproxen	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Naproxen-d_3 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Progesterone	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Progesterone-d_9 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Salicylic Acid	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Salicylic Acid-d_4 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Testosterone	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Testosterone-d_3 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Triclosan	Analyze within 30 days	43	43	100.0
EPA 1694M	Weck	Water	Triclosan-d3 (IsoDilAnalogue)	Analyze within 30 days	43	43	100.0
EPA 180.1 [1]	Physis	Water	Turbidity	Analyze within 48 hours	26	26	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanesulfonic acid (PFOS)	Extract within 14 days, analyze within 28 days	40	40	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanesulfonic acid-$^{13}C_8$ (IsoDilAnalogue)	Extract within 14 days, analyze within 28 days	40	40	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanoic acid (PFOA)	Extract within 14 days, analyze within 28 days	40	40	100.0
EPA 537M	Enthalpy	Water	Perfluorooctanoic acid-$^{13}C_2$ (IsoDilAnalogue)	Extract within 14 days, analyze within 28 days	40	40	100.0

METHOD	LAB	MATRIX	ANALYTE	ACCEPTABILITY CRITERIA	TOTAL SAMPLES	SAMPLES IN LIMITS	ACCEPTABILITY MET (%)
EPA 625.1M	Physis	Water	Bisphenol A	Extract within 7 days, analyze within 40 days	42	40	95.2
EPA 625.1M	Physis	Water	Galaxolide	Extract within 7 days, analyze within 40 days	42	40	95.2
EPA 625.1M	Physis	Water	Galaxolide-d_6 (Surrogate)	Extract within 7 days, analyze within 40 days	42	40	95.2
EPA 625.1M_MRM	Physis	Water	Triclocarban	Extract within 7 days, analyze within 40 days	42	40	95.2
EPA 625.1M_MRM	Physis	Water	Triclocarban-$^{13}C_6$ (Surrogate)	Extract within 7 days, analyze within 40 days	42	40	95.2
Total					**1446**	**1436**	**99.3**

[1] Turbidity was measured by field crews instead of analyzed by the laboratory for seven sites in the POTW 1 Year 3 gradient study area during the first event for the study

Quality Control Sample Acceptability: Contamination

Field Blanks Samples

Table C.6. Field blank (FB) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total FB Samples	FB Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Particulate	Suspended Sediment Concentration	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Bisphenol A	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Estrone	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol, 17alpha-	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Gemfibrozil	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Iopromide	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Naproxen	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Progesterone	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Testosterone	< RL	2	2	100.0
EPA 1694M	Weck	Water	Total	Triclosan	< RL	2	2	100.0
EPA 180.1[1]	**Physis**	**Water**	**Total**	**Turbidity**	**< RL**	**1**	**0**	**0.0**
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	< RL	2	2	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	< RL	2	2	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	< RL	2	2	100.0
EPA 625.1M	**Physis**	**Water**	**Total**	**Galaxolide**	**< RL**	**2**	**0**	**0.0**

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total FB Samples	FB Samples in Limits	Acceptability Met (%)
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	< RL	2	2	100.0
Total						**39**	**36**	**92.3**

[1] Turbidity was measured by field crews instead of analyzed by the laboratory for seven sites in the POTW 1 Year 3 gradient study area during Event 1; field equipment was calibrated by field crews the day of sampling and no additional blank sample was performed.

Equipment Blanks Samples

Table C.7. Equipment blank (EB) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total EB Samples	EB Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Particulate	Suspended Sediment Concentration	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Bisphenol A	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Estrone	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol, 17alpha-	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Gemfibrozil	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Iopromide	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Naproxen	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Progesterone	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Testosterone	< RL	4	4	100.0
EPA 1694M	Weck	Water	Total	Triclosan	< RL	4	4	100.0
EPA 180.1	**Physis**	**Water**	**Total**	**Turbidity**	**< RL**	**3**	**0**	**0.0**

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total EB Samples	EB Samples in Limits	Acceptability Met (%)
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	< RL	4	4	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	< RL	4	4	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	< RL	4	4	100.0
EPA 625.1M	**Physis**	**Water**	**Total**	**Galaxolide**	**< RL**	**4**	**0**	**0.0**
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	< RL	4	4	100.0
Total						**79**	**72**	**91.1**

Laboratory Blank Samples

Table C.8. Laboratory blank (LB) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total LB Samples	LB Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Total	Suspended Sediment Concentration	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Particulate	Bisphenol A	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Estrone	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol, 17alpha-	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Gemfibrozil	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Iopromide	< MDL	3	3	100.0

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total LB Samples	LB Samples in Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Total	Naproxen	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Progesterone	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Testosterone	< MDL	3	3	100.0
EPA 1694M	Weck	Water	Total	Triclosan	< MDL	3	3	100.0
EPA 180.1	Physis	Water	Total	Turbidity	< RL	2	2	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	< MDL	2	2	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	< MDL	2	2	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	< MDL	2	2	100.0
EPA 625.1M	Physis	Water	Total	Galaxolide	< MDL	2	2	100.0
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	< MDL	2	2	100.0
Total						**54**	**54**	**100.0**

Quality Control Sample Acceptability: Accuracy

Laboratory Control Spike Samples

Table C.9. Laboratory control spike (LCS) recovery acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total LCS Samples	LCS Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Particulate	Suspended Sediment Concentration	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Bisphenol A	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Estrone	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol, 17alpha-	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Gemfibrozil	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Iopromide	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Naproxen	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Progesterone	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Testosterone	50-150%	3	3	100.0
EPA 1694M	Weck	Water	Total	Triclosan	50-150%	3	3	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	50-150%	3	3	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	50-150%	3	3	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	50-150%	4	4	100.0
EPA 625.1M	Physis	Water	Total	Galaxolide	50-150%	4	4	100.0

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total LCS Samples	LCS Samples in Limits	Acceptability Met (%)
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	50-150%	4	4	100.0
Total						**60**	**60**	**100.0**

Matrix Spike Samples

Table C.10. Matrix spike (MS) recovery acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria[1]	Total MS Samples	MS Samples in Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Total	Bisphenol A	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Estrone	50-150%	6	6	100.0
EPA 1694M	**Weck**	**Water**	**Total**	**Ethynylestradiol, 17alpha-**	**50-150%**	**6**	**4**	**66.7**
EPA 1694M	Weck	Water	Total	Gemfibrozil	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Iopromide	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Naproxen	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Progesterone	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Testosterone	50-150%	6	6	100.0
EPA 1694M	Weck	Water	Total	Triclosan	50-150%	6	6	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	50-150%	4	4	100.0
EPA 625.1M	Physis	Water	Total	Galaxolide	50-150%	4	4	100.0
EPA 625.1M_MRM	**Physis**	**Water**	**Total**	**Triclocarban**	**50-150%**	**4**	**2**	**50.0**

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria[1]	Total MS Samples	MS Samples in Limits	Acceptability Met (%)
Total						90	86	95.5

[1] There are no DRMP MS recovery MQOs for PPCPs analyzed by EPA method 1694M; MS results provided by were evaluated against the laboratory criteria of 50-150%.

