Regional Monitoring Program

for Water Quality in San Francisco Bay

Cruise Report

2018 RMP Sediment Cruise

Contract #1343

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Prepared by

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Contribution #907

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1. Introduction

This report outlines details from the annual Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) sediment cruise, conducted August 14 – 21, 2018. The Regional Monitoring Program conducts routine monitoring of water, sediment and biological tissue. The current study design calls for monitoring of water and bivalves every two years and sediment every four years. Bird egg monitoring (cormorant and terns) is conducted triennially, while sport fish are monitored on a five-year rotation. For 2018, sampling operations entailed dry season collections at 27 RMP sediment sampling sites.

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:

1. Collect a water column profile at each of the 27 sediment sites for analysis of temperature, salinity, electrical conductivity, optical backscatter, dissolved oxygen, density, and pressure by Applied Marine Sciences (AMS).
2. Collect cores for on-board analysis of ORP at 27 sites by San Francisco Estuary Institute (SFEI).
3. Collect direct pH measurements from the interstitial water found in the undisturbed sediment in the grab at 27 sites by AMS.
4. Collect sediment samples from 27 sites plus 2 field blanks and 2 field duplicates for analysis of:
    1. Sediment Quality Parameters (Total Solids, TN, total organic carbon) by ALS
    2. Sediment Grain Size by ALS
    3. Trace Elements (Al, Cd, Cu, Fe, Pb, Mn, Ni, Ag, and Zn) by the City and County of San Francisco (CCSF)
    4. Trace Elements (As, Hg, MeHg, Se) and Total Solids by Brooks Analytical Labs (BAL)
    5. Polycyclic Aromatic Hydrocarbons and Total Solids by SGS AXYS Analytical
    6. Polychlorinated Biphenyls and Total Solids by SGS AXYS Analytical
    7. Polybrominated Diphenyl Ethers and Total Solids by SGS AXYS Analytical
    8. Fipronil and Total Solids by SGS AXYS Analytical
5. Collect sediment samples for special studies:
    - Collect sediment samples from 16 sites plus 2 field dups and 2 field blanks for analysis of Siloxanes by DTSC
    - Collect sediment samples from 13 sites for analysis of QACs and antibiotics by UMinn
    - Collect sediment samples from 5 sites plus 1 field blank and 1 field duplicate for non-targeted analysis by Duke and SDSU
    - Collect water samples from 5 sites plus 1 field blank and 1 field duplicate for analysis of gadolinium by UFB
6. Collect sediment samples from 27 sites for short-term trace metals archives
7. Collect sediment samples from 27 sites for short-term trace organics archives
8. Collect sediment samples from 7 sites for long-term archive at NIST
9. Collect sediment samples from 7 sites for long-term NIST archive for PFCs

10. Send archive samples from three sites for analysis of:
    1. Trace Elements (Al, Cd, Cu, Fe, Pb, Mn, Ni, Ag, and Zn) by the City and County of San Francisco (CCSF)
    2. Trace Elements (As, Hg, MeHg, Se) and Total Solids by Brooks Analytical Labs (BAL)
    3. Polycyclic Aromatic Hydrocarbons and Total Solids by SGS AXYS Analytical
    4. Polychlorinated Biphenyls and Total Solids by SGS AXYS Analytical
    5. Polybrominated Diphenyl Ethers and Total Solids by SGS AXYS Analytical
    6. Fipronil and Total Solids by SGS AXYS Analytical

2.2. Personnel

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

Table 1. Personnel for 2018 RMP Sediment Cruise

Name	Affiliation	Duties
Paul Salop	AMS	Cruise Manager, Field Sampling 8/14-8/15, 8/20
Sara Driscoll	AMS	Field Sampling, 8/14 - 8/16
Clifton Herrmann	AMS	Field Sampling, 8/17, 8/21
Winn McEnery	AMS	Field Sampling, 8/20 – 8/21
Aroon Melwani	AMS	Field Sampling, 8/16 - 8/17
Don Yee	SFEI	Field Sampling, 8/14 - 8/15
Amy Franz	SFEI	Field Sampling, 8/17, 8/20 - 8/21
Adam Wong	SFEI	Field Sampling, 8/15 - 8/16
Ila Shimabuku	SFEI	Field Sampling, 8/14 - 8/15, 8/21
Diana Lin	SFEI	Field Sampling, 8/14
Lawrence Sim	SFEI	Field Sampling, 8/16, 8/21
Meg Sedlak	SFEI	Field Sampling, 8/17, 8/20
Nina Buzby	SFEI	Field Sampling, 8/16-8/17, 8/20
Shira Bezalel	SFEI	Photographer, 8/21
Chris Vallee	USGS	*RV Turning Tide*, Captain, 8/14-8/21
Norbert VandenBranden	USGS	*RV Turning Tide*, Mate, 8/14-8/21
Jerry Eldorado	Aloha Trans	Logistics. 8/14-8/20

Mr. Salop was responsible for oversight of sampling operations; compliance with cruise plan, quality assurance guidelines, and field operations manual; maintenance of the sample field log; chain-of-custody procedures; and CTD profiling. Ms. Franz was responsible for coordination of SFEI field personnel. AMS and SFEI personnel were jointly responsible for sample collection and sample processing. Captain Vallee was responsible for vessel operation and safety.

