2. SAMPLING AND ANALYSIS: LOCATIONS AND METHODS

This section briefly describes the methods used in the four study elements of the Sediment Toxicity Study for Pago Pago Harbor. In the following sections, each study element is addressed and includes a brief description of the specific methods and analyses used. Each Study Element Report (submitted under separate cover) includes a detailed description including a study element Plan of Study (POS), task specific sample handling and data evaluation procedures, and reporting and presentation criteria. A summary of the results obtained from each study element is provided in Section 3 of this report.

2.1 Station Locations and General Methods

Station locations for all sediment samples (Study Elements 1, 3, and 4) are shown on Figure 2-1, which is the bathymetric (water depth) map generated by the surveys conducted under Study Element 2. The location coordinates were recorded using the Global Positioning System (GPS) as describe in each study element report. Samples were managed in the field, preserved, and shipped using standard methods detailed in the study plans for each element. All laboratory analyses were performed by Columbia Analytical Services in Kelso Washington. A list of methods used for the analyses, and associated handling procedures, is provided in Table 2-1. Not all COCs were analyzed in each sample or under each study element.

2.2 Sediment Screening Study (Study Element 1)

This section briefly describes the methods used during the Sediment Screening Study (Study Element 1) associated with station selection, collection of samples, and COCs analyzed.

2.2.1. Station Locations

Pre-selected sampling stations were determined and occupied, with minor deviations allowed based on field conditions and the ability to collect samples. In some cases stations were relocated in the field when hard bottom conditions were encountered. GPS coordinates were recorded for the actual location of all samples at the time of sampling. A total of 48 stations were occupied on February 25, 26, and 27, 2004. The locations of the Stations are provided in Figure 2-1. The distribution of stations was concentrated in the Inner Harbor (24 stations), with fewer stations in the Middle Harbor (9 stations) and Outer Harbor (16 stations). Two of the Outer Harbor stations were located in Faga'alu Bay. (See Figure 2-1 for definition of Harbor Segments.)

2.2.2 Field Sampling Methods

Samples were taken with a Ponar grab sampler (Figure 2-2). The sampler is lowered to the seabed. When the sampler hits the seabed the pin keeping it open is ejected and on retrieval it closes taking a bite (grab sample) of surficial bottom sediment. The Ponar sampler containing bottom sediment is brought to the surface using a small line puller. If repeated attempts did not result in a useable sample because of bottom conditions (hard bottom with little or no sediment) the station location was adjusted slightly. The number of attempts required to obtain a sample was recorded in the field book.

Insert Figure 2-1 – Station Locations

11x17

Table 2-1
Sediment Sample Analyses and Handling Procedures

Parameter	Analytical Methods [A]	Detection Limits [B]	Sample Holding Time	Sample Container	Sample Preservation
Conventional Parameters					
Particle Size Analysis	ASTM D422	N/A	6 months	8-oz. glass	None
Calcium	EPA 6010B	3.1 mg/Kg	6 months	8-oz. glass	4º C
Total Organic Carbon (%)	PSEP	0.02%	14 days	8-oz. glass	4º C
Total Volatile Solids (%)	EPA 160.4M	0.1%	14 days	8-oz. glass	4º C
Total Solids (%)	EPA 160.3M	0.1%	14 days	8-oz. glass	None
Total Sulfides	PSEP (p32)	2.5 mg/Kg	7 days	4-oz. glass	4º C, Zn-acetate
Nitrate + Nitrite as Nitrogen	EPA 353.2	0.3 mg/Kg	14 days	8-oz. glass	4º C
Total Kjeldahl Nitrogen	EPA 351.4M	6 mg/Kg	14 days	8-oz. glass	4º C
Total Phosphorus	EPA 365.3	0.4 mg/Kg	14 days	8-oz. glass	4º C
Metals					
Antimony	EPA 200.8	0.15mg/Kg	6 months	8-oz. glass	4º C
Arsenic	EPA 200.8	1.1 mg/Kg			
Beryllium	EPA 200.8	0.024 mg/Kg			
Cadmium	EPA 200.8	0.029 mg/Kg			
Chromium	EPA 200.8	0.22 mg/Kg			
Copper	EPA 200.8	0.36 mg/Kg			
Lead	EPA 200.8	0.11 mg/g			
Nickel	EPA 200.8	0.16 mg/Kg			
Selenium	EPA 200.8	0.5 mg/Kg			
Silver	EPA 200.8	0.1 mg/Kg			
Thallium	EPA 200.8	0.02 mg/Kg			
Zinc	EPA 200.8	0.5 mg/Kg			
Mercury	EPA 7471A	0.009 mg/Kg			
Monomethyl-Mercury	BR-0011	0.02 ng/g			
Pesticides and Organic Compounds					
Organochlorine Pesticides	8081A	varies	14 days	8-oz. glass	4º C
Polychlorinated Biphenyls	8082	2.8			
PCB Congeners	8082	varies			
Semi-volatile Compounds	8270C	varies			
Volatile Compounds	8260B	varies			
Other Parameters					
Cyanide	9010B	0.2	14 days	8-oz. glass	4º C
Butyltin	Krone	varies	14 days		
Dioxins	8290	varies	30 days		