Surrogate Samples

Table C.11. Surrogate recovery acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total Surrogate Samples	Surrogate Samples in Limits	Acceptability Met (%)
EPA 625.1M	Physis	Water	Total	Galaxolide-d_6 (Surrogate)	30-130%	50	50	100.0
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban-$^{13}C_6$ (Surrogate)	50-150%	50	50	100.0
Total						100	100	100.0

Isotope Dilution Standards

Table C.12. Isotope dilution analogue recovery acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total IDA Samples	IDA Samples in Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Total	Bisphenol A-d_{16} (IsoDilAnalogue)	50-200%	52	50	96.2
EPA 1694M	Weck	Water	Total	Estradiol-d_3, 17beta- (IsoDilAnalogue)	50-200%	52	52	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol-d_4, 17alpha- (IsoDilAnalogue)	50-200%	52	48	92.3
EPA 1694M	Weck	Water	Total	Gemfibrozil-d_6 (IsoDilAnalogue)	50-200%	52	50	96.2
EPA 1694M	Weck	Water	Total	Ibuprofen-d_3 (IsoDilAnalogue)	50-200%	54	54	100.0

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria	Total IDA Samples	IDA Samples in Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Total	Iopromide-d_3 (IsoDilAnalogue)	50-200%	24	24	100.0
EPA 1694M	Weck	Water	Total	Naproxen-d_3 (IsoDilAnalogue)	50-200%	52	49	94.2
EPA 1694M	Weck	Water	Total	Progesterone-d_9 (IsoDilAnalogue)	50-200%	52	52	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid-d_4 (IsoDilAnalogue)	50-200%	52	52	100.0
EPA 1694M	Weck	Water	Total	Testosterone-d_3 (IsoDilAnalogue)	50-200%	52	52	100.0
EPA 1694M	Weck	Water	Total	Triclosan-d_3 (IsoDilAnalogue)	50-200%	52	50	96.2
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid-$^{13}C_8$ (IsoDilAnalogue)	25-150%	45	45	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid-$^{13}C_2$ (IsoDilAnalogue)	25-150%	45	45	100.0
Total						**636**	**623**	**98.0**

Quality Control Sample Acceptability: Precision

Field Duplicate Samples

Table C.13. Field duplicate (FD) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria [1]	Total FD Samples	FD Samples in Limits	Acceptability Met (%)
ASTM D3977	Weck	Water	Particulate	Suspended Sediment Concentration	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Bisphenol A	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Estrone	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Ethynylestradiol, 17alpha-	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Gemfibrozil	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Iopromide	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Naproxen	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Progesterone	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Testosterone	RPD ≤ 35	2	2	100.0
EPA 1694M	Weck	Water	Total	Triclosan	RPD ≤ 35	2	2	100.0
EPA 180.1[2]	Physis	Water	Total	Turbidity	RPD ≤ 35	1	1	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	RPD ≤ 35	2	2	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	RPD ≤ 35	2	2	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	RPD ≤ 35	2	2	100.0

Method	Lab	Matrix	Fraction	Analyte	Acceptability Criteria [1]	Total FD Samples	FD Samples in Limits	Acceptability Met (%)
EPA 625.1M	Physis	Water	Total	Galaxolide	RPD ≤ 35	2	2	100.0
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	RPD ≤ 35	2	2	100.0
Total						**39**	**39**	**100.0**

[1] RPD criteria not applicable if the concentration of either sample is < RL.
[2] Turbidity was measured by field crews instead of the laboratory for seven sites in the POTW 1 Year 3 gradient study area during Event 1; no turbidity duplicate was performed.

Laboratory Duplicate Samples (Unspiked)

Table C.14. Laboratory duplicate (LD) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fractions	Analyte	Acceptability Criteria	Total LD Samples	LD Samples Within Limits	Acceptability Met (%)
EPA 180.1	Physis	Water	Total	Turbidity	RPD ≤ 25[1]	2	2	100.0
Total						**2**	**2**	**100.0**

[1] RPD criteria not applicable if the concentration of either sample is < RL.

Laboratory Control Spike Duplicate Samples

Table C.15. Laboratory control spike duplicate (LCSD) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fractions	Analyte	Acceptability Criteria	Total LCSD Samples	LCSD Samples Within Limits	Acceptability Met (%)
EPA 537M	Enthalpy	Water	Total	Perfluorooctanesulfonic acid (PFOS)	RPD ≤ 30	1	1	100.0
EPA 537M	Enthalpy	Water	Total	Perfluorooctanoic acid (PFOA)	RPD ≤ 30	1	1	100.0
EPA 625.1M	Physis	Water	Total	Bisphenol A	RPD ≤ 25[1]	2	2	100.0

Method	Lab	Matrix	Fractions	Analyte	Acceptability Criteria	Total LCSD Samples	LCSD Samples Within Limits	Acceptability Met (%)
EPA 625.1M	Physis	Water	Total	Galaxolide	RPD ≤ 25[1]	2	2	100.0
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	RPD ≤ 25[1]	2	2	100.0
Total						**8**	**8**	**100.0**

[1] RPD criteria not applicable if concentration of either sample < MDL

Matrix Spike Duplicate Samples

Table C.16. Matrix spike duplicate (MSD) acceptability for Year 3 CEC Monitoring.

Method	Lab	Matrix	Fractions	Analyte	Acceptability Criteria	Total MS Samples	MS Samples Within Limits	Acceptability Met (%)
EPA 1694M	Weck	Water	Total	Bisphenol A	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Diclofenac	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Estradiol, 17beta-	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Estrone	RPD ≤ 25	3	3	100.0
EPA 1694M	**Weck**	**Water**	**Total**	**Ethynylestradiol, 17alpha-**	**RPD ≤ 25**	**3**	**2**	**66.7**
EPA 1694M	Weck	Water	Total	Gemfibrozil	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Ibuprofen	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Iopromide	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Naproxen	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Progesterone	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Salicylic Acid	RPD ≤ 25	3	3	100.0
EPA 1694M	Weck	Water	Total	Testosterone	RPD ≤ 25	3	3	100.0
EPA 1694M	**Weck**	**Water**	**Total**	**Triclosan**	**RPD ≤ 25**	**3**	**2**	**66.7**

Method	Lab	Matrix	Fractions	Analyte	Acceptability Criteria	Total MS Samples	MS Samples Within Limits	Acceptability Met (%)
EPA 625.1M	Physis	Water	Total	Bisphenol A	RPD ≤ 25[1]	2	2	100.0
EPA 625.1M	Physis	Water	Total	Galaxolide	RPD ≤ 25[1]	2	2	100.0
EPA 625.1M_MRM	Physis	Water	Total	Triclocarban	RPD ≤ 25[1]	2	2	100.0
Total						**45**	**43**	**95.6**

[1] RPD criteria not applicable if the concentration of either sample is < MDL.

