



**Regional Monitoring Program
for Water Quality in San Francisco Bay**

Sampling and Analysis Plan

2023 RMP Sediment Cruise

Jul 19, 2023

Prepared by

Amy Kleckner, Rebecca Sutton, Don Yee, Adam Wong, and Jay Davis (SFEI)
with
Paul Salop (AMS)

Contribution #1138
San Francisco Estuary Institute
4911 Central Avenue
Richmond, CA 94804



www.sfei.org

Prepared by

Amy Kleckner, Rebecca Sutton, Don Yee, Adam Wong, and Jay Davis (SFED)

Introduction

1. Cruise Plan

1.1. Objectives

1.2. Cruise Schedule

1.3. Sample Labeling

1.4. Sample Collection Plan

1.5. Sampling Procedures

1.6. Sampling Stations

1.9 Sample Shipping

2. Laboratory Analyses

2.1. Laboratory Contacts

2.2. QA/QC Sample Collection and Analysis Plan

2.3. Plan for Analyzing Sediment Archives

Appendix A – RMP 2023 Oversample Site Coordinates

Appendix B - Archive Sample Bank Protocol

Introduction

This report details plans associated with the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) deep bay sediment cruise. The RMP, through the Status and Trends monitoring program, conducts routine monitoring of water, sediment and biological tissue. Deep bay stations (water depth lower than 1 foot below MLLW) have been sampled for the Status and Trends sediment program since its inception. The current monitoring design (reflective of changes made to the Program through the Status and Trends Review process) calls for sampling frequency of deep bay sediment for CECs, PBDEs, and ancillary analytes every five years during the dry season. Every ten years, metals, PAHs, and PCBs will also be sampled. For 2023, sampling operations will entail dry season sample collection at 16 RMP sediment sampling stations for CECs, PBDEs, and ancillary analytes in Central Bay, South Bay, and Lower South Bay.

Name	Affiliation	Duties	Cell	Initial and Date to Indicate Approval of SAP
Paul Salop	AMS	Cruise Manager	510-323-6523	PS 7/20/23
Amy Kleckner	SFEI	RMP Manager	415-531-3390	AK 7/24/23
Jay Davis	SFEI	RMP Lead Scientist	530-304-2308	
Don Yee	SFEI	RMP QA Officer	650-530-0603	
Rebecca Sutton	SFEI	RMP Scientist (CECs)	510-710-7050	RAS 7/20/23

1. Cruise Plan

1.1. Objectives

All sampling will be conducted from the R/V Questuary. The objectives of the sampling effort include the following:

1. Profile the water column at each of the 16 sediment stations for temperature, salinity, electrical conductivity, optical backscatter, dissolved oxygen, density, and pressure by Applied Marine Sciences (AMS).
2. Collect direct pH measurements from the interstitial water found in the undisturbed sediment in the grab at 16 stations by AMS.
3. Collect surface (top 5 cm) sediment samples from 16 stations plus 1 field blank and 1 field replicate for analysis of:
 1. Sediment Quality Parameters (total solids, TN, total organic carbon) by ALS
 2. Sediment Grain Size by ALS
 3. PFAS by SGS AXYS

4. Bisphenols by SGS AXYS
5. Polybrominated Diphenyl Ethers and total solids by SGS AXYS
5. Collect sediment samples for special studies:
 1. Collect samples from 3 stations for QACs by Bill Arnold / UMN
6. Collect sediment samples from the 4 historical/fixed stations for long-term archive at NIST
7. Collect sediment samples from 16 stations for short-term archives
8. Send archive samples from two stations for analysis of:
 1. Polybrominated Diphenyl Ethers and Total Solids by SGS AXYS