2.3. Sampling Activities

Sampling activities for the 2018 RMP Water Cruise are shown in Table 2.

Table 2. Sampling Activities for 2018 RMP Sediment Cruise

Date	Time	Activity
August 13, 2018	1400 – 1800	AMS personnel transported and mobilized all sampling gear aboard vessel *RV Turning Tide* at Redwood City Marina.
August 14, 2018	0715 – 0800	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Redwood City Marina. Conducted safety briefing and departed for LSB011S.
	0835 – 1002	Sampled LSB011S, departed for LSB001S
	1017 – 1126	Sampled LSB001S, departed for BA10
	1133 – 1313	Sampled BA10, departed for LSB002S
	1322 – 1405	Sampled LSB002S, departed for LSB056S
	1420 – 1501	Sampled LSB056S, departed for Redwood City Marina
	1550 – 1610	Arrived Redwood City Marina and demobilized vessel. Aloha Transportation retrieved all samples for transport to AMS.
August 15, 2018	0840 – 0907	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Redwood City Marina. Conducted safety briefing and departed for BA41.
	0948 – 1043	Sampled BA41, departed for SB058S
	1054 – 1137	Sampled SB058S, departed for SB042S
	1202 – 1259	Sampled SB042S, departed for SB011S
	1345 – 1416	Sampled SB011S, departed for CB002S
	1426 – 1449	Sampled CB002S, departed for SB002S
	1540 – 1610	Sampled SB002S, departed for Emeryville Marina
	1749 - 1805	Arrived Emeryville Marina and demobilized vessel. Aloha Transportation retrieved all samples for transport to AMS and transferred sampling personnel to Redwood City.
August 16, 2018	0750 – 0800	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Emeryville Marina. Conducted safety briefing and departed for BC11.
	0840 – 0950	Sampled BC11, departed for CB001S
	1006 – 1042	Sampled CB001S, departed for CB057S
	1055 – 1115	Sampled CB057S, departed for CB011S
	1205 – 1240	Sampled CB011S, departed for SPB047S

Date	Time	Activity
	1308 – 1331	Sampled SPB047S, departed for SPB057S
	1408 – 1440	Sampled SPB057S, departed for Benicia Marina
	1600 – 1615	Arrived Benicia Marina and demobilized vessel. Aloha Transportation retrieved all samples for transport to AMS and transferred sampling personnel to Emeryville.
August 17, 2018	0715 – 0730	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Benicia Marina. Conducted safety briefing and departed for SPB002S.
	0825 – 0908	Sampled SPB002S, departed for BD31
	0920 – 1005	Sampled BD31, departed for SPB001S
	1035 – 1100	Sampled SPB001S, departed for Benicia Marina
	1200 – 1220	Arrived Benicia Marina and demobilized vessel. Aloha Transportation retrieved all samples for transport to AMS.
August 20, 2018	0645 – 0715	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Benicia Marina. Conducted safety briefing and departed for SU073S.
	0754 – 0833	Sampled SU073S, departed for BF21
	0842 – 0918	Sampled BF21, departed for SU041S
	0940 – 1024	Sampled SU041S, departed for SU011S
	1045 – 1132	Sampled SU011S, departed for SU001S
	1139 – 1204	Sampled SU001S, departed for Driftwood Marina
	1310 – 1325	Arrived Driftwood Marina and demobilized vessel. Aloha Transportation retrieved all samples for transport to AMS and transferred sampling personnel to Benicia.
August 21, 2018	0730 – 0800	SFEI and AMS personnel mobilized all sampling gear aboard vessel at Driftwood Marina. Conducted safety briefing and departed for BG30.
	0825 – 0915	Sampled BG30, departed for BG20
	0940 – 1020	Sampled BG20, departed for Driftwood Marina
	1130 – 1230	Arrived Driftwood Marina and demobilized vessel. Mr. Salop retrieved all samples and sampling gear for transport to AMS.