ASTM, American Society for Testing Materials. 1974. Part 19:D422; Standard Method for Particle Size Analysis of Soils.

PSEP = Puget Sound Estuary Protocols, USEPA Region 10, May 1991

[A] EPA methods are defined in 40 CFR 136.3, Guidelines Establishing Test Procedures for the Analysis of Pollutants; Methods for Chemical Analysis of Water and Wastes, 1983.

[B] Nominal method detection limits with no sample dilution.

The Ponar sampler was placed on deck and a sample was taken directly from the sampler by removing the sliding panels on the top of the sampler (Figure 2-3). Photos were taken of each sample, redox potential was measured, and field observations of color, texture, and odor were recorded. Samples were placed in pre-cleaned and labeled jars supplied by the analytical laboratory, stored, and shipped according to established protocols.

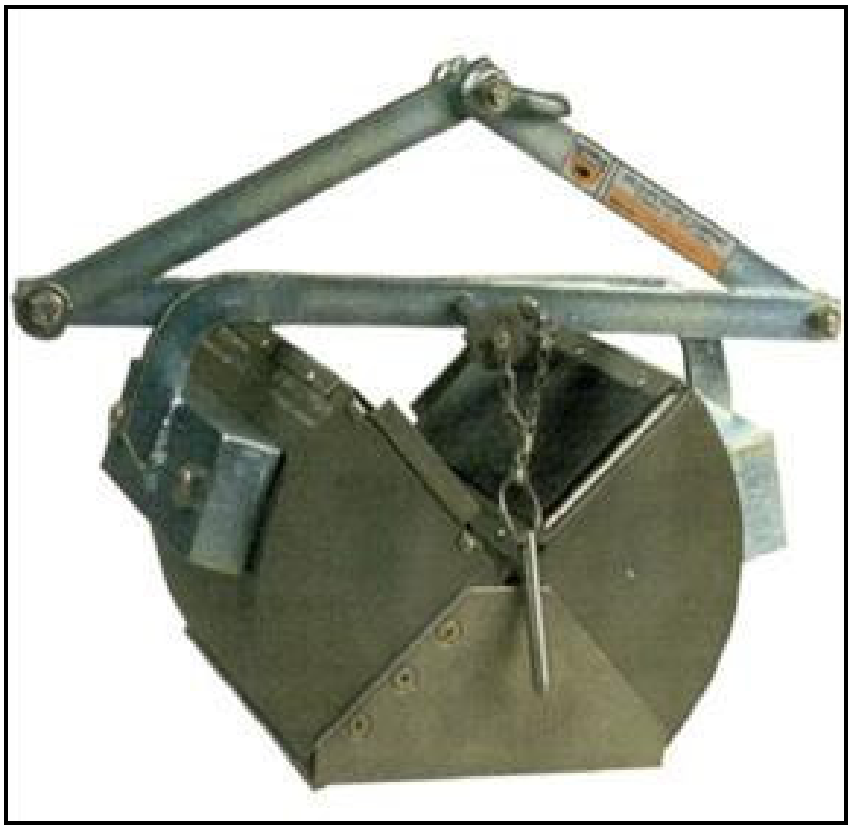

Figure 2-2. Ponar Sediment Sampler

Figure 2-3. Ponar Sampler on Deck with Sample

2.2.3 Parameters Analyzed

A schedule of parameters analyzed in the samples was developed in consultation with ASEPA and is provided in Table 2-2. Not all parameters were analyzed in all samples. The associated laboratory analytical methods are provided in Table 2-1.