Personnel

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

Table 1. Personnel for July 24-28, 2023 RMP Sediment Cruise

Name	Affiliation	Duties	Cell
Paul Salop	AMS	Cruise Manager, Field Sampling: 7/24-7/27	510-323-6523
Theresa Venello	AMS	Field Sampling, 7/27	609-202-4030
Ellen Goldenberg	AMS	Field Sampling, 7/24	925-989-3646
Jackie Mohay	AMS	Field Sampling, 7/25, 7/26	571-274-8059
Colin Bowser	AMS	Field Sampling, 7/25	206-972-7830
Don Yee	SFEI	Field Sampling, 7/24/2023	650-530-0603
Amy Kleckner	SFEI	Field Sampling, TBD	415-531-3390
Martin Trinh	SFEI	Field Sampling, 7/27/2023	864-913-8237
Jennifer Dougherty	SFEI	Field Sampling, 7/24 - 7/26/2023	650-814-3403
Kayli Paterson	SFEI	Field Sampling, 7/26 - 7/27/2023	541-598-6285
Ezra Miller	SFEI	Field Sampling, 7/25/2023	505-239-6931
Shira Bezalel	SFEI	Photographer, 7/24/2023	510-761-3321
Chris Brown	CSUM	CSUM contact	415-300-6241
Nicolas Shields	CSUM	Captain RV Questuary	707-342-2291
Stephen Kielar	CSUM	Tech/Deckhand RV Questuary	315-790-0085

Paul Salop will be 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. Amy Kleckner will be responsible for coordination of SFEI field personnel. AMS and SFEI personnel will be responsible for sample collection and sample processing. Captain Nicolas Shields will be responsible for vessel operation and safety. Representatives of program sponsors and collaborating organizations may be aboard the *R/V Questuary* during portions of the cruise to observe/assist with sampling operations.

1.2. Cruise Schedule

The cruise schedule shown in Table 2 assumes that an average of forty-five minutes will be required for sampling at each station. The schedule is for planning purposes only, and may be revised during sampling operations to reflect weather conditions, tide restrictions, equipment performance, or other factors. Any sites unable to be sampled at the scheduled time will be rescheduled later in the cruise, if possible, or will be replaced with the first available oversample site from the same segment (see Appendix A). Any sites displaying a lack of suitable substrate within the immediate vicinity (*i.e.*, a complete lack of fine materials within a 100 m radius of the target coordinates) will be automatically replaced with the first available site from the oversample list.

Table 2. Anticipated Cruise Schedule for July 24-28, 2023 RMP Sediment Cruise

Date	Time	Activity
7/19	1100-1300	Mob equipment, Pittsburg Yacht Club
7/24	0800 - 1500	Mob, Safe Harbor Marina, Emeryville (3310 Powell St). Sample CB049S, CB001S, BD31, BC11. Return to Safe Harbor Marina.
7/25	0800 - 1000 1030 - 1800	Transit Questuary from Emeryville to Redwood City Mob, Westpoint Harbor Marina, Redwood City (101 Westpoint Harbor Dr). Sample SB051S, CB050S, CB048S, and SB002S (high tide 7.4' at 18:36). Return to Westpoint Harbor.
7/26	0730 - 0230	Mob, Westpoint Harbor Marina, Redwood City. Sample LSB049S, LSB048S, LSB002S, BA10, and LSB050S. Return to Westpoint Harbor.
7/27	0700 - 1230 12:30 - 14:30	Mob, Westpoint Harbor Marina, Redwood City. Sample SB046S, SB050S, and BA41 (lower high tide 5.8' at 9:32). Return to Westpoint Harbor. Demob, Westpoint Harbor Marina.

1.3. Sample Labeling

Each container will be labeled with a unique sample ID, the station code, analyte code, collection date, and collection time. The 4 digit unique ID number included in the sample ID should be written in permanent marker (Avoid regular and thick sized markers of any brand; fine and ultra-fine are acceptable) on top of the container in case the label becomes detached from the container.

