

**SITE INVESTIGATION REPORT AND
ENVIRONMENTAL HAZARD EVALUATION**

**East Kapolei II Pesticide Mixing and Loading Site
Ewa, Oahu, Hawaii
TMK (1) 9-1-017: Parcel 93 (Portion)**

Prepared For:
HAWAII STATE DEPARTMENT OF HAWAIIAN HOME LANDS
P.O. Box 1879
Honolulu, Hawaii 96805

Prepared By:
ENVIROSERVICES & TRAINING CENTER, LLC
505 Ward Avenue, Suite 202
Honolulu, Hawaii 96814

Project No. 09-2012

March 2010

TABLE OF CONTENTS

1.0	CERTIFICATIONS AND LIMITATIONS.....	1
2.0	INTRODUCTION AND PURPOSE.....	2
3.0	BACKGROUND	3
3.1	SITE DESCRIPTION.....	3
3.2	SITE GEOLOGY.....	4
3.3	SITE HYDROGEOLOGY.....	4
3.4	HISTORICAL LAND USE.....	4
3.5	FUTURE LAND USE.....	5
3.6	CONTAMINANTS OF CONCERN	6
3.7	CONCEPTUAL SITE MODEL.....	6
3.7.1	<i>Receptors of Concern</i>	7
3.7.2	<i>Exposure Pathways</i>	8
3.8	PROJECT ACTION LEVELS	10
4.0	INVESTIGATION HISTORY.....	11
4.1	UNIVERSITY OF HAWAII/HAWAII DEPARTMENT OF AGRICULTURE - 1990.....	12
4.2	HAWAII DEPARTMENT OF HEALTH - 2000.....	12
4.3	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - 2000	12
4.4	ENVIROSERVICES & TRAINING CENTER LLC - 2007.....	12
4.5	HAWAII DEPARTMENT OF HEALTH (NO REPORT) - 2007.....	13
4.6	UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (NO REPORT) - 2009	13
4.7	HAWAII DEPARTMENT OF HEALTH (NO REPORT) - 2009.....	13
4.8	AREA-WIDE INVESTIGATION.....	14
4.9	SUMMARY OF HISTORIC DATA.....	14
5.0	SUMMARY OF DATA QUALITY OBJECTIVES.....	17
5.1	PROBLEM STATEMENT	17
5.2	DECISION MAKING.....	17
5.3	DECISION INPUTS	18
5.4	INVESTIGATION BOUNDARIES	18
5.5	DECISION RULES	18
5.6	DECISION ERROR.....	18
5.7	SAMPLING DESIGN	19
6.0	FIELD ACTIVITIES.....	20
6.1	SELECTION OF DECISION UNITS	20
6.2	SURFACE AND SUBSURFACE SOIL SAMPLING ACTIVITIES	21
6.2.1	<i>Surface Soil Sample Collection</i>	21
6.2.2	<i>Spill Area Subsurface Soil Sample Collection</i>	21
6.2.3	<i>Investigation Area Trench Sample Collection</i>	22
6.3	SUMMARY OF ENVIRONMENTAL SAMPLES.....	22
7.0	SAMPLE CONTROL PROCEDURES.....	24
7.1	SAMPLE IDENTIFICATION	24
7.2	SAMPLE CHAIN-OF-CUSTODY AND TRANSPORTATION	24
7.3	SAMPLE PRESERVATION AND HANDLING PROCEDURES	25
7.4	LABORATORY ANALYTICAL PROCEDURES.....	25
8.0	FIELD OBSERVATIONS.....	27

9.0	DATA QUALITY	28
9.1	LABORATORY QUALITY CONTROL.....	28
9.2	FIELD QUALITY CONTROL.....	28
9.3	DATA QUALITY ASSESSMENT	29
10.0	ANALYTICAL RESULTS AND DISCUSSION	31
11.0	ENVIRONMENTAL HAZARD EVALUATION	39
11.1	PREVIOUS INVESTIGATIONS	40
11.2	MAGNITUDE AND EXTENT OF CONTAMINATION	40
11.3	COMPARISON TO DOH EALS.....	41
11.3.1	<i>Arsenic</i>	42
11.3.2	<i>Dioxins/Furans</i>	43
11.3.3	<i>Pentachlorophenol</i>	46
11.3.4	<i>Ametryn</i>	47
11.3.5	<i>Atrazine</i>	48
11.3.6	<i>Simazine</i>	49
11.3.7	<i>Trifluralin</i>	50
11.4	SUMMARY OF ENVIRONMENTAL HAZARDS	51
12.0	CONCLUSIONS	53
12.1	SPILL AREAS	53
12.2	INVESTIGATION AREAS	54
12.3	OUTSIDE PML SITE.....	55
12.4	FUTURE ACTIVITIES	56
13.0	REFERENCES	57

TABLES

TABLE 1:	DEFAULT DOH EALS FOR SOIL	10
TABLE 2:	SUMMARY OF PRIMARY SAMPLES, SAMPLE DEPTHS, ESTIMATED VOLUMES, AND ANALYSES	23
TABLE 3:	SAMPLE HANDLING AND PRESERVATION.....	25
TABLE 4:	FIELD REPLICATE CALCULATIONS.....	30
TABLE 5:	ANALYTICAL DATA – REPORTED CONCENTRATIONS, PRIMARY ANALYSES	31
TABLE 6:	ANALYTICAL DATA – SECONDARY ANALYSES.....	33
TABLE 7:	ANALYTICAL DATA – TCLP ANALYSES	33
TABLE 8:	SORPTION COEFFICIENTS AND LEACHING POTENTIAL	35
TABLE 9:	ADJUSTED DIOXIN TEQ AND ARSENIC DATA.....	36
TABLE 10:	ADJUSTED PENTACHLOROPHENOL AND TRIAZINE PESTICIDE DATA	38
TABLE 11:	SUMMARY OF ENVIRONMENTAL HAZARDS.....	51
TABLE 12:	IMPACTED SOIL VOLUMES, SPILL AREAS	53
TABLE 13:	IMPACTED SOIL VOLUMES, INVESTIGATION AREAS.....	55

APPENDICES

Appendix I:	Figures & Photographs
Appendix II:	Summary Tables of Historic Data
Appendix III:	Summary of TEQ Calculations & Laboratory Reports

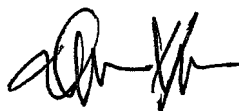
1.0 CERTIFICATIONS AND LIMITATIONS

EnviroServices & Training Center (ETC), LLC has completed this Site Investigation Report and Environmental Hazard Evaluation for the project site. ETC's findings and conclusions presented in this report are professional opinions based solely upon visual observations of the project site, government laws/guidance documents, and upon interpretation of the laboratory data and field measurements gathered at the time and location of the study.

This report is intended for the sole use and purpose of ETC's Client, exclusively for the project site indicated. The scope of services performed in execution of these site investigation activities may not be appropriate for satisfying the needs of other users, and any use or reuse of this report or the findings and conclusions presented herein is at the sole risk of said user.

ETC makes no guarantee or warranty; either expressed or implied, except that our services are consistent with good commercial or customary practices designed to conform to acceptable industry standards and governmental laws/guidance documents. No warranty or representation, expressed or implied, is included or intended in its proposal, contracts, or reports. Information stated in this report applies only to the site as outlined and apply to the conditions present at the time of site investigation activities.

Prepared By:



Damon Hamura
Project Manager

2.0 INTRODUCTION AND PURPOSE

This Site Investigation Report and Environmental Hazard Evaluation (SIR-EHE) provides documentation of site investigation activities performed at the East Kapolei II Pesticide Mixing and Loading Site (referred to herein as the “East Kapolei PML site” or “the property”). EnviroServices & Training Center, LLC (ETC) was contracted by the Hawaii State Department of Hawaiian Home Lands (DHHL) to provide environmental engineering services in support of future remedial action at the East Kapolei PML site. This SIR-EHE has been prepared to satisfy Task 2.9 (“Perform Environmental Hazard Evaluation”) in Attachment A: Scope of Work as described in the June 30, 2009 Agreement for Remedial Action between DHHL and the Hawaii State Department of Health (DOH).

This SIR-EHE provides a detailed description of additional site characterization activities conducted at the East Kapolei PML site to further delineate the extent of chemical impacts in site soils and to provide additional data to be used in scoping applicable and appropriate remedial alternatives. Furthermore, this SIR-EHE compares current and historic data to appropriate Hawaii Department of Health (DOH) Environmental Action Levels (EALs) and identifies environmental hazards associated with residual contaminant concentrations at the property due to former pesticide mixing and loading operations.

Previous environmental investigations have identified elevated concentrations of contaminants typically associated with historic sugar cane cultivation in soils within the East Kapolei PML site. DHHL plans to identify and implement appropriate remedial actions to address environmental hazards associated with the elevated contaminant concentrations. Gaps in the existing data previously included the estimation of mean contaminant concentrations in site soils within various areas of the PML site and estimations of the vertical extent of contamination. As such, the overall goal for the site investigation was to obtain additional data to further delineate the extent and magnitude of contaminant impacts by filling data gaps and to facilitate estimating site remediation costs.

For the purposes of this investigation, analytical data were compared to DOH EALs for areas where a current or potential source of drinking water is not threatened and where the nearest surface water body is greater than 150 meters from the site.

3.0 BACKGROUND

3.1 Site Description

The project site is the former Oahu Sugar Company pesticide mixing and loading area located near Kualakai Parkway approximately 1.2 miles east of Kapolei and 2.0 miles southwest of Waipahu. A map illustrating the site location is included as Figure 1 in Appendix I. The site was previously occupied by two abandoned buildings and several elevated aboveground storage tanks. These structures were recently demolished (December 2009) and documentation of site demolition activities is provided in the January 2010 *Demolition and Disposal Report, East Kapolei II, Former Pesticide Mixing and Loading Site, Ewa, Oahu, Hawaii* prepared by ETC on behalf of DHHL.

The East Kapolei PML site consists of approximately 0.634-acres that are part of a larger 374.515-acre parcel owned by DHHL and identified as Tax Map Key (TMK): (1) 9-1-017:093, Honouliuli, Ewa, Oahu, Hawaii (see Appendix I, Figure 2). The property is located within the State Urban District and is zoned by the City and County of Honolulu for agricultural use.

The East Kapolei PML site has no street address and is accessible via cane haul roads from Palehua Road, an unimproved roadway. The property is centrally located within agricultural fields that either remain fallow or are currently under short-term lease to agricultural tenants, primarily Aloun Farms, for commercial cultivation of fruit and vegetables. Existing uses in the vicinity of the property include the Ewa Villages Golf Course to the south, the West Loch Golf Course to the east, and city of Kapolei to the west. The nearest existing residences to the East Kapolei PML site are located in the Ewa Villages community and in the DHHL's "Kanehili" (East Kapolei I) development, situated approximately 0.7 miles southeast and 0.7 miles to the southwest, respectively.

The East Kapolei PML site is situated at an elevation of approximately 100 feet above mean sea level (msl) and the topography suggests a slight surface gradient to the south. No drinking water wells are located within one mile of the property, and the nearest surface water body is the West Loch of Pearl Harbor, located approximately 1.6 miles to the east.

The East Kapolei PML site was formerly characterized by abandoned, derelict buildings and several elevated storage tanks surrounded by a chain-link fence (see Appendix I, Figures 3 and 4). Ground cover within the fenced area consisted primarily of crushed coral covering native clay. A concrete-lined irrigation ditch runs adjacent to and through the fenced area. Prior to site sampling activities, all structures at the property were demolished. At the time of sample collection, ground cover consisted of bare soil with limited vegetation.

The East Kapolei PML site is not in use and is fenced off and locked. Warning signs are posted around the property. Outside of the fenced area, groundcover generally consists of loose native soil in the field areas, coral and cinder used as a base for the field roads, and concrete pads adjacent to the site gates.

3.2 Site Geology

The East Kapolei PML site is situated at an elevation of approximately 100 feet above msl. Soil at the property is classified by the U.S. Department of Agriculture (USDA) Soil Conservation Service as Honouliuli clay (HxA). The Honouliuli Series consists of well-drained soils on coastal plains in the Ewa area. These soils developed in alluvium derived from basic igneous rock. Honouliuli clay is dark reddish-brown, very sticky and very plastic clay, with 0 to 2 percent slopes underlain with coral reef limestone. Permeability is moderately slow, runoff is slow, and the erosion hazard is no more than slight. Workability is slightly difficult because of the very sticky and very plastic clay. The shrink-swell potential is high (USDA, 1972).

Observations made during recent and previous subsurface investigations at the site indicated that existing site soils generally consist of a dark reddish-brown clay interspersed with relatively thin layers of coralline material. Deeper soils exhibited a very plastic consistency, which impeded previous direct-push sampling efforts at greater depths, slowed hollow-stem auger drilling for monitoring well installation, and slowed groundwater recharge into boreholes.

3.3 Site Hydrogeology

According to Mink & Lau, 1990, the site is located above two aquifers within the Pearl Harbor Aquifer Sector, Ewa Aquifer System. The upper aquifer is a basal, unconfined formation in sedimentary (nonvolcanic) lithology. Groundwater within this upper aquifer is currently used but is neither a drinking water source nor ecologically important. This groundwater source is considered replaceable, moderately saline, and has a high vulnerability to contamination. The lower aquifer is a basal, confined aquifer in horizontally extensive lavas. The groundwater in this lower aquifer is neither a drinking water source nor ecologically important, and is further characterized as being an irreplaceable formation with a low salinity (between 250 and 1000 milligrams Cl per liter) and low vulnerability to contamination.

The depth to groundwater in three monitoring wells previously installed within the site ranged from 79 to 85 feet below existing ground surface.

3.4 Historical Land Use

The East Kapolei PML site and surrounding lands were in sugarcane cultivation for over 100 years from approximately 1890 to 1994. Ewa Plantation Company operated the first sugar plantation in the area from 1890 to 1970, followed by Oahu Sugar Company, who leased the Project Site and surrounding lands from the Estate of James Campbell until 1994.

Ewa Plantation Company constructed the existing buildings at the project site in 1953. The site was actively used for the storage, mixing, and loading of agricultural pesticides for approximately 40 years up to 1994. Pesticides were stored, mixed, and loaded onto trucks for distribution and dispersal in the plantation fields. In the 1950s, pentachlorophenol with diesel or kerosene was also mixed and applied. It is suspected that soils at the site became contaminated as a result of periodic chemical spills over the years. Such spills were typically not cleaned up by the plantation. Storm water runoff and truck movement from the site appear to have dispersed pesticides and contaminants outside the currently fenced area.

Activities on the East Kapolei PML site ceased when Oahu Sugar Company shut down operations in 1994. Through a condemnation proceeding, the State of Hawaii acquired the Project Site on August 22, 1994 by Land Court Document No. 2181717, recorded at the State of Hawaii Bureau of Conveyances on September 21, 1994. The site has not been utilized since plantation activities ceased.

Two abandoned buildings and several elevated storage tanks were located on the site, but have since been removed (see Appendix I, Figures 3 and 4). DHHL completed consultation with the State Historic Preservation Division (SHPD) of the Department of Land and Natural Resources (DLNR) regarding the historic significance of the structures on the Project Site prior to demolition. In a letter dated May 14, 2009, SHPD provided a determination regarding the historic significance of the site. SHPD determined that, although the structures on the property are eligible for nomination to the National Register for their association with sugar plantations in Hawaii, “demolition will be [a] ‘no adverse effect to a historic property agreed upon mitigation.’” The Architectural Inventory Survey and photographs are an appropriate mitigation and no further mitigation is needed. Work may proceed.”

3.5 Future Land Use

Following completion of remediation activities, DHHL proposes the redevelopment of the East Kapolei PML site and surrounding lands as part of the agency’s “East Kapolei II” community. DHHL’s master plan for “East Kapolei II” shows the site as located within a five-acre lot. No residential units will be located on the site itself, however, future land uses to be hosted at the site are contingent upon the selected methods of remediation.

“East Kapolei II” will include 1,000 affordable, for-sale homes to be constructed by DHHL for native Hawaiian beneficiaries and 1,000 affordable rental units to be constructed by other agencies for the general public. Public facilities planned within the “East Kapolei II” development include schools, parks, and the Kroc Center, a major new community center to be built by the Salvation Army. The planned land uses in the vicinity of the Project Site are illustrated in Figure 5. The “East Kapolei II” community and DHHL’s regional development plans are described in the agency’s May 2008 *Kapolei Development Plan*. DHHL’s mission is to manage effectively the Hawaiian Home Lands Trust and to develop and deliver lands to native Hawaiians. DHHL works in partnership with other government agencies, private sector entrepreneurs, and non-profit organizations to carry out this mission. This work includes collaborative visioning, long-range planning, resource allocation, and project-specific joint ventures. DHHL believes that these partnerships benefit not only its native Hawaiian beneficiaries but the larger community as well.

The “East Kapolei II” development is an example of DHHL’s effective partnerships with government agencies, the private sector, and community organizations to develop its lands and improve community life. For the planned residential development, DHHL has reduced the cost of homes to beneficiaries and lessees by providing infrastructure, promoting energy efficiency, and partnering with developers. As noted above, the Salvation Army and DHHL are partnering to bring about a multi-service community complex in “East Kapolei II” with a broad range of programs to serve the public. In coordination with DLNR by way of a licensing agreement with the Hawaii State Department of Transportation (DOT), DHHL is protecting a unique ecosystem and the red ilima (*abutilon menziesii*) in a designated plant conservation reserve within “East Kapolei II”. DHHL’s partnership with the DOT and other agencies facilitated the construction of Kualakai Parkway and related infrastructure improvements to the benefit of the greater Kapolei community.

3.6 Contaminants of Concern

Multiple lines of evidence, including data obtained from previous investigations at the site and descriptions of historic use, were used to identify the contaminants of concern (COC) for the East Kapolei PML site. A summary of the information obtained during previous environmental investigation activities and used to determine the COC described herein is provided in Section 4.0. The suspected sources of contamination at the East Kapolei PML site include the bulk storage, mixing, and distribution of pesticides and herbicides during sugarcane cultivation operations. Specifically, COC included:

- Arsenic (metal associated with historic pesticides);
- Polychlorinated dibenzo-dioxins/polychlorinated dibenzo-furans (dioxins/furans, associated with pentachlorophenol);
- Pentachlorophenol (chlorinated herbicide); and
- Triazine pesticides (specifically ametryn, atrazine, simazine, and trifluralin).

Note that other chlorinated herbicides and organochlorine pesticides were excluded from the COC list based on historical data. Pentachlorophenol and triazine pesticides were included based on elevated concentrations (i.e., exceeding appropriate action levels) in recent samples and based on their common usage in the Hawaii sugar industry.

3.7 Conceptual Site Model

A conceptual site model (CSM) was prepared as part of the Site Investigation Work Plan. A CSM provides a generalized framework regarding site-specific conditions relevant to potential contaminants, contaminant sources, migration pathways, routes of exposure, potential receptors, and environmental hazards (i.e., leaching to groundwater/ discharge to surface waters, ecological toxicity) that may be affected by the contaminants. Establishment of this framework is essential for assessing environmental hazards associated with the contaminants, determining what receptors are at risk, determining appropriate remedial strategies, and addressing unacceptable hazards.

The following environmental hazards were initially considered:

- Direct exposure threats to human health;
- Intrusion of subsurface vapors into buildings;
- Leaching and subsequent threats to groundwater resources;
- Threats to terrestrial habitats; and
- Gross contamination and general resource degradation concerns.

Preliminary evaluation of environmental hazards based on the historical data concluded that the primary environmental hazard posed by arsenic, dioxins/furans, and pentachlorophenol at the site is direct exposure threats to human health and that the primary environmental hazard posed by triazine pesticides is leaching and potential impacts to groundwater (see CSM diagram in Appendix I). These considerations were used to identify and create decision units for the site investigation. Decision units for areas suspected to have been primarily impacted by arsenic and dioxins were designated based on hypothetical exposure areas (i.e., 5000-square foot areas). Decision units for areas suspected to have been primarily impacted by triazine pesticides (as well as pentachlorophenol, arsenic, and dioxins) were designated based on apparent concentrated spill areas.

3.7.1 Receptors of Concern

When identifying potential receptors, plausible exposure under both current and future land-use was evaluated. Accordingly, potential receptors were identified for both current and future use scenarios. For the purposes of this investigation, the following potential receptors were identified.

Future Site Users

Current land use plans identify residential development surrounding the existing East Kapolei PML site. The use of the area encompassing and including the current East Kapolei PML site has not been identified. Exposure pathways for future site users include:

- Inhalation of particulates from surface soil
- Dermal contact with soil
- Incidental ingestion of soil

Future Residents in Surrounding Areas

Future residents of surrounding dwellings may be exposed to contaminants stemming from the East Kapolei PML site. Exposure pathways for future residents in surrounding areas include:

- Inhalation of fugitive dust from site soil
- Dermal contact with soil and sediment from surface water runoff
- Incidental ingestion of soil and sediment from surface water runoff

Site Construction Worker

The future land use scenarios could include the development of the site. As a result, the construction worker would be present during development. It is assumed that construction workers could be exposed to contaminated soil. Specifically, the exposure pathways for a construction worker include:

- Inhalation of fugitive dust from soil
- Dermal contact with soil
- Incidental ingestion of soil

Aquatic Ecological Receptors

Although remote due to the site's distance to the nearest surface water body, aquatic ecological habitats may be impacted by contaminants through sediment runoff and dissolved chemicals that may enter the groundwater (and subsequently migrate to surface waters).

3.7.2 Exposure Pathways

Exposure is defined as the contact of an organism with a chemical or physical agent. An exposure pathway is defined as "the course a chemical or physical agent takes from a source to an exposed organism." It describes "a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site (USEPA, 1989)." In order for an exposure pathway to be considered potentially complete, four elements must exist: 1) a source or release from a source; 2) a transport/exposure media; 3) an exposure point (point of contact with the contaminated medium); and 4) an exposure route. The potential exposure pathways present at the property are described below.