2.4. Discussion

All cruise objectives were met. The sediment sampling took place during a period not particularly conducive to sampling shallower locations, as daily higher tides occurred during darkness. Therefore, sampling personnel made changes to the order of stations from the original cruise plan to optimize ability to access shallower sites. Additionally, one station was abandoned in the field and replaced with one of the preestablished 2018 oversample sites:

- SPB011S is located near the mouth of the Petaluma River in the northern portion of San Pablo Bay. This site was found to be too shallow for the *RV Turning Tide*, and was replaced with

SPB0057S. As this site is a repeating site, it will not be replaced permanently, but will instead be attempted upon its next turn in the rotation.

As described within the Sampling and Analysis Plan (SAP), an additional three sites were pre-abandoned during the cruise planning stage. These sites are described below:

- Site SB043S is located in a fouled area around SFO that has multiple hazards identified on nautical charts (e.g., duck blinds, ruins, submerged stakes). It was replaced with oversample site SB058S.

- Site CB047S is located at approximately 150' depth in a known high current area. Based upon prior experience, the odds of collecting two viable grabs is remote. The site was replaced with oversample site CB057S.

- Site LSB047S is located in a restricted anchoring zone around a pipeline south of the Dumbarton Bridge and an adjacent railroad bridge. It was replaced with oversample site LSB056S.

Some samples were compromised to an extent during collection. Actions taken to address specific issues are listed below:

- Collection of field blank samples for analysis of Total Nitrogen, TOC, Particle Size, Trace Elements by both CCSF and BAL, Organics, Gadolinium, and NTAs was planned for collection at site BA10 (ID FB-002) on August 14th. Blanks were collected at this site for Gadolinium and NTA, but the remaining containers were inadvertently filled with sediment by sampling personnel. When this was discovered, these samples were discarded by AMS, and arrangements were made for field blanks of these analytes to be collected at site SU073S instead. Field blanks for all of the above analytes were assigned the ID FB-002, although the sampling location was different and was identified as such on the sample collection info spreadsheet provided by AMS.

- Blind duplicates for the analytes Total Nitrogen, TOC, Particle Size, Trace Elements by both CCSF and BAL, and PCB's were planned for collection at site SPB011S. Field staff instead collected these duplicates (ID BLIND4) at site CB011S.

All samples were received by laboratories the week of August 20 (ALS, AXYS, and CCSF) or August 27 (BAL, NIST, and U-Minn). Sample labels for two of the sample containers shipped to BAL fell off during shipping. AMS provided information to attempt to distinguish between the two samples, but it is unknown how this issue was resolved at the lab.

Short-term archives are currently stored in a -20 C freezer at AMS. They will remain at AMS until the 2018 bivalve archives are returned from AXYS, at which time all 2018 archives will be transferred to Schaefer's and tracked as a new lot.

2.5. Sample Labeling

The sample ID labeling system used for the 2018 cruise is as follows:

RMP-18SC-XXXX-Y

Where:

RMP	=	Project
18	=	Cruise Year
SC	=	Matrix (Sediment Cruise)
XXXX	=	Unique ID number
Y	=	Unique aliquot number (applies only to archives)

2.6. Sampling Sites

2018 RMP Sediment 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.

Table 3. 2018 RMP Water Cruise Site Coordinates and Water Depth. Sample depths are not corrected for tidal action.

