



RMP
REGIONAL MONITORING
PROGRAM FOR WATER QUALITY
IN SAN FRANCISCO BAY

sfei.org/rmp

2019 RMP Water Cruise Report

Prepared by:

Paul Salop & Clifton Herrmann, Applied Marine Sciences

CONTRIBUTION NO. 967 / September 2019

Cruise Report

2019 RMP Water Cruise

Contract No. 1300

September 19, 2019

Submitted to:

San Francisco Estuary Institute
4911 Central Ave
Richmond, CA 94804

Submitted by:



4749 Bennett Drive, Suite L
Livermore, CA 94551
925-373-7142

1. Introduction

This report details activities associated with the annual Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) water cruise. The RMP water sampling program was redesigned in 2002 to adopt a randomized sampling design at thirty-one sites in place of the twenty-six “spine of the Estuary” stations sampled previously. In 2007, the number of sites was decreased to twenty-two stations and it remains as such for 2019.

2. Cruise Report

2.1. Objectives

All sampling was conducted from the *RV Turning Tide*. The objectives of the sampling effort were to collect the following:

Real-time Data on Field Parameters

1. Real-time data over the duration of sampling for conductivity, temperature, optical back scatter (OBS), and dissolved oxygen (DO) by AMS (1-meter CTD cast for duration of sampling, plus a full water column profile where water depth allows).
2. Water samples from 22 sites for on-board (field meter) measurement of DO, pH, salinity, conductivity, and temperature by SFEI.
3. Document current and recent weather conditions at each site.

Water Samples – Total Fraction (Unfiltered water samples)

4. 22 sites (and 2 replicates and 1 blank) for analysis of Weak Acid Dissociable (WAD) Cyanide (BAL)
5. 22 sites (and 2 replicates and 1 blank) for analysis of SSC (BAL)
6. 22 sites (and 2 replicates and 1 blank) for analysis of Chla (Caltest)
7. 9 sites (and 0 replicates and 0 blanks) for analysis of aquatic toxicity (PER)
8. 19 sites (and 2 replicates and 2 blanks) for ethoxylated surfactants (Duke)

Water Samples – Particulate Fraction (Filters)

9. 22 sites (and 2 replicates and 1 blank) for Particulate Organic Carbon (POC) (ALS)
10. 22 sites (and 2 replicates and 1 blank) for analysis of Cu (BAL)
11. 22 sites (and 2 replicates and 1 blank) for analysis of Se (BAL)
12. 22 sites (and 2 replicates and 1 blank) for analysis of MeHg (BAL)

Water Samples – Dissolved Fraction (Filtrate)

13. 22 sites (and 2 replicates and 1 blank) for analysis of Dissolved Organic Carbon (DOC) (ALS)
14. 22 sites (and 2 replicates and 1 blank) for analysis of hardness (BAL)
15. 22 sites (and 2 replicates and 1 blank) for analysis of MeHg (BAL)
16. 22 sites (and 2 replicates and 1 blank) for analysis of Cu - column chelation (BAL)
17. 22 sites (and 2 replicates and 1 blank) for analysis of Cu - reductive precipitation (BAL)

2.2. Personnel

The personnel and work assignments for this cruise are shown in Table 1.

Table 1. Personnel for 2019 RMP Water Cruise

Name	Affiliation	Duties
Paul Salop	AMS	Cruise Manager (7/30)
Winn McEnergy	AMS	Cruise Manager (7/30 - 8/1)
Clifton Herrmann	AMS	Cruise Manager (8/1-8/5)
Don Yee	SFEI	Field Sampling (7/30-7/31)
Amy Franz	SFEI	Field Sampling (7/31-8/2)
Diana Lin	SFEI	Field Sampling (7/30)
Ila Shimabuku	SFEI	Field Sampling (7/30-8/2)
Nina Buzby	SFEI	Field Sampling (7/30-8/1, 8/5)
Liz Miller	SFEI	Field Sampling (7/30, 8/1)
Melissa Foley	SFEI	Field Sampling (8/2, 8/5)
Adam Wong	SFEI	Field Sampling (8/2, 8/5)
Chris Vallee	USGS	Captain, RV Turning Tide
Norbert VandenBranden	USGS	1st Mate, RV Turning Tide
Jerry Eldorado	Aloha Trans	Logistics

2.3. Sampling Activities

Sampling activities for the 2019 RMP Water Cruise are shown in Table 2

Table 2. Sampling Activities for 2019 RMP Water Cruise

Date	Time	Activity
July 29	0900-1635	<i>RV Turning Tide</i> transits from Oakley to Redwood City Marina.
	1600-1830	AMS and SFEI personnel mobilize sampling equipment and load aboard vessel <i>RV Turning Tide</i> at Redwood City Marina .
July 30	0700-1558	Mobilized remaining sampling gear aboard vessel at Redwood City Marina . Sampled BA30, LSB074W, LSB075W, LSB077W, LSB076W, and LSB078W. Returned to Redwood City Marina and demobilized vessel.
	1500-1730	Aloha retrieved all samples and transferred to AMS.