Appendix D. Deviation Forms

2023-01. CEC Year 3 Event 1 Roseville Turbidity Measures Recorded with Probe

Deviation Report / Corrective Action Form

Title:	**CEC Year 3 Roseville Turbidity Measures Recorded with Probe**
Deviation Number:	2023-01_CECv3.3_Dev_Event1_MLJ_RosevilleTurbidityProbe
Prepared By:	Cassandra Lamerdin

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	**Notes/Description (optional)**
Date Deviation Occurred:	10/19/2023	
Date DRMP Program Manager was notified:	10/18/2023	Once it was determined that a deviation would occur on 10/19, email communication occurred with Regional Board to get approval.
Date CVRWQCB QA Representative Notified:	10/18/2023	
Deviation Form sent for Review:	10/30/2023	Will Hagan (DRMP QA Officer)
Deviation Form Sent for Signatures:	10/31/2023	

Description of Deviation/Change:

Constituents of Emerging Concern (CEC) monitoring for Year 3 Event 1 was conducted on October 16, 18, and19, 2023. Field crews collected samples from the two urban runoff sites on October 16 and for the gradient monitoring at the POTW 2 area sites on October 18 and the POTW 1 area sites on October 19. Turbidity was measured in the field instead of collecting water for a laboratory analysis at the POTW 1 sites sampled on October 19, 2023. At these sites, turbidity was measured using a Hanna Turbidity Meter following method EPA 180.1 instead of submitting samples to Physis Laboratories for analysis by Method EPA 180.1, as outlined in the approved QAPP.

Reason for Deviation/Change

The gradient sampling at the POTW 1 study area for Event 1 of Year 3 CEC monitoring was postponed a day due to concerns regarding the influence of upstream pumping activities observed near one of the sample locations. During the site scouting on Monday, October 16, Sacramento County staff were pumping water out of the area of Steelhead Creek upstream of the flow control structure into the confluence area with Dry Creek near the sample area at R5 (519SHCDDC). Due to concerns regarding similar activity occurring on the same day as sample collection, field crews visited the R5 site on the originally scheduled sample date, Wednesday, October 18, prior to the first sample collection of the day. Pumping activities were documented during this visit, and field crews were instructed to postpone the POTW 1 sampling to the next day. Field staff were able to confirm via a site visit and contact with the pump operators that no pumping activities took place on October 19. Field crews were instructed to proceed with the POTW 1 area sample collection on October 19, one day after the originally planned sample date. Sampling a day later than planned is not a deviation from the QAPP since the sampling requirements in the QAPP state, "Urban runoff sites may be collected within 1-3 days of the gradient study monitoring, as deemed necessary by field crews" (CEC Year 3 QAPP p. 54).

The planned sampling schedule includes samples being collected on a Monday and a Wednesday to allow for all samples (except turbidity) to be shipped together on Thursday and avoid shipping issues that could occur over a weekend. Since samples were collected on Thursday, the samples that required shipment to Southern California for analysis were retained in MLJ custody over the weekend to avoid potential shipping and delivery errors that could have compromised the sample handling requirements. Of the analytes that required shipping, all but turbidity (with a holding time of 48 hours) could be delivered to the laboratories within their respective holding time requirements if shipped overnight on Monday, October 23. Therefore, MLJ field crews collected turbidity as a field measurement in lieu of a laboratory analysis for the POTW 1 samples to avoid holding time violations for that analyte.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

This deviation is associated with seven sites (519DRYCRK, 519POTW01, 519DRYCRB, 519DRYWAB, 519DRYRLB, 519SHCUDC and 519SHCDDC) sampled in the POTW 1 gradient study area during the first event for the study.

While not defined in the current version of the QAPP, previous years of the CEC Pilot Study obtained turbidity results as field measurements; therefore, turbidity field results are consistent with previous project data. In addition, turbidity is an ancillary measurement, not one of the targeted CECs to be monitored, and the resolution of the field instrument (0.1 NTU) is comparable to the laboratory reporting limit (0.5 NTU). Data usability was unaffected by the substitution of a field measurement for the laboratory analysis. The field turbidity measurements obtained on October 19, 2023 will meet the project needs for interpreting associated CEC data.

Corrective Action	By Date	By Whom
None	NA	NA

ACKNOWLEDGED BY:

CVRWQCB QA Representative:	DocuSigned by: Selina Cole F3102A0E248746B...	Date:	12/5/2023
	Selina Cole		

DRMP Program Manager:	DocuSigned by: Melissa Turner 9796DD915C44446...	Date:	12/5/2023
	Melissa Turner		

DRMP QA Officer:	DocuSigned by: Will Hagan A4691C48F968433...	Date:	12/5/2023
	Will Hagan		

2023-02 CEC Year 3 Event 2 Enthalpy Missing Laboratory Control Sample Duplicate

Deviation Report / Corrective Action Form

Title:	**CEC Year 3 Event 2 Enthalpy Missing Laboratory Control Sample Duplicate**
Deviation Number:	2023-02_CECv3.3_Dev_Event2_Enthalpy_MissingLabDuplicate
Prepared By:	Cassandra Lamerdin

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:	11/27/2023	
Date DRMP Program Manager was notified:	11/27/2023	Enthalpy informed DRMP Program Manager Melissa Turner, via email that the lab did not run a laboratory control sample duplicate (LCSD).
Date CVRWQCB QA Representative Notified:	11/28/2023	Selina Cole, QA Representative, was informed via email.
Deviation Form sent for Review:	12/01/2023	Teresa Morrison, Enthalpy QA Director
Deviation Form sent for Review:	12/18/2023	Will Hagan, DRMP QA Officer
Deviation Form Sent for Signatures:	12/21/2023	Originally sent for signatures
Approval Letter Received from CVRWQCB:	10/25/2024	The Central Valley Regional Water Quality Control Board's QA Representative position is currently vacant; however, Regional Board

	Date	Notes/Description (optional)
		staff have reviewed the submitted QAPP Deviations Form and find the corrective actions sufficient. Regional Board approval was provided by Patrick Pulupa (CVRWQCB Executive Officer) for six CUP deviations including this one. The approval letter was sent to Debbie Mackey (DRMP President) on October 25, 2024.
Deviation Form Sent for Signatures post approval:	11/21/2024	

Description of Deviation/Change:

Constituents of Emerging Concern (CEC) monitoring for Year 3 Event 2 was conducted on October 30 and November 1, 2023. Enthalpy was contracted to run Per-, Poly- Fluoroalkyl Substances (PFAS) constituents. The CEC QAPP v 3.3 requires that a laboratory duplicate to be analyzed on a per batch basis. An LCSD is used by Enthalpy to meet this requirement. On 11/27/2023, the Enthalpy Project Manager, Rajwinder Kaur, informed the DRMP Program Manager, Melissa Turner, that the laboratory missed analyzing the LCSD during the analysis of the samples associated with Event 2.