The sample ID labeling system used for the 2023 cruise is as follows:

RMP-23SC-XXXX

Where:

RMP	=	Project
23	=	Cruise Year
SC	=	Matrix (Sediment Cruise)
XXXX	=	Unique ID number

The sample ID labeling system used for the NIST and short term archive samples for the 2023 cruise is as follows:

RMP-23SC-XXXX-Y

Where:

RMP	=	Project
23	=	Cruise Year
SC	=	Matrix (Sediment Cruise)
XXXX	=	Unique ID number
Y	=	Unique aliquot number

1.4. Sample Collection Plan

The number of samples, type and size of container and handling requirements for each analyte at each station are shown in Table 4.

[Table 4. Analyte Collection, Counts and Handling Instructions](#)

1.5. Sampling Procedures

Order of Sample Collection:

Notes: Field replicate samples of the same sample type should be collected at the same time.

Field blanks will be collected by opening the sample jar provided by SGS AXYS (containing Ottawa sand) during the filling process and closing it up again. This should occur near the van Veen grab for field samples collected directly, and in the cabin for field samples collected from the composite. Field blank for

the QACs analysis will be collected by opening an empty sample jar provided by UMN during the filling process (in the cabin) and closing it up again.

Unless otherwise indicated, samples collected at all 16 stations.

Samples collected from side of ship

- 1.1. SeaBird depth cast measurement

Samples collected directly from VanVeen grab (small uncoated stainless steel scoops may be used as needed to fill containers)

- 1.2. Measure pH in each grab
- 1.3. PFAS samples directly out of grab for SGS AXYS
- 1.4. Long-term archive for PFAS directly out of grab for NIST (historic/fixed stations only)
- 1.5. Short-term archive for PFAS directly out of grab

Fill order for samples collected from the composite bucket (bucket and scoops are stainless, coated with Kynar® industrial coating <https://www.metcoat.com/pvdf-kynar-coatings.htm>).

- 1.6. Bisphenols, Polybrominated Diphenyl Ethers, and total solids for SGS AXYS
- 1.7. Short-term archive for bisphenols and PBDEs
- 1.8. Total Nitrogen for ALS
- 1.9. TOC/TS for ALS
- 1.10. Sediment for grain size determination for ALS
- 1.11. Collect short-term archive from composite
- 1.12. QACs for UMN (select stations)

Water Quality Measurement Protocol

A profile of water quality conditions will be measured at each site following the protocols in the [2019 Field Operations Manual](#).

Sediment Sampling Protocol

Sediment samples will be collected from the top 5 cm of the VanVeen grab and field measurements will be made at each site following the protocols in the [2019 Field Operations Manual](#). The number of grabs needed for each site is estimated in Table 4.

To avoid contamination between stations, equipment used at different sampling stations should be re-cleaned in the field between uses. This includes the Van Veen grab, scoops, and compositing bucket. The procedure is as follows:

- Rinse equipment with station water.
- Scrub with dilute Alconox detergent, rinse with station water.
- Rinse with dilute HCl, followed by a methanol rinse, followed by a PFAS-free DI rinse (small uncoated stainless steel scoops) or reagent-grade DI water rinse (grab, larger Kynar-coated scoops, compositing bucket).

Sampling Protocols

1. PFAS:

(Note: This sampling involves PFAS Contamination Risk)

- 1.1. Nitrile gloves are essential; latex is prohibited. Avoid touching gloves with materials that are waterproof (e.g., waterproof clothing and shoes, including but not limited to Coated Tyvek®, Gore-Tex®, Scotchgard™, and RUCO®; waterproof paper and notebooks such as Rite in Rain®) or greaseproof (e.g., food packaging materials, including food wrap, paper towels, aluminum foil), because these materials may contain PFAS. Avoid touching gloves with first aid adhesive wrappers. Avoid touching gloves to your face or exposed skin, as some personal care products and sunscreens may contain PFAS. Avoid regular and thick sized markers of any brand (fine and ultra-fine are acceptable), sticky notes, and plastic clipboards. Avoid anti-fogging lens spray, wipes, or solutions for glasses or safety goggles. Avoid new (unwashed) clothing, and any clothes recently treated with fabric softeners, fabric protectors, insect resistance and water/stain/dirt-resistant chemicals.
- 1.2. Collect samples directly from the center of the grab, avoiding contact with the edges of the Van Veen that may have been in contact with the grab. Small uncoated stainless steel scoops can be used to collect the small NIST samples. For larger samples, the container will be used to collect most of the sample directly into the container; the same scoops can be used to complete sample collection. The sampler should wear clean nitrile gloves and, IF NEEDED, should wipe off excess sediment on the top rim and grooves of the container with gloves or a kimwipe to allow for a good seal. Fill all containers 80% full. Place on wet ice (no blue ice) and freeze after collection. Store frozen.