Date	Time	Activity
July 31	0700-1430	Mobilized sampling gear aboard vessel at Redwood City Marina . Sampled SB074W, SB075W, SB076W, CB050W, and BC10. Transited to Emeryville Marina and demobilized vessel.
	1100-1300	Aloha Transportation retrieved 7/30 toxicity samples and delivered to PER.
	1430-1730	Aloha Transportation met vessel at Emeryville Marina and delivered all personnel to personal vehicles in Redwood City and all samples to AMS.
Aug 1	0630-1358	Mobilized sampling gear aboard vessel at Emeryville Marina . Sampled BC20, CB047W, and CB049W. Transited to Emeryville Marina and demobilized vessel.
	1000-1200	Aloha Transportation retrieved 7/31 toxicity samples from AMS and delivered to PER.
	1400-1700	Aloha Transportation met vessel at Emeryville Marina and retrieved all samples; delivered 8/1 toxicity samples to PER and all remaining samples to AMS.
Aug 2	0730-1523	Mobilized sampling gear aboard vessel at Emeryville Marina . Sampled SPB046W, SPB047W, and SPB048W. Transited to Benicia Marina and demobilized vessel.
	1430-1830	PER courier met vessel at Benicia Marina and received 8/2 toxicity samples. Aloha Transportation met vessel at Benicia Marina and delivered all personnel to personal vehicles in Emeryville and all samples to AMS.
Aug 5	0730-1530	Mobilized sampling gear aboard vessel at Benicia Marina . Sampled SU057W, SU055W, and SU056W.
	1145-1230	Transited to Pittsburg Marina to deliver ethoxylated surfactant samples for shipping.
	1250-1545	Sampled BG20, and BG30. Transited to Driftwood Marina and demobilized vessel. PER courier met vessel at Driftwood Marine and received all toxicity samples. AMS returned all sampling equipment and samples to AMS.
	1515-1600	Aloha Transportation met vessel at Driftwood Marina and delivered sampling personnel to personal vehicles in Benicia.

2.4. Discussion

As discussed in the Sampling and Analysis Plan, two sites were removed from the list of target sites prior to sampling. Site SPB045W was replaced due to its inaccessibility across a wide, shallow flat. Site CB048W was replaced because of its location within Seaplane Lagoon within the former Alameda Naval Air Station.

Due to the rough seas offshore San Francisco at BC20, the surface CTD cast and depth cast were cut short. In addition, engines were left on at BC20 during sampling to maintain boat orientation. All other CTD casts during the 2019 water cruise were completed without issue.

Due to a miscommunication, samples collected on August 1st and 2nd, 2019, and intended for analysis of DOC were mistakenly frozen rather than refrigerated upon their arrival at AMS on August 2nd. The mistake was identified on Monday, August 5th and affected samples were allowed to thaw in the refrigerator. Upon thawing, several of the DOC containers fractured, rendering them unusable. Affected samples included the following:

CB047W	- 0 of 2 lost
CB049W	- 0 of 2 lost
BC20	- 0 of 2 lost
BLIND4	- 0 of 2 lost
FB3	- 2 of 2 lost
SPB046W	- 2 of 2 lost
SPB047W	- 2 of 2 lost
SPB048W	- 1 of 2 lost

Samples that survived the thawing process were deemed acceptable to forward to the laboratory for analysis. To make up for lost samples, SFEI coordinated with Caltest to retrieve unused sample material originally collected for analysis of chlorophyll-a samples to generate replacement field samples and laboratory blank water provided by ALS for collection of replacement equipment blank. AMS and SFEI then collaborated to complete filtering of replacement samples at SFEI on August 13th. The replacement field samples will show the original field sample collection date and time (8/1/19 or 8/2/19), while the field blank will show date and time of filtering as sample collection time. A list of dates and times that filtering was conducted for each of the replacement samples was provided to ALS to assist with EDD generation.

2.5. Sample Labeling

The sample ID system for all samples was as follows:

RMP-19WC-XXXX

Where:

RMP	=	Project
19	=	Cruise Year
WC	=	Matrix (Water Cruise)
XXXX	=	Unique ID number

2.6. Sampling Sites

2019 RMP Water Cruise sampling sites are listed in Table 3. All samples collected are listed in Table 4. Sample containers and sample handling procedures are summarized in Table 5. Weather conditions encountered at time of sampling are shown in Table 6. Snapshot of water quality parameters recorded from SFEI YSI meter are shown in Table 7.