A. Soil Exposure Pathway

Direct contact with soil may result in incidental oral ingestion and/or dermal absorption of COC. Although generally associated with surface soil, direct contact may also occur with subsurface soil during trenching and excavation work.

B. Air Exposure Pathway

Air exposure pathways become potential routes of exposure when COC enter the air via volatilization or via adsorption to fugitive dust particles. Volatilization occurs when COC partition to the air. Such volatilization may occur from surface soil, subsurface soil, and/or groundwater. When considering volatilization from subsurface soil or groundwater, transport of COC occurs through void spaces in unsaturated soils, asphalt, and concrete to the outdoor air or to future indoor air through foundation cracks. For this site, volatilization is not considered to be a concern due to the semi- to non-volatile nature of the COC.

Generation of fugitive dust may occur through disturbance of affected soil, such as wind or construction activities. Dust particles may be inhaled, may settle on human skin and be ingested (hand to mouth), and/or may settle on vegetation that may be ingested by humans.

C. Sediment Exposure Pathway

Receptors may be exposed to COC in sediment from the property as a result of surface runoff during storm events to nearby drainageways, which may eventually discharge to the ocean. Sediment may accumulate in the marine environment and be available for contact with various receptors. Recreational users of the marine environment (swimmers, surfers, fishermen) may come into direct contact with sediment and be exposed through oral ingestion and/or dermal absorption. Ecological receptors may live directly in the impacted sediment and may be exposed to COC through feeding within the sediment. As a secondary transport mechanism, COC may accumulate in ecological receptors (i.e., fish, shellfish), then be ingested by human receptors.

D. Groundwater Exposure Pathway

Groundwater beneath the site may have been impacted by surface spills through leaching from impacted soils, particularly associated with triazine pesticides. Receptors may be exposed to COC in the groundwater by direct contact or by inhaling volatile COC emitted from the groundwater to air. For this site, direct contact with groundwater is not anticipated since the aquifer is not considered to be usable as a drinking water resource and the depth to groundwater (approximately 80 feet below ground surface) makes direct human contact very unlikely. Inhalation of volatile COC is not anticipated due to the semi- to non-volatile nature of the COC. Although direct exposure to groundwater at the property is unlikely, the potential exists for contaminants that may leach into the groundwater to migrate or be drawn into downgradient wells.

Ecological receptors may also be affected in shallow marine environments within groundwater discharge zones. This is the primary concern associated with the groundwater exposure pathway.

3.8 Project Action Levels

The Action Levels (ALs) used to evaluate data obtained from this investigation are the DOH EALs for areas where a current or potential source of drinking water is not threatened and where the nearest surface water body is greater than 150 meters from the site. The ALs listed are default (or the lowest) EALs for unrestricted (i.e., residential) land use and are intended to address potential direct exposure and leaching hazards as discussed in Section 3.7.

Table 1: Default DOH EALs for Soil

Contaminants of Concern	EAL
Arsenic	20 mg/kg
Dioxins/Furans TEQ	450 ng/kg
Pentachlorophenol	3.0 mg/kg
Ametryn (Triazine Pesticide)	11 mg/kg
Atrazine (Triazine Pesticide)	2.1 mg/kg
Simazine (Triazine Pesticide)	0.25 mg/kg
Trifluralin (Triazine Pesticide)	32 mg/kg

4.0 INVESTIGATION HISTORY

A number of environmental investigations have been performed throughout the East Kapolei PML site and surrounding areas. Findings from these investigations indicate the presence of various pesticides and pesticide-related chemicals in site soils at elevated concentrations. The primary sources of site-specific information include the following documents:

- Miles, C.J., Yanagihara, K., Ogata, S., Van De Berg, G., and Boesch, R. 1990. *Soil and Water Contamination at Pesticide Mixing and Loading Sites on Oahu, Hawaii*. Conducted by the University of Hawaii and Hawaii State Department of Agriculture. Printed in: *Bulletin of Environmental Contamination and Toxicology*. 44:955-962. January 8.
- U.S. EPA. 2000. *Extent of Contamination, Oahu Sugar Company Site, Ewa, Hawaii, December 2000*. U.S. EPA Work Assignment No. 0-125, Lockheed Martin Work Order No. R1A00125, U.S. EPA Contract No. 68-C9-223.
- Hawaii State Department of Health. 2000. *Site Inspection – Ewa Sugar Mill/Oahu Sugar Co. Pesticide Mixing and Loading Site*. EPA Site ID Number HISFN0905536, submitted to EPA Region IX, July 3, 2000.
- AMEC Earth and Environmental Inc. 2004. *Phase I Environmental Site Assessment at East Kapolei Brownfield, Kapolei, Hawaii*. Prepared for the State of Hawaii DBEDT, ASO Log No. 02-131. September.
- EnviroServices & Training Center, LLC. 2007. *Final Site Investigation and Preliminary Remedial Alternatives Analysis Report, East Kapolei – Brownfields, Former Oahu Sugar Company, Pesticide Mixing and Loading Areas, Kapolei, Oahu, Hawaii TMK (1)-9-1-017: Parcel 088*. Prepared for the State of Hawaii DBEDT. August.
- Environet, Inc. 2009. *Phase I Environmental Site Assessment, East Kapolei Brownfields Site, Kapolei, Oahu, Hawaii 96707, TMK (1) 9-1-17: 71 (portion)*. Prepared for the State of Hawaii DHHL. January 22.

Data from other sources (i.e., DOH HEER Office, EPA Region 9) are available and have been reviewed, but such data have not been officially compiled into reports for release. Summary tables of the existing data have been included as Appendix II and a portion of the corresponding sample locations are shown in Appendix I, Figure 5.

4.1 University of Hawaii/Hawaii Department of Agriculture - 1990

As documented in an article published on January 8, 1990 in the *Bulletin of Environmental Contamination and Toxicology*, the researchers collected discrete soil samples at the East Kapolei PML site during active operations. Analytical data indicated elevated concentrations of ametryn, atrazine, and DDT in the soil samples. Although the locations of these samples could not be accurately identified, the data helped to identify COC targeted for further investigation.

4.2 Hawaii Department of Health - 2000

As documented in the July 3, 2000 *Site Inspection – Ewa Sugar Mill/Oahu Sugar Co. Pesticide Mixing and Loading Site*, discrete soil sample data collected by the DOH in May 1997 and September 1999 indicated the presence of elevated metals, pesticides/herbicides, and dioxins concentrations in site soils. Specifically, arsenic, lead, zinc, pentachlorophenol, dalapon, and dioxins concentrations exceeded current default DOH EALs.

4.3 United States Environmental Protection Agency - 2000

As a follow up to the Site Inspection conducted by the DOH, the U.S. EPA conducted additional sampling at the East Kapolei PML site and documented findings in the December 2000 *Extent of Contamination, Oahu Sugar Company Site, Ewa, Hawaii* report. Discrete soil sample data indicated concentrations of metals, pesticides/herbicides, and dioxins at concentrations exceeding current default DOH EALs. The data generally indicated that the extent of contamination was limited to within the original fence line of the East Kapolei PML site. However, dioxins concentrations appeared to extend beyond the original fence line and therefore triggered the construction of the second, outer fence line.

4.4 EnviroServices & Training Center LLC - 2007

Under a contract with the Hawaii Department of Business, Economic Development, and Tourism (DBEDT), ETC conducted additional sampling at the East Kapolei PML site to screen for depth of contamination, delineate the extent of dioxin impacts to surface soils outside of the fence line using multi-increment sampling protocols, and screen for contaminant concentrations in the underlying groundwater. The resultant data was presented in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis Report, East Kapolei – Brownfields, Former Oahu Sugar Company, Pesticide Mixing and Loading Areas, Kapolei, Oahu, Hawaii TMK (1)-9-1-017: Parcel 088*.

Discrete data indicated relatively low to non-detectable contaminant concentrations in subsurface soils (with the exception of dioxins concentrations, which were slightly higher than the current DOH EAL). Multi-increment soil sampling data from two “rings” of decision units located outside of the East Kapolei PML site fence line indicated the presence of elevated dioxin concentrations beyond the southwest gate, but limited to areas within the second ring of decision units. Groundwater data indicated that pesticide/herbicide concentrations in the groundwater samples were generally below method detection limits and/or default DOH EALs.

4.5 Hawaii Department of Health (No Report) - 2007

The DOH HEER Office collected triplicate multi-increment samples from surface soils within the East Kapolei PML site, in a low-lying area adjacent to the former boiler structure. The DOH’s intent was to determine whether leaching of pesticides in the soil was a significant concern. The triplicate samples were initially analyzed for total concentrations of pesticides and herbicides. After receipt of the sample data, the samples were further analyzed for select pesticides and herbicides using Synthetic Precipitation Leaching Procedure (SPLP) extraction methodology to determine the amount of contaminant that would leach out of the soil (via calculation of sorption coefficients). Although problems were encountered with sample holding times and therefore data was deemed suspect, results indicated that there may be a potential for contaminants to leach out of the soil into the underlying groundwater.

4.6 United States Environmental Protection Agency (No Report) - 2009

The U.S. EPA funded the collection of eighty-two discrete soil samples from assumed depths of 0 to 1 feet below ground surface (bgs) and 1 to 2 feet bgs in areas outside of and adjacent to the East Kapolei PML site. All samples were analyzed for dioxins and arsenic. Data generally indicated that dioxin concentrations outside the East Kapolei PML site fence line were relatively low, with only three of the eighty-two discrete samples having dioxin TEQ values exceeding the DOH EAL. However, arsenic data suggests a pattern of arsenic impacted soil at depths of 1 to 2 feet bgs outside of the southwestern gate and within the adjacent dirt roadway. Arsenic was detected at concentrations as high as 519 mg/kg in these areas.

4.7 Hawaii Department of Health (No Report) - 2009

In 2009, the DOH HEER Office funded a bench-scale study to determine whether the specific contaminants (particularly dioxins) could be treated using a thermal desorption technology. Multi-increment triplicate samples were collected from two separate decision units – the boiler room (low-lying area adjacent to the former boiler structure) and the spill area (soil beneath an apparent mixing tank embedded within the storage structure). The multi-increment samples were analyzed for dioxins, pentachlorophenol, and DDT. Analytical data to determine the baseline concentrations indicated very high dioxin TEQs in both decision units, as well as elevated pentachlorophenol/slightly elevated DDT concentrations.

4.8 Area-Wide Investigation

Note that an area-wide investigation was completed by TetraTech EM Inc. in December 2007 on the entire 404-acre property initially targeted for development, excluding approximately three acres centered on the East Kapolei PML site and approximately 83 acres on the western portion of the property where drainage basins were being excavated. Findings of the investigation indicated that “there are no elevated concentrations of chemicals of potential concern in the soil that suggest conditions are not suitable for residential reuse, or that any additional sampling or evaluation is necessary.” These findings were documented in TetraTech EM Inc.’s December 12, 2007 *Final Site Assessment Report, East Kapolei Affordable Housing Project, Kapolei, Oahu, Hawaii* prepared for DOH HEER Office.

Based on this information, the bulk of the planned “East Kapolei II” community is being developed on land that has been deemed by the DOH as appropriate for residential development. Therefore, DHHL is focusing its efforts to address residual contamination at the East Kapolei PML site.

4.9 Summary of Historic Data

In general, data from these previous investigations have indicated that the East Kapolei PML site has been impacted by arsenic, dioxins/furans, pentachlorophenol, and triazine pesticides. Patterns within the data suggest that the areas beneath the elevated ASTs, beneath a mixing tank built into the patio of the office/storage structure, and behind the boiler building contain the highest contaminant concentrations (Appendix I, Figure 5). Specifically:

- Arsenic concentrations as high as 160 mg/kg (sample SM-2), dioxin concentrations as high as 752,000 ng/kg (sample S-1), and pentachlorophenol concentrations as high as 310 mg/kg (sample SM-1) were identified in soil beneath the elevated ASTs.
- Dioxin concentrations as high as 581,720 ng/kg (sample “Spill Area 2”) and pentachlorophenol concentrations as high as 32.7 mg/kg (sample “Spill Area 3”) were identified in soil beneath the mixing tank within the office/storage building.
- Dioxin concentrations as high as 1,814,480 ng/kg (in parts per million range, sample “Boiler Room 2”), pentachlorophenol concentrations as high as 28.4 mg/kg (sample “Boiler Room 3”), ametryn concentrations as high as 120 mg/kg (sample S-1a,b,c), atrazine concentrations as high as 86 mg/kg (sample S-1a,b,c), and trifluralin concentrations as high as 190 mg/kg (sample S-1a,b,c) were identified in soil behind the boiler building.

The data from samples collected within the East Kapolei PML site were used to formulate the COC for the current site investigation and these COC were chosen since they were consistently identified at elevated concentrations.

In addition to surface and subsurface soil data, groundwater data from historical investigations were also evaluated. Three, 2-inch diameter groundwater monitoring wells were installed by ETC (documented in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis*) within (MW3) and immediately adjacent to (MW2 and MW4) the fenced areas of the East Kapolei PML site (Appendix I, Figure 5). These monitoring wells were installed at depths of 90 to 100 feet below existing ground surface and groundwater in these wells were measured at 80 to 85 feet below existing ground surface. Data from groundwater samples collected from these wells indicated that all analyte concentrations (including arsenic, pentachlorophenol, and triazine pesticides) were either below method detection limits or below applicable default DOH EALs. As such, data suggested that contaminants from the East Kapolei PML site did not significantly impact underlying groundwater and that groundwater would not be included as a medium of concern for the current investigation.

Historical investigations also suggest that there are contaminant impacts in soils outside of the existing East Kapolei PML site fence line. In particular, data obtained by ETC and documented in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* indicate that dioxin impacts extend beyond the fence line, generally outside of the southwest gate, beyond decision units 8, 9, and 10 from the first “ring” of decision units, but limited to within the second “ring” of decision units. Similarly, discrete sample data collected by the US EPA in 2009 indicate that elevated arsenic concentrations exist in soil at depths of approximately 1 to 2 feet bgs in the same area and extending out to the south of the PML site, within the intersection of the coral/dirt roads. Finally, limited data collected by the DOH/EPA in the July 2000 *Site Inspection* indicate the presence of elevated dioxin TEQ concentrations (composite sample SDa,b,c at 1,400 ng/kg) in soil/sediment accumulated in the concrete-lined ditch adjacent to the East Kapolei PML site. Although the extent of dioxin impacts were not determined, DHHL and DOH decided that soil/sediment from sections of the concrete lined ditch located adjacent to and southwest (downgradient) of the East Kapolei PML site would be removed from the ditch during site remediation activities and addressed similar to other dioxin-impacted soil.

Through extensive discussions with the DOH HEER Office regarding historic data available to-date, the objectives of the current investigation were developed. The following points were agreed upon:

- The lateral extents of off-site dioxin impacts were delineated within the decision unit rings from the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis*. Therefore, dioxin-impacted soil located beyond the East Kapolei PML site fence line will need to be addressed with impacted soil located within the fence line.
- The lateral extents of off-site arsenic impacts were delineated based on discrete sampling data obtained by the U.S. EPA in their 2009 investigation. Therefore, arsenic-impacted soil located beyond the East Kapolei PML site fence line will need to be addressed with impacted soil located within the fence line.

- The lateral extents of pentachlorophenol and triazine pesticide impacts were defined by historical data as being within “spill areas” of the site, or areas immediately beneath or adjacent to the former ASTs, storage structure, and boiler room where the highest dioxin concentrations were identified.
- There are currently no significant COC impacts to groundwater based on groundwater data documented in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis*. The three existing monitoring wells will need to be decommissioned in accordance with DOH HEER Office guidance during site remediation.
- Accumulated soil/sediment located within the concrete-lined ditch located adjacent to and continuing west towards the new Kualakai Parkway were impacted with dioxins at elevated concentrations. Therefore, the soil/ sediment in the ditch will need to be addressed with other impacted soil.

Based on these findings, the December 2009 *Site Investigation Work Plan* was developed. The objectives of the work plan were to address the following:

- Vertical delineation of COC-impacted soil within the East Kapolei PML site.
- Quantification of the volume of soil impacted by specific COC within the East Kapolei PML site.
- Obtaining this information by quantifying mean COC concentrations in the surface and subsurface soil within decision units throughout the East Kapolei PML site. These decision units would be delineated based on the locations of historic structures and through review of historic data.

5.0 SUMMARY OF DATA QUALITY OBJECTIVES

The data quality objectives (DQO) process described in the Site Investigation Work Plan was used to define the criteria for environmental data collection operations. The DQOs were formulated to identify: 1) the reason for the investigation; 2) the inputs to the decision-making process; 3) the boundaries of the investigation; 4) the decision rules to be applied; 5) the potential decision errors and tolerable limits; and 6) the optimal sampling design to be used in the investigation.

5.1 Problem Statement

Previous environmental investigations at the East Kapolei PML site indicated the presence of elevated COC concentrations in site soils. The suspected sources of contamination include historic spills/leaks/releases from the former mixing and loading ASTs, historic overfilling of mobile tanks, and historic spills/leaks/releases from mobile tanks. Existing data suggest that the highest COC concentrations were typically found within the fenced area of the site, adjacent to existing structures and beneath existing ASTs. The extent of contamination was generally delineated within the existing fence line, with the exception of arsenic, which was found at elevated concentrations in near surface (approximately 1 to 2 feet bgs) soils adjacent to and outside of the fence line.

The primary goals for this investigation were to obtain refined estimates of COC-impacted soil areas and volumes to assist in evaluating appropriate remedial alternatives. For the purposes of the investigation activities described herein, the problem statement was formulated:

“In order to obtain more refined volume estimates of residual COC-impacted soil at the East Kapolei PML site, additional data for surface and subsurface soils is needed to evaluate appropriate remedial alternatives.”

5.2 Decision Making

The decision statements were then formulated based on the principal study questions for the project (i.e., the decisions to be made, the key unknown/unresolved issues) and the feasible alternative actions that may be taken based on the outcome of the investigation. The decision statements for this project were identified as follows:

- Decision Statement 1: Determine whether mean COC concentrations in surface soil within the identified decision units within the East Kapolei PML site exceed ALs and may require additional investigation and/or corrective actions to mitigate exposure pathways; if not then decision unit will not be included in the area requiring corrective actions.
- Decision Statement 2: Determine whether mean COC concentrations in subsurface soil within the identified decision units within the East Kapolei PML site exceed ALs and may require additional investigation and/or corrective actions to mitigate exposure pathways; if not then no further action regarding subsurface soil is required.

5.3 Decision Inputs

The inputs to the decision were identified as new data obtained through the analysis by a National Environmental Laboratory Accreditation Conference (NELAC)-certified laboratory using standardized analytical methods (i.e., standard EPA analytical methods described in the Third Edition of *SW-846 On-line Test Methods for Evaluating Solid Waste Physical/Chemical Methods*) and through comparison to current DOH EALs.

5.4 Investigation Boundaries

The populations of interest were identified as surface and subsurface soil (soil particles that pass through a 2-millimeter sieve) within the fence line of the East Kapolei PML site. The investigation was not considered to be constrained by temporal boundaries since the COC being investigated are relatively persistent in the environment and will not greatly vary in concentrations in the soil over relatively short time periods.

5.5 Decision Rules

The decision rules were then formulated to govern the decision-making process. Using the information gathered in the previous steps of the DQO process, the following decision rules were formulated:

“If COC concentrations in surface and/or subsurface soil decision units at the property exceed the ALs established for this project, then additional activities may need to be performed to evaluate and/or mitigate exposure pathways to potential receptors. If COC concentrations in surface and/or subsurface soil decision units at the property are below the ALs, then no additional activities will need to be performed for the specific decision unit and the exposure pathways for the specific decision unit will be considered incomplete.”

5.6 Decision Error

Decision errors occur when sample data misleads the decision maker(s) into making a wrong decision and therefore taking the wrong response action. The possibility of a decision error exists since decisions are based on sample data that may be inaccurate due to random and systematic errors incurred at different stages of acquisition.

In order to control the various sources of decision error, a sampling methodology designed to minimize the sources of significant decision error was selected (multi-increment sampling). In addition, it was deemed prudent to incorporate a statistics-based bench mark for margin of error. As such, the relative standard deviation was identified as a means to evaluate the potential effect of error on the investigation process. Furthermore, to account for uncertainty in the data due to variance, it was determined that one standard deviation from the mean would be added to reported concentrations as recommended in DOH guidance.

5.7 Sampling Design

The multi-increment sampling approach was selected to obtain representative samples that exhibit mean concentrations of the media being sampled and that accounts for the variability of concentrations within that media. The multi-increment sampling methodology takes into account the need for sufficiently accurate and precise sample data. The methodology includes requirements for: 1) collection of random samples; 2) collection of a larger number of samples; and 3) collection of a physically larger volume than standard discrete sampling methodologies. Since mean concentrations would be obtained using the multi-increment sampling methodology, defining the appropriate decision units was considered to be essential for meeting the project DQOs.

In general, the former East Kapolei PML site was divided into twelve surface decision units, with each decision unit ranging from roughly 1,000 square feet to less than 5,000 square feet in area. Three of these surface decision units were considered spill area decision units, or areas where the highest COC concentrations were anticipated based on their location in relation to the historic contaminant sources (i.e., in the immediate vicinity of storage and mixing equipment).

The nine remaining surface decision units were considered investigation area decision units, or areas outside of the immediate vicinity of contaminant sources that may have been impacted through other mechanisms. These decision units were sized to be consistent with hypothetical exposure areas (i.e., maximum 5,000 square feet in area) to be consistent with the investigation of the nearby field areas.

The three spill area decision units consisted of four separate “layers” in order to identify the vertical extent of COC impacts. These layers included a 0 to 0.5-foot layer, 0.5-foot to 2-foot layer, 2-foot to 5-foot layer, and 5-foot to 10-foot layer. The data obtained would provide a clearer picture of the volume of soil impacted by COC in these areas considered to be the most contaminated.

Five of the nine investigation area decision units also included subsurface layers to identify the vertical extent of certain COC impacts. These layers consisted of a 0 to 0.5-foot layer, 0.5-foot to 2-foot layer, and 2-foot to 3-foot layer. Similar to the spill area decision units, depth layers would provide a better estimate of COC-impacted soil volumes.