Reason for Deviation/Change

The reason for this error was laboratory oversight.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

This deviation is associated with all samples (n=20) that were collected on October 30th and November 1st for Event 2 and are identified with Batch Code ENTHALPY_DRMP_CEC_B23K040_W_PFAS.

The Lab Batch will be flagged following the DRMP Data Management SOP where the Lab Submission Code is updated to "QI" to indicate incomplete QC. A Lab Batch Comment will be added to indicate which batch QC frequency was not met and why which in this case was lab oversight.

Corrective Action	By Date	By Whom
None	NA	NA

ACKNOWLEDGED BY:

Enthalpy QA Representative:	DocuSigned by: Teresa Morrison 3B7BB1D27DC2410...	Date:	11/27/2024
	Teresa Morrison		

DRMP Program Manager:	DocuSigned by: Melissa Turner 9796DD915C44446...	Date:	11/21/2024
	Melissa Turner		

DRMP QA Officer:	DocuSigned by: Will Hagan A4691C48F968433...	Date:	12/9/2024
	Will Hagan		

CVRWQCB QA Representative*:	**Not Applicable**	Date:	10/25/2024
	Vacant		

*While these QAPP Deviation Forms will remain unsigned by the Central Valley Water Board due to the vacant QA Representative position, the current form is approved based on CVRWQCB staff scientist review and approval by the Central Valley Regional Water Quality Control Board Executive Officer Patrick Pulupa.

2023-04. CEC Event1 Missed Physis Reporting Deadline and Extraction Hold Time Exceedance.

Deviation Report / Corrective Action Form

Title:	**CEC Event 1 Missed Physis Reporting Deadline and Extraction Hold Time Exceedance**
Deviation Number:	2023-04_CECv3.3_Dev_Event1_Physis_MissedReportingDeadline_ExtractionHoldtime
Prepared By:	Robert Pangle, MLJ Environmental

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Resolution R5-2021-0054 Approval of Delta Regional Monitoring Program Governance Structure and Implementing Entity

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:	12/28/2023	Physis reported the Event 1 EDDs to MLJ Environmental (MLJ) on 12/20/2023 for all results (turbidity and PPCPs). The MLJ data review team performed a cursory review of the results and noted that the samples were not reported within 60 days of analysis and that two samples appeared to be extracted outside of hold time.
Date DRMP Program Manager Notified:	12/28/2023	Email sent from Cassandra Lamerdin (DRMP Data Manager) to Melissa Turner (DRMP Program Manager) and Selina Cole (QA Representative, CVRWQCB) regarding the deviation and noting that the Data Manager was reaching out to the laboratory to confirm deviations.

	Date	Notes/Description (optional)
Date CVRWQCB QA Representative Notified:	12/28/2023	
	01/03/2024	Confirmation email received from Rich Gossett (Physis) to Cassandra Lamerdin regarding analysis dates and confirmation that two samples were extracted outside of hold time.
Deviation Form sent for Review:	03/20/2024	Rich Gossett, Physis Technical Lab Director
Deviation Form sent for Review:	04/05/2024	Will Hagan, DRMP QA Officer
Deviation Form Sent for Signatures:	04/10/2024	Originally sent for signatures
Approval Letter Received from CVRWQCB:	10/25/2024	The Central Valley Regional Water Quality Control Board's QA Representative position is currently vacant; however, Regional Board staff have reviewed the submitted QAPP Deviations Form and find the corrective actions sufficient. Regional Board approval was provided by Patrick Pulupa (CVRWQCB Executive Officer) for six CUP deviations including this one. The approval letter was sent to Debbie Mackey (DRMP President) on October 25, 2024.
Deviation Form Sent for Signatures post approval	11/21/2024	

Description of Deviation/Change:

1) Physis submitted the Event 1 Electronic Data Deliverables (EDDs) to MLJ on 12/21/2023 for all results (turbidity and PPCPs) for samples collected on 10/18/2023. Eight samples had a turbidity analysis date of 10/20/2023; therefore, reporting the turbidity results on 12/21/2023 resulted in a deviation from the Resolution requirement to report preliminary results within 60 days of the analysis date (7 days late).

2) In addition, Data Management staff noted that two samples (519PGC010 and 519SACUR3) collected on 10/16/2023 were extracted on 10/25/2023 which is two (2) days after the 7-day hold time requirement for PPCPs using method EPA 625.1.

Rich Gossett at Physis Labs confirmed that the two samples in question were extracted outside of the hold time requirement and that the analysis dates were correct for the turbidity results reported outside of the required time frame.

Reason for Deviation/Change:

1) The laboratory noted that it was an oversight in reporting the results 67 days after analysis. It is notable to report that the majority of the results (65 results for PPCPs) in the Event 1 EDD were reported within the required 60 days from analysis, and it was missed within the laboratory that nine (9) results would be reported late for Turbidity.

2) The laboratory erroneously assumed that all the samples were collected on October 18th (they did not realize two samples were collected two days earlier). Therefore, they planned a single extraction for all Event 1 samples thinking that the extraction date was within the hold time requirement of seven (7) days.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

1) Preliminary results were reported 67 days after analysis; the delay of seven days did not affect any other reporting deadlines.

2) Results were flagged with a "H" QA Code flag and a batch comment was added indicating there was a two-day extraction hold time violation on two samples in batch. Both samples extracted out of hold time had detections above the reporting limit for galaxolide but not Bisphenol A (BPA).

Corrective Action	By Date	By Whom
The laboratory has reminded staff about requirement to report results within 60 days of the analysis date.	1/15/2024	Rich Gossett
The laboratory reviewed the error with staff and reminded them to confirm analysis dates of all samples when scheduling extractions to ensure hold times are not missed.	1/15/2024	Rich Gossett
Flag the affected data with a "H" QA Code flag and add a batch comment indicating there was a two-day extraction hold time violation on two samples in batch.	2/15/2024	Cassandra Lamerdin, DRMP Data Manager

ACKNOWLEDGED BY:

Technical Director at Physis Environmental Laboratories, Inc.	DocuSigned by: Rich Gossett 46AD07B3C680402...	Date:	11/21/2024
	Rich Gossett		

DRMP Program Manager:	DocuSigned by: Melissa Turner 9790DD915C44440...	Date:	11/21/2024
	Melissa Turner		

DRMP QA Officer:	DocuSigned by: Will Hagan A4691C48F968433...	Date:	11/21/2024
	Will Hagan		

CVRWQCB QA Representative*:	**Not Applicable**	Date:	10/25/2024
	Vacant		

*While these QAPP Deviation Forms will remain unsigned by the Central Valley Water Board due to the vacant QA Representative position, the current form is approved based on CVRWQCB staff scientist review and approval by the Central Valley Regional Water Quality Control Board Executive Officer Patrick Pulupa.