2. Bisphenols and PBDEs (common container):

- 2.1. Collect samples from the bucket after the sample has been homogenized. Sample bottles can be filled using the Kynar-coated scoops. The 250 ml bottles provided by the lab should be filled 80% full. Freeze after collection. Store frozen.

3. Quaternary Ammonium Compounds (QACs):

(Note: This sampling involves QAC Contamination Risk)

- 3.1. Avoid using QAC products (i.e., Lysol disinfecting sprays, Clorox wipes; alcohol-based antimicrobial products are acceptable). Avoid touching gloves with clothing that has been washed/dried with fabric softeners or dryer sheets. Cleaning sampling equipment with Liquinox is not recommended due to presence of lauramine oxide; Alconox is the preferred alternative.
- 3.2. Collect samples from the bucket after the sample has been homogenized. Sample bottles can be filled using the Kynar-coated scoops. The 250 ml bottles provided by the lab should be filled 80% full. Freeze after collection. Store frozen. Be careful to not smudge the label.

1.6. Sampling Stations

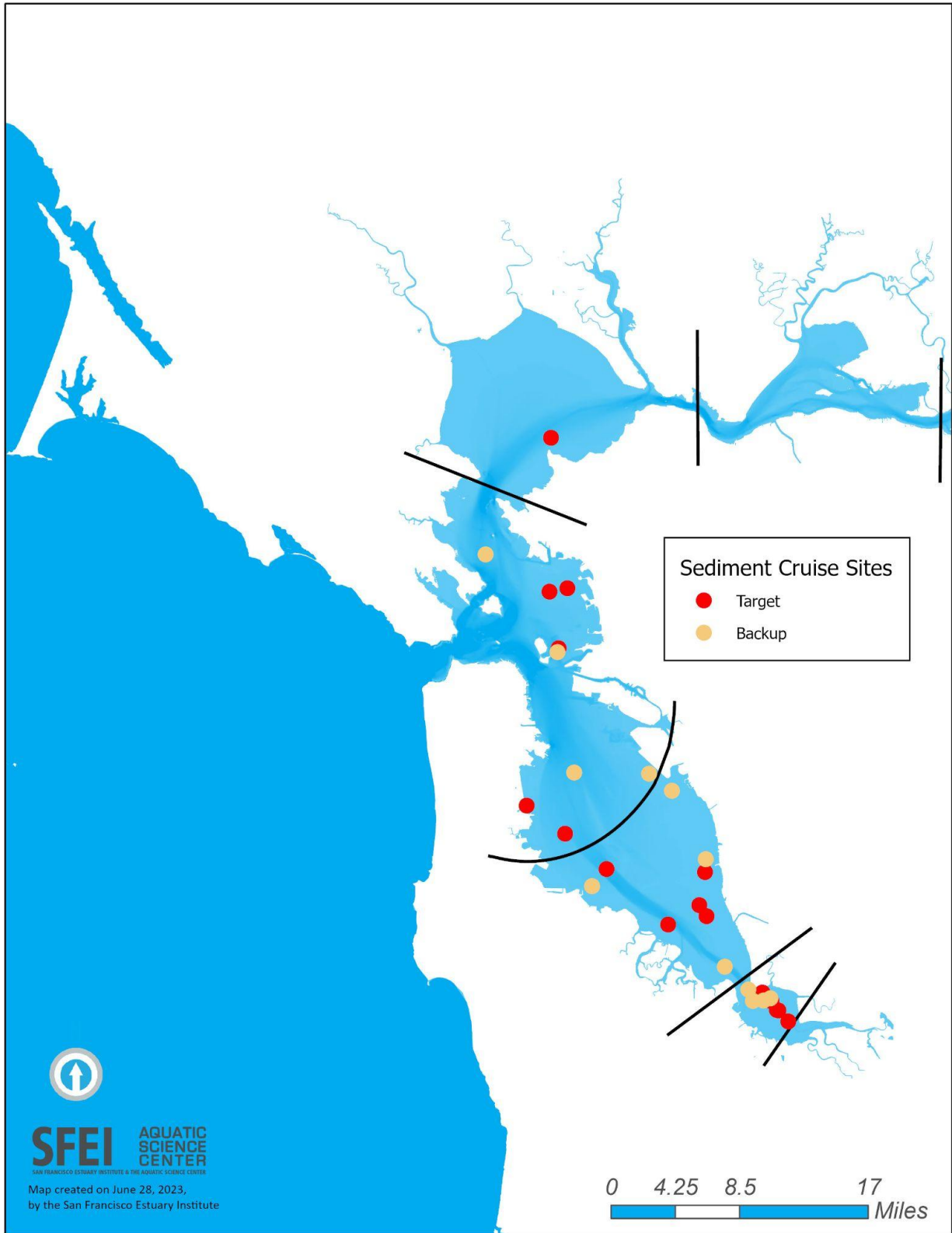
Sixteen stations will be targeted in 2023. Four of these stations (one in each of the San Pablo bay, central bay, south bay, and lower south bay subembayments) are historic stations that have been monitored repeatedly during sediment cruises. Twelve stations were identified through the RMP random GRTS design.