Table 2-2
Schedule of Analyses by Station – Sediment Screening Study

Station	General: Grain Size, Solids, TOC, TVS, Calcium, Sulfide	Nutrients: TN and TP	All Heavy Metals	6 Metals: As, Cr, Cu, Pb, Ni, Zn	Mercury and methylmercury	Cyanide	Dioxin	PCBs and 8082 Congeners	Organotin	Pesticides	PAHs	Semivols	Volatiles
1	x												
2	x												
3	x	x		x						x		x	x
3 A	x	x		x									
4	x												
5	x	x		x	x	x		x	x	x	x	x	x
6	x												
7	x												
8	x			x	x								
9	x	x		x						x		x	x
10	x	x											
11	x	x		x						x		x	x
12	x	x		x									
13	x												
14	x												
14 A	x			x									
15	x	x		x									
16	x												
17	x												
18	x	x											
19	x												
20	x												
21	x			x	x								
22	x												
23	x	x											
24	x	x											
25	x	x	x					x		x	x	x	x
26	x	x											
27	x												
28	x	x											
29	x	x		x	x					x		x	x
30	x	x		x									
31	x			x									
31 A	x			x									
32	x												
33	x												
34	x	x		x				x	x	x	x	x	x
35	x												
41	x								x				
42	x	x		x	x	x		x	x	x	x	x	x
43	x			x					x				
43 A	x			x					x				
44	x												
44 A	x	x	x		x		x	x	x	x	x	x	x
45	x												
46	x	x											
47	x	x											
48	x	x		x	x				x	x	x	x	x
No. of Samples	48	22	2	19	7	2	1	5	8	10	6	10	10

2.3 Seabed Characterization and Mapping (Study Element 2)

Several geophysical techniques were used to accomplish the Seabed Characterization and Mapping element of the overall study. The following sections provide brief descriptions of the instrumentation and methods used.

2.3.1 Navigation and Survey Coverage

Differential GPS was used to determine the location of the survey vessel and the acquired geophysical data. The navigation system was interfaced with the other geophysical instruments so that all information was co-registered and can be input, if desired, to a geographic database or model grid. The bathymetric and geophysical data were obtained on a series of parallel transects oriented east-west and north-south over Pago Pago Harbor. A total of 125 transects were run on the Inner Harbor, 60 transects on the Middle Harbor, and 30 transects on the Outer Harbor. The highest density of coverage was within the Inner Harbor where the highest sedimentation rates were expected and where there is the highest potential for elevated COC concentrations.

2.3.2 Bathymetry

Bathymetric (water depth) data for Pago Pago Harbor were obtained with a survey grade precision echosounder. The depth data were acquired digitally and stored on a computer simultaneously with the navigation data. A paper record was also produced in real-time as part of QA/QC procedures, and to provide preliminary onsite data analysis. Calibration of the system was done each day using a standard bar check.

The navigation and bathymetric digital data were edited for anomalous or extreme values. The depths were then reduced to mean lower low water (MLLW) using predicted tides from tide tables for Pago Pago Harbor. It is reasonable to assume that because there were no major weather systems active at the time of this work, and because there is a relatively small tidal range in the Harbor, the difference between the predicted values and the measured water levels is insignificant and introduces only a minor source of potential error in depth. Validation of the depths was checked by plotting all of the soundings and checking for consistency at the intersection of transects. The edited and corrected values were then gridded and contoured to produce detailed topographic maps of the Harbor (Figure 2-1 is based on the bathymetric map generated during this study element).

2.3.3 Sidescan Sonar

Sidescan sonar uses acoustics to produce a plan view image of the seabed that is equivalent to an aerial photograph on land (Figure 2-4). The sonar image provided basic information for mapping the lateral distribution of sediment type (silt, sand, gravel, etc.), imaging coral, rock and habitat types, and detecting cultural artifacts on the seabed such as pipelines, discarded debris, or sunken vessels. The sidescan sonar data were acquired with a state-of-the-art dual frequency system using digital acquisition and post-processing of the data. The images were also printed in real-time on an EPC thermal graphic recorder for QA/QC and for preliminary data analysis while on site.

The sidescan sonar data were processed to adjust the scale and to highlight potential areas of interest that were identified on the field record such as lateral changes in sediment type and

the presence of objects on the seabed. The interpreted information including boundaries of sediment type, location of coral, and sunken vessels was then mapped on the final surficial features maps (all final maps are provided in the final report for Study Element 2).