2023-05. CEC Events 1 and 2 Weck Missed Preliminary Reporting Deadline

Deviation Report / Corrective Action Form

Title:	**CEC Events 1 and 2 Weck Missed Preliminary Reporting Deadline**
Deviation Number:	2023-05_CECv3.3_Dev_Events1-2_Weck_MissedPreliminaryReportingDeadlines
Prepared By:	Robert Pangle, MLJ Environmental

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Resolution R5-2021-0054 Approval of Delta Regional Monitoring Program Governance Structure and Implementing Entity

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
	01/04/2024	Weck sent Event 1 PPCP Lab Reports and EDDs for samples collected on October 16, 2023 (3J20079) and October 18, 2023 (3J20081) to MLJ.
	01/10/2024	On January 10, 2024, Weck sent the PPCP Lab Report and EDD for sample date October 19, 2023 (3J24067) to MLJ.
Date Deviation Occurred:	01/10/2024	Cassandra Lamerdin (DRMP Data Manager) reviewed the EDDs for any missed Resolution reporting deadlines after receiving all Weck Laboratory Reports and EDDs for Event 1.
Date DRMP Program Manager was notified:	01/11/2024	Email sent from Cassandra Lamerdin (DRMP Data Manager) to Melissa Turner (DRMP Program Manager) and Selina Cole (QA Representative, CVRWQCB) of the missed reporting deadline for Event 1 samples and the potential to miss the deadline for Event 2 samples

	Date	Notes/Description (optional)
Date CVRWQCB QA Representative Notified:	01/11/2024	See above
	01/17/2024	MLJ sent reminder email to Weck for reporting of Event 2 PPCP data.
	01/17/2024	Weck sent Event 2 Lab Reports and EDDs to MLJ staff.
	01/18/2024	Email sent from Cassandra Lamerdin to Selina Cole with notification that Weck had missed the reporting timeline for Event 2 by 3 days.
Deviation Form sent for Review:	03/20/2024	Kim Tu (Weck Senior Project Manager)
Deviation Form sent for Review:	03/20/2024	Will Hagan, DRMP QA Officer
Deviation Form Sent for Signatures:	03/25/2024	

Description of Deviation/Change:

As per Resolution R5-2021-0054, preliminary raw data and monitoring results shall be provided to the Central Valley Regional Water Quality Control Board within 60 calendar days from the date of sample analysis.

MLJ Environmental collected samples for Event 1 of the Constituents of Emerging Concern (CEC) Year 3 project on October 16, 18, and 19th, 2024. Event 2 samples were collected on October 30 and November 1, 2024.

On January 4, 2024, Weck sent Event 1 PPCP Lab Reports and EDDs for samples collected on October 16, 2023 (3J20079) and October 18, 2023 (3J20081) to MLJ, with an acknowledgement that results for samples collected on October 19, 2023 as well as all results from Event 2 were still pending. On January 10, 2024, Weck sent the PPCP Lab Report and EDD for sample date October 19, 2023 (3J24067) to MLJ, with a further acknowledgement that MLJ had requested Event 2 results from Weck. Once all results for Event 1 were reported (January 10, 2024), the DRMP Data Manager assessed whether preliminary reporting deadlines were missed. On January 11, 2024, the DRMP Data Manager sent an email to Selina Cole (QA Representative, CVRWQCB) to provide notification that the CEC Event 1 PPCP preliminary reporting deadline was missed for the Event 1 collections. Specifically, the samples collected on October 16 and 18, 2023 were analyzed on October 26, 2023, and reported on January 4, 2024 (10 days past deadline), and the samples collected on October 19, 2023 were analyzed on November 4, 2024 and reported on January 10, 2024 (7 days past deadline).

Additionally, Selina Cole was notified that the exact analysis dates for Event 2 samples were currently unknown, and it was anticipated that those results might also be received by MLJ outside the 60 days reporting timeline. On January 17, 2024, the DRMP Data Manager sent an additional reminder to Weck requesting data for Event 2. On January 17, 2024, Weck sent Event 2 sample dates October 19, 2023 (3K03096) and November 1, 2023 (3K03096, 3K03103) Lab Reports and EDDs to MLJ. On January 18, 2024, the DRMP Data Manager sent an email to Selina Cole with a notification that Event 2 Weck files were received on January 17, 2024, and the analysis was done on November 15, 2023; the preliminary reporting timeline was missed by three (3) days for Event 2 PPCP results.

Reason for Deviation/Change

On January 2, 2024, Weck responded to DRMP Data Manager inquiries regarding their timing for reporting data that they were on a 4-month turnaround time for analyzing samples and reporting results. On January 3, 2024, the DRMP Data Manager responded with a reminder that results must be reported as soon as possible and no later than 60 days after analysis to meet programmatic requirements. Weck Senior Project Manager, Kim Tu, informed DRMP Data Management staff that Weck was currently behind schedule and reporting of PPCP results was expected to be about 4 months from time of sample receipt. After discussions regarding contract agreements and DRMP requirements, Weck was able to provide results sooner than originally thought but still outside of the reporting deadline for preliminary data.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

This deviation only affects the timing for when preliminary results were received; there were no hold time violations associated with these results. This deviation has no impact on the results themselves. The Data Management team has been able to review the results and verify them in time to meet other Resolution reporting deadlines.

Corrective Action	By Date	By Whom
There were only two events for this project and therefore any corrective actions by the laboratory does not affect this specific project. For future DRMP projects with Weck, the 60-day reporting timeline will be discussed in a kickoff meeting with the laboratory in addition to noting this requirement in contract language and analysis quote requests.	Before sampling occurs for future projects with samples being analyzed by Weck	Cassandra Lamerdin, DRMP Data Manager
For future contracts and study design implementation, reporting timelines will be a key criterion for future DRMP laboratory selections.	As applicable	Melissa Turner , DRMP Program Manager

ACKNOWLEDGED BY:

Weck Laboratory Senior Project Manager:	DocuSigned by: Kim Tu 4516D717C3DE42C...	Date:	3/26/2024
	Kim Tu		

Regional Board Representative:	DocuSigned by: Selina Cole F3102A0E248746B...	Date:	3/26/2024
	Selina Cole		

DRMP Program Manager:	DocuSigned by: Melissa Turner 9790DD915C44446...	Date:	3/28/2024
	Melissa Turner		

DRMP QA Officer:	DocuSigned by: Will Hagan A4691C48F968433...	Date:	3/26/2024
	Will Hagan		

2023-08. CEC Events 1 and 2 Physis Field Contamination

Deviation Report / Corrective Action Form

Title:	**CEC Events 1 and 2 Physis Field Contamination**
Deviation Number:	2023-08_CECv3.3_Dev_Event1-2_Physis_FieldContaminationv5
Prepared By:	Robert Pangle, MLJ Environmental

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:	01/30/2024	
Date CVRWQCB QA Representative Notified:	01/30/2024	Email sent from Cassandra Lamerdin to Selina Cole (CVRWQCB QA Representative) to inquire whether multiple field contamination flags applied to galaxolide and turbidity results constitute a deviation since the results were flagged according to the Data Management SOP. Received confirmation that a deviation form should be completed. This led to additional investigations into the potential sources of contamination and confirmation of results.
Deviation Form sent for Review:	03/20/2024	Rich Gossett, Physis Technical Lab Director
Deviation Form sent for Review:	06/04/2024	Will Hagan, DRMP QA Officer
Deviation Form Sent for CVRWQCB Review:	10/17/2024	Ryan Brown, CVRWQCB Staff