Site Code	Latitude		Longitude		Depth (m)	Sediment Character and Comments
	Target	Actual	Target	Actual		
BC11	37.82232768	37.82216	-122.3492815	-122.34910	6.1	Soft, benthos present
BA10	37.46823888	37.46819	-122.0639734	-122.06343	4.2	Fines, shell
BG20	38.05895268	38.05979	-121.8143678	-121.81104	9.9	Fines, sand
BG30	38.02282086	38.02044	-121.8083671	-121.80568	9.5	Fines, sand
BA41	37.55903527	37.55948	-122.210577	-122.21006	3.6	Fines, shell
BD31	38.02412178	38.02368	-122.363683	-122.36467	7.1	Unconsolidated fines
BF21	38.11551792	38.11542	-122.0404754	-122.04058	2.4	Unconsolidated fines
CB001S	37.87631112	37.87595	-122.3615019	-122.36154	2.8	Fine, tubes present
CB002S	37.62508623	37.62509	-122.3472116	-122.34694	3.5	Fines, *Ampeliska*
CB011S	37.96757351	37.96787	-122.4506445	-122.45097	1.8	Very soft/sandy
CB057S	37.87648219	37.87648	-122.3817323	-122.38176	3.3	Fines
LSB001S	37.49183613	37.49172	-122.0985143	-122.09888	5.9	Fines, shells
LSB002S	37.47912655	37.47886	-122.0779838	-122.07785	9.9	Fines, shells, clams
LSB011S	37.50367068	37.50401	-122.1187347	-122.11941	14.3	Fines, shells, some rocks.
LSB056S	37.49187127	37.49177	-122.0766739	-122.07634	2.4	Fines, evidence of worms
SB002S	37.61019366	37.61020	-122.1673764	-122.16745	2.8	Fines, unconsolidated over consolidated
SB011S	37.61016066	37.61006	-122.3395914	-122.33975	13	Fines, *Ampeliska*, shell
SB042S	37.59018928	37.59010	-122.1948669	-122.19474	2.6	Fines, *Ampeliska*
SB058S	37.56262121	37.56269	-122.1955567	-122.19563	7.7	Fines, *Ampeliska*
SPB001S	38.07196053	38.07132	-122.3865946	-122.38689	3.1	Fines, anoxic
SPB002S	38.01640698	38.01648	-122.3412822	-122.34154	2.9	Fines
SPB047S	38.00754627	38.00769	-122.4580252	-122.45798	2.5	Fines, sand
SPB057S	38.04839316	38.04862	-122.4278153	-122.42782	5.5	Consolidated fines, anoxic
SU001S	38.09944846	38.09929	-122.0465753	-122.04653	7	Consolidated fines, peat
SU011S	38.07633053	38.07545	-122.1042465	-122.10023	4.5	Fines
SU041S	38.11116618	38.11110	-122.0584658	-122.05835	3.1	Fines
SU073S	38.11074613	38.11065	-122.0487255	-122.04864	2.4	Unconsolidated Fines

Table 4. 2018 RMP Sediment Samples Collected by Site (does not include QA samples).

SITE CODE	REGION	pH / Eh / CTD	ALS_N	ALS_TOC_TS	ALS_PCMSC	TE_CCSF	TE_BAL	PCB_AXYS	ARCH_TE_250	ARCH_ORG_60	ARCH_NIST_22	ARCH_PFC_10	Silox_DTSC	QAC/AB_UMN	NTA_SFEI	Gadolinium	pH (avg.)
BC11	CB	x	x	x	x	x	x	x	x	x	x	x	x	x			7.3
BA10	LSB	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	7.5
BG20	Rivers	x	x	x	x	x	x	x	x	x	x	x	x	x			7.5
BG30	Rivers	x	x	x	x	x	x	x	x	x	x	x	x	x			7.8
BA41	SB	x	x	x	x	x	x	x	x	x	x	x	x	x	x		7.3
BD31	SPB	x	x	x	x	x	x	x	x	x	x	x	x				7.5
BF21	SU	x	x	x	x	x	x	x	x	x	x	x	x				7.5
CB001S	CB	x	x	x	x	x	x	x	x	x			x	x			7.3
CB002S	CB	x	x	x	x	x	x	x	x	x				x			7.3
CB011S	CB	x	x	x	x	x	x	x	x	x			x				7.2
CB057S	CB	x	x	x	x	x	x	x	x	x			x				7.3
LSB001S	LSB	x	x	x	x	x	x	x	x	x			x	x		x	7.3
LSB002S	LSB	x	x	x	x	x	x	x	x	x				x	x	x	7.1
LSB011S	LSB	x	x	x	x	x	x	x	x	x						x	7.6
LSB056S	LSB	x	x	x	x	x	x	x	x	x						x	7.
SB002S	SB	x	x	x	x	x	x	x	x	x			x	x	x		7.3
SB011S	SB	x	x	x	x	x	x	x	x	x							7.4
SB042S	SB	x	x	x	x	x	x	x	x	x					x		7.4
SB058S	SB	x	x	x	x	x	x	x	x	x							7.2
SPB001S	SPB	x	x	x	x	x	x	x	x					x			7.3
SPB002S	SPB	x	x	x	x	x	x	x	x	x			x				7.0
SPB047S	SPB	x	x	x	x	x	x	x	x	x			x	x			7.2
SPB057S	SPB	x	x	x	x	x	x	x	x	x			x				7.3
SU001S	SU	x	x	x	x	x	x	x	x	x							7.5
SU011S	SU	x	x	x	x	x	x	x	x	x			x	x			7.8
SU041S	SU	x	x	x	x	x	x	x	x	x							7.3
SU073S	SU	x	x	x	x	x	x	x	x	x							7.5
Total		27	27	27	27	27	27	27	27	26	7	7	16	13	5	5	-

Table 5. Containers and Sample Handling for 2018 RMP Sediment Cruise.