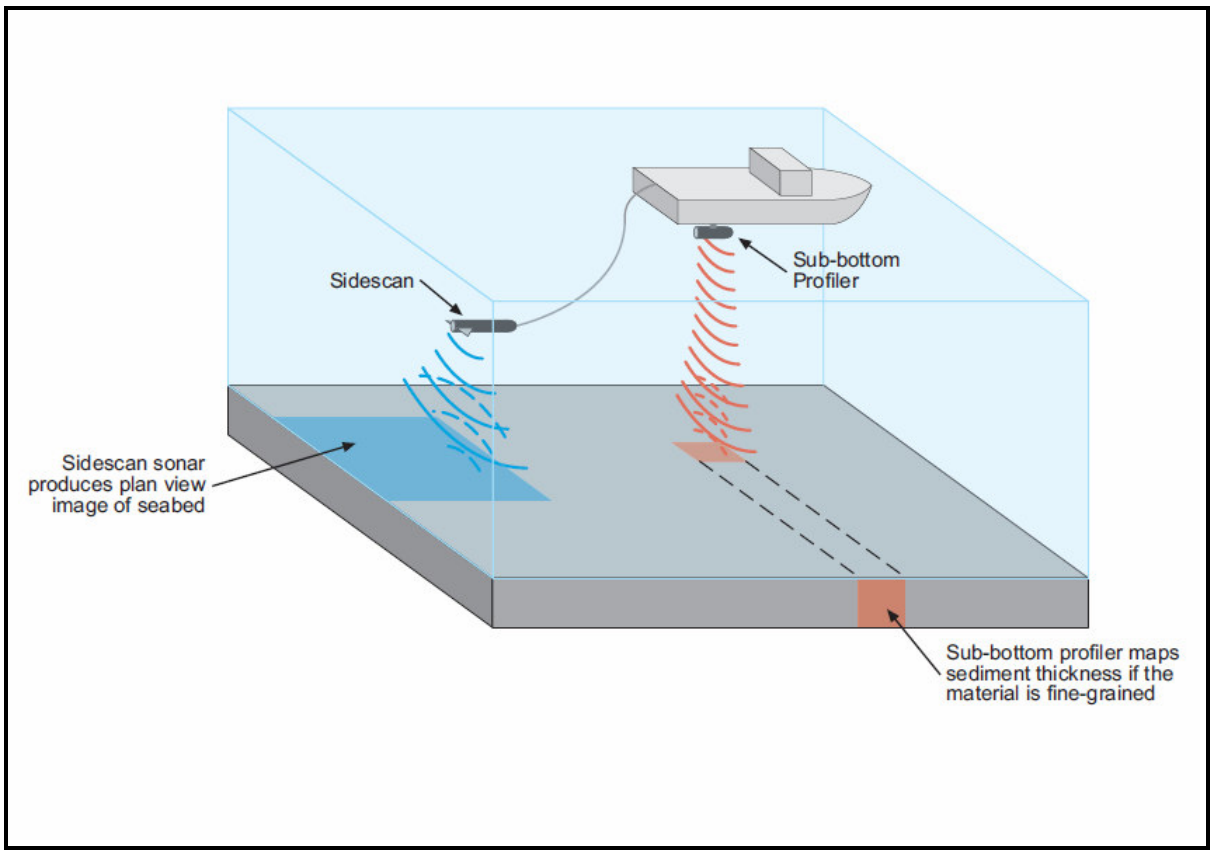

Figure 2-4. Schematic of Sidescan Sonar and Sub-bottom Profiler Operation

2.3.4 Sub-bottom Profiling

An acoustic sub-bottom profiling system (Figure 2-4) was used to determine the thickness of the sediment throughout the Harbor. This system was capable of mapping the thickness of fine-grained sediment to a maximum depth of 75 feet below the seafloor. A hard copy image was printed in real-time on an EPC thermal graphic recorder. These records were used to QA/QC the data and to perform preliminary analysis of the data each day.

The sub-bottom data were reprocessed using standard techniques to improve the resolution of shallow reflectors, enhance deep reflectors, and to adjust the vertical and horizontal scales prior to interpretation. The data were interpreted by a qualified marine geophysicist based on identification of various reflection patterns (reflection free, uniform horizontal reflectors, discontinuous, chaotic reflectors, etc.) observed on the graphic records. The sediment type (fine-grained sediment) or depositional environment (deep-water, shallow-water, near-shore high-energy environment, etc.) and sediment thickness was mapped throughout the Harbor.