6.0 FIELD ACTIVITIES

This section provides information regarding the selection of decision units and the specific field methods employed to perform sampling activities during this site investigation. The activities described herein were performed in general accordance with available sections of the DOH HEER Office *Technical Guidance Manual for Implementation of the Hawaii State Contingency Plan, Interim Final* and the DOH's Summer 2008 (Updated October 2008) *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater*.

6.1 Selection of Decision Units

In general, the former East Kapolei PML site was divided into twelve surface decision units, with each decision unit ranging from roughly 1,000 square feet to less than 5,000 square feet in area (see Appendix I, Figure 6). Three of these surface decision units (SA1 to SA3) were considered spill area decision units, or areas where the highest COC concentrations were anticipated based on their location in relation to the historic contaminant sources (i.e., in the immediate vicinity of storage and mixing equipment).

The nine remaining surface decision units were considered investigation area decision units (IA1 to IA4 and IAT1 to IAT5), or areas outside of the immediate vicinity of contaminant sources that may have been impacted through other mechanisms. These decision units were sized to be consistent with hypothetical exposure areas (i.e., maximum 5,000 square feet in area) and to be consistent with the investigation of the nearby field areas.

The three spill area decision units consisted of four separate "layers" in order to identify the vertical extent of COC impacts. These layers included a 0 to 0.5-foot layer (SA1.A to SA3.A), 0.5-foot to 2-foot layer (SA1.B to SA3.B), 2-foot to 5-foot layer (SA1.C to SA3.C), and 5-foot to 10-foot layer (SA1.D to SA3.D). It was anticipated that the data obtained would provide a clearer picture of the volume of soil impacted by COC in these areas considered to be the most contaminated.

Five of the nine investigation area decision units also included subsurface layers to identify the vertical extent of certain COC impacts. These layers consisted of a 0 to 0.5-foot layer (IAT1.A to IAT5.A), 0.5-foot to 2-foot layer (IAT1.B to IAT5.B), and 2-foot to 3-foot layer (IAT1.C to IAT5.C). Similar to the spill area decision units, it was anticipated that depth layers would provide a better estimate of COC-impacted soil volumes.

The lateral extent of these decision units were initially established using a topographic survey provided in a State Plane, North American Datum 1983 coordinate system. Using coordinates uploaded from the topographic survey to handheld global positioning system (GPS) instrumentation, ETC personnel then mobilized to the East Kapolei PML site to physically demarcate the decision unit boundaries. Aluminum spikes and surveyors' tape were used to provide physical markers showing the decision unit boundaries.

6.2 Surface and Subsurface Soil Sampling Activities

Sample collection activities were divided into three phases: surface soil sample collection, Spill Area subsurface soil sample collection, and Investigation Area trench sample collection. A total of thirty-one primary multi-increment soil samples and six field replicate multi-increment soil samples were collected as part of this investigation. A summary of the decision units, sample depths, volumes of soil represented, and the primary analyses have been included in Table 2.

6.2.1 Surface Soil Sample Collection

Surface soil samples were collected from all twelve surface decision units using pre-cleaned stainless steel trowels. Each sample consisted of fifty soil increments and each increment consisted of soil from the ground surface to 0.5 feet deep. Care was taken to ensure that each increment had a representative amount of soil from the entire 0- to 0.5-foot column of soil and that the volume of each increment was consistent. Rocks and debris were not included with each increment. The soil increments were collected using a stratified, random pattern within each decision unit, ensuring the overall fifty-increment sample represented all portions of the decision unit area. All soil increments from the same multi-increment sample were placed into new, 1-gallon sized resealable polyethylene bags and each bag was labeled with the sample identification, date/time of sample collection, and the initials of the collector. The samples were then placed in a designated sample cooler with ice pending delivery to the laboratory. The decision unit areas are shown in Figure 6, Appendix I.

6.2.2 Spill Area Subsurface Soil Sample Collection

Subsurface multi-increment soil samples collected from within the Spill Area decision units (SA1 through SA3) were collected in a stratified, random manner using a direct-push rig equipped with stainless steel core samplers and operated by Geotek Hawaii. The core samplers were driven into the ground and soil increments from each depth layer (0.5-feet to 2-feet, 2-feet to 5-feet, and 5-feet to 10-feet) were extracted and placed within the appropriate resealable plastic bag. Soil increments were extracted from the soil cores by cutting out a section of the core length-wise, ensuring a representative aliquot of soil from the targeted depth interval was obtained. A total of twenty soil increments were collected from each decision unit within the Spill Areas. All soil increments from the same multi-increment sample were placed into new, 1-gallon sized resealable polyethylene bags and each bag was labeled with the sample identification, date/time of sample collection, and the initials of the collector. The samples were then placed in a designated sample cooler with ice pending delivery to the laboratory.

6.2.3 Investigation Area Trench Sample Collection

Subsurface multi-increment soil samples collected from the Investigation Area decision units targeted for trenching (IAT1 through IAT5) were collected in a stratified, random manner from within trenches created using a backhoe. The backhoe was used to excavate 3-foot deep trenches within each decision unit, with the intention that the trenches provide a representative vertical cross-section of subsurface soil throughout the decision unit. In general, ETC personnel excavated diagonal trenches to obtain the maximal coverage of the decision unit areas (for example, excavate one trench diagonally across a rectangular decision unit, then excavate a second trench diagonally in the opposite direction of the first trench across the decision unit, resulting in an “X” pattern). The excavated soil was placed adjacent to the trench from which it originated to facilitate replacement of the soil after sample collection activities were completed.

After exposing a representative cross-section, ETC personnel collected fifty soil increments from each depth layer (0.5-feet to 2-feet and 2-feet to 3-feet) in a stratified, random manner using pre-cleaned, stainless steel trowels and aluminum foil-lined stainless steel bowls (to retain soil increments). All soil increments from the same multi-increment sample were placed into new, 1-gallon sized resealable polyethylene bags and each bag was labeled with the sample identification, date/time of sample collection, and the initials of the collector. The samples were then placed in a designated sample cooler with ice pending delivery to the laboratory.

Upon completion of sample collection, the soil excavated from the trenches was returned to the trench from which the soil originated. In no instance was soil removed from the site, other than the volumes required for sample analyses.

6.3 Summary of Environmental Samples

A summary of the environmental samples collected from the East Kapolei PML site during this investigation is provided with corresponding analyses in Table 2.

Table 2: Summary of Primary Samples, Sample Depths, Estimated Volumes, and Analyses

Decision Unit	Type/Depth	Collection Protocol	Surface Area (sf)	Layer Vol. (cy)	Analyses
SA1.A	0-0.5'	MI	2560	47.4	arsenic, dioxins, PCP, triazines, SPLP triazines
SA1.B	0.5'-2'	MI borings		142.2	arsenic, dioxins, PCP, triazines, SPLP triazines
SA1.C	2'-5'	MI borings		284.4	arsenic, dioxins, PCP, triazines, SPLP triazines
SA1.D	5'-10'	MI borings		474.1	arsenic, dioxins, PCP, triazines, SPLP triazines
SA2.A	0-0.5'	MI	1695	31.4	arsenic, dioxins, PCP, triazines, SPLP triazines
SA2.B	0.5'-2'	MI borings		94.2	arsenic, dioxins, PCP, triazines, SPLP triazines
SA2.C	2'-5'	MI borings		183.3	arsenic, dioxins, PCP, triazines, SPLP triazines
SA2.D	5'-10'	MI borings		313.9	arsenic, dioxins, PCP, triazines, SPLP triazines
SA3.A	0-0.5'	MI	1050	19.4	arsenic, dioxins, PCP, triazines, SPLP triazines
SA3.B	0.5'-2'	MI borings		58.3	arsenic, dioxins, PCP, triazines, SPLP triazines
SA3.C	2'-5'	MI borings		116.7	arsenic, dioxins, PCP, triazines, SPLP triazines
SA3.D	5'-10'	MI borings		194.4	arsenic, dioxins, PCP, triazines, SPLP triazines
IA1	0-0.5'	MI	4210	78	arsenic, dioxins
IA2	0-0.5'	MI	4480	83	arsenic, dioxins
IA3	0-0.5'	MI	4255	78.8	arsenic, dioxins
IA4	0-0.5'	MI	3615	66.9	arsenic, dioxins
IAT1.A	0-0.5'	MI	4710	87.2	arsenic, dioxins
IAT1.B	0.5'-2'	MI trench		261.7	arsenic, dioxins
IAT1.C	2'-3'	MI trench		174.4	arsenic, dioxins
IAT2.A	0-0.5'	MI	4850	89.8	arsenic, dioxins
IAT2.B	0.5'-2'	MI trench		269.4	arsenic, dioxins
IAT2.C	2'-3'	MI trench		179.6	arsenic, dioxins
IAT3.A	0-0.5'	MI	2885	53.4	arsenic, dioxins
IAT3.B	0.5'-2'	MI trench		160.3	arsenic, dioxins
IAT3.C	2'-3'	MI trench		106.9	arsenic, dioxins
IAT4.A	0-0.5'	MI	3000	55.6	arsenic, dioxins
IAT4.B	0.5'-2'	MI trench		166.7	arsenic, dioxins
IAT4.C	2'-3'	MI trench		111.1	arsenic, dioxins
IAT5.A	0-0.5'	MI	2460	45.6	arsenic, dioxins
IAT5.B	0.5'-2'	MI trench		136.7	arsenic, dioxins
IAT5.C	2'-3'	MI trench		91.1	arsenic, dioxins

Decision Units SA1 and SA3 = Spill Area decision units

Decision Units IA1 to IA4 = Investigation Area decision units (surface soil only)

Decision Units IAT1 to IAT5 = Investigation Area-Trench decision units

7.0 SAMPLE CONTROL PROCEDURES

This section provides information regarding specific control procedures utilized during site activities to maintain control over sample management. Such procedures were discussed in the December 2009 Site Investigation Work Plan.

7.1 Sample Identification

The sample identification, or sample naming, procedure describes the naming convention for samples collected and analyzed during this field investigation. The following format was used for multi-increment soil samples collected at the property.

DU.X where:

- DU = decision unit designation (SA-spill area, IA-investigation area, or IAT-investigation area trench)
- X = depth layer
For SA decision units, A=0-0.5 ft, B=0.5-2 ft, C=2-5 ft, D=5-10 ft
For IA decision units, A=0-0.5 ft
For IAT decision units, A=0-0.5 ft, B=0.5-2 ft, C=2-3 ft

Field replicate samples were labeled in a similar manner as described above using fictitious depth layer designations such that the samples were indistinguishable from primary samples.

The labeling method was used for all samples collected at the site. Each sample container (resealable plastic bag) was labeled with the sample ID, date/time of sampling, and sampler's initials using an indelible ink marker.

7.2 Sample Chain-of-Custody and Transportation

Chain of custody documentation, described in the December 2009 Site Investigation Work Plan, was maintained to track possession of the samples. All samples collected during the investigation were recorded on chain of custody forms. Information included on the chain of custody forms included:

- Sample ID number
- Matrix
- Date and time of collection
- Number and type of containers
- Analytical method to be performed
- Number of pages

An ETC representative retained custody of the samples at all times prior to hand delivery to TestAmerica – Honolulu in Aiea, Hawaii. Upon delivery of the samples, ETC representatives signed the chain of custody form to indicate the date and time custody of the samples were relinquished and a TestAmerica employee signed the form to indicate the change in custody. Copies of the completed chain of custody forms have been included with the laboratory data packages in Appendix III.

7.3 Sample Preservation and Handling Procedures

Sample handling and preservation were conducted in compliance with the respective method requirements. Table 3 below summarizes these requirements.

Table 3: Sample Handling and Preservation

Analyte	Analytical Method	Sample Container Size, Type	Preservation	Holding Time
Arsenic	EPA 6010B/6020	1-gallon resealable polyethylene bag	none	6 months
Dioxins/furans	EPA 8290	1-gallon resealable polyethylene bag	Dark, 4° C*	30 days*
Pentachlorophenol	EPA 8151A	1-gallon resealable polyethylene bag	Cool, 4° C	14 days
Triazine Pesticides	EPA 8270CM	1-gallon resealable polyethylene bag	Cool, 4° C	14 days

Note: Preservation and holding times in accordance with EPA SW-846 On-Line Revision 3: Test Methods for Evaluation Solid Wastes.
 *Preservation and holding time specified for EPA Method 8290 are recommendations. The method states that dioxins/furans are very stable in the environment and holding times under the preservation conditions may be as high as a year.

7.4 Laboratory Analytical Procedures

ETC delivered a total of thirty-one primary multi-increment samples and six field replicate multi-increment samples to TestAmerica – Honolulu (TA-H) in Aiea, Hawaii with completed chain of custody documentation. TA-H performed multi-increment subsampling in accordance with the EPA’s November 2003 *Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples* (EPA 600/R-03/027), which included air-drying, sieving, and obtaining representative subsamples using either an appropriate mechanical splitter or through multi-increment sampling protocols. TA-H was instructed to analyze the processed samples for total arsenic via EPA Method 6010B, dioxins/furans via EPA Method 8290, pentachlorophenol via EPA Method 8151A, and/or triazine pesticides via EPA Method 8270C Modified.

TA-H was also instructed to perform additional analyses on the twelve primary multi-increment samples and two field replicate multi-increment samples collected from the Spill Area decision units. These analyses included pentachlorophenol using the Synthetic Precipitation Leaching Procedure (SPLP) via EPA Method 1312/8270C, SPLP triazine pesticides via EPA Method 1312/8270C Modified, total organic carbon (TOC) via EPA Method 9060A Modified, clay fraction analysis (physical analysis to approximate the percentage of clay particles during sieving using a 250 micrometer sieve), RCRA8 metals using the Toxicity Characteristic Leaching Procedure (TCLP) via EPA Method 1311/6010/7000 series (surface samples only), TCLP pentachlorophenol via EPA Method 1311/8270C (surface samples only), and TCLP organochlorine pesticides via EPA Method 1311/8081 (surface samples only).

The SPLP analyses were run to assess the mobility of pentachlorophenol and triazine pesticides in soil within the Spill Area decision units (SA1 through SA3). The TOC and clay fraction analysis were run to assess some of the physical parameters of the soil within the Spill Area decision units to provide further information regarding contaminant mobility. The TCLP analyses were run on soil from the Spill Area decision units (anticipated to contain the highest contaminant concentrations) to determine whether, if excavated, these soils would be considered a RCRA-regulated (hazardous) waste.

8.0 FIELD OBSERVATIONS

In general, the soils at the East Kapolei PML site consisted of a brown silty clay material mixed with gravel at ground surface. The field sampling team observed a number of areas where thin layers of silty soils were underlain by asphalt pavement. Furthermore, areas of compacted coral fill materials, including varying sizes of coralline rock, were interspersed with the brown silty clay. Immediately outside of the site fencing, soils generally consisted of a brown to reddish brown, plastic silty clay. Large, deep cracks (2- to 4-inches wide and 12- to 24-inches deep) were observed in the areas between the East Kapolei PML site and the adjacent agricultural fields. The adjacent dirt roadways consisted of a mixture of coral fill, asphalt, deteriorating concrete, and brown silty clay.

Observations made during subsurface sampling activities utilizing the direct push rig indicated the presence of a brown silty clay from ground surface to 10 feet bgs, interspersed with coral fill material generally at depths ranging from ground surface to 5 feet bgs. Olfactory observations made during sampling of subsurface soil in the Spill Areas indicated the presence of a chemical odor, particularly in soil from SA2.

Observations made during trenching activities were consistent with observations made during surface sampling and subsurface sampling using the direct push rig. Brown silty clay mixed with gravel was encountered from ground surface to depths of 0.5 feet bgs, with brown silty clay observed at greater depths. Interspersed with the brown silty clay were areas consisting of coral fill material.

9.0 DATA QUALITY

Data obtained from an investigation should be of sufficient quality to ensure that site characterization data are adequate to accurately define impacts to the site and to evaluate potential environmental hazards. The identification of site impacts and potential environmental hazards is crucial for the decision-making process and more specifically for this project, the proper selection of remedial alternatives to ensure that the appropriate environmental hazards are addressed. The integration of quality control procedures during both the laboratory and field sampling aspects of the site investigation help to ensure that the resultant data can be considered sufficiently reliable for evaluating future site activities.

9.1 Laboratory Quality Control

Laboratory quality control procedures for soil analyses followed the specific US EPA methods as described in SW-846. Procedures included the measurement of surrogate standard recoveries, method blanks, laboratory control samples (LCS), matrix spike (MS) samples, and MS Duplicate (MSD) samples. Quality control data are initially reviewed by the laboratory project managers to ensure that data meets acceptable standards for use and reliability. In instances where potential problems were encountered during analyses (i.e., relative percent differences or percent recoveries exceed initially specified control limits, matrix interferences, etc.), the laboratory project manager evaluated the issue and made a determination on how such problems affect the data usability. In these instances, data qualifiers or flags are used to indicate which data may be affected by the issue.

Generally, ETC personnel evaluate the laboratory data packages as they become available. For this particular project, review of laboratory quality control data did not reveal any significant issues associated with data usage. The most consistent issue identified was the elevated reporting limits for dioxins/furans. Due to the high concentrations of these chemicals in the soil samples analyzed, dilutions were needed to obtain concentration values. In certain instances, the dioxins/furans concentrations were higher than could be quantified by the laboratory methods. In these situations, the laboratory had to estimate the concentration values. ETC determined that this would not affect the overall decision-making process since the resultant concentrations were well above the action levels identified for this project. Therefore, laboratory accuracy at these elevated levels was not considered crucial.

9.2 Field Quality Control

The data obtained through collection of multi-increment replicate samples (triplicates) were used for field quality control purposes. As discussed in the December 2009 *Site Investigation Work Plan*, ETC collected one primary multi-increment sample and two field replicate multi-increment samples (i.e., field triplicate samples) at a frequency of approximately one set of field triplicate samples for every ten primary multi-increment samples (10%) for quality control purposes. The primary sample and the two field replicate samples were collected in the same manner, as if three separate multi-increment samples were being collected from the same decision unit.

Three decision units were selected for triplicate sampling and were specified in the Site Investigation Work Plan. Surface soil field replicate samples were collected from decision units SA2 and IAT5. Subsurface soil field replicate samples were collected from decision unit IAT1. Table 4 below presents the reported concentrations, means, standard deviations, and relative standard deviations.

9.3 Data Quality Assessment

As described in the December 2009 *Site Investigation Work Plan*, since data from multi-increment samples theoretically provides estimates of the mean concentrations in the particular decision unit being assessed, a measure of the variation from the mean is needed to evaluate how that variation affects the decision making process. In an effort to account for variance in the data, standard deviations were calculated from the triplicate samples collected during the investigation (see Table 4 below). These standard deviations, coupled with the calculated means of the triplicate samples, were used to obtain relative standard deviations (RSDs) for each set of triplicate samples. The RSDs were then reviewed to determine the effects of total error on the data set. As shown in Table 4, a wide range of RSD values were observed for the various decision units and COC.

These standard deviations were then added to the reported concentrations for each COC and presented as “adjusted” concentrations. The adjusted concentrations were then used to make decisions regarding whether COC concentrations present a specific environmental hazard for the decision unit.

An overall review and evaluation of both laboratory quality control and field quality control information indicated that analytical data obtained during the site investigation can be relied upon to make decisions regarding site conditions and contaminant levels. Although some level of uncertainty exists regarding the exact concentrations of dioxins/furans at high levels, such uncertainty does not affect the overall data usability since such concentrations are orders of magnitude higher than the project action level. Similarly, uncertainty exists due to the elevated standard deviations and relative standard deviations calculated for certain COC. However, such uncertainty does not significantly affect the overall decision-making process for the site. For example, the addition of the high, calculated standard deviations to the reported concentrations for pentachlorophenol, ametryn, and atrazine resulted in the finding that all results exceed their respective default DOH EALs. In this particular situation, this is not a significant issue since all decision units affected will already need to be addressed due to elevated dioxins/furans TEQ concentrations existing in these same decision units. In other words, regardless of the pentachlorophenol, ametryn, and atrazine concentrations, these decision units require additional evaluation due to the elevated dioxins/furans concentrations, which are generally considered to be the risk-driver for the site.

Table 4: Field Replicate Calculations

Analyte	Spill Area, Surface Soil			Investigation Area, Subsurface			Investigation Area, Surface Soil		
	SA2.A	SA2.E	SA2.F	IAT1.B	IAT1.D	IAT1.E	IAT5.A	IAT5.D	IAT5.E
Arsenic	57.1	45.2	90	3.63	3.92	6.75	6.68	7.12	7.49
Mean	64.1			4.77			7.10		
SD	23.21			1.72			0.41		
RSD	36%			36%			6%		
TOC	53,000	43,000	70,000	NA			NA		
Mean	55,333.33								
SD	13,650.40								
RSD	25%								
Dioxin TEQ	350,420	453,020	335,410	324	545	196	10,980	5,410	15,897
Mean	379,616.67			355.00			10,762.33		
SD	64,010.64			176.55			5,246.89		
RSD	17%			50%			49%		
PCP	53.8	99.4	50.4	NA			NA		
Mean	67.87								
SD	27.36								
RSD	40%								
Ametryn	73.4	77.1	117	NA			NA		
Mean	89.17								
SD	24.18								
RSD	27%								
Atrazine	12.4	16.5	7.22	NA			NA		
Mean	12.04								
SD	4.65								
RSD	39%								
Simazine	0.572	0.627	0.855	NA			NA		
Mean	0.68								
SD	0.15								
RSD	22%								
Trifluralin	0.577	0.382	5.09	NA			NA		
Mean	2.02								
SD	2.66								
RSD	132%								

Notes: NA = not analyzed
SD = standard deviation
RSD = relative standard deviation
TOC = total organic carbon
Dioxin TEQs calculated using 2005 World Health Organization TEFs
PCP = pentachlorophenol
Dioxin TEQ results in nanograms per kilogram (ng/kg), all other results in milligrams per kilogram (mg/kg)

10.0 ANALYTICAL RESULTS AND DISCUSSION

A total of thirty-one primary and six field replicate multi-increment soil samples were collected from the site at varying depths. Analytical data obtained from this site investigation has been compiled in Tables 5 to 7.