Analyte Code	Parameters	Container	Handling Requirements
pH / Eh / CTD	pH, Oxidation-Reduction Potential, CTD	None	Measurements on board vessel
ALS_TN	Total Nitrogen	8 oz clear glass jar	Store and ship on wet ice.
ALS_TOC_TS	Total Organic Carbon/Total Solids	8 oz clear glass jar	Store and ship on wet ice.
ALS_PCMSC	Particle Size Determination	16 oz clear glass jar	Store and ship on wet ice.
TE_CCSF	Trace Elements – (Al,Cd,Cu,Fe,Pb,Mn,Ni,Ag,Zn) Total Solids	250 mL HDPE	Place on dry ice
TE_BAL	Trace Elements – (As, Hg, MeHg, Se) Total Solids	250 mL plastic wide mouth jar, double bagged	Place on dry ice immediately (within 20 minutes) following collection.
PCB_AXYS	Organics (PCBs, PBDEs, PAHs, Fipronils)	250 mL (8 oz) amber glass jar	Fill ¾ full. Store and ship on wet ice.
ARCH_TE_250	Short-term trace metals archive	250 mlLHDPE (2 per site)	Place on dry ice after collection
ARCH_ORG_60	Short-term trace organics archive	60 ml glass (3 per site)	Place on dry ice after collection
ARCH_NIST_22	Long Term Archive	22 ml Teflon vial (3 per site)	Place on dry ice after collection
ARCH_NIST_10	Long Term Archive for PFAS	10 ml cryovial (3 per site)	Collect directly from grab. Place on dry ice after collection.
Silox_DTSC	Siloxanes	250 mL clear glass jars	Collect directly out of grab top 5-10 mm using scoops provided for CECs work. Do not homogonize. Fill a little more than 3/4 full. Place on wet ice within 20 minutes of first successful grab collection.
QAC/AB_UMN	QACs and antibiotics	Qorpack bottles (250 mL) and lids	Fill ~ 80% full. Put in cooler on wet ice after collection, freeze at end of day.
NTA_SFEI	Non-targeted analyses	500 mL glass	Collect directly from grab using CECs scoops provided. Take one scoop from each grab collected (up to three). Fill composite jar ~80% full (250 mL actual amount needed). Put in cooler on wet ice after collection and bring to SFEI for compositing. DO NOT FREEZE in field. Blanks collected in amber glass, samples collected in clear glass.
Gadolinium_UFB	Gadolinium	250 mL plastic	Water grab, fill ~75% full; place in cooler on wet ice (do not freeze)

Table 6. Weather Conditions for 2018 RMP Sediment Cruise.

Site	Sea State	Current (kts)	Tide Stage	Wind Speed (kts)	Wind Dir.	Cloud Cover, % Overcast	Comments
BC11	Calm	0.6	Flood	6	SW	50	
BA10	Light Ripple	1.2	Slack	16	WNW	60	
BG20	Moderate Chop	0.6	Flood	19	WSW	0	
BG30	Small Chop	0.3	Ebb	10	SW	0	
BA41	Calm	0.3	Flood	7	W	100	
BD31	Light Chop	0.6	Slack	3	W	90	
BF21	Moderate Chop	0.6	Flood	23	WSW	10	
CB001S	Moderate Chop	0.6	Slack	13	SW	10	
CB002S	Moderate Chop	0.3	Flood	21	W	10	
CB011S	Moderate ripple	0.3	Flood	8.5	ESE	0	
CB057S	Moderate Chop	0.6	Slack	15	SW	5	
LSB001S	Calm	0.6	Ebb	8.4	WNW	85	
LSB002S	Choppy	1.8	Slack	20	NW	10	
LSB011S	Calm	0.3	Light flood	6	W	95	
LSB056S	Choppy	0.9	Slack	22	NW	5	
SB002S	Choppy	0.3	Flood	18	W	0	
SB011S	Moderate Chop	0.3	Flood	21	W	10	
SB042S	Light Chop	0.6	Ebb	19	WNW	90	
SB058S	Light Chop	0.3	Light ebb	8	W	100	
SPB001S	Calm	0.3	Ebb	2	SSW	50	
SPB002S	Calm	0.3	Flood	6	SSW	100	
SPB047S	Light Chop	0.3	Slack	12	SE	0	
SPB057S	Moderate Chop	0.3	Slack	15	SSW	0	
SU001S	Light Chop	0.3	Flood	20	WSW	0	
SU011S	Light Chop	0.3	Flood	15	W	0	
SU041S	Light Chop	0.3	Flood	22	WSW	0	
SU073S	Moderate Chop	0.6	Flood	21	WSW	10	