2.4 Detailed Sediment Analysis(Study Element 3)

This section describes the methods associated with the collection and analysis of sediment cores. The locations sampled and parameters analyzed were based largely on the results of Study Elements 1 and 2. A brief description of station location selection, collection of samples, and COCs analyzed is presented.

2.4.1 Station Locations

A total of 18 stations were occupied on March 8 - 13, 2005. Pre-selected sampling stations, based on review of Study Elements 1 and 2 and consultation with ASEPA, were determined and occupied, with minor deviations allowed based on field conditions and the ability to collect samples. In some cases stations were relocated in the field when hard bottom conditions were encountered. GPS coordinates were recorded for the actual location of all samples at the time of sampling. The locations of the Stations are shown on Figure 2-1 and included: 14 stations (20 cores) in the Inner Harbor, 1 station (2 cores) in the Middle Harbor, and 3 stations (4 cores) in the Outer Harbor (including 1 station in Faga'alu Bay).

2.4.2 Field Sampling Methods

Samples were taken with either a gravity corer (Figure 2-5), a vibra-corer (Figure 2-5), or a piston corer (Figure 2-6). The gravity cores, the corer was lowered slowly to the bottom, with the fall speed increased for the last few feet (estimated based on water depth and amount line out). For vibratory cores, the vibra-corer was set in position and the vibration apparatus engaged. A piston corer is similar to a gravity corer but includes a piston in the core barrel that enhances penetration of the corer into the sediments. As the corer is retrieved, a pre-installed sediment catcher closes blocking the loss of material and the sample is brought to the surface using a winch. If repeated attempts did not result in a useable sample because of bottom conditions (hard bottom with little or no sediment) the station location was adjusted. The number of stations and attempts required to obtain a sample was recorded in the field book. Table 2-3 provides the core penetration depth, the core length recovered, and the types of corer used.

After a sample was collected the corer was placed on deck and the plastic liner tube, which houses the sediment core, was removed. The core tube was transported to a convenient work station on land. The plastic liner was split and samples were taken from the core at intervals along the core. At a minimum samples were collected from the top and bottom of the core. Photos were taken of each core, and field observations of color, texture, and odor were recorded. Samples were placed in pre-cleaned and labeled jars supplied by the analytical laboratory and stored on ice in an ice chest until prepared for shipping to the analytical laboratory.

2.4.3 Parameters Analyzed

As mentioned above all parameters were not analyzed in all samples. A schedule of parameters analyzed in the samples was developed in consultation with ASEPA and is provided in Table 2-4. Table 2-4 lists the cores, samples from each core in terms of the interval along the core (0 cm being at the surface), and the parameters analyzed. Samples not analyzed were archived for a limited time for additional analyses if needed.

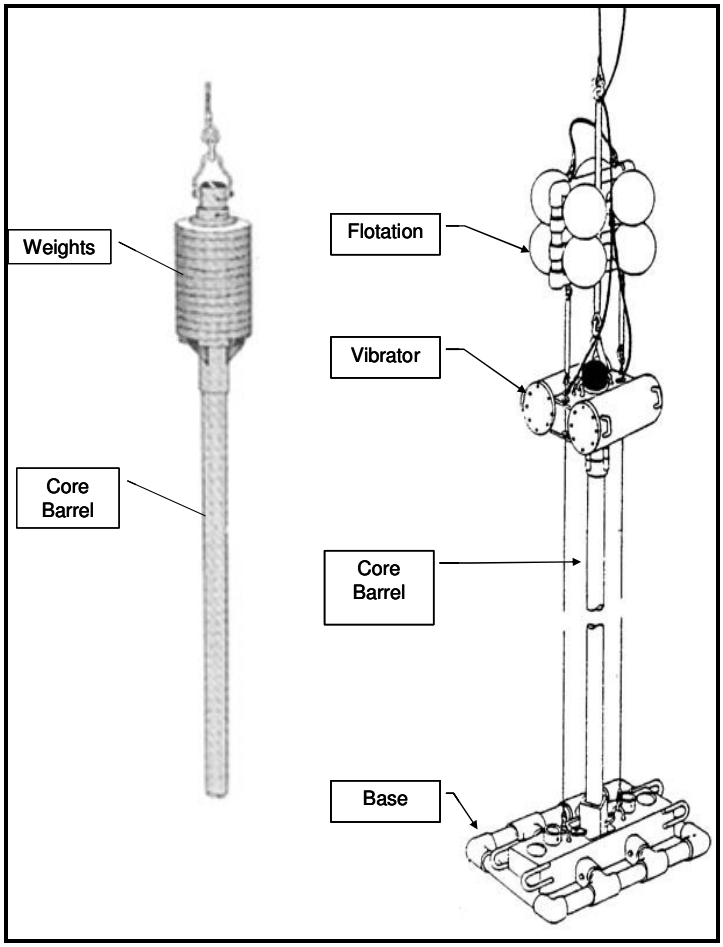

Figure 2-5. Gravity Corer (on left) and Vibra-corer (on right)