All sample deliveries and subsample processing were handled by TestAmerica-Honolulu as the primary laboratory. However, samples were also sent out to associated or subcontracted laboratories for specialized analyses. Specifically, pentachlorophenol and triazine pesticide analyses (total and SPLP) were performed by Anatek Labs, Inc., a NELAC-certified laboratory in Moscow, Idaho. Dioxins/furans analyses were performed by TestAmerica-West Sacramento, a laboratory that specializes in dioxin analyses.

Table 5: Analytical Data – Reported Concentrations, Primary Analyses

Sample ID	Sample Depth (ft)	Lab Sample ID	TEQs ⁽¹⁾ (ng/kg)	Arsenic (mg/kg)	PCP ⁽²⁾ (mg/kg)	Ametryn (mg/kg)	Atrazine (mg/kg)	Simazine (mg/kg)	Trifluralin (mg/kg)
SA1.A	0 – 0.5	HTA0029-03	162,190	78.4	2.17	141	3.00	0.201	4.16
SA1.B	0.5 – 2	HTA0030-01	20,475	33.3	0.955	0.941	0.05	0.05	0.05
SA1.C	2 – 5	HTA0030-02	3,982	9.53J	0.712	0.560	0.05	0.05	0.05
SA1.D	5 – 10	HTA0030-03	2,810	3.95J	0.374	1.64	0.0853	0.05	0.05
SA2.A*	0 – 0.5	HTA0029-04	350,420	57.1	53.8	73.4	12.4	0.572	0.577
SA2.B	0.5 – 2	HTA0032-01	167,683	41.5	2.29	2.41	0.174	0.05	0.249
SA2.C	2 – 5	HTA0032-02	29,307	9.03J	0.692	0.283	0.05	0.05	0.05
SA2.D	5 – 10	HTA0032-03	6,057	4.65J	1.30	1.46	0.05	0.05	0.05
SA2.E*	0 – 0.5	HTA0029-05	453,020	45.2	99.4	77.1	16.5	0.627	0.382
SA2.F*	0 – 0.5	HTA0029-06	335,410	90	50.4	117	7.22	0.855	5.09
SA3.A	0 – 0.5	HTA0029-07	615,100	27.4	4.98	15.2	9.46	4.31	0.314
SA3.B	0.5 – 2	HTA0032-04	55,102	7.13J	1.11	1.41	0.05	0.05	2.03
SA3.C	2 – 5	HTA0032-05	321,457	13.2	3.24	1.32	0.05	0.05	0.05
SA3.D	5 – 10	HTA0032-06	36,907	5.05J	8.47	6.43	0.127	0.05	0.05
IA1	0 – 0.5	HSL0151-01	701.98	8.41J	NA	NA	NA	NA	NA
IA2	0 – 0.5	HSL0151-02	724.01	6.19J	NA	NA	NA	NA	NA
IA3	0 – 0.5	HSL0151-03	1,324.48	7.60J	NA	NA	NA	NA	NA
IA4	0 – 0.5	HSL0151-04	479.28	6.27J	NA	NA	NA	NA	NA
IAT1.A	0 – 0.5	HTA0012-01	2,386	6.49J	NA	NA	NA	NA	NA
IAT1.B**	0.5 – 2	HTA0041-01	324	3.63J	NA	NA	NA	NA	NA
IAT1.C	2 – 3	HTA0041-04	22	19.9	NA	NA	NA	NA	NA
IAT1.D**	0.5 – 2	HTA0041-02	545	3.92J	NA	NA	NA	NA	NA
IAT1.E**	0.5 – 2	HTA0041-03	196	6.75J	NA	NA	NA	NA	NA
IAT2.A	0 – 0.5	HTA0012-02	3,959	4.63J	NA	NA	NA	NA	NA
IAT2.B	0.5 – 2	HTA0067-03	1,505	5.23J	NA	NA	NA	NA	NA
IAT2.C	2 – 3	HTA0067-04	4,432	1.43J	NA	NA	NA	NA	NA
IAT3.A	0 – 0.5	HTA0012-03	18,371	19	NA	NA	NA	NA	NA
IAT3.B	0.5 – 2	HTA0067-01	1,615	5.59J	NA	NA	NA	NA	NA
IAT3.C	2 – 3	HTA0067-02	223	5.94J	NA	NA	NA	NA	NA

Sample ID	Sample Depth (ft)	Lab Sample ID	TEQs ⁽¹⁾ (ng/kg)	Arsenic (mg/kg)	PCP ⁽²⁾ (mg/kg)	Ametryn (mg/kg)	Atrazine (mg/kg)	Simazine (mg/kg)	Trifluralin (mg/kg)
IAT4.A	0 – 0.5	HTA0012-04	14,606	8.14J	NA	NA	NA	NA	NA
IAT4.B	0.5 – 2	HTA0062-01	2,382	3.31J	NA	NA	NA	NA	NA
IAT4.C	2 – 3	HTA0062-02	27,860	<i>0.75J</i>	NA	NA	NA	NA	NA
IAT5.A***	0 – 0.5	HTA0012-05	10,980	6.68J	NA	NA	NA	NA	NA
IAT5.B	0.5 – 2	HTA0062-03	2,328	8.61J	NA	NA	NA	NA	NA
IAT5.C	2 – 3	HTA0062-04	2,580	3.27J	NA	NA	NA	NA	NA
IAT5.D***	0 – 0.5	HTA0029-02	5,410	7.12J	NA	NA	NA	NA	NA
IAT5.E***	0 – 0.5	HTA0029-01	15,897	7.49J	NA	NA	NA	NA	NA
DOH EALs			450	20	3.0	11	2.1	0.25	32

Notes: NA = not analyzed

(1) = Dioxin/furan TEQs calculated based on 2005 World Health Organization TEFs, calculation shown in Appendix III.

(2) = PCP refers to pentachlorophenol

Blue, italicized values indicate results below method detection limit (MDL), MDL value shown.

J = estimated value, concentration less than reporting limit but exceeds MDL

Boldfaced, shaded value indicates concentration exceeds default DOH EAL.

DOH EAL = Summer 2008 (March 2009 Update) default DOH EAL for sites above non-drinking water aquifers and that are greater than 150 meters from the nearest surface water body.

*Samples SA2.A, SA2.E, and SA2.F are field replicates, values used to calculate mean and standard deviation for surface soils in Spill Areas

**Samples IAT1.B, IAT1.D, and IAT1.E are field replicates, values used to calculate mean and standard deviation for subsurface soils in Spill Areas and Investigation Areas

***Samples IAT5.A, IAT5.D, and IAT5.E are field replicates, values used to calculate mean and standard deviation for surface soils in Investigation Areas

As indicated in Table 5, samples from the three Spill Areas (SA1 to SA3) contained the highest dioxins/furans TEQ concentrations, as anticipated. The Spill Areas also contained elevated concentrations of arsenic, pentachlorophenol, and triazine pesticides. In general, COC concentrations were highest in the first 0.5 feet of soil in each of the three Spill Areas. The data shows that COC concentrations generally become significantly lower in each successive depth layer (0.5- to 2-foot layer, 2- to 5-foot layer, and 5- to 10-foot layer). Spill Area 3 is the only exception to this pattern, with dioxins/furans TEQs and pentachlorophenol concentrations remaining relatively high, even in the 5- to 10-foot layer.

The Investigation Areas (IA1 to IA4, IAT1 to IAT5) of the site also contain elevated dioxins/furans TEQ concentrations, particularly in the surface soils (top 0.5 feet of soil). Similar to the Spill Areas, dioxins/furans TEQ concentrations tend to be lower in deeper layers, with the exception being in decision unit IAT4, where the concentration in the 2- to 3-foot layer is higher than the concentration at the surface. The data also indicate that elevated dioxins/furans TEQ concentrations in decision units IAT1 and IAT3 only exist in the top 0.5 feet of soil and the top 2-feet of soil, respectively, with concentrations in deeper layers detected below the 450 ng/kg EAL. Furthermore, the data indicates that arsenic concentrations in the Investigation Areas are below the background EAL of 20 mg/kg.

Table 6: Analytical Data – Secondary Analyses

Sample ID	Sample Depth (ft)	SPLP PCP (mg/l)	SPLP Ametryn (mg/l)	SPLP Atrazine (mg/l)	SPLP Simazine (mg/l)	SPLP Trifluralin (mg/l)	Clay Fraction	Total Organic Carbon (mg/kg)
SA1.A	0 – 0.5	0.220	12.3	0.188	<i>0.05</i>	<i>0.05</i>	49.32%	27,000
SA1.B	0.5 – 2	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	23.45%	10,000
SA1.C	2 – 5	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	33.95%	2,900J
SA1.D	5 – 10	<i>0.05</i>	0.070J	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	39.07%	<i>1,700</i>
SA2.A*	0 – 0.5	3.93	3.80	0.858	<i>0.05</i>	<i>0.05</i>	41.36%	53,000
SA2.B	0.5 – 2	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	33.00%	48,000
SA2.C	2 – 5	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	31.74%	41,000
SA2.D	5 – 10	0.103	0.075J	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	40.65%	4,000J
SA2.E*	0 – 0.5	3.91	4.46	1.52	0.385	<i>0.05</i>	38.92%	43,000
SA2.F*	0 – 0.5	3.44	2.51	0.462	<i>0.05</i>	<i>0.05</i>	36.91%	70,000
SA3.A	0 – 0.5	0.270	1.25	0.698	<i>0.05</i>	<i>0.05</i>	27.99%	25,000
SA3.B	0.5 – 2	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	34.75%	24,000
SA3.C	2 – 5	0.094	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	33.8%	2,300J
SA3.D	5 – 10	0.845	0.354	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	38.65%	2,400J

Notes: Blue, italicized values indicate results below MDL, MDL value shown.
 J = estimated value, concentration less than reporting limit but exceeds MDL

Data from secondary analyses indicate that pentachlorophenol and triazine pesticides (minus trifluralin) are leachable from site soils based on SPLP data. A further evaluation of the leaching potential is presented in calculations summarized in Table 8.

Table 7: Analytical Data – TCLP Analyses

Analyte	SA1.A	SA2.A	SA3.A	Toxicity Threshold
Arsenic	<i>0.0089</i>	0.2430J	<i>0.0089</i>	5
Barium	0.6380J	0.5060J	0.7410J	100
Cadmium	0.0057J	0.0229J	0.0109J	1
Chromium	0.0272J	0.2620	0.0849J	5
Lead	0.0607J	0.0100J	0.0851J	5
Mercury	<i>0.000283</i>	<i>0.00028</i>	<i>0.00028</i>	0.2
Selenium	<i>0.0041</i>	<i>0.0041</i>	<i>0.0041</i>	1
Silver	<i>0.0123</i>	<i>0.0123</i>	<i>0.0123</i>	5
Pentachlorophenol	0.059J	0.630	<i>0.05</i>	100
Chlordane	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>	0.03
Endrin	<i>0.002</i>	<i>0.002</i>	<i>0.002</i>	0.02
Heptachlor	<i>0.002</i>	<i>0.002</i>	<i>0.002</i>	0.008
Heptachlor epoxide	<i>0.002</i>	<i>0.002</i>	<i>0.002</i>	0.008
Lindane (Gamma-BHC)	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	0.4
Methoxychlor	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	10
Toxaphene	<i>0.05</i>	<i>0.05</i>	<i>0.05</i>	0.5

Notes: All results in mg/L
 Blue, italicized values indicate results below MDL, MDL value shown.
 J = estimated value, concentration less than reporting limit but exceeds MDL

Data from TCLP analyses of surface soils within the Spill Areas, the area and layer anticipated to contain the highest COC concentrations, indicate that all detected concentrations are below the respective toxicity threshold criteria identified in 40 CFR 261.24. As such, the soil would not be considered a RCRA-regulated hazardous waste based on toxicity characteristics.

Furthermore, through discussions with the DOH and review of certain sections of the CFR, it was determined that although it is suspected that the dioxin-contaminated soil is associated with the use of pentachlorophenol and other pesticides at the East Kapolei PML site, such soil would not be considered a F-listed waste since it is believed that the farmers' exemption provided in 40 CFR 262.70 would apply. The farmers' exemption indicates that farmers disposing of waste pesticides from their own use at the site upon which the pesticides were used are exempt from hazardous waste rules provided that the pesticides were being used in the manner intended and that cleaning of the pesticide containers was performed in accordance with accepted practices and product labeling at the time. Specifically, 40 CFR 262.10(f) states: "A farmer who generates waste pesticides which are hazardous waste and who complies with all the requirements of §262.70 is not required to comply with other standards in this part or 40 CFR parts 270, 264, 265, or 268 with respect to such pesticides." The farmers' exemption in 40 CFR 262.70 states: "A farmer disposing of waste pesticides from his own use which are hazardous wastes is not required to comply with standards in this part or other standards in 40 CFR parts 264, 265, 268, or 270 for those wastes provided he triple rinses each emptied pesticide container in accordance with §261.7(b)(3) and disposes of the pesticide residues on his own farm in a manner consistent with the disposal instructions on the pesticide label."

The DOH concurs that contaminated soils at the East Kapolei PML site are likely from the use of pesticides in the manner intended and cleaning of product containers were conducted in accordance with accepted practices and labeling instructions at the time; and not associated with the improper disposal of excess or waste pesticides. Therefore, based on the TCLP data and DOH's concurrence with DHHL (the generator) that the impacted soil falls under the farmers' exemption, it is anticipated that soil from the East Kapolei PML site would not be considered a RCRA hazardous waste.

Table 8: Sorption Coefficients and Leaching Potential

Sample ID	PCP Mass Ratio	K _d -PCP (cm ³ /g)	Ametryn Mass Ratio	K _d -Ametryn (cm ³ /g)	Atrazine Mass Ratio	K _d -Atrazine (cm ³ /g)	Simazine Mass Ratio	K _d -Simazine (cm ³ /g)	Trifluralin Mass Ratio	K _d -Trifluralin (cm ³ /g)
SA1.A	203%	*0	174%	*0	125%	*0	249%	NC	12%	150
SA1.B	52%	18	53%	18	-	-	-	-	-	-
SA1.C	70%	8.5	89%	2.4	-	-	-	-	-	-
SA1.D	134%	NC	85%	3.4	586%	NC	-	-	-	-
SA2.A*	146%	*0	104%	*0	138%	*0	87%	2.9	87%	3.1
SA2.B	22%	72	21%	76	287%	NC	-	-	201%	NC
SA2.C	72%	7.7	177%	NC	-	-	-	-	-	-
SA2.D	158%	*0	103%	*0	-	-	-	-	-	-
SA2.E*	79%	5.4	116%	*0	184%	*0	1228%	*0	131%	NC
SA2.F*	137%	*0	43%	27	128%	*0	58%	14	10%	180
SA3.A	108%	*0	164%	*0	148%	*0	12%	15	159%	NC
SA3.B	45%	24	35%	36	-	-	-	-	25%	61
SA3.C	58%	14	38%	33	-	-	-	-	-	-
SA3.D	200%	*0	110%	*0	394%	NC	-	-	-	-

Notes: Mass Ratio = total contaminant mass in the SPLP solution (reported concentration in solution multiplied by volume of solution used) divided by contaminant mass in the soil sample (reported concentration in soil multiplied by mass of soil used).

K_d = sorption coefficient

*0 = total contaminant mass in SPLP solution exceeds contaminant mass in the soil sample, K_d value of "1" estimated

NC = contaminant not detected in SPLP analysis, mass ratio exceeds 100% using ½ SPLP MDL, minimum K_d value could not be estimated

- = contaminant not detected in either soil sample or SPLP extract

K_d values less than 20 cm³/g indicate potential leaching hazard

Boldfaced, shaded values = contaminant concentrations in the soil sample exceed leaching EAL and K_d value less than 20 cm³/g

As shown in Table 8, calculations using both total and SPLP pentachlorophenol and triazine pesticides data indicate that the contaminant concentrations present at the site, particularly in the surface soils, have a potential to leach out of the soil into underlying groundwater.

Table 9: Adjusted Dioxin TEQ and Arsenic Data

Sample ID	TEQs (ng/kg)	Adjusted TEQs (ng/kg)	Arsenic (mg/kg)	Adjusted Arsenic (mg/kg)
SA1.A	162,190	226,201	78.4	101.61
SA1.B	20,475	20,652	33.3	35.02
SA1.C	3,982	4,159	9.53J	11.25
SA1.D	2,810	2,987	3.95J	5.67
SA2.A*	350,420	414,431	57.1	80.31
SA2.B	167,683	167,860	41.5	43.22
SA2.C	29,307	29,484	9.03J	10.75
SA2.D	6,057	6,234	4.65J	6.37
SA2.E*	453,020	517,031	45.2	46.92
SA2.F*	335,410	399,421	90	91.72
SA3.A	615,100	679,111	27.4	50.61
SA3.B	55,102	55,279	7.13J	8.85
SA3.C	321,457	321,634	13.2	14.92
SA3.D	36,907	37,084	5.05J	6.77
IA1	701.98	5,949	8.41J	8.82
IA2	724.01	5,971	6.19J	6.6
IA3	1,324.48	6,571	7.60J	8.01
IA4	479.28	5,726	6.27J	6.68
IAT1.A	2,386	7,633	6.49J	6.9
IAT1.B**	324	501	3.63J	5.35
IAT1.C	22	199	19.9	21.62
IAT1.D**	545	722	3.92J	5.64
IAT1.E**	196	373	6.75J	8.47
IAT2.A	3,959	9,206	4.63J	5.04
IAT2.B	1,505	1,682	5.23J	6.95
IAT2.C	4,432	4,609	1.43J	3.15
IAT3.A	18,371	23,618	19	19.41
IAT3.B	1,615	1,792	5.59J	7.31
IAT3.C	223	400	5.94J	7.66
IAT4.A	14,606	19,853	8.14J	8.55
IAT4.B	2,382	2,559	3.31J	5.03
IAT4.C	27,860	28,037	0.75J	2.0955

Sample ID	TEQs (ng/kg)	Adjusted TEQs (ng/kg)	Arsenic (mg/kg)	Adjusted Arsenic (mg/kg)
IAT5.A***	10,980	16,227	6.68J	7.09
IAT5.B	2,328	2,505	8.61J	10.33
IAT5.C	2,580	2,757	3.27J	4.99
IAT5.D***	5,410	10,657	7.12J	7.53
IAT5.E***	15,897	21,144	7.49J	7.9
DOH EALs	450	450	20	20

Notes: Blue, italicized values indicate results below MDL, MDL value shown.
J = estimated value, concentration less than reporting limit but exceeds MDL
Boldfaced, shaded value indicates concentration exceeds default DOH EAL.
DOH EAL = Summer 2008 (March 2009 Update) default DOH EAL for sites above non-drinking water aquifers and that are greater than 150 meters from the nearest surface water body.
*Samples SA2.A, SA2.E, and SA2.F are field replicates, values used to calculate mean and standard deviation for surface soils in Spill Areas
**Samples IAT1.B, IAT1.D, and IAT1.E are field replicates, values used to calculate mean and standard deviation for subsurface soils in Spill Areas and Investigation Areas
***Samples IAT5.A, IAT5.D, and IAT5.E are field replicates, values used to calculate mean and standard deviation for surface soils in Investigation Areas

Table 9 presents the adjusted dioxins/furans TEQ and adjusted arsenic concentrations calculated using standard deviations from the appropriate set of field replicate samples (see Table 4). As indicated, the addition of one standard deviation did not result in significant changes to the findings. The primary change was to the dioxins/furans TEQ concentration for sample IAT1.B, which had a reported concentration below the default DOH EAL and an adjusted dioxins/furans TEQ concentration exceeding the default EAL. Similarly, the reported arsenic concentration in sample IAT1.C was below the DOH EAL, however the adjusted arsenic concentration just exceeds the DOH EAL.

Table 10: Adjusted Pentachlorophenol and Triazine Pesticide Data

Sample ID	PCP (mg/kg)	Adjusted PCP (mg/kg)	Ametryn (mg/kg)	Adjusted Ametryn (mg/kg)	Atrazine (mg/kg)	Adjusted Atrazine (mg/kg)	Simazine (mg/kg)	Adjusted Simazine (mg/kg)	Trifluralin (mg/kg)	Adjusted Trifluralin (mg/kg)
SA1.A	2.17	29.49	141	165.18	3.00	7.65	0.201	0.351	4.16	6.82
SA1.B	0.955	28.275	0.941	25.121	<i>0.05</i>	4.68	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA1.C	0.712	28.032	0.560	24.74	<i>0.05</i>	4.68	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA1.D	0.374	27.694	1.64	25.82	0.0853	4.74	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA2.A*	53.8	81.12	73.4	97.58	12.4	17.05	0.572	0.722	0.577	3.237
SA2.B	2.29	29.61	2.41	26.59	0.174	4.82	<i>0.05</i>	0.175	0.249	2.909
SA2.C	0.692	28.012	0.283	24.463	<i>0.05</i>	4.68	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA2.D	1.30	28.62	1.46	25.64	<i>0.05</i>	4.68	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA2.E*	99.4	126.72	77.1	101.28	16.5	21.15	0.627	0.777	0.382	3.042
SA2.F*	50.4	77.72	117	141.18	7.22	11.87	0.855	1.005	5.09	7.75
SA3.A	4.98	32.3	15.2	39.38	9.46	14.11	4.31	4.46	0.314	2.974
SA3.B	1.11	28.43	1.41	25.59	<i>0.05</i>	4.68	<i>0.05</i>	0.175	2.03	4.69
SA3.C	3.24	30.56	1.32	25.5	<i>0.05</i>	4.68	<i>0.05</i>	0.175	<i>0.05</i>	2.685
SA3.D	8.47	35.79	6.43	30.61	0.127	4.78	<i>0.05</i>	0.175	<i>0.05</i>	2.685
DOH EALs	3.0	3.0	11	11	2.1	2.1	0.25	0.25	32	32

Notes: Blue, italicized values indicate results below MDL, MDL value shown.
 J = estimated value, concentration less than reporting limit but exceeds MDL
 Boldfaced, shaded value indicates concentration exceeds default DOH EAL.
 DOH EAL = Summer 2008 (March 2009 Update) default DOH EAL for sites above non-drinking water aquifers and that are greater than 150 meters from the nearest surface water body.
 *Samples SA2.A, SA2.E, and SA2.F are field replicates, values used to calculate mean and standard deviation for surface soils in Spill Areas
 **Samples IAT1.B, IAT1.D, and IAT1.E are field replicates, values used to calculate mean and standard deviation for subsurface soils in Spill Areas and Investigation Areas
 ***Samples IAT5.A, IAT5.D, and IAT5.E are field replicates, values used to calculate mean and standard deviation for surface soils in Investigation Areas

Table 10 presents the adjusted pentachlorophenol and triazine pesticides concentrations calculated using standard deviations from the appropriate set of field replicate samples (see Table 4). As shown, the addition of the standard deviation to reported concentrations of pentachlorophenol, ametryn, and atrazine resulted in all adjusted concentrations for these three COC to exceed their respective default DOH EALs. In addition, the addition of the standard deviation resulted in the adjusted simazine concentration in sample SA1.A to exceed the default DOH EAL.