Table 3. 2019 RMP Water Cruise Site Coordinates and Water Depth at Initiation of Sampling.
 Sample depths are not corrected for tidal action.

Site Code	Target		Actual		Depth (m)
	Lat	Long	Lat	Long	
BA30	37.51375	-122.1346	37.51361	-122.13433	5.6
BC10	37.82158	-122.3495	37.82161	-122.34959	7.9
BC20	37.7915	-122.6733	37.79206	-122.67448	30.1
BG20	38.0597	-121.8113	38.05966	-121.81125	9.5
BG30	38.02054	-121.8063	38.02043	-121.80579	9.8
CB047W	37.82831	-122.4415	37.82901	-122.43998	11
CB049W	37.86503	-122.3599	37.86528	-122.35982	4.4
CB050W	37.63793	-122.3541	37.63778	-122.35443	5.4
LSB074W	37.49131	-122.1008	37.49115	-122.10049	7
LSB075W	37.47856	-122.0751	37.47821	-122.07488	6.7
LSB076W	37.4945	-122.086	37.49440	-122.08599	2.1
LSB077W	37.46904	-122.0601	37.46836	-122.06030	4
LSB078W	37.49277	-122.1087	37.49290	-122.10899	4.4
SB074W	37.53723	-122.1759	37.53715	-122.17591	9.4
SB075W	37.6292	-122.2681	37.62895	-122.26797	3.5
SB076W	37.61765	-122.2049	37.61747	-122.20483	2.9
SPB046W	38.05308	-122.2977	38.05290	-122.29797	11.3
SPB047W	38.08404	-122.429	38.04822	-122.42922	2.6
SPB048W	38.07982	-122.351	38.07996	-122.35076	2.6
SU055W	38.07263	-122.0817	38.07251	-122.08178	3.6
SU056W	38.06362	-122.008	38.06352	-122.00813	8.1
SU057W	38.12622	-122.0513	38.12605	-122.05124	1.8

Table 4. 2019 RMP Water Samples Collected by Site.

Parameter	FB1 (at BA30)	BA30	LSB074W	LSB075W	LSB077W + BLIND1	LSB076W	LSB078W	FB2 (at SB074W)	SB074W	SB075W	SB076W	CB050W + BLIND2	BC10	CB047W + BLIND3	BC20	CB049W	FB3 (at SPB046W)	SPB046W	SPB047W	SPB048W + BLIND4	SU057W	SU056W + BLIND5	SU055W	BG20	BG30	Total
CTD profile		1	1	1	1	1	1		1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	22
DO, SC, pH, T, Sal		1	1	1	1	1	1		1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	22
POC		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
DOC		2	2	2	2	2	2		2	2	2	4	2	2	2	2	2	2	2	4	2	2	2	2	2	50
Cu (P)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Se (P)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
MeHg (P)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
CN (WAD)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
SSC		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Chla		3	3	3	6	3	3		3	3	3	6	3	6	3	3	3	3	3	6	3	6	3	3	3	84
Tox (& TIE)		1	1						1					1	1								1	3	3	13
Hardness		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
MeHg (D)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Cu_ColChelation (D)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Cu_RedPrecip (D)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Se_ColSep (D)		1	1	1	1	1	1		1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	25
Ethoxylated Surfactant	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	0	0	0	0	1	1	1	1	1	23

Table 5. Containers and Sample Handling for 2019 RMP Water Cruise (T=total, P=particulate, D=dissolved). Samples to be stored with no additional preservation, on wet ice or refrigerated (4C), and in the dark, unless otherwise noted.

Parameter	T/P/D	Lab	Container	Handling Requirements
DO, cond, pH, temp, OBS	T	AMS	None	CTD deployment
DO, cond, pH, temp, sal	T	SFEI	None	Grab measurement on board vessel
POC	P	ALS	1 filter	Field filtered (particulate on filter of DOC sample) and stored on dry ice (-20C). 28-day hold time.
DOC	D	ALS	2 - 20 ml amber vial	Field filtered (filtrate of POC sample), stored in 1-2 mL H2SO4 in bottle on wet-ice. 28-day hold time.
Cu	P	BAL	1 filter	Stored on wet ice. 1-year hold time.
Se	P	BAL	1 filter	Stored on wet ice. 1-year hold time.
MeHg	P	BAL	1 filter	Stored on wet ice. 1-year hold time.
CN (WAD)	T	BAL	125-mL HDPE bottle	Pre-preserved containers with 130 uL of 50% NaOH to pH >10. Stored on wet ice. 14-day hold time.
SSC	T	BAL	1 L HDPE	Stored on wet ice. 7-day hold time.
Chla	T	Caltest	3 - 1L Amber HDPE bottles	Stored on wet ice.
Tox (& TIE)	T	PER	5 gallon FLPE-lined jerrycan	Stored on wet ice with 36-day hold time. 2 extra carboys at BG20 and BG30 collected.
Hardness	D	BAL	60 mL HDPE	Stored with HNO3 on wet ice. 14-day hold time.
MeHg	D	BAL	250 ml FLPE	No rinse; Stored in pre-preserved containers to 0.2% H2SO4, in dark environment and on wet ice. 6-month hold time.
Cu_ColChelation	D	BAL	60 mL HDPE	Stored with HNO3 on wet ice. 14-day hold time.
Cu_RedPrecip	D	BAL	1 L HDPE	Stored with HNO3 to 0.2% on wet ice. 14-day hold time.
Se_ColSep	D	BAL	125 mL glass	Stored with HNO3 to 0.1% on wet ice. 14-day hold time.
Ethoxylated Surfactant	T	Duke	2.5 L amber glass	Stored on wet ice. 24-hour hold time.