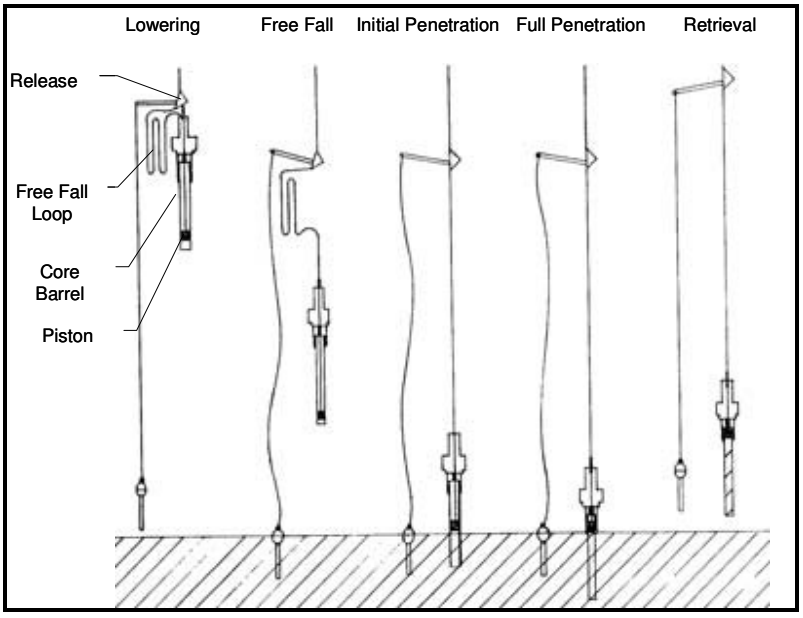

Figure 2-6. Piston Corer – Features and Operation

Table 2-3
Coring Stations and Core Recovery Log

Station	Core	Date	Time	Water Depth (feet)	Penetration (inches)	Core Length (inches)	Core Diameter (inches) and Type
1	1	3/8/2005	17:30	25	42	36	2 / gc
1	1A	3/9/2005	10:20	25	48	35	4 / gc
2	2	3/9/2005	12:30	26	54	48	4 / gc
3	3	3/9/2005	15:24	25	54	44	4 / gc
4	4	3/9/2005	16:00	34	55	50	4 / gc
5	5	3/9/2005	17:00	45	45	34	4 / gc
6	6	3/9/2005	18:14	45	64	60	4 / gc
10	10.1	3/10/2005	11:50	126	52	12	4 / gc
10	10.2	3/10/2005	12:20	126	80	16	4 / gc
9	9A	3/10/2005	15:19	82	60	46	2 / pc
9	9B	3/10/2005	16:30	85	85	33	2 / pc
2	2vc/20	3/11/2005	11:40	26	100	65	4 / vc
5	5	3/11/2005	13:30	45	48	18	4 / vc
7	NA	3/12/2005	8:15	74	70	(a)	2 / pc
7	NA	3/12/2005	8:15	74	70	(a)	4./ vc
10	10	3/12/2005	10:30	131	84	33	2 / pc
10A	10A	3/12/2005	11:10	133	80	36	2 / pc
11	NA	3/12/2005	11:35	103	60	2 (b)	2 / pc
11	NA	3/12/2005	11:45	82	50	6 (c)	2 / pc
11A	11A	3/12/2005	12:10	116	87	44	2 / pc
11B	11B	3/12/2005	14:00	117	60	21	2 / pc
12*	12	3/12/2005	14:30	160	71	22	2 / pc
12A*	12A	3/12/2005	14:55	161	75	31	2 / pc
13*	NA	3/12/2005	15:15	70	20	(d)	2 / pc
13*	13A1	3/12/2005	15:45	110	57	14	2 / pc
13*	13B	3/12/2005	16:13	113	24	(e)	2 / pc
13*	13A2	3/12/2005	16:25	111	47	11.5	2 / pc
8*	NA	3/12/2005	16:50	79	33	(b)	2 / pc
8*	8	3/12/2005	17:13	83	88	38	2 / pc
8*	NA	3/12/2005	17:30	83	80	(a)	2 / pc
15*	NA	3/13/2005	8:20	191	20	(a)	2 / pc
15*	15	3/13/2005	8:30	190	18	13	2 / pc
14*	14.1	3/13/2005	9:00	188	12	11 (e)	2 / pc
14*	14.2	3/13/2005	9:15	184	12	(e)	2 / pc
16*	16	3/13/2005	9:45	34	12	(e)	4 / vc