11.0 ENVIRONMENTAL HAZARD EVALUATION

The Environmental Hazard Evaluation (EHE) process was developed by the Hawaii DOH to serve as a link between site investigation activities and the proposed response activities to be undertaken and evaluated in a Remedial Alternatives Analysis (RAA). The EHE is intended to identify potential environmental hazards associated with contaminant concentrations in site media through comparison with DOH EALs established for common environmental hazards. A summary of these common environmental hazards are listed below:

Contaminated Soil

- **Direct Exposure:** exposure to contaminants via incidental ingestion, dermal absorption, and inhalation of vapors or dust in outdoor air
- **Vapor Intrusion:** emission of volatile contaminants from soil into overlying buildings
- **Leaching:** leaching of contamination from soil by infiltration of surface water (rainfall, irrigation, etc.) and downward migration of leachate into underlying groundwater
- **Terrestrial ecotoxicity:** toxicity to terrestrial flora and fauna
- **Gross contamination:** potentially mobile free product, odors, aesthetics, explosive hazards, and general resource degradation

Contaminated Groundwater

- **Drinking water toxicity:** toxicity concerns associated with contamination of groundwater used as a current or potential drinking water source
- **Vapor intrusion:** emission of volatile contaminants from groundwater into overlying buildings
- **Aquatic ecotoxicity:** discharges of contaminated groundwater to surface water bodies and toxicity to aquatic organisms, including fish and shellfish used for human consumption
- **Gross contamination:** potentially mobile free product, odors, aesthetics, explosive hazards, and general resource degradation

11.1 Previous Investigations

Historical investigations, summarized in Section 4.0, indicated that substantial impacts associated with the COC were identified within the East Kapolei PML site, particularly in the areas immediately surrounding the mixing and loading operations (i.e., the Spill Areas identified in the existing investigation). Although other contaminants were tested for in previous investigations based on their suspected use in sugarcane cultivation operations, the data suggest that the COC identified for the current investigation were the most consistently identified at elevated concentrations. Therefore, the current investigation was performed to obtain a better estimation of the extent and magnitude of contamination within the East Kapolei PML site.

Historical investigations also suggest that there are contaminant impacts in soils outside of the existing East Kapolei PML site fence line. In particular, data obtained by ETC and documented in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* indicate that dioxin impacts extend beyond the fence line, generally outside of the southwest gate, beyond decision units 8, 9, and 10 from the first “ring” of decision units, but limited to within the second “ring” of decision units. Similarly, discrete sample data collected by the US EPA in 2009 indicate that elevated arsenic concentrations exist in soil at depths of approximately 1 to 2 feet bgs in the same area and extending out to the south of the PML site, within the intersection of the coral/dirt roads. Finally, limited data collected by the DOH/EPA in the July 2000 *Site Inspection* indicate the presence of elevated dioxin TEQ concentrations in soil/sediment accumulated in the concrete-lined ditch adjacent to the East Kapolei PML site. Although the extent of dioxin impacts were not determined, DHHL and DOH decided that soil/sediment from sections of the concrete lined ditch located adjacent to and southwest (downgradient) of the East Kapolei PML site would be removed from the ditch during site remediation activities and addressed similar to other dioxin-impacted soil.

11.2 Magnitude and Extent of Contamination

Based on review of current and historic data, the extent of COC impacts to soils at concentrations exceeding default DOH EALs within and adjacent to the East Kapolei PML site is shown in Figures 7 through 9 in Appendix I. In general, the highest dioxins/furans TEQ concentrations were identified in the surface soil within the Spill Areas (decision units SA1 through SA3, see Appendix I, Figure 8), with decreasing concentrations in the Investigation Areas (decision units IA1 through IA4 and IAT1 through IAT5, see Appendix I, Figure 8) and the lowest concentrations out beyond the fence line. The dioxins/furans TEQ concentrations also appeared to decrease with depth, however the concentrations within the 5- to 10-foot depth layers of the Spill Area still contained elevated concentrations (e.g., vertical delineation of dioxins/furans contamination has not been completed). Elevated dioxin concentrations were also identified in surface soils outside the southwest gate, but limited to within the second ring of decision units described in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* report.

Arsenic concentrations were elevated within the Spill Areas, but concentrations generally decreased with depth and appeared to be limited to the top 2 feet of soil. Although elevated arsenic concentrations were not identified in the Investigation Areas, discrete sample data from outside of the fence line indicated elevated arsenic concentrations in the 1- to 2-foot layer of soil outside the southwest gate and within the intersection of the coral/dirt roadways.

Historic data indicated that elevated pentachlorophenol and triazine pesticide concentrations were generally limited to the Spill Areas of the East Kapolei PML site. Therefore, pentachlorophenol and triazine pesticides were only analyzed for soil samples within the Spill Areas. Data from the current investigation indicate that elevated concentrations were generally limited to the surface soil layer (with the exception of decision unit area SA3, where elevated pentachlorophenol concentrations were found within the 5- to 10-foot soil layer). However, uncertainty in the data measured by the calculated standard deviation (and thus the adjusted concentrations) requires that the assumption be made that pentachlorophenol and triazine pesticide contamination extend to 10 feet bgs.

Based on an overall evaluation of all available data compared to default DOH EALs, the following conclusions were made regarding the extent of contamination:

- Dioxin contamination exists within surface soils of all areas of the East Kapolei PML site (within the fence line) to depths of at least 10 feet bgs within the Spill Areas; to 5 feet in decision units IAT2, IAT4, and IAT5; to 2 feet bgs in decision units IAT1 and IAT3; and to 1 feet bgs in decision units IA1 through IA4. Discussions with DOH indicate that anything beyond 10 feet bgs would not be considered a significant issue since soil beyond 10 feet bgs would not be considered accessible to site users. It is also anticipated that dioxin contamination in soils outside of the fence line extend to a depth of 1 feet bgs and it is assumed that all soil and sediment in the concrete-lined ditch, from immediately adjacent to the PML site and downgradient (to Kualakai Parkway) is impacted with dioxins/furans at concentrations exceeding the default DOH EAL.
- Arsenic contamination exists in the top 2 feet of soil within the Spill Areas and within the top 2 feet of soil outside of the East Kapolei PML site fence line, within the coral/dirt roadways immediately adjacent to the southwest gate and within the roadway intersection.
- Pentachlorophenol and triazine pesticide contamination exists within the Spill Areas of the East Kapolei PML site down to 10 feet bgs.

11.3 Comparison to DOH EALs

Analytical data were initially compared to current, default DOH EALs to identify areas of concern. In particular, historical data for areas within the East Kapolei PML site boundaries (i.e., within the fence line) were screened using the default DOH EALs to assist with establishing decision unit boundaries and selecting COC for the current investigation. Data from the current investigation was used to identify existing environmental hazards. Historical data for areas outside of the East Kapolei PML site boundaries (i.e., outside of the fence line) were used to assess the lateral extent of COC impacts and identify existing environmental hazards. The following subsections present the environmental hazards and associated DOH EALs for the various COC. All DOH EALs are for soil based on unrestricted land use scenarios, assuming that groundwater beneath the site is not a current or potential drinking water source and the nearest surface water body is greater than 150 meters from the property.

11.3.1 Arsenic

Environmental hazards and associated DOH EALs for arsenic are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	20 mg/kg (background)
Vapor Emissions	-
Terrestrial Ecotoxicity	20 mg/kg (background)
Gross Contamination	1,000 mg/kg
Leaching	Batch Test

PML Site, Spill Areas

Data for samples collected from within the Spill Area decision units indicate reported concentrations of arsenic exceeded the Hawaii background EAL of 20 mg/kg (pertains to both direct exposure and terrestrial ecotoxicity hazards) in samples SA1.A (0- to 0.5-foot layer), SA1.B (0.5- to 2-foot layer), SA2.A (0- to 0.5-foot layer), SA2.B (0.5- to 2-foot layer), SA2.E (0- to 0.5-foot layer, field replicate of SA2.A), SA2.F (0- to 0.5-foot layer, field replicate of SA2.A), and SA3.A (0- to 0.5-foot layer); with the highest detected concentration being 90 mg/kg. Reported arsenic concentrations did not exceed the gross contamination EAL and arsenic is not considered to be significantly leachable under neutral pH conditions.

Calculation of the adjusted arsenic values were performed by adding the standard deviation of 23.21 mg/kg (calculated for surface soils in the Spill Areas using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to surface soil results in the Spill Areas. The standard deviation of 1.72 mg/kg (calculated for subsurface soils in the Investigation Areas using reported concentrations from replicate samples IAT1.B, IAT1.D, and IAT1.E) to subsurface soil results in the Spill Areas. The calculated relative standard deviations were 36% and 36%, respectively.

Additions of the standard deviations to the reported concentrations did not change the findings. All reported concentrations that were below the Hawaii background EAL remained below the EAL.

PML Site, Investigation Areas

Data for samples collected from within the Investigation Area decision units indicate reported concentrations of arsenic were below the Hawaii background EAL of 20 mg/kg in all Investigation Area samples.

Calculation of the adjusted arsenic values were performed by adding the standard deviation of 0.41 mg/kg (calculated for surface soils in the Investigation Areas using reported concentrations from replicate samples IAT5.A, IAT5.D, and IAT5.E) to surface soil results in the Investigation Areas. The standard deviation of 1.72 mg/kg (calculated for subsurface soils in the Investigation Areas using reported concentrations from replicate samples IAT1.B, IAT1.D, and IAT1.E) was added to subsurface soil results in the Investigation Areas. The calculated relative standard deviations were 6% and 36%, respectively.

Addition of the standard deviations to the reported concentrations resulted in one sample (IAT1.C, 2- to 3-foot layer) having an adjusted arsenic concentration of 21.62 mg/kg, just above the Hawaii background EAL of 20 mg/kg.

Outside PML Site

Discrete soil sample data from the 2009 EPA investigation indicated the presence of arsenic concentrations exceeding the Hawaii background EAL of 20 mg/kg in certain samples collected from 0- to 1-foot bgs and 1- to 2-foot bgs. The elevated arsenic concentrations were generally identified in discrete samples collected from the south and southwest of the East Kapolei PML site, located outside of the southwest gate and within the coral/dirt roadway intersection. Although there were two discrete surface (0- to 1-foot bgs) samples and four discrete near-surface (1- to 2-foot bgs) samples that had arsenic concentrations exceeding the Hawaii background EAL, concentrations were on the lower range of values and were not considered to be indicative of the entire area. Based on the data, the areas with elevated arsenic concentrations were considered to pose a direct exposure hazard to future site users.

11.3.2 Dioxins/Furans

Environmental hazards and associated DOH EALs for dioxins/furans are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	450 ng/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	-
Gross Contamination	1,000 mg/kg
Leaching	0.19 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate all reported concentrations of dioxins/furans TEQ in the Spill Area samples exceeded the direct exposure Tier 2 EAL of 450 ng/kg. Furthermore, reported concentrations in samples SA2.A, SA2.E, SA2.F, SA3.A, and SA3.C exceeded the soil leaching EAL of 0.19 mg/kg (190,000 ng/kg).

Calculation of the adjusted dioxin TEQ values were performed by adding the standard deviation of 64,011 ng/kg (calculated for surface soils in the Spill Areas using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to surface soil results in the Spill Area. The standard deviation of 177 ng/kg (calculated for subsurface soil in the Spill Areas using reported concentrations from replicate samples IAT1.B, IAT1.D, and IAT1.E) was added to subsurface soil results in the Spill Areas. The calculated relative standard deviations were 17% and 50%, respectively.

Use of the adjusted dioxin TEQ values did not change any of the findings from the reported concentrations.

PML Site, Investigation Areas

Data for samples collected from the Investigation Area decision units indicate reported concentrations of dioxins/furans TEQ in the Investigation Area samples IA1 – IA4, IAT1.A, IAT1.D, IAT2.A – IAT2.C, IAT3.A, IAT3.B, IAT4.A, IAT4.B, IAT4.C, IAT5.A, IAT5.B, IAT5.C, IAT5.D, and IAT5.E exceeded the direct exposure Tier 2 EAL of 450 ng/kg. None of the reported concentrations exceeded the soil leaching EAL.

Calculation of the adjusted dioxin TEQ values were performed by adding the standard deviation of 5,247 ng/kg (calculated for surface soils in the Investigation Areas using reported concentrations from replicate samples IAT5.A, IAT5.D, and IAT5.E) to surface soil results in the Investigation Areas. The standard deviation of 177 ng/kg (calculated for subsurface soil in the Investigation Areas using reported concentrations from replicate samples IAT1.B, IAT1.D, and IAT1.E) was added to subsurface soil results in the Investigation Areas. The calculated relative standard deviations were 49% and 50% respectively.

Use of the adjusted dioxin TEQ values did not change any of the findings from the reported concentrations, with the exception of sample IAT1.B, which exceeded the direct exposure Tier 2 EAL of 450 ng/kg.

Note that the reported concentrations in surface samples collected from decision units IA1 through IA4 (located between the original PML site fence line and the second PML site fence line) ranged from 479.28 ng/kg to 1,324.48 ng/kg, which were relatively similar in magnitude to the Tier 2 EAL of 450 ng/kg as compared to concentrations in other areas of the site. The standard deviation of 5,247 ng/kg obtained from triplicate samples collected from decision unit area IAT5 (situated in closer proximity to the Spill Areas, or the suspect source areas of contamination) may not be indicative of the actual variance in these particular decision units (IA1 through IA4). Lacking triplicate data for soil samples from these specific areas, a more appropriate method to quantify variance may be adding the RSD from the IAT5 triplicate samples (49%) to the reported concentrations from IA1 through IA4. This would result in values ranging from 714.13 ng/kg to 1,973.48 ng/kg.

Outside PML Site

Data from the July 3, 2000 *Site Inspection – Ewa Sugar Mill/Oahu Sugar Co. Pesticide Mixing and Loading Site* indicate that soil/sediment within the section of concrete-lined ditch adjacent to the PML site contains dioxins/furans TEQ concentrations exceeding the direct exposure Tier 2 EAL. It is also assumed that soil/sediment in downgradient portions of the concrete-lined ditch (southwest of the PML site to Kualakai Parkway) also contain elevated dioxins/furans TEQ concentrations.

Data from the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* report indicate that dioxins/furans TEQ concentrations exceeded the direct exposure Tier 2 EAL approximately 50 feet south-southwest of the PML site within decision units 8, 9, and 10 from the first “ring” of decision units (located adjacent and to the north-northwest of the current decision units IA1 through IA4) but were below the direct exposure Tier 2 EAL within the second “ring” of decision units approximately 50 feet beyond the first ring. Data from multi-increment samples collected from decision units 11 through 19 from the first “ring” of decision units (located adjacent to the current decision units IA1 through IA4) indicated dioxin TEQ concentrations were below the Tier 2 EAL. Comparing this data with the recent data obtained from decision units IA1 through IA4 shows a discernable concentration gradient in this direction (i.e., topographically upgradient), with the highest dioxin concentrations in the suspect Spill Areas gradually decreasing within the fenced PML site to below the DOH EAL in areas outside of the fence line. This pattern is consistent with speculation made by the U.S. EPA and the DOH during earlier investigations that culminated in the construction of the outer fence line of the PML site.

Although data indicates that dioxin TEQ concentrations in the surface soil decision units IA1 through IA4 exceed the Tier 2 EAL, it is believed that if decision units IA1 through IA4 were broken up into smaller decision units, such smaller decision units would continue to show a descending concentration gradient towards the north-northwest fence line and beyond. It is suspected that the soil increments collected from portions of decision units IA1 through IA4 in closer proximity to the Spill Areas contributed to the higher mean dioxin TEQ concentrations obtained for the overall decision unit. In other words, smaller decision units situated closer to the Spill Areas would likely exhibit dioxin TEQ concentrations higher than the mean and smaller decision units closer to the PML fence line (and therefore farther from the Spill Areas) would likely exhibit dioxin TEQ concentrations lower than the mean.

Discrete soil sample data from the 2009 EPA investigation indicated one discrete surface soil sample with a dioxins/furans TEQ concentration of 470 ng/kg (sample EK-20) approximately 250 feet southwest of the PML site. Furthermore, the investigation identified two discrete near-surface soil samples (1- to 2-feet bgs) with dioxins/furans TEQ concentrations of 480 ng/kg (sample EK-11) and 880 ng/kg (sample EK-46) adjacent to the north-northeast of the PML site. Based on discussions with the DOH, the dioxins/furans TEQ concentrations in these three discrete samples were not considered to be representative of the concentrations in the immediate vicinity based on other existing data from nearby samples and based on the mean concentrations reported in decision unit rings from the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* report. Therefore, these data points do not indicate a potential direct exposure hazard in these areas.

11.3.3 Pentachlorophenol

Environmental hazards and associated DOH EALs for pentachlorophenol are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	3.0 mg/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	5.0 mg/kg
Gross Contamination	500 mg/kg
Leaching	7.3 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate reported concentrations of pentachlorophenol exceeded the direct exposure EAL of 3.0 mg/kg in Spill Area samples SA2.A (0- to 0.5 feet bgs layer), SA2.E (0- to 0.5 feet bgs layer, replicate of SA2.A), SA2.F (0- to 0.5 feet bgs layer, replicate of SA2.A), SA3.A (0- to 0.5 feet bgs layer), SA3.C (2- to 5-foot bgs layer), and SA3.D (5- to 10-foot bgs layer).

Pentachlorophenol concentrations in SA2.A, SA2.E, SA2.F, and SA3.D also exceeded the terrestrial ecotoxicity and leaching EALs.

Calculation of the adjusted pentachlorophenol concentrations were performed by adding the standard deviation of 27.36 mg/kg (calculated for Spill Area soil samples using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to reported concentrations in the Spill Areas. The calculated relative standard deviation was 40%.

All adjusted pentachlorophenol concentrations exceeded the direct exposure, terrestrial ecotoxicity, and leaching EALs since the calculated standard deviation of 27.36 mg/kg alone exceeds the direct exposure, terrestrial ecotoxicity, and leaching EALs. Although leachable pentachlorophenol values were obtained using SPLP extractions, the calculated adsorption coefficients generally suggest that the pentachlorophenol is leachable from soils at the site.

PML Site, Investigation Areas and Outside PML Site

Historical data indicate that elevated pentachlorophenol concentrations were generally limited to the designated Spill Areas. Data collected for areas outside of the Spill Areas indicate pentachlorophenol concentrations below default DOH EALs. Therefore, pentachlorophenol analyses were limited to soil sample collected from within the Spill Area decision units.

11.3.4 Ametryn

Environmental hazards and associated DOH EALs for ametryn are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	110 mg/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	-
Gross Contamination	500 mg/kg
Leaching	11 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate reported concentrations of ametryn exceeded the soil leaching EAL of 11 mg/kg in all Spill Area surface soil samples (SA1.A, SA2.A, SA2.E, SA2.F, and SA3.A). The reported concentration of ametryn in sample SA1.A and in replicate sample SA2.F also exceeded the direct exposure EAL of 110 mg/kg.

Calculation of the adjusted ametryn concentrations were performed by adding the standard deviation of 24.18 mg/kg (calculated for Spill Area soil samples using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to reported concentrations in the Spill Areas. The calculated relative standard deviation was 27%.

All adjusted ametryn concentrations exceeded the soil leaching EAL since the calculated standard deviation of 24.18 mg/kg alone exceeds the soil leaching EAL.

In addition, the adjusted ametryn concentrations for sample SA1.A and the adjusted mean concentration of the replicate samples (SA2.A, SA2.E, and SA2.F) for SA2.A exceeded the direct exposure EAL.

Although leachable ametryn values were obtained using SPLP extractions, the calculated adsorption coefficients generally suggest that the ametryn is leachable from soils at the site.

PML Site, Investigation Areas and Outside PML Site

Historical data indicate that elevated ametryn concentrations were generally limited to the designated Spill Areas. Data collected for areas outside of the Spill Areas indicate ametryn concentrations below default DOH EALs. Therefore, ametryn analyses were limited to soil sample collected from within the Spill Area decision units.

11.3.5 Atrazine

Environmental hazards and associated DOH EALs for atrazine are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	2.1 mg/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	-
Gross Contamination	500 mg/kg
Leaching	13 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate reported concentrations of atrazine exceeded the direct exposure EAL of 2.1 mg/kg in all Spill Area surface soil samples (SA1.A, SA2.A, SA2.E, SA2.F, and SA3.A). The reported concentration of atrazine in one of the surface soil replicate samples (SA2.E) also exceeded the soil leaching EAL of 13 mg/kg.

Calculation of the adjusted atrazine concentrations were performed by adding the standard deviation of 4.65 mg/kg (calculated for Spill Area soil samples using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to reported concentrations in the Spill Areas. The calculated relative standard deviation was 39%.