Coordinates for all target RMP sampling stations are shown in Table 5 and Figure 1. All scheduled samples to be collected at each station and the sampling bottles and handling requirements for each parameter are shown in Table 4.

Table 5. Coordinates for 2023 RMP Sediment Cruise Target Sampling Sites. All coordinates are listed in NAD83 datum. Depths are estimated relative to MLLW.

Site Code	Site Name / Region	Target Lat	Target Long	Depth (ft)
BD31	SPB	38.02412178	-122.636383	12+
BC11	CB	37.82232768	-122.3492815	12+
CB001S	CB	37.87631112	-122.3615019	6 to 12
CB048S	CB	37.67051199	-122.3841123	1 to 3
CB049S	CB	37.88012193	-122.3399716	6 to 12
CB050S	CB	37.64436243	-122.3372313	12+
BA41	SB	37.55903527	-122.210577	12+
SB002S	SB	37.61019366	-122.1673764	1 to 3
SB046S	SB	37.56803314	-122.164676	1 to 3
SB051S	SB	37.61148093	-122.2864597	12+
SB050S	SB	37.57839475	-122.1736463	1 to 3
BA10	LSB	37.46823888	-122.0639734	12+
LSB002S	LSB	37.47912655	-122.0779838	12+
LSB048S	LSB	37.48713633	-122.084654	12+
LSB049S	LSB	37.49563406	-122.0957543	12+
LSB050S	LSB	37.47849557	-122.0762538	12+

Figure 1: 2023 RMP Deep Bay Sediment Cruise Target Sampling Sites



1.9 Sample Shipping

Samples will be shipped following the guidelines provided in Table 4. AMS will send draft COCs to Adam Wong adamw@sfei.org prior to shipping the samples.

2.Laboratory Analyses

2.1. Laboratory Contacts

Laboratory contact information for RMP field sampling is shown in Table 6.

Table 6. Laboratory Contact Information for 2023 RMP Sediment Cruise.