	Date	Notes/Description (optional)
Approval Letter Received from CVRWQCB:	Under Review by CVRWQCB	

Description of Deviation/Change:

Physis Environmental Laboratories Inc. (Physis) reported Event 1 and Event 2 EDDs to MLJ on December 20, 2023, for all results (turbidity and PPCPs). It was noted by MLJ staff upon review of the EDD data (submitted on December 20, 2023) that there was field contamination for galaxolide and turbidity (MQO for field and equipment blanks is < Reporting Limit (RL)) in field and equipment blanks for Event 1 and Event 2 sampling performed on October 18, October 19, and November 1, 2023; appropriate flags were applied following the Data Management SOP. It was also noted that all laboratory blanks analyzed with samples from these sampling events were non-detect (ND) for all parameters. Specifically, the samples affected were the following: 1) October 18, 2023 (sample ID # 511NACDOA-EB), 2) October 19, 2023 (sample ID # 519POTW01-EB and 519DRYRLB-FB), and 3) November 1, 2023 (sample ID # 511NACDOA-EB, 511OACCLN-FB, and 519POTW01-EB).

Table 1lists the field and equipment blank results for galaxolide and turbidity; all samples had detections above the RL. A majority (four of six) of the samples with field contamination are associated with equipment blanks. An equipment blank is created by using lab-supplied blank water to run through the sampling equipment (same process that is done with the environmental water) and poured into the appropriate container. A field blank is created by pouring blank water directly into the container. MLJ field sampling staff confirmed that Physis supplied the blank water used by MLJ staff during CEC Event 1 and Event 2 field sampling and that the blank water was received and handled according to DRMP CEC field sampling standard operating procedures (SOPs).

On January 30, 2024, CVRWQCB QA Representative, Selina Cole, was contacted to determine if the multiple flags for field contamination constituted a deviation since the samples were flagged according to the Data Management SOP. Selina Cole noted that field contamination will impact data quality and should be documented in a deviation form that identifies corrective actions aimed at preventing similar issues in future monitoring events.

Table 1. Summary of CEC Year 3 Equipment and Field Blank Contamination reported from Physis.

Event	Station Code	Sample Date	Sample Time	Sample Type Code	Equipment	Analyte Name	Unit Name	Result	Res Qual Code	MDL	RL	QA Code	Lab Result Comments	Batch Identifier	Lab Batch Comment
1	511NACDOA	18-Oct-23	13:30	Equip Blank	MLJ Conbar Dipper	Galaxolide	ng/L	43.5	=	0.1	1	IP	(<1/5 env sample, env ample=4700)	44004	Galaxolide detected in Equipment and Field Blanks at levels above Reporting Limits.
						Turbidity	NTU	0.02	=	0.02	0.02	IP	(<1/5 env sample, env sample=11.7)	74082	Turbidity detected in Equipment Blank at levels at the Reporting limit.
2	511NACDOA	01/Nov/2023	14:30	Equip Blank	MLJ Conbar Dipper	Galaxolide	ng/L	182	=	0.1	1	IP	(<1/5 env sample, env sample=6730)	44014	Galaxolide detected in Equipment and Field Blanks at levels above the Reporting Limit.
						Turbidity	NTU	0.12	=	0.02	0.02	IP	(<1/5 env sample, env sample=28.3)	74089	Turbidity detected in Equipment and Field Blanks at levels above the Reporting Limit.
2	511OACCLN	01/Nov/2023	10:20	Field Blank	None	Galaxolide	ng/L	72.9	=	0.1	1	IP	(<1/5 env sample, env sample=11400)	44014	Galaxolide detected in Equipment and Field Blanks at levels above the Reporting Limit.
						Turbidity	NTU	0.62	=	0.02	0.02	IP	(>1/5 env sample, env sample=2.6)	74089	Turbidity detected in Equipment

Event	Station Code	Sample Date	Sample Time	Sample Type Code	Equipment	Analyte Name	Unit Name	Result	Res Qual Code	MDL	RL	QA Code	Lab Result Comments	Batch Identifier	Lab Batch Comment
															and Field Blanks at levels above the Reporting Limit.
1	519DRYRLB	19/Oct/2023*	13:30	Field Blank	None	Galaxolide	ng/L	42.5	=	0.1	1	IP	(<1/5 env sample, env sample=2760)	44004	Galaxolide detected in Equipment and Field Blanks at levels above Reporting Limits.
1	519POTW01	19/Oct/2023*	9:30	Equip Blank	Bailer	Galaxolide	ng/L	62.1	=	0.1	1	IP	(<1/5 env sample, env sample=13800)	44004	Galaxolide detected in Equipment and Field Blanks at levels above Reporting Limits.
2	519POTW01	01/Nov/2023	9:20	Equip Blank	Bailer	Galaxolide	ng/L	76.9	=	0.1	1	IP	(<1/5 env sample, env sample=1300)	44014	Galaxolide detected in Equipment and Field Blanks at levels above the Reporting Limit.
						Turbidity	NTU	0.1	=	0.02	0.02	IP	(<1/5 env sample, env sample=0.69)	74089	Turbidity detected in Equipment and Field Blanks at levels above the Reporting Limit.

* Turbidity measured by Field Probe on this date

Reason for Deviation/Change

For the results listed in Table 1, it is likely that contamination occurred in the blank water between when the water left Physis and when it was poured into the container. It is well known that galaxolide is present in most materials and is difficult to avoid contamination. It is less common to have turbidity contamination and it is unclear the cause.

Physis laboratory confirmed that blank water tested in house (tested prior to sending blank water to MLJ Environmental for sample collection) had a turbidity concentration of 0.02 NTUs.

The field sampling SOP includes extra measures to avoid contamination of the different CEC analytes (including galaxolide) such as establishing staging and sampling areas to identify potential sources of contamination prior to collection, instructing field staff of prohibited field clothing and materials that contain possible sources of contamination for analytes in study, and a strict decontamination process of equipment and proper storage during transport. Additional efforts were made for a contaminant-free staging area by providing a mobile stainless-steel workstation that was decontaminated and wrapped in foil to prevent environmental exposure between sites.

Of the field-contaminated samples, three of four were equipment blanks compared to one that was a field blank sample. It is likely that the equipment used to the collect the samples was introducing some low-level contamination. The equipment used to collect samples include a bailer which has a wide opening allowing for airborne particulates (e.g., dust particles) to come into contact with the equipment prior to adding blank water or between the time that the blank water is added and then poured off into the sample bottle.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

Field samplers went through extensive training prior to CEC Year 3 sampling with special attention paid to field contamination. Staff were reminded about sampling procedures to reduce contamination, and the laboratory was also communicated with regarding contamination concerns.