All adjusted atrazine concentrations exceeded the direct exposure EAL since the calculated standard deviation of 4.65 mg/kg alone exceeded the direct exposure EAL.

In addition, the adjusted atrazine concentration for SA2.A and the adjusted mean concentration for samples SA2.A, SA2.E and SA2.F exceeded the soil leaching EAL of 13 mg/kg.

Leachable atrazine concentrations were obtained using SPLP extractions. The calculated adsorption coefficients suggest that atrazine is leachable from surface soils (SA1.A, SA2.A, SA2.E, SA2.F, and SA3.A), however adjusted concentrations in SA2.A, SA2.E, SA2.F, and SA3.A would be the only instances where leachable atrazine concentrations would pose an environmental hazard.

PML Site, Investigation Areas and Outside PML Site

Historical data indicate that elevated atrazine concentrations were generally limited to the designated Spill Areas. Data collected for areas outside of the Spill Areas indicate atrazine concentrations below default DOH EALs. Therefore, atrazine analyses were limited to soil sample collected from within the Spill Area decision units.

11.3.6 Simazine

Environmental hazards and associated DOH EALs for simazine are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	4.0 mg/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	-
Gross Contamination	500 mg/kg
Leaching	0.25 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate reported concentrations of simazine exceeded the soil leaching EAL of 0.25 mg/kg in Spill Area surface samples SA2.A, SA2.E, SA2.F, and SA3.A. The reported concentration of simazine in Spill Area surface soil sample SA3.A also exceeded the direct exposure EAL of 4.0 mg/kg.

Calculation of the adjusted simazine concentrations were performed by adding the standard deviation of 0.15 mg/kg (calculated for Spill Area soil samples using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to reported concentrations in the Spill Areas. The calculated relative standard deviation was 22%.

Addition of the standard deviation to the reported concentrations resulted in Spill Area surface sample SA1.A exceeding the soil leaching EAL, in addition to the findings based on the reported concentrations. As such, all adjusted simazine concentrations in Spill Area surface samples (SA1.A, SA2.A, SA2.E, SA2.F, and SA3.A) exceeded the soil leaching EAL of 0.25 mg/kg and the adjusted simazine concentration in Spill Area surface soil sample SA3.A also exceeded the direct exposure EAL of 4.0 mg/kg.

Leachable simazine concentrations were obtained using SPLP extractions. The calculated adsorption coefficients suggest that simazine is leachable from surface soils (SA1.A, SA2.A, SA2.E, SA2.F, and SA3.A).

PML Site, Investigation Areas and Outside PML Site

Historical data indicate that elevated simazine concentrations were generally limited to the designated Spill Areas. Data collected for areas outside of the Spill Areas indicate simazine concentrations below default DOH EALs. Therefore, simazine analyses were limited to soil sample collected from within the Spill Area decision units.

11.3.7 Trifluralin

Environmental hazards and associated DOH EALs for trifluralin are presented in the table below.

Environmental Hazards	DOH EALs
Direct Exposure	63 mg/kg
Vapor Emissions	-
Terrestrial Ecotoxicity	-
Gross Contamination	100 mg/kg
Leaching	32 mg/kg

PML Site, Spill Areas

Data for samples collected from the Spill Area decision units indicate reported concentrations of trifluralin in all Spill Area soil samples were below the default EAL of 32 mg/kg (pertaining to soil leaching).

Calculation of the adjusted trifluralin concentrations were performed by adding the standard deviation of 2.66 mg/kg (calculated for Spill Area soil samples using reported concentrations from replicate samples SA2.A, SA2.E, and SA2.F) to reported concentrations in the Spill Areas. The calculated relative standard deviation was 132%.

Addition of the standard deviation to the reported concentrations did not result in any changes, all trifluralin concentrations remained below the default EAL of 32 mg/kg. Therefore, there are no environmental hazards associated with trifluralin.

PML Site, Investigation Areas and Outside PML Site

Historical data indicate that elevated trifluralin concentrations were generally limited to the designated Spill Areas. Data collected for areas outside of the Spill Areas indicate trifluralin concentrations below default DOH EALs. Therefore, trifluralin analyses were limited to soil sample collected from within the Spill Area decision units.

11.4 Summary of Environmental Hazards

An overall summary of environmental hazards by decision unit at the East Kapolei PML site is provided in Table 11 below. The summary is based on adjusted COC concentrations. Note that there were no vapor emissions or gross contamination hazards identified.

Table 11: Summary of Environmental Hazards

Decision Unit	Type/Depth	Layer Vol. (cy)	Direct Exposure	Terrestrial Ecotoxicity	Leaching to Groundwater
SA1.A	0-0.5'	47.4	Dioxins, As, PCP, ametryn, atrazine	As, PCP	PCP, ametryn, simazine
SA1.B	0.5'-2'	142.2	Dioxins, As, PCP, atrazine	As, PCP	PCP, ametryn
SA1.C	2'-5'	284.4	Dioxins, PCP, atrazine	PCP	PCP, ametryn
SA1.D	5'-10'	474.1	Dioxins, PCP, atrazine	PCP	PCP, ametryn
SA2.A	0-0.5'	31.4	Dioxins, As, PCP, ametryn, atrazine	As, PCP	Dioxins, PCP, ametryn, atrazine, simazine
SA2.B	0.5'-2'	94.2	Dioxins, As, PCP, atrazine	As, PCP	PCP, ametryn
SA2.C	2'-5'	183.3	Dioxins, PCP, atrazine	PCP	PCP, ametryn
SA2.D	5'-10'	313.9	Dioxins, PCP, atrazine	PCP	PCP, ametryn
SA3.A	0-0.5'	19.4	Dioxins, As, PCP, atrazine, simazine	As, PCP	Dioxins, PCP, ametryn, atrazine, simazine
SA3.B	0.5'-2'	58.3	Dioxins, PCP, atrazine	PCP	PCP, ametryn
SA3.C	2'-5'	116.7	Dioxins, PCP, atrazine	PCP	Dioxins, PCP, ametryn
SA3.D	5'-10'	194.4	Dioxins, PCP, atrazine	PCP	PCP, ametryn
IA1	0-0.5'	78	Dioxins		
IA2	0-0.5'	83	Dioxins		
IA3	0-0.5'	78.8	Dioxins		
IA4	0-0.5'	66.9	Dioxins		
IAT1.A	0-0.5'	87.2	Dioxins		
IAT1.B	0.5'-2'	261.7	Dioxins		
IAT1.C	2'-3'	174.4	As	As	
IAT2.A	0-0.5'	89.8	Dioxins		
IAT2.B	0.5'-2'	269.4	Dioxins		
IAT2.C	2'-3'	179.6	Dioxins		
IAT3.A	0-0.5'	53.4	Dioxins		
IAT3.B	0.5'-2'	160.3	Dioxins		
IAT3.C	2'-3'	106.9			
IAT4.A	0-0.5'	55.6	Dioxins		
IAT4.B	0.5'-2'	166.7	Dioxins		
IAT4.C	2'-3'	111.1	Dioxins		
IAT5.A	0-0.5'	45.6	Dioxins		
IAT5.B	0.5'-2'	136.7	Dioxins		
IAT5.C	2'-3'	91.1	Dioxins		

Outside of the East Kapolei PML site fence line, direct exposure and terrestrial ecotoxicity hazards associated with elevated arsenic concentrations exist in surface and near surface soil south and southwest of the PML, generally adjacent to the southwest gate and within the coral/dirt road intersection. Furthermore, direct exposure hazards associated with elevated dioxins/furans TEQ concentrations exist in surface soil southwest of the site out to the second decision unit ring identified in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* report and within portions of the concrete-lined ditch adjacent to and southwest of the PML site. The estimated extent of direct exposure hazards and leaching to groundwater hazards are presented in Appendix I, Figures 10 and 11.

12.0 CONCLUSIONS

Data obtained to-date at the East Kapolei PML site and for areas immediately adjacent to the East Kapolei PML site indicate elevated COC concentrations, particularly within the designated Spill Areas, or areas where the bulk of the pesticide mixing and loading operations occurred. COC concentrations (specifically arsenic and dioxins/furans) generally tended to decrease with increased distance from the Spill Areas and with increased depth. Exceptions to this occurred with arsenic (highest concentrations located outside of PML site in near surface soils within the coral/dirt road intersection) and dioxins in the Spill Area decision unit SA3 (high concentrations remain in the 5- to 10-foot bgs layer).

The data indicate that while the lateral extent of contamination has been generally delineated, the vertical extent of contamination has not been delineated. Based on discussions with the DOH HEER Office, calculations of the total volume of soil impacted by COC will need to be estimated based on assumed depths through evaluation of the patterns in the data.

12.1 Spill Areas

For the Spill Areas, total volume of impacted soil will be based on a depth of 10 feet bgs. Soil beneath 10 feet bgs is considered by the DOH to be unavailable to direct contact by surface receptors in unrestricted land use scenarios. Furthermore, the reported COC concentrations associated with leaching concerns at these depths were generally below their respective DOH EALs pertaining to soil leaching hazards. Total volumes of impacted soil in the Spill Areas with the associated environmental hazards are presented in Table 12, below.

Table 12: Impacted Soil Volumes, Spill Areas

Decision Unit	Depth Layer	Environmental Hazards	Total Volume (cy)
SA1	0' – 0.5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	47
	0.5' – 2'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	142
	2' – 5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	284
	5' – 10'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	474
SA2	0' – 0.5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	31
	0.5' – 2'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	94
	2' – 5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	183
	5' – 10'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	314
SA3	0' – 0.5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	19
	0.5' – 2'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	58
	2' – 5'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	117
	5' – 10'	Direct exposure, terrestrial ecotoxicity, leaching to groundwater	194

The total volume of soil impacted by COC in the Spill Areas is approximately 1,957 cubic yards (in-place, compacted). The environmental hazards associated with direct exposure, terrestrial ecotoxicity, and leaching to groundwater were identified for the entire volume. Dioxins/furans TEQ concentrations in the impacted soil from all decision units were well above the 1,000 ng/kg (1 part per billion) level.

Although terrestrial ecotoxicity hazards were identified to be associated with the elevated arsenic and pentachlorophenol concentrations, ETC does not believe that this hazard is considered significant. There are no known terrestrial ecological habitats in the immediate vicinity of the site and the East Kapolei PML site is currently and has historically been located in an area used for commercial agricultural operations. Anticipated future use does not include plans that would be conducive to terrestrial ecological habitats and/or use by endangered species. Furthermore, the primary concern is human direct exposure and remedies to address this hazard would also address terrestrial ecotoxicity concerns (since the ecotoxicity EALs for arsenic and pentachlorophenol are equal to or higher than the direct exposure EALs). Therefore, the terrestrial ecotoxicity hazard will no longer be considered for the Spill Areas.

12.2 Investigation Areas

For the Investigation Areas, total volume of impacted soil will be based on a depth of 5 feet bgs for decision units IAT1, IAT2, IAT4, and IAT5 (since dioxins and arsenic concentrations still exceeded their respective EALs at the 3-foot bgs depth limit of the trenches). For decision unit IAT3, the total volume of impacted soil will be based on a depth of 2 feet bgs (since COC concentrations in the 2- to 3-foot bgs layer were below default DOH EALs). For decision units IA1 to IA4, the total volume of impacted soil will be based on a depth of 2 feet bgs (since the dioxins concentrations in the 0- to 0.5-foot layer were close to the EAL and elevated concentrations are not anticipated to extend beyond the 2 foot depth). Total volumes of impacted soil in the Investigation Areas with the associated environmental hazards are presented in Table 13, below.

Table 13: Impacted Soil Volumes, Investigation Areas

Decision Unit	Depth Layer	Environmental Hazards	Total Volume (cy)
IA1	0 – 2'	Direct exposure	312
IA2	0 – 2'	Direct exposure	332
IA3	0 – 2'	Direct exposure	316
IA4	0 – 2'	Direct exposure	268
IAT1	0 – 0.5'	Direct exposure	87
	0.5' – 2'	Direct exposure	262
	2' – 3'	Direct exposure, terrestrial ecotoxicity	174
	3' – 5'	Direct exposure, terrestrial ecotoxicity	349
IAT2	0 – 0.5'	Direct exposure	90
	0.5' – 2'	Direct exposure	269
	2' – 3'	Direct exposure	180
	3' – 5'	Direct exposure	360
IAT3	0 – 0.5'	Direct exposure	53
	0.5' – 2'	Direct exposure	160
IAT4	0 – 0.5'	Direct exposure	56
	0.5' – 2'	Direct exposure	167
	2' – 3'	Direct exposure	112
	3' – 5'	Direct exposure	224
IAT5	0 – 0.5'	Direct exposure	46
	0.5' – 2'	Direct exposure	137
	2' – 3'	Direct exposure	92
	3' – 5'	Direct exposure	184

The total volume of soil impacted by COC (mostly dioxins, with arsenic in IAT1) in the Investigation Areas is approximately 4,230 cubic yards (in-place, compacted). The environmental hazards associated with direct exposure and terrestrial ecotoxicity were identified for the entire volume. Adjusted dioxins/furans TEQ concentrations were well above the 1,000 ng/kg level in all impacted soils, with the exception of soil in decision unit IAT1 at depths of 2- to 5-feet bgs (approximately 523 cubic yards with dioxins/furans TEQ concentrations between 450 ng/kg and 1,000 ng/kg). Arsenic impacts were only identified for soil from decision unit IAT1 at depths of 2- to 5-feet bgs.

As discussed in Section 12.1 above, the terrestrial ecotoxicity hazard will no longer be considered, since addressing the direct exposure hazard associated with arsenic in the Investigation Areas will also address the terrestrial ecotoxicity hazard.

12.3 Outside PML Site

For areas outside of the East Kapolei PML site fence line, direct exposure hazards associated with elevated dioxin concentrations and direct exposure/terrestrial ecotoxicity hazards associated with arsenic concentrations were identified.

Direct exposure hazards associated with dioxin impacts exist in an estimated 2 feet of soil located between the fence line of the PML site and the second ring of decision units described in the August 2007 *Final Site Investigation and Preliminary Remedial Alternatives Analysis* report. Direct exposure concerns (terrestrial ecotoxicity hazard removed from consideration, see Section 12.1) associated with arsenic impacts also exist in these general areas in an estimated 3 feet of soil, and extend further out into the intersection of the three coral/dirt roads. A total volume of dioxin and arsenic impacted soil is estimated at approximately 2,830 cubic yards (in-place, compacted, 1,340 cubic yards dioxin impacts only, 1,490 cubic yards dioxin and/or arsenic impacts). These areas are shown in Appendix I, Figure 10. Note that this volume also includes soil located between the East Kapolei PML site fence line and the coral road to the east. Based on the data, the dioxins/furans TEQ concentrations in these soils are anticipated between 450 ng/kg and 1,000 ng/kg.

Direct exposure hazards associated with dioxin impacts also exist in the soil/sediment contained within the portions of the concrete-lined ditch adjacent to and downgradient from the East Kapolei PML site. The estimated thickness of soil/sediment in the ditch is approximately 3 feet. The ditch is approximately 3- to 4-feet wide and the total length is approximately 800 feet. The total volume of dioxin impacted soil is estimated at approximately 311 cubic yards (not compacted). Based on data from the July 3, 2000 *Site Investigation*, the anticipated dioxins/furans TEQ concentrations exceed 1,000 ng/kg.

12.4 Future Activities

Based on the evaluation of data obtained to date for the East Kapolei PML site and adjacent areas, enough information exists to formulate alternatives to address the environmental hazards associated with the detected COC concentrations. As the next step in this overall project, ETC will be preparing a Remedial Alternatives Analysis to evaluate the feasibility of potential remedies to address the identified environmental hazards. Specifically, remedial alternatives will need to consider both direct exposure hazards throughout the entire site, as well as leaching to groundwater hazards associated with the Spill Areas.

13.0 REFERENCES

- AMEC Earth and Environmental Inc. 2004. *Phase I Environmental Site Assessment at East Kapolei Brownfield, Kapolei, Hawaii*. Prepared for the State of Hawaii DBEDT, ASO Log No. 02-131. September.
- Environet, Inc. 2009. *Phase I Environmental Site Assessment, East Kapolei Brownfields Site, Kapolei, Oahu, Hawaii 96707, TMK (1) 9-1-17: 71 (portion)*. Prepared for the State of Hawaii DHHL. January 22.
- EnviroServices & Training Center, LLC. 2007. *Final Site Investigation and Preliminary Remedial Alternatives Analysis Report, East Kapolei – Brownfields, Former Oahu Sugar Company, Pesticide Mixing and Loading Areas, Kapolei, Oahu, Hawaii TMK (1)-9-1-017: Parcel 088*. Prepared for the State of Hawaii DBEDT. August.
- EnviroServices & Training Center, LLC. 2009. *Site Safety & Health Plan, Site Demolition and Remedial Investigation, East Kapolei Pesticide Mixing and Loading (PML) Area, Kapolei, Oahu, Hawaii*. September.
- EnviroServices & Training Center, LLC. 2009. *Community Involvement Plan, East Kapolei II Pesticide Mixing and Loading Site, Ewa, Oahu, Hawaii*. Prepared for the State of Hawaii DHHL. October.
- EnviroServices & Training Center, LLC. 2009. *Site Demolition and Hazardous Materials Disposal Plan, East Kapolei II, Former Pesticide Mixing and Loading Site, Ewa, Oahu, Hawaii*. Prepared for the State of Hawaii DHHL. November.
- EnviroServices & Training Center, LLC. 2009. *Site Investigation Work Plan, East Kapolei II Pesticide Mixing and Loading Site, Ewa, Oahu, Hawaii TMK (1) 9-1-017: Parcel 93 (Portion)*. Prepared for State of Hawaii DHHL. December.
- Hawaii State Department of Health. 2000. *Site Inspection – Ewa Sugar Mill/Oahu Sugar Co. Pesticide Mixing and Loading Site*. EPA Site ID Number HISFN0905536, submitted to EPA Region IX, July 3, 2000.
- Hawaii State Department of Health. 2007. Review by R. Brewer on June 28, 2007. Summary Sheet of Sampling Results + technical review memo. February 14.
- Hawaii State Department of Health. 2008. (Updated October 2008) *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater*. Summer.
- Hawaii State Department of Health. 2008. *Technical Guidance Manual for Implementation of the Hawaii State Contingency Plan, Interim Final*. November.
- Macdonald, G.A., Abbot, A.T. and Peterson, F.L. 1983. *Volcanoes and the Sea*. University of Hawaii Press.

- Miles, C.J., Yanagihara, K., Ogata, S., Van De Berg, G., and Boesch, R. 1990. *Soil and Water Contamination at Pesticide Mixing and Loading Sites on Oahu, Hawaii*. Conducted by the University of Hawaii and Hawaii State Department of Agriculture. Printed in: *Bulletin of Environmental Contamination and Toxicology*. 44:955-962. January 8.
- Mink, John F. and Stephen L. Lau. 1990. *Aquifer Identification and Classification for Oahu: Groundwater Protection Strategy for Hawaii*. Technical Report No. 179. Water Resources Research Center, University of Hawaii at Manoa. February.
- Tetra Tech EM Inc. 2007. *Final Site Assessment Report, East Kapolei Affordable Housing Project, Kapolei, Oahu, Hawaii*. Prepared for the State of Hawaii DOH HEER Office. December 12.
- U.S. Department of Agriculture Soil Conservation Service. 1972. *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*.
- U.S. EPA. 1989. *Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual, Part A, Interim Final*. EPA/540/1-89/002. December.
- U.S. EPA. 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations (EPA QA/G-4) Final*. EPA/600/R-00/007. January.
- U.S. EPA. 2000. *Extent of Contamination, Oahu Sugar Company Site, Ewa, Hawaii, December 2000*. U.S. EPA Work Assignment No. 0-125, Lockheed Martin Work Order No. R1A00125, U.S. EPA Contract No. 68-C9-223.
- U.S. EPA. *SW-846 On-line Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*.
- U.S. EPA. 2003. *Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (EPA 600/R-03/027)*. November.