Table 6. Weather Conditions for 2019 RMP Water Cruise.

Site	Sea State	Tide Stage & Current (fps)	Wind Speed (kts)	Wind Dir.	Cloud Cover, % Overcast	Comments
BA30	Calm	Flood, < 1	4.4	West	10%	
BC10	White Capping, 1-2 ft chop	Light ebb	26	West southwest	0%	
BC20	1-3 ft Wind waves	West, 10	6	West	100%	Engines left on to maintain orientation
BG20	1 ft waves	Light ebb	11	West	60%	
BG30	Wavelets	Flood, 0.5	7	West	60%	
CB047W	Choppy	Strong flood	14	South southwest	100%	
CB049W	Choppy	Light flood	9	South southwest	90%	
CB050W	Light chop	Light flood	6	North	0%	
LSB074W	Calm	Flood, 1	2	East northeast	10%	
LSB075W	Calm	Flood, 1.5	10	North northwest	5%	
LSB076W	Light chop	Light ebb	20	Northwest	0%	
LSB077W	Light ripple	Flood, < 1	12	Northwest	0%	
LSB078W	Choppy	Ebb, < 1	12 - 15	North northwest	0%	
SB074W	Calm	Light flood	< 2	South	100%	
SB075W	Light chop	Light flood	< 1	East	80%	
SB076W	Calm	NR	2	West	60%	
SPB046W	1-2 ft waves	Flood, 1	9.5	South	0%	
SPB047W	White caps, 1ft waves	Light flood	15	South	0%	
SPB048W	Choppy 1 ft wind waves	Flood	1.5	South southwest	0%	
SU055W	1-2ft waves	Ebb	14	West northwest	0%	
SU056W	1-3 ft Waves	Ebb, 1	10	Southwest	10%	
SU057W	Light chop	Ebb	11	West	0%	

Table 7. Recorded Water Quality Parameters. All results recorded as snapshot from SFEI YSI meter deployed at approximately 1m depth for duration of sampling. NR=Not recorded.

Site	DO (%)	DO (mg/L)	Cond. (mS/cm)	Temp (°C)	pH	Salinity (ppt)
BA30	80	NR	37.52	22.61	7.88	23.81
BC10	107.3	8.26	44.86	18.39	8.19	29.07
BC20	94.1	7.78	49.57	15.02	8.21	32.45
BG20	90.1	7.7	0.485	23.15	7.65	0.23
BG30	90.5	7.62	0.943	23.82	7.71	0.46
CB047W	96.8	7.81	47.48	16.53	8.16	30.96
CB049W	97.6	7.81	45.27	17.49	7.98	29.37
CB050W	114.5	8.88	43.87	19.5	8.37	28.36
LSB074W	82.1	6.16	37.49	22.77	8.04	23.79
LSB075W	82.4	6.19	37.43	22.73	6.18	23.74
LSB076W	95.4	7.11	37.55	22.74	8.11	23.89
LSB077W	83.6	6.29	37.1	22.82	7.82	23.52
LSB078W	97.1	7.24	38.57	22.96	8.2	24.56
SB074W	84.7	NR	38.37	22.31	7.99	24.42
SB075W	94.9	7.27	41.4	20.81	8.19	26.59
SB076W	92.2	7.02	40.04	21.55	8.19	25.6
SPB046W	92.7	7.47	30.89	20.29	7.93	19.22
SPB047W	106.4	8.43	34.4	20.36	8.07	21.66
SPB048W	104.4	8.31	34.34	20.16	7.95	21.56
SU055W	95.5	7.94	17.94	21.19	7.81	10.63
SU056W	92.5	7.79	11.2	22.17	7.86	6.38
SU057W	91.5	7.66	13.1	21.96	7.4	7.61