In all cases but one (a single turbidity sample), the field contamination was less than five times the environmental sample indicating that the impact is likely minimal.

Corrective Action	By Date	By Whom
Add a QA Code to records where the result is greater than the Reporting Limit with a QA Code of IP [Analyte detected in field or lab generated blank].	February 2, 2024	Cassandra Lamerdin, DRMP Data Manager
The lab batch comment will include the following "[Analyte] reported in equipment and field blank at levels above the RL". See **Table 1** for specifics	February 2, 2024	Cassandra Lamerdin, DRMP Data Manager
Add recommendations to the Year 3 Data Report that additional blank samples be added to future CEC projects to assess possible sources of contamination in both the field and laboratory.	Year 3 Data Report Draft	Melissa Turner, DRMP Program Manager

ACKNOWLEDGED BY:

MLJ Field Lead:		Date:	
	Matt Bundock		

Physis Laboratories Technical Director:		Date:	
	Rich Gossett		

DRMP Program Manager:		Date:	
	Melissa Turner		

DRMP QA Officer:		Date:	
	Will Hagan		

CVRWQCB QA Representative*:	**Not Applicable**	Date:	
	Vacant		

2023-09. CEC Events 1 and 2 Physis Missing LCS samples for Turbidity

Deviation Report / Corrective Action Form

Title:	**CEC Events 1 and 2 Physis Missing LCS samples for Turbidity**
Deviation Number:	2023-09_CECv3.3_Dev_Event1-2_Physis_MissingTurbidityLCS
Prepared By:	Robert Pangle

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:	01/30/2024	Upon review of the Physis EDDs for Events 1 and 2 (WY2024), MLJ staff noted that turbidity Laboratory Control Spikes (LCS), as required per batch in QAPP Table 6, were not performed by Physis.
Date DRMP Program Manager was notified:	01/30/2024	Email sent from Cassandra Lamerdin (DRMP Data Manager) to Melissa Turner (DRMP Program Manager).
Date CVRWQCB QA Representative Notified:	01/30/2024	Email sent from Cassandra Lamerdin to Selina Cole (CVRWQCB).
	01/30/2024	Confirmation email received from Rachel Hansen (Physis) and Rich Gossett (Physis) to Cassandra Lamerdin indicating that no Laboratory Control Spikes (LCS) were performed for turbidity.
Deviation Form sent for Review:	04/09/2024	Rich Gossett, Physis Technical Lab Director

	Date	Notes/Description (optional)
Deviation Form sent for Review:	04/10/2024	Will Hagan, DRMP QA Officer
Deviation Form Sent for Signatures:	04/11/2024	Originally sent for signatures
Approval Letter Received from CVRWQCB:	10/25/2024	The Central Valley Regional Water Quality Control Board's QA Representative position is currently vacant; however, Regional Board staff have reviewed the submitted QAPP Deviations Form and find the corrective actions sufficient. Regional Board approval was provided by Patrick Pulupa (CVRWQCB Executive Officer) for six CUP deviations including this one. The approval letter was sent to Debbie Mackey (DRMP President) on October 25, 2024.
Deviation Form Sent for Signatures post approval	11/21/2024	

Description of Deviation/Change:

On January 30, 2024, MLJ staff reviewed the Physis EDDs for Events 1 and 2 (CEC Year 3) and noted that a turbidity LCS, as required per batch in QAPP Table 6, was not performed by the laboratory for two batches. Samples were collected on October 16, 18, and 19, 2023 for Event 1 and October 30 and November 1, 2023 for Event 2. Electronic data deliverables (EDDs) were received by the Data Management Team on January 17, 2024.

Cassandra Lamerdin (DRMP Data Manager) contacted Physis Laboratories on January 30, 2024, to inquire about missing LCS for turbidity in the following lab batches: 1) Physis_DRMP_CEC_C-74082_W_TURB and 2) Physis_DRMP_CEC_C-74089_W_TURB. Rachael Hansen at Physis responded on January 30, 2024, and indicated that Physis did not perform LCS for turbidity. Rich Gossett at Physis further responded on January 30, 2024, and indicated that Physis only performed lab blanks and lab duplicates for QAQC purposes in relation to turbidity.

Reason for Deviation/Change

The deviation was an oversight by the laboratory technician performing the analysis since for other projects an LCS is not typically required as it is for the CEC Year 3 project.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

It is anticipated that the completeness requirement of 90% or more of analytes meeting MQOs for accuracy will still be met for the project. Physis confirmed that all other required QC were performed including a mid-level calibration check, laboratory blanks, and laboratory duplicates for all turbidity batches.

Corrective Action	By Date	By Whom
All batches missing the required QC in Table 6 will be flagged with a QA Code of QI. A Lab Batch Comment will be added to indicate which batch QC frequency was not met and why.	02/13/2024	MLJ Environmental and Moss Landing Marine Laboratories
Future kickoff meetings will continue to emphasize batch QC requirements including references to QAPP tables.	Future kickoff meetings	Cassandra Lamerdin, DRMP Data Manager

ACKNOWLEDGED BY:

Technical Director at Physis Environmental Laboratories, Inc.	DocuSigned by: Rich Gossett 46AD07B3C680402...	Date:	11/21/2024
	Rich Gossett		

DRMP Program Manager:	DocuSigned by: Melissa Turner 9796DD915C44446...	Date:	11/21/2024
	Melissa Turner		

DRMP QA Officer:	DocuSigned by: Will Hagan A4691C48F968433...	Date:	11/21/2024
	Will Hagan		

CVRWQCB QA Representative*:	**Not Applicable**	Date:	10/25/2024
	Vacant		

*While these QAPP Deviation Forms will remain unsigned by the Central Valley Water Board due to the vacant QA Representative position, the current form is approved based on CVRWQCB staff scientist review and approval by the Central Valley Regional Water Quality Control Board Executive Officer Patrick Pulupa.

2023-19. CEC Events 1 and 2 MLJ Environmental Discharge Measurement and Data Entry Error

Deviation Report / Corrective Action Form

Title:	**CEC Events 1 and 2 MLJ Discharge Measurement and Data Entry Error**
Deviation Number:	2023-19_CECv3.3_Dev_Event1-2_MLJEnvDischargeEntryError.docx
Prepared By:	Robert Pangle, MLJ Environmental

Applicable Reference(s):

Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta Quality Assurance Project Plan Version 3.3, August 17, 2023

Complete the following table regarding the major milestones for the relevant deviation. Add additional rows as needed.