APPENDIX I
FIGURES & PHOTOGRAPHS

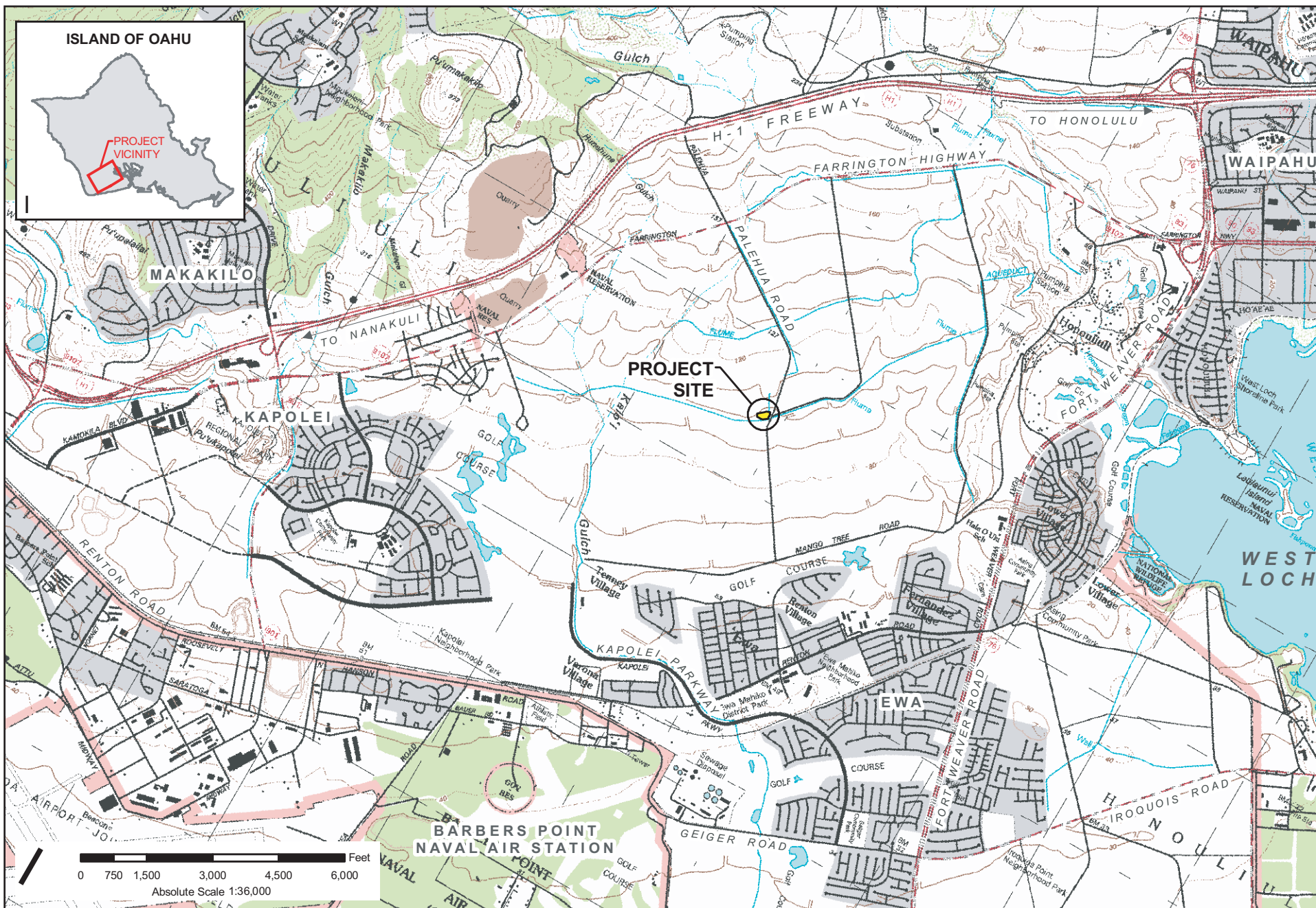
APPENDIX II

SUMMARY TABLES OF HISTORIC DATA

APPENDIX III

**SUMMARY OF TEQ CALCULATIONS &
LABORATORY REPORTS**

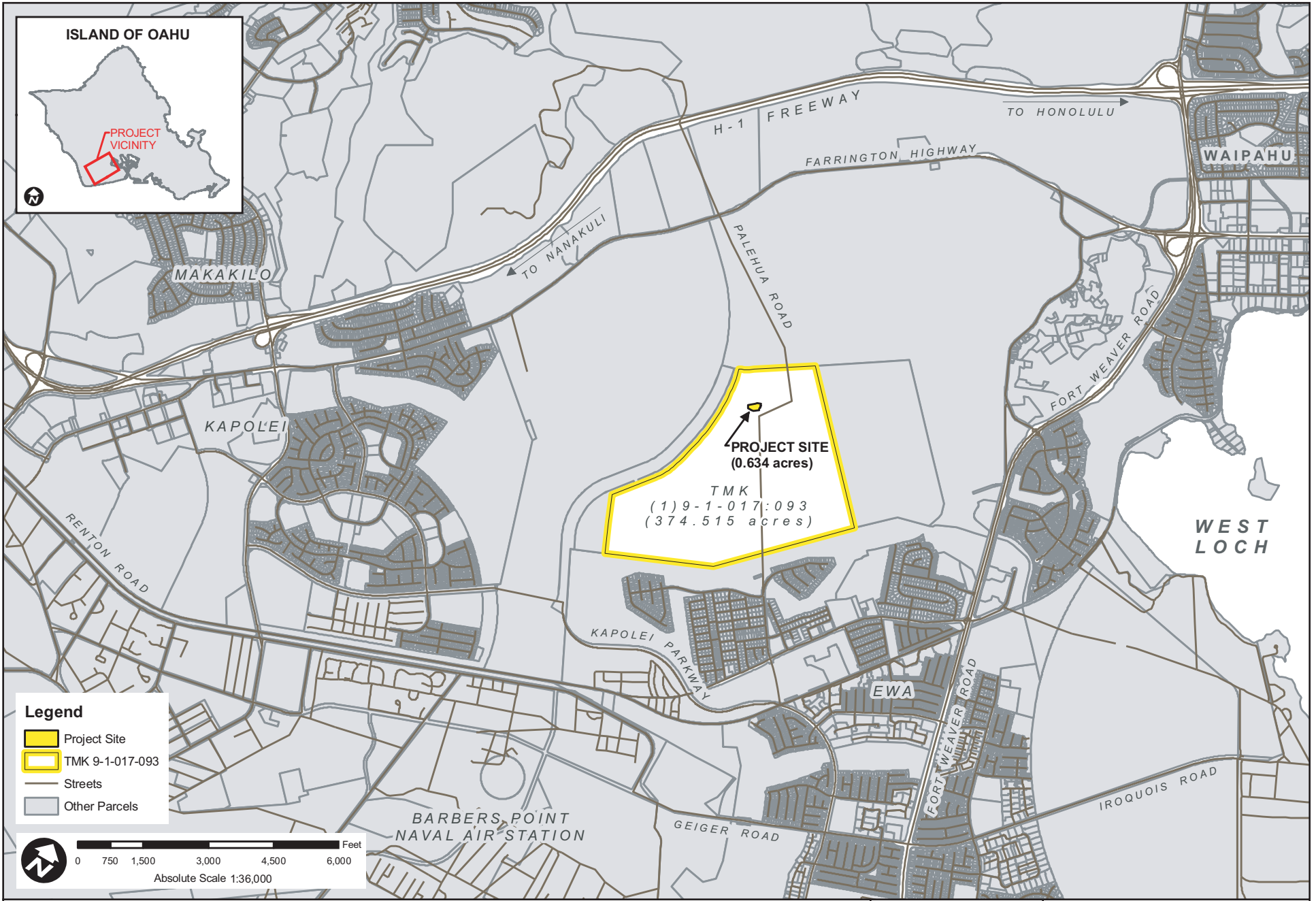
APPENDIX I
FIGURES & PHOTOGRAPHS



ETC Project 09-2012

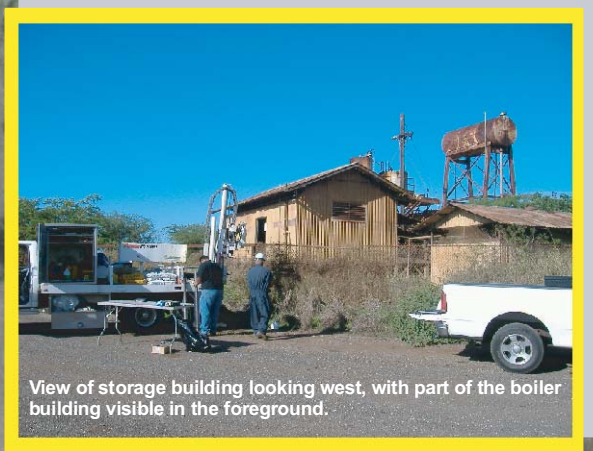
March 2010

Figure 1 - Location Map
Site Investigation Report & Environmental
Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii

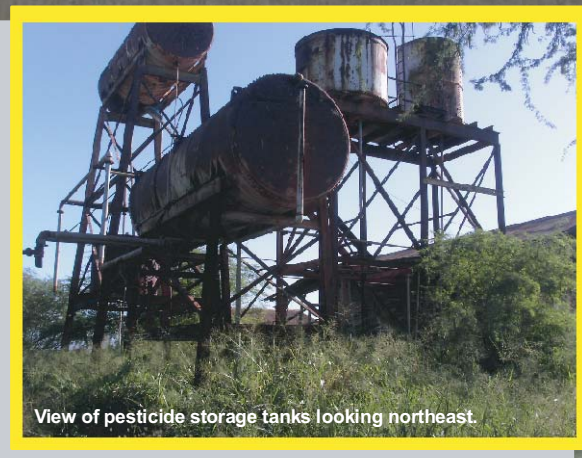




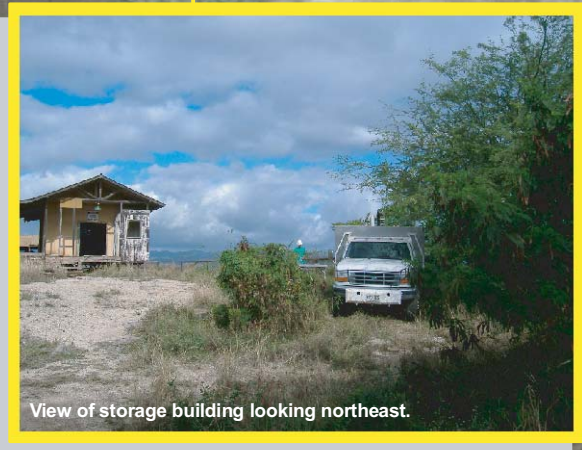
Pesticide mixing area adjacent to storage building.



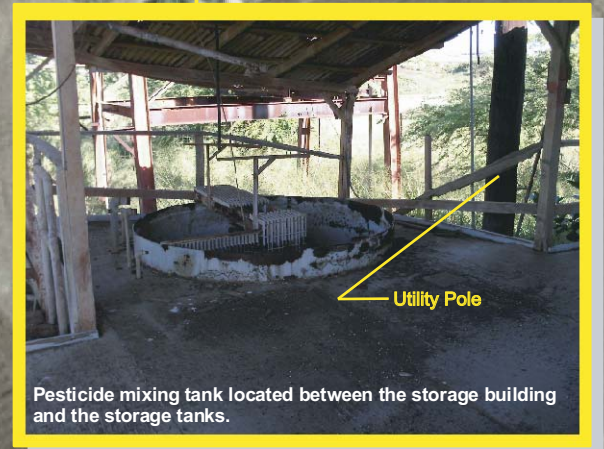
View of storage building looking west, with part of the boiler building visible in the foreground.



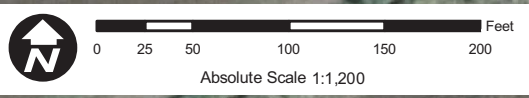
View of pesticide storage tanks looking northeast.

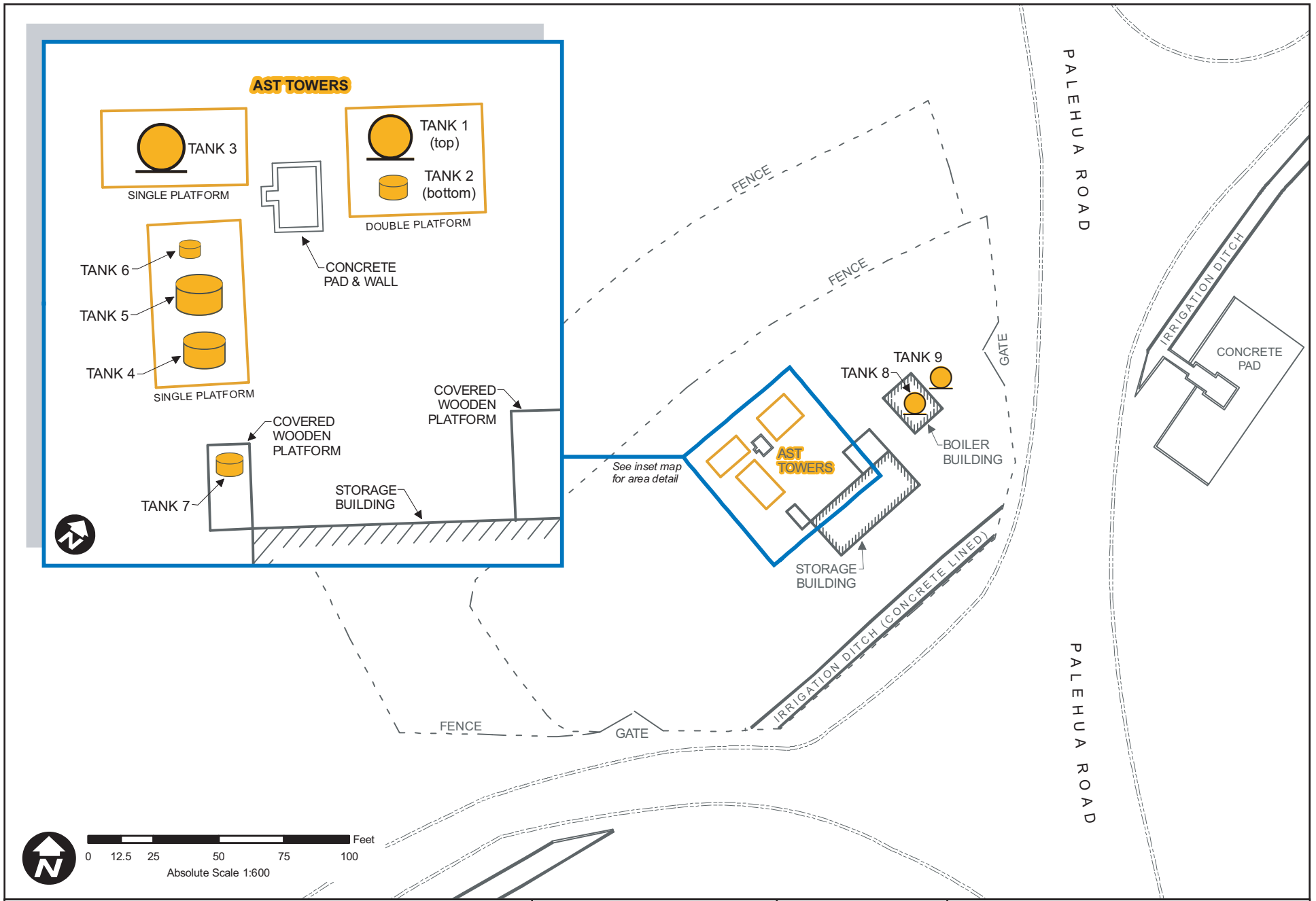


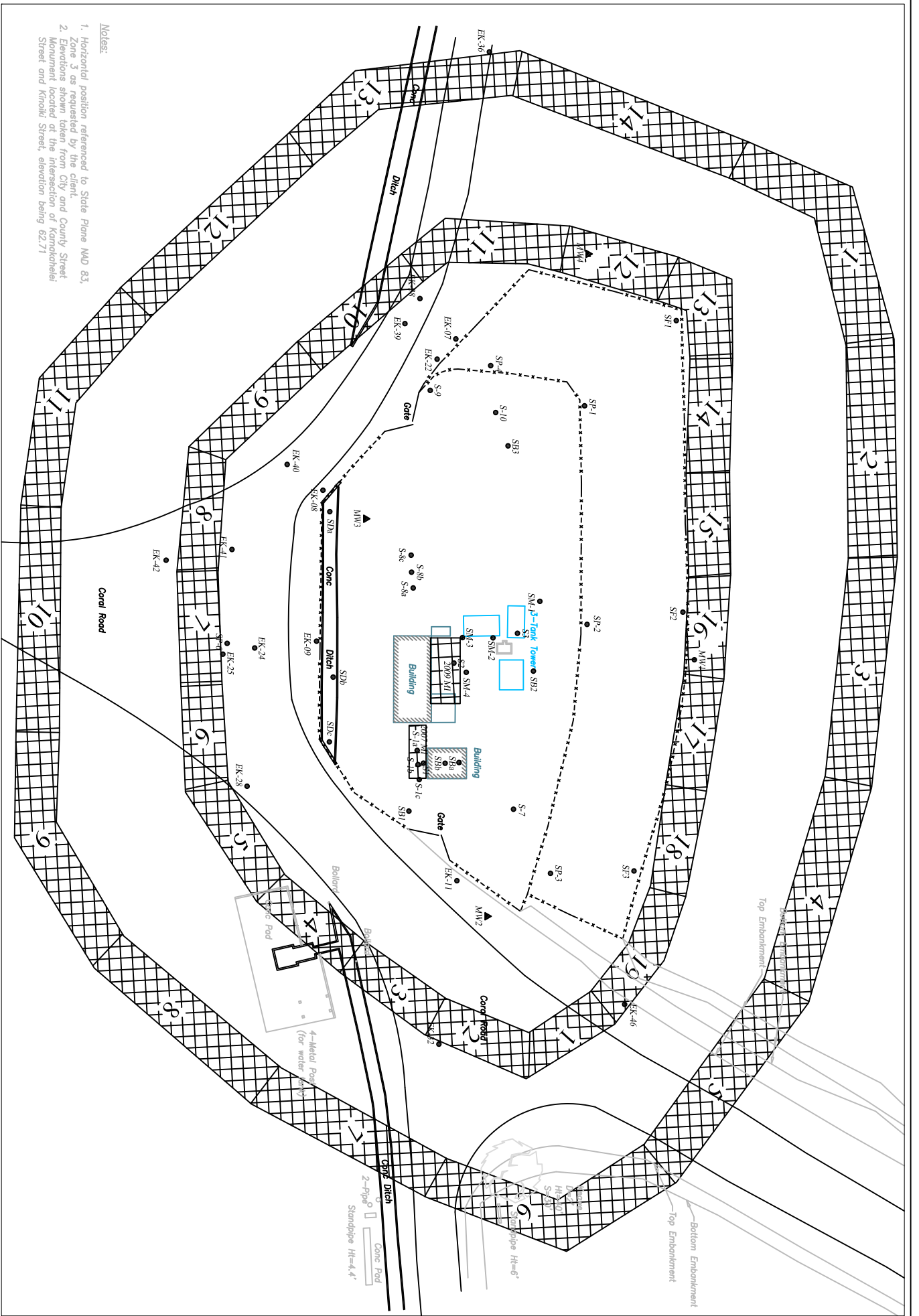
View of storage building looking northeast.



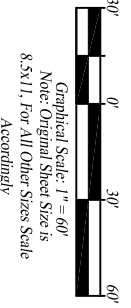
Pesticide mixing tank located between the storage building and the storage tanks.



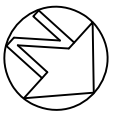




Notes:
 1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamaohalei Street and Kinohi Street, elevation being 62.71



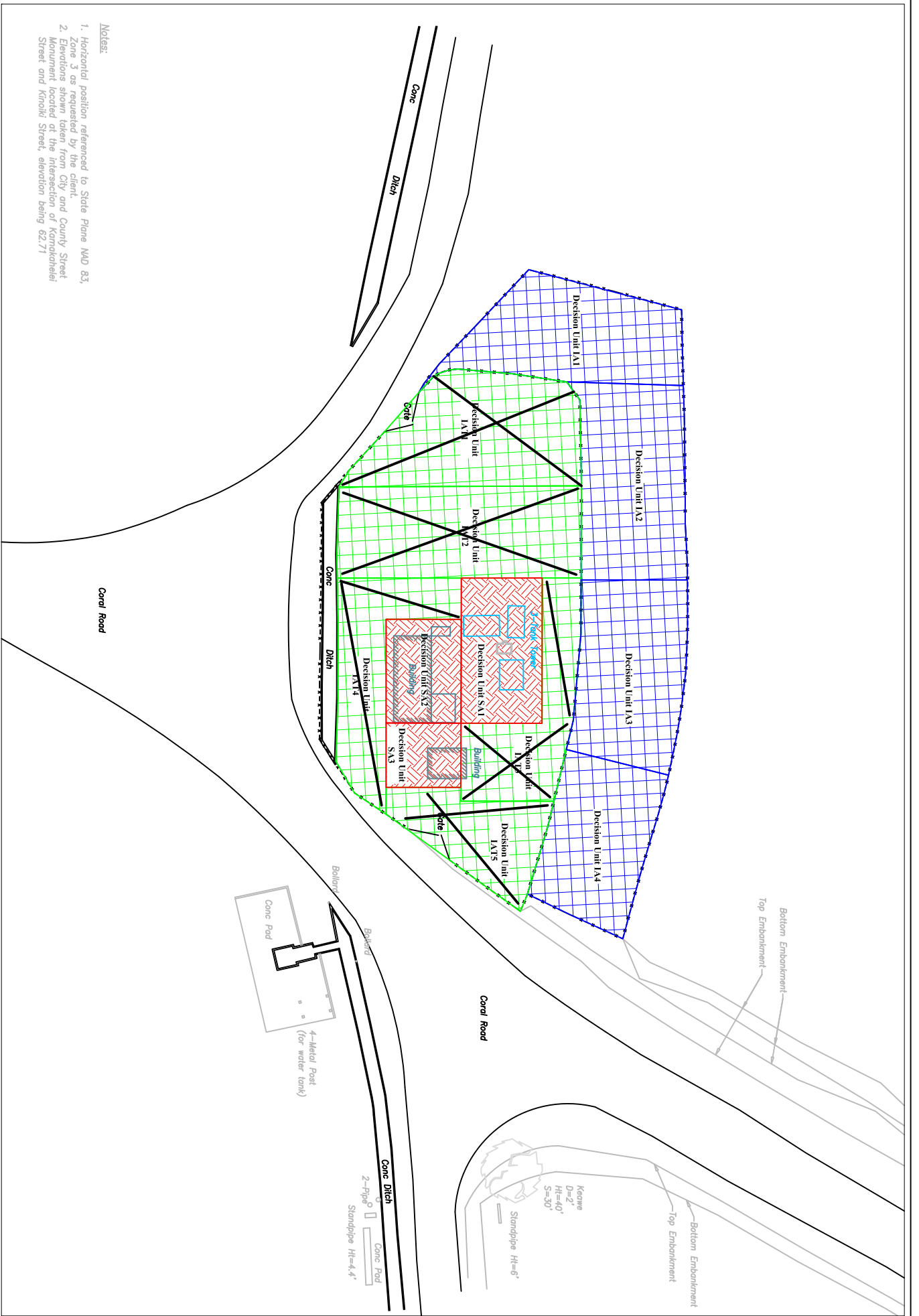
- Discrete sample location
- ▲ Monitoring well location
- Multi-increment sample decision unit, 0-6 inches bps
- EPA 2009 samples w/ arsenic > 20 mg/kg



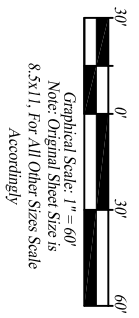
EnviroServices & Training Center LLC

Project 09-2012
 March 2010

Figure 5 - Historic Sample Locations
 Site Investigation Report and Environmental Hazard Evaluation
 East Kapolei PML Site
 Ewa, Oahu, Hawaii