Core Type: gc=gravity core, pc=piston core, vc=vibra-core

Recovery Notes:
- (a) No recovery
- (b) Coral (not used)
- (c) Coral and sediment (not used)
- (d) Sample in nose cone only (not used)
- (e) Sample bagged, short core

* Location Notes:
- Station 12 is off shore of the fuel dock
- Station 13 is off shore of Aua
- Station 8 is off shore of the Satala power plant
- Station 15 is the historic sediment monitoring reference station
- Station 14 is between the abandon cannery outfalls
- Station 16 is in Faga'alu Bay

Table 2-4
Sample Analysis Schedule - Study Element 3

Core	Length (cm)	Sample	Interval (cm)	Grain Size/ TOC/Ca	TKN and TP	Mercury and methylmercury	Primary Metals As, Hg, Cr, Cu, Ni, Pb, Zn, Se	Total PCBs	TBT	Pesticides	PAH (Semi-Volatiles)	Dioxin
STC-1A	85	STC-1A	0-9	X						X	X	
		STC-1B	36-44	X								
		STC-1C	76-85	X						X	X	
		STC-1B*	17-24	X								
		STC-1C*	56-64	X						X	X	
STC-1*	87	STC-1A*	0-20									
		STC-1D*	28-54									
		STC-1E*	64-87									
STC-2	123	STC-2A	0-10									
		STC-2B	29-36									
		STC-2C	56-63									
		STC-2D	86-94									
		STC-2E	117-123									
		STC-2EN	123~133									
		STC-2A*	10-19									
		STC-2B*	36-40									
		STC-2C*	63-69									
		STC-2D*	94-100									
		STC-2E*	111-117									
STC-2vc	167	STC-20A	0-9	X	X	X	X	X				
		STC-20B	40-47	X	X	X	X					
		STC-20C	80-85	X	X	X	X	X				
		STC-20D	120-126	X	X		X					
		STC-20E	160-167	X	X	X	X	X				
		STC-20B*	55-62	X	X		X	X				
STC-3	112	STC-3A	0-10									
		STC-3B	25-32									
		STC-3C	50-60									
		STC-3D	80-87									
		STC-3E	102-112									
		STC-3EN	112~122									
STC-4	127	STC-4A	0-9	X	X		X			X	X	X
		STC-4B	33-40	X	X							
		STC-4C	58-64	X	X		X			X	X	
		STC-4D	89-95	X	X							
		STC-4E	121-127	X	X		X			X	X	X
		STC-4EN	127~137									
		STC-4A*	9-14									
		STC-4B*	40-46									
		STC-4C*	64-70									
		STC-4D*	95-101									
		STC-4E*	115-121									
STC-5	87	STC-5A	0-7			X	X					
		STC-5B	23-30				X					
		STC-5C	40-47			X	X					
		STC-5D	57-62				X					
		STC-5E	?-87?			X	X					