	Date	Notes/Description (optional)
Date Deviation Occurred:	08/02/2024	Upon review of CEC Event 1 and Event 2 (WY2024), volumetric flow measurements and calculations, MLJ Environmental (MLJ) staff noted that there was a data entry error for two sampled stations and an additional field measurement protocol error that occurred at two other sampling stations.
Date DRMP Program Manager was notified:	08/05/2024	Melissa Turner (DRMP Program Manager) was notified and briefed on the deviation during an in-person meeting on August 5, 2024.
Date CVRWQCB QA Representative Notified:	08/09/2024	As of May 30, 2024, the CVRWQCB does not have a QA Representative. In the interim, Ryan Brown (CVRWQCB) has been tasked with tracking deviations. Email sent from Robert Pangle (MLJ) to Ryan Brown (CVRWQCB).
Deviation Form sent for Review:	09/15/2024	Matthew Bundock, MLJ Field Lead
Deviation Form sent for Review:	TBD	Will Hagan, DRMP QA Officer

	Date	Notes/Description (optional)
Deviation Form Sent for Signatures:	TBD	Deviation currently under Internal Review

Description of Deviation/Change:

On August 2, 2024, MLJ staff reviewing field measurement datasheets and volumetric flow (discharge) calculations for Events 1 and 2 (CEC Year 3) noted two data entry errors (511OACUNA and 511NACDOA) and two field protocol measurement errors (519DRYWAB and 511NACUOA). These errors resulted in erroneous discharge estimates for Event 1 and Event 2.

For 511OACUNA (Event 1, October 18, 2023), it was discovered that there was a data entry error that occurred on the discharge calculation spreadsheet. In this instance, a value of "4.2 meters" was entered into the spreadsheet for the left wet edge stream location measurement; however, the correct value on the field data sheets indicates "2.0 meters". This resulted in a revision of the discharge estimate from an incorrect value of 1.07 $m^3 s^{-1}$ (37.79 $ft^3 s^{-1}$) to a revised value of 0.62 $m^3 s^{-1}$ (21.82 $ft^3 s^{-1}$).

For 511NACDOA (Event 2, November 1, 2023), it was discovered that there was a data entry error in the discharge calculation spreadsheets. In this instance, the substrate type was entered into the spreadsheet as "riprap"; however, the correct substrate type listed on the field data sheets was "concrete". Rip-rap and concrete have differing roughness coefficients, hence this data entry error resulted in an erroneous discharge estimate. Correcting the substrate entry in this instance resulted in a revision of the flow discharge estimate from an incorrect value of 0.93 $m^3 s^{-1}$ (32.90 $ft^3 s^{-1}$) to a revised value of 0.99 $m^3 s^{-1}$ (34.96 $ft^3 s^{-1}$).

For 519DRYWAB (Event 1, October 19, 2023), it was discovered that there was a field protocol measurement error in relation to the midpoint locations where individual flow measurement intervals occurred (across the watercourse width). The MLJ Field Standard Operating Procedure (SOP) utilizes the United States Geological Survey (USGS) current meter midsection flow methodology in assessing flows for discharge calculations. According to MLJ Field SOP, an interval width of 1.62 meters should have been utilized for each of n=5 flow measurement intervals based on an overall watercourse width of 9.70 meters (wet edge). For an interval width of 1.62 meters, the n=5 mid-point locations for each interval should have occurred at 1.62, 3.24, 4.86, 6.48, and 8.1 meters from the watercourse wet edge. In actuality, the midpoint locations were established at 1.6, 2.5, 3.4, 4.3, and 5.2 meters from the watercourse wet edge. This produced an error in both the proper location of the flow interval mid-point locations across the watercourse width (as the total width was only partially assessed), along with a subsequent error in the calculation of both interval and total discharge estimates as the interval widths used in calculations were erroneous.

For 511NACUOA (Event 1, October 18, 2023), it was also discovered that there was a field protocol measurement error in relation to the establishment of the correct midpoint locations for individual flow measurement intervals (across the watercourse width). Again, according to the MLJ SOP field protocols, an interval width of 1.65 meters should have been utilized for each of n=5 discharge measurement intervals for the station location flow measurements, which had an overall watercourse width of 9.90 meters (wet edge). For an interval width of 1.65 meters, the n=5 mid-point locations for each interval should have occurred at 1.65, 3.3, 4.95, 6.6, and 8.25 meters from the watercourse wet edge. In actuality, the midpoint locations were established at 1.65, 3.3, 4.95, 5.6, and 7.25 meters from the watercourse wet edge. The mis-location of the final two midpoint locations produced an error in both the proper location of the discharge interval mid-point locations across the watercourse width (as the total width was only partially assessed), along with a subsequent error in the calculation of both interval and total discharge estimates as the interval widths used in calculations were erroneous for several intervals.

Reason for Deviation/Change

The first part of the deviation occurred due to data entry errors for the 511OACUNA (Event 1) and 511NACDOA (Event 2) field data. Data entered into calculation spreadsheets are doubled checked by two different MLJ staff members to catch data entry errors. Despite this protocol, these two data entry errors occurred when transcribing the data from the field sheet into the database.

The second part of the deviation occurred due to staff not following MLJ Field SOPs for collecting flow measurements at both 519DRYWAB and 511NACUOA during Event 1. MLJ Field SOP s (related to measuring flow discharge) state that "midpoint verticals are to be evenly spaced, and total stream width will be divided by six to obtain five verticals". In the instance of these deviations, the intervals were not established consistently (with even spacing) across the watercourse wet edge width, and this led to calculation errors for total flow discharge at both locations.

Impact on Present and Completed Work (discuss potential magnitude of impact and bias of deviation/change, if this can be anticipated, if no impact is expected please indicate this)

For the 511OACUNA (Event 1) and 511NACDOA (Event 2) field data entry errors, the spreadsheet data entry was corrected and revised estimates for total discharge were calculated. Corrected values will need to be updated in ancillary datasets and any published public data products.

For the 519DRYWAB (Event 1) and 511NACUOA (Event 1) field protocol deviations, it is not possible to revise how the measurements were taken during the sampling event. Therefore, these results will be flagged in the database to indicate that the method was not followed. In addition, to the flags, the increased uncertainty in the mean velocity value due to interval measurement locations not being evenly spaced, is noted in the CEC Year 3 Annual Report.

Corrective Action	By Date	By Whom
For the 511OACUNA (Event 1) and 511NACDOA (Event-2) field data entry errors, the spreadsheet data entry was corrected and revised estimates for total discharge were calculated.	August 16, 2024	Robert Pangle, DRMP Junior Project Manager
Corrected values were updated in ancillary datasets and any published public data products.	August 16, 2024	Cassandra Lamerdin, DRMP Data Manager
For the 519DRYWAB and 511NACUOA (Event 1) measurement protocol errors, a QA Code of MN [Method procedures not followed] was applied to the discharge results, the compliance codes were updated to "Qual" and a comment was added to the result.	August 16, 2024	Cassandra Lamerdin, DRMP Data Manager
Additional training for field crew staff on the correct sampling protocol was taken.	October 4, 2024	Matthew Bundock

ACKNOWLEDGED BY:

Field Lead at MLJ Environmental		Date:	
	Matthew Bundock		

CVRWQCB QA Representative:		Date:	
	TBD		

DRMP Program Manager:		Date:	
	Melissa Turner		

DRMP QA Officer:		Date:	
	Will Hagan		