Lab / Company / Agency	Contact	Shipping Address	Phone / Email
SGS AXYS	Sean Campbell	2045 Mills Rd. Sidney, BC Canada V8L 5X2	1 250-655-5834 scampbell@axys.com
ALS	Howard Boorse	1317 South 13 th Ave Kelso, WA 98626	360-577-7222 Howard.Boorse@alsglobal.com
UMN	William Arnold	William Arnold Department of Civil, Environmental, and Geo- Engineering University of Minnesota 500 Pillsbury Dr.SE Minneapolis, MN 55455	952.693.8603, arnol032@umn.edu
Archive Agency Contacts			
NIST	Amanda Moors	NIST Hollings Marine Laboratory 331 Ft. Johnson Rd. Charleston, SC 29412	843-762-8953 amanda.moors@noaa.gov
Short-Term Archives	Paul Salop	Applied Marine Sciences 4749 Bennett Dr., Ste. L Livermore, CA 94551	925-373-7142 salop@amarine.com

2.2. QA/QC Sample Collection and Analysis Plan

The number of QA/QC samples required by each analytical lab by analyte is shown in Table 8.

Table 8. QA/QC Samples by Analyte

Lab	Analyte Group	Lab Blanks	Lab Control Samples	Lab Duplicate	MS	MSD	CRM
ALS-Tucson	TN	1	0	1	1	0	1
ALS-Kelso	Grain Size	0	0	1	0	0	1
ALS-Kelso	Total Solids	1	1	1	0	0	0
ALS-Kelso	TOC	1	0	1	1	0	1
SGS AXYS	PFAS	1 per batch	1 per batch	1 per batch	1 per batch	0	0
SGS AXYS	TOP	1 per batch	1 per batch	1 per batch	0	0	0
SGS AXYS	Bisphenols	1 per batch	1 per batch	1 per batch	1	0	0
SGS AXYS	PBDEs	1 per batch	1 per batch	1 per batch	0	0	1 per batch
SGS AXYS	Chlorinated Paraffins	1 per batch	1 per batch	1 per batch	1	0	0
UMN	QACs	1 per batch	1 per batch	1 per batch	1	0	0

2.3. Plan for Analyzing Sediment Archives

Two archived sediment samples will be retrieved from the short term archive sample bank (Schaefer's Cold Storage) and shipped to SGS AXYS along with the samples collected during the cruise as part of a QA Check project. The archive samples that have been selected for the QA check are listed in Table 9.

Table 9. Archived Sediment samples to be analyzed as a QA check

Station	SampleID	Lot Number	Container	For analysis of:
BA10	RMP-18SC-1005-3	20716	60 mL amber glass jar	PBDEs
BA41	RMP-18SC-1019-1	20716	60 mL amber glass jar	PBDEs

Appendix A – RMP 2023 Oversample Site Coordinates

All coordinates are in NAD83 datum.

Site Code	Site Name / Region	Target Lat	Target Long	Depth (ft)	Comments
CB051S	Central Bay	37.9110053	-122.4937737	12+	
CB053S	Central Bay	37.81867079	-122.3506315	12+	
CB054S	Central Bay	37.70375457	-122.2368793	3 to 6	
CB056S	Central Bay	37.70322529	-122.327361	12+	
SB054S	South Bay	37.51976795	-122.1418053	12+	
SB055S	South Bay	37.68768404	-122.2092782	1 to 3	
SB056S	South Bay	37.62243824	-122.1666665	1 to 3	
SB057S	South Bay	37.59469171	-122.3034002	6 to 12	
LSB051S	Lower South Bay	37.49830489	-122.1129746	12+	
LSB052S	Lower South Bay	37.49012325	-122.085954	12+	
LSB053S	Lower South Bay	37.48773525	-122.0942842	3 to 6	
LSB055S	Lower South Bay	37.48730018	-122.1068944	1 to 3	

Appendix B - [Archive Sample Bank Protocol](#)