Table 2-4 Sample Analysis Schedule - Study Element 3												
Core	Length (cm)	Sample	Interval (cm)	Grain Size/ TOC/Ca	TKN and TP	Mercury and methylmercury	Primary Metals As, Hg, Cr, Cu, Ni, Pb, Zn, Se	Total PCBs	TBT	Pesticides	PAH (Semi-Volatiles)	Dioxin
STC-6A	70	STC-6A	0 - 9	X								
		STC-6B	30-37	X								
		STC-6C	63-70	X								
STC-8	102	STC-8A	3-16	X			X	X	X			
		STC-8C	43-57	X			X	X	X			
		STC-8E	87-100	X			X	X	X			
STC-9A	118	STC-9A	0-20	X	X		X	X	X			
		STC-9B	58-72	X	X		X	X	X			
		STC-9C	93-118	X	X		X	X	X			
STC-9B	72	STC-9D*	0-28									
		STC-9E*	52-72									
STC10.1	44	STC-10A	0-10									
		STC-10B	38-44									
STC 10.2	30	STC-10C	0-8									
		STC-10D	25-30									
STC-10*	90	STC-10A*	0-15	X	X	X	X					
		STC-10B*	40-52	X	X	X	X					
		STC-10C*	77-90	X	X	X	X					
STC-11	110	STC-11A	0-16	X	X		X			X	X	
		STC-11B	36-50	X	X		X					
		STC-11C	85-110	X	X		X			X	X	
STC-12	85	STC-12A	0-14									
		STC-12B	46-58									
		STC-12C	58-85									
STC-13	37	STC-13A	0-20	X	X	X	X					
		STC-13B	20-37	X	X	X	X					
STC-14	bagged	STC-14A	~0-10									
STC-15	15	STC-15A	0-15									
STC-16	bagged	STC-16A	~0-10									

2.5 Sediment Fate and Transport Analysis (Study Element 4)

Based on the results of the three study elements described above, additional sampling was conducted to better evaluate the sources, sinks, and transport paths of the identified principal COCs. Stream sediments and Harbor sediment pore water samples were collected and analyzed. This section provides a brief description of the selection of station locations, collection of samples, and COCs analyzed. Steam bed sediments were collected from five perennial streams with the capacity to transport sediment directly into Pago Pago Harbor. Surficial grab samples were colleted at four Harbor stations for pore water analysis.

2.5.1. Station Locations

The five perennial streams flowing into Pago Pago Harbor were selected for sediment analysis (Figure 2-1). Sediment samples were collected on 31 May 2006. The samples from the

five streams were designated S1 through S5 following a clockwise pattern around the Harbor. Sediment samples were collected from two separate locations in each stream (designated 1 and 2). The five streams included:

S1: Faga'alu Stream (which runs along the quarry and hospital)

S2: Vailoa Stream (located southwest of the Executive Office Building)

S3: Fagatogo Drainage (flows through the village of Fagatogo)

S4: Pago stream and its main left hand tributary Laolao Stream

S5: Lalolamaula stream (flowing through the village of Aua).

Four stations within Pago Pago Harbor were sampled for bottom sediments on 27 May 2006 (Figure 2-1). Station locations were previously identified based on the previous study elements and were located and reoccupied using previously established GPS coordinates. The Harbor Stations included:

Station ST4-5: In the Outer Harbor. This station is the traditional reference station for sediment sampling in the Harbor. It is the same stations as STS-5 (from Study Element 1) and STC-15 (from Study Element 3).

Station ST4-30: Near the abandoned cannery outfalls in the Inner Harbor. This is the same station as STS-30 occupied during Study Element 1.

Station ST4-43: Offshore from the Satala Power Station. This is the same station as STS-43 occupied during Study Element 1.

Station ST4-44: In the Inner Harbor. This is the same station as STS-44 occupied during Study Element 1.

2.5.2 Field Sampling Methods

Sections of stream above tidal influence were surveyed for fine sediment deposits. Recently deposited sediments were preferred, with stream bank sediment being used if the stream channel was significantly lacking deposits of fine sediment. Sediments were collected using a small hand trowel. The depth of the excavated material, color, odor, and texture were recorded in addition to the date and time. Photographs of the channel and sediment collection site were taken. One sample from each stream was selected and sent to the laboratory for analysis.

Harbor sediment grab samples were collected using a standard Ponar grab sampler and followed the methods described for Study Element 1 (Section 2.2). Photographs were taken of each sediment sample. Oxidation-reduction potential was measured as soon as the sample was brought on board the sampling vessel. Twelve samples jars were filled at each station. The sediment samples were sealed into zip-lock bags and stored on ice, in an ice chest, for

transport to the laboratory. Pore water was extracted by the analytical laboratory after homogenization.

2.5.3 Parameters Analyzed

A schedule of parameters analyzed in the samples was developed in consultation with ASEPA. The parameters are listed by sample type below. The laboratory analysis method associated with each parameter is provided in Table 2-1 above.

- Analysis of stream sediments included total solids, grain size, TKN, total phosphorus, metals, PCBs/Aroclors, and pesticides.

- Analysis of Harbor sediments included total solids, grain size, and metals.

- Analysis of pore water from the Harbor sediments included metals, PCBs/Aroclors, and pesticides.