- Notes:**
1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamahelei Street and Kinohi Street, elevation being 62.71



- Trench locations in LATS through LATS to depths of 3 feet bgs
- ▨ Multi-increment sample DUs, 0-6 inches bgs
- ▧ Multi-increment sample DUs, up to 10 feet bgs



Project 09-2012
March 2010

Figure 6 - Current Sample Locations
Site Investigation Report and Environmental Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii

Cone Ditch
2-Pipe
Standpipe H=4.4'

Keowe
D=2'
H=40'
S=30'

Standpipe H=6'

4-Metal Post
(for water tank)

Coral Road

Coral Road

Bottom Embankment
Top Embankment

Bottom Embankment
Top Embankment

Bohler

Bakera

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

Cone Pod

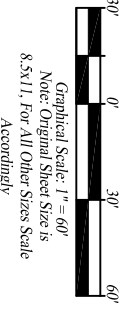
Cone Pod

Cone Pod

Cone Pod



- Notes:
1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamohāmele Street and Kinohi Street, elevation being 62.71

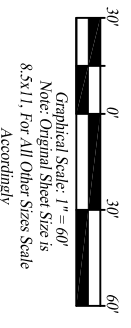


Project 09-2012
March 2010

Figure 7 - Extent of Arsenic Impacts
Site Investigation Report and Environmental Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii



- Notes:
1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamohāmele Street and Kinohi Street, elevation being 62.71

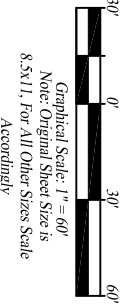


Project 09-2012
March 2010

Figure 8 - Extent of Dioxin Impacts
Site Investigation Report and Environmental Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii



- Notes:
1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamohāhā Street and Kinohi Street, elevation being 62.71



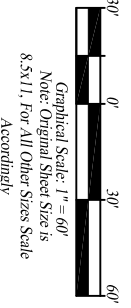
Project 09-2012
 March 2010

Figure 9 - Extent of PCP/Triazine Impacts
 Site Investigation Report and
 Environmental Hazard Evaluation
 East Kapolei PML Site
 Ewa, Oahu, Hawaii



Notes:

1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
2. Elevations shown taken from City and County Street Monument located at the intersection of Kamohāmele Street and Kinohi Street, elevation being 62.71



- Direct exposure hazards associated with dioxins/furans only
- Direct exposure hazards associated with arsenic, dioxins/furans, PCP, and/or triazine pesticides

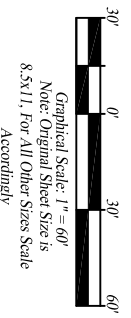


Project 09-2012
March 2010

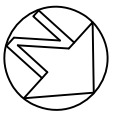
Figure 10 - Direct Exposure Hazards
Site Investigation Report and Environmental Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii



- Notes:
1. Horizontal position referenced to State Plane NAD 83, Zone 3 as requested by the client.
 2. Elevations shown taken from City and County Street Monument located at the intersection of Kamohāmele Street and Kinohi Street, elevation being 62.71



Leaching hazards associated with dioxins/furans, PCP, and/or triazine pesticides



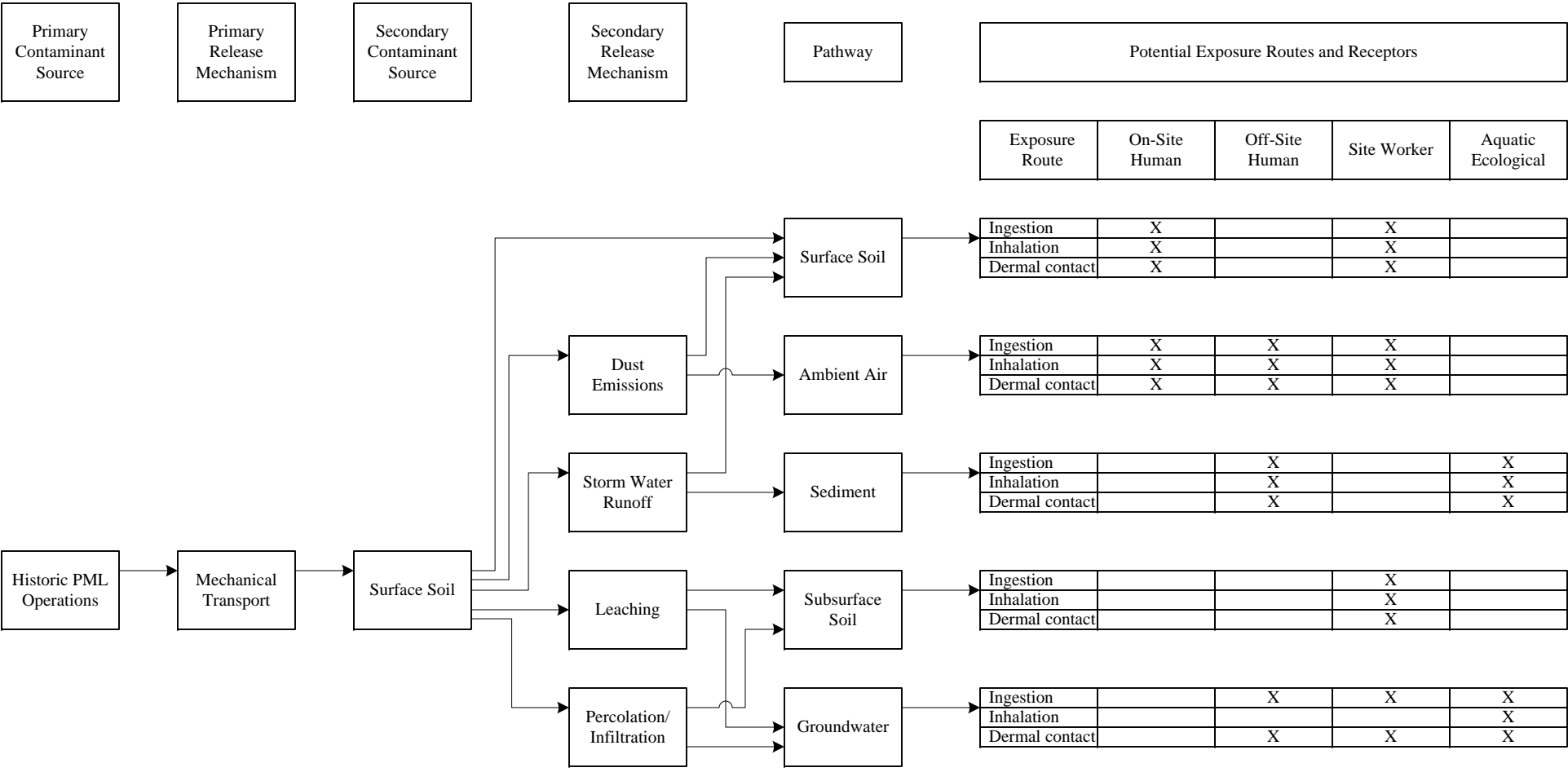
EnviroServices & Training Center LLC

Project 09-2012
March 2010

Figure 11 - Leaching to Groundwater Hazards
Site Investigation Report and Environmental Hazard Evaluation
East Kapolei PML Site
Ewa, Oahu, Hawaii

APPENDIX I - CONCEPTUAL SITE MODEL DIAGRAM

EAST KAPOLEI PML SITE, CURRENT CONDITIONS





Aerial photograph depicting the East Kapolei PML Site after completion of sample collection activities.



**EnviroServices &
Training
Center, LLC**

Project 09-2012

March 2010

Photographic Documentation
Site Investigation & Environmental
Hazard Evaluation
East Kapolei II Pesticide Mixing & Loading Site
Ewa, Oahu, Hawaii



Photo 1: ETC personnel laying out decision units



Photo 2: Decision unit boundaries marked using surveyors' tape



Photo 3: Aluminum spikes used for decision unit layout



Photo 4: View of site conditions prior to sample collection



**EnviroServices &
Training
Center, LLC**

Project 09-2012

March 2010

Photographic Documentation
Site Investigation Report & Environmental
Hazard Evaluation
East Kapolei II Pesticide Mixing & Loading Site
Ewa, Oahu, Hawaii



Photo 5: View of Geoprobe direct-push rig operation



Photo 6: collection of soil boring from Spill Area



Photo 7: Typical view of soil boring from Spill Area



Photo 8: Typical view of core sampler decontamination



**EnviroServices &
Training
Center, LLC**

Project 09-2012

March 2010

Photographic Documentation
Site Investigation Report & Environmental
Hazard Evaluation
East Kapolei II Pesticide Mixing & Loading Site
Ewa, Oahu, Hawaii



Photo 9: Typical view of trench excavation



Photo 10: Typical view of trench prior to sample collection



Photo 11: ETC personnel collecting soil increment from trench



Photo 12: View of polyethylene sheeting placed over SA3 after sample collection to minimize storm water infiltration



**EnviroServices &
Training
Center, LLC**

Project 09-2012

March 2010

Photographic Documentation
Site Investigation Report & Environmental
Hazard Evaluation
East Kapolei II Pesticide Mixing & Loading Site
Ewa, Oahu, Hawaii

APPENDIX II

SUMMARY TABLES OF HISTORIC DATA

Table 1: 1990 UH/Dept. of Ag Data

Sample Location	Depth (cm)	Diuron	Atrazine	Terbacil	Ametryn	Hexazinone	DDT	DDE	DDD
Boring 1	0 - 10	ND	3472	ND	17664	2.19	6.339	0.304	1.867
	10 - 17	ND	1613	ND	8333	1.25	2.39	0.110	0.570
	17 - 30	0.27	147.3	1.4	623.9	1	0.418	0.030	0.079
	30 - 61	0.71	16.94	3.3	69.32	1.15	0.048	0.009	0.018
	152 - 183	1.22	2.68	ND	184.8	2.08	ND	ND	ND
	244 - 274	1.05	1.6	ND	53.4	1.38	ND	ND	ND
Boring 2	0 - 15	1.26	6.77	3.38	19.71	0.23	0.025	0.060	0.100
	61 - 91	0.08	0.03	1.43	1.59	0.1	ND	ND	ND
	152 - 183	ND	0.09	0.32	2.06	0.18	ND	ND	ND
	244 - 274	ND	0.8	ND	3.03	0.25	ND	ND	ND
Boring 3	0 - 18	1.1	5.36	1.43	7.42	ND	ND	0.004	0.005
	61 - 91	0.06	0.12	0.71	0.53	ND	ND	ND	ND
	152 - 183	0.22	0.32	0.43	0.38	ND	ND	ND	ND
	244 - 274	0.18	0.61	ND	0.53	0.11	ND	ND	ND
MDL		0.06	0.01	0.05	0.02	0.02	0.003	0.002	0.004
DOH EAL		4.5	2.1	160	11	400	1.7	1.4	2.0

Location of borings are unknown.

ND = not detected

MDL = method detection limit (ppm wet weight)

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

Shading and bold type = exceedance of the EAL

Table 2: Surface Soil Sample Data, DOH May 1997/September 1999
Metals and Pesticides Only

Sample ID	S1	S2	S3	S4	S5 (bg)	S6 (S4 dup)	DOH EAL
Arsenic	29.9	27.2	51.7	13.9	11.5	13	20
Chromium	127	84.1	69	67.8	74.3	65	500
Lead	153	200	230	43.1	8.6	43.9	200
Mercury	0.64	0.82	0.3	nd<0.06	nd<0.05	nd<0.05	4.7
Zinc	1740	1900	1120	241	107	233	600
PCP (SVOC)	8.1	1.4	1.1	nd<4.3	nd<0.37	nd<4.3	3
PCP (ChlorHerb)	13	0.98	8.9	0.55	nd<0.042	0.46	3
DDE	0.11	nd<0.038	nd<0.0034	0.0037	nd<0.0037	0.0046	1.4
DDD	nd<0.038	0.057	0.0073	nd<0.0034	nd<0.0037	0.0058	2
DDT	0.068	0.3	0.0039	0.0051	0.0056	0.0069	1.7
2,4-D	nd<0.21	0.62	nd<0.21	0.38	nd<0.21	0.41	0.98
Dalapon	nd<2.1	nd<2.3	nd<2.1	nd<2.0	nd<2.1	nd<2.0	1.4
Dioxin TEQ (ppt)	752,000	--	--	73700	--	--	450

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

Table 3: Soil Sample Data - Metals, EPA December 2000

Sample ID	Depth	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
BG	0-1	14	290	nd<5.3	120	56	30	7	2000	nd<0.11	53	220	120
SB	0-1	16	130	nd<5.2	180	35	140	270	1600	0.54	65	110	3500
S-1a,b,c	0-1	39	190	nd<3.1	170	33	180	300	820	0.92	71	110	2400
S-1c	1-2	22	210	0.81	100	29	35	30	1100	0.16	44	170	440
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-7	0-1	18	140	nd<2.5	77	44	49	16	1600	nd<0.1	95	130	260
S-8	0-0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-9	0-0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-10	0-0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDa,b,c	0-1	18	150	nd<2.6	95	47	52	14	1800	nd<0.01	110	140	140
SF-1	0-1	11	260	nd<2.7	93	55	29	6.4	2000	0.16	51	210	120
SF-2	0-1	9.6	270	nd<5.5	94	57	30	7.4	2100	nd<0.11	54	220	130
SF-3	0-1	8.9	300	nd<2.8	100	58	30	6.9	2100	nd<0.11	53	220	120
SF-4	0-1	43	280	nd<2.7	84	57	35	6.1	2200	nd<0.11	57	210	130
SM-1	0-1	50	150	nd<1.5	62	22	55	210	680	0.15	57	68	720
	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-2	0-1	160	230	nd<2.9	160	33	170	240	880	nd<1.3	95	130	2000
	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-3	0-1	30	250	nd<2.7	100	22	72	350	690	nd<0.39	52	76	3000
	1-2 ⁽¹⁾	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3 ⁽¹⁾	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-4	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-1	0-1	12	150	nd<2.7	62	34	33	35	1300	0.16	54	130	130
SP-2	0-1	16	190	nd<5.5	75	43	34	33	1500	nd<0.11	54	170	170
	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-3	0-1	16	200	nd<2.8	91	49	41	39	1800	nd<0.11	68	170	270
SP-4	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-6	1-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EALs		20	750	12	500	40	230	200	NA	4.7	150	110	600

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

NA = not analyzed

Table 4: Soil Sample Data - Pesticides, EPA December 2000

Sample ID	Depth	DDD	DDE	DDT	delta-BHC	Dieldrin	Endrin Aldehyde	Chlordane
BG	0-1	nd<0.035	nd<0.035	nd<0.035	nd<0.018	nd<0.035	nd<0.035	nd<0.018
SB	0-1	0.034	0.04	0.067	nd<0.017	0.0027	nd<0.035	0.0068
S-1a,b,c	0-1	nd<0.041	nd<0.041	nd<0.041	0.079	0.049	nd<0.041	nd<0.02
S-1c	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
	3-4	NA	NA	NA	NA	NA	NA	NA
S-7	0-1	nd<0.34	nd<0.34	nd<0.34	nd<0.0.17	nd<0.34	nd<0.34	nd<0.0.17
S-8	0-0.25	NA	NA	NA	NA	NA	NA	NA
S-9	0-0.25	NA	NA	NA	NA	NA	NA	NA
S-10	0-0.25	NA	NA	NA	NA	NA	NA	NA
SDa,b,c	0-1	nd<0.35	nd<0.35	nd<0.35	nd<0.018	nd<0.036	nd<0.35	nd<0.17
SF-1	0-1	nd<0.037	nd<0.037	nd<0.037	nd<0.018	nd<0.037	nd<0.037	nd<0.018
SF-2	0-1	nd<0.037	nd<0.037	nd<0.037	nd<0.018	nd<0.037	nd<0.018	nd<0.018
SF-3	0-1	nd<0.038	nd<0.038	nd<0.038	nd<0.019	nd<0.039	nd<0.038	nd<0.019
SF-4	0-1	nd<0.036	nd<0.036	nd<0.036	nd<0.018	nd<0.036	nd<0.036	nd<0.018
SM-1	0-1	nd<0.034	0.014	nd<0.034	0.013	nd<0.034	nd<0.034	nd<0.017
	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
SM-2	0-1	nd<0.038	0.043	0.22	0.14	nd<0.038	0.084	0.0095
	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
SM-3	0-1	0.13	0.081	0.31	nd<0.018	nd<0.036	0.036	nd<0.018
	1-2 ⁽¹⁾	NA	NA	NA	NA	NA	NA	NA
	2-3 ⁽¹⁾	NA	NA	NA	NA	NA	NA	NA
SM-4	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
SP-1	0-1	nd<0.036	nd<0.036	0.035	nd<0.018	nd<0.036	nd<0.036	0.0032
SP-2	0-1	nd<0.038	nd<0.038	0.041	nd<0.019	nd<0.038	nd<0.038	nd<0.019
	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
SP-3	0-1	nd<0.037	nd<0.037	nd<0.037	nd<0.018	nd<0.037	nd<0.018	nd<0.018
SP-4	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
SP-6	1-2	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA
EALs		2	1.4	1.7	0.09	0.03	0.06	7

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

NA = not analyzed

Table 5: Soil Sample Data - Herbicides, EPA December 2000

Sample ID	Depth	Ametryn	Glyphosate	Diuron	Atrazine	Simazine	Terbacil	Trifluralin	Propiconazole	2,4-D	Dalapon	Picloram
BG	0-1	nd<0.69	nd<5.25	nd<0.087	nd<0.69	nd<0.69	nd<0.69	nd<0.69	nd<0.11	0.047	nd<0.0099	nd<0.03
SB	0-1	3.6	34	3.02	nd<6.9	nd<6.9	nd<6.9	nd<6.9	nd<1.1	0.64	nd<0.02	nd<0.059
S-1a,b,c	0-1	120	4.61	16.5	86	nd<8	nd<8	190	nd<1.3	1.7	nd<0.01	nd<0.031
S-1c	1-2	35	26	0.5	nd<0.67	nd<0.67	nd<0.67	nd<0.67	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3-4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S-7	0-1	nd<6.7	nd<5.07	0.0788	nd<6.7	nd<6.7	nd<6.7	0.77	nd<1.1	0.024	nd<0.0098	nd<0.029
S-8	0-0.25	NA	NA	NA	nd<14	NA	NA	NA	NA	NA	NA	NA
S-9	0-0.25	NA	NA	NA	nd<14	NA	NA	NA	NA	NA	NA	NA
S-10	0-0.25	NA	NA	NA	nd<15	NA	NA	NA	NA	NA	NA	NA
SDa,b,c	0-1	nd<6.9	nd<5.36	0.0613	nd<6.9	nd<6.9	nd<6.9	nd<6.9	nd<1.1	0.026	nd<0.01	nd<0.03
SF-1	0-1	nd<0.73	nd<5.47	0.0765	nd<0.73	nd<0.73	nd<0.73	nd<0.73	nd<0.11	nd<0.02	nd<0.01	nd<0.03
SF-2	0-1	nd<0.72	nd<5.42	0.047	nd<0.72	nd<0.72	nd<0.72	nd<0.72	nd<0.11	0.12	nd<0.0099	nd<0.03
SF-3	0-1	nd<0.75	nd<1.131	0.0504	nd<0.75	nd<0.75	nd<0.75	nd<0.75	nd<0.12	0.061	nd<0.01	nd<0.03
SF-4	0-1	nd<0.71	nd<5.32	0.0235	nd<0.71	nd<0.71	nd<0.71	nd<0.71	nd<0.11	0.034	nd<0.0099	nd<0.03
SM-1	0-1	2.1	2.43	0.683	nd<3.4	nd<3.4	nd<3.4	nd<3.4	nd<0.052	nd<0.2	nd<0.0099	0.044
	1-2	NA	NA	NA	nd<7.1	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-2	0-1	8	5.93	3.03	nd<7.6	nd<7.6	0.94	1.9	nd<1.2	0.62	0.037	nd<0.03
	1-2	NA	NA	NA	nd<0.8	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-3	0-1	13	21.8	10.1	3	2.9	nd<3.2	nd<7.1	nd<1.1	0.32	nd<0.0099	nd<0.03
	1-2 ^(d)	NA	NA	NA	nd<0.72	NA	NA	NA	NA	NA	NA	NA
	2-3 ^(d)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SM-4	1-2	NA	NA	NA	nd<0.72	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-1	0-1	nd<7.1	2.63	0.188	nd<7.1	nd<7.1	nd<7.1	nd<7.1	nd<1.1	0.18	nd<0.01	nd<0.03
SP-2	0-1	nd<3.8	2.52	0.374	nd<3.8	nd<3.8	nd<3.8	nd<3.8	nd<0.58	0.1	nd<0.0099	nd<0.03
	1-2	NA	NA	NA	nd<0.77	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-3	0-1	nd<7.3	nd<5.48	0.2	nd<7.3	nd<7.3	nd<7.3	nd<7.3	nd<1.1	0.057	nd<0.01	nd<0.03
SP-4	1-2	NA	NA	NA	nd<7.7	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SP-6	1-2	NA	NA	NA	nd<7.1	NA	NA	NA	NA	NA	NA	NA
	2-3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EALs		11	1.9	4.5	2.1	0.25	160	32	160	0.98	1.4	NA

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

NA = not analyzed

Table 6: Soil Sample Data - Dioxins, PCP, Tetrachlorophenol, EPA December 2000

Sample ID	Depth	Dioxin TEQ (ppt)	2,3,4,6-Tetrachlorophenol	Pentachlorophenol
BG	0-1	65	nd<0.35	nd<0.35
SB	0-1	63100	nd<3.5	1.6
S-1a,b,c	0-1	333600	nd<4.1	15
S-1c	1-2	271000	NA	22
	2-3	33400	NA	NA
	3-4	42000	NA	NA
S-7	0-1	2300	nd<8.5	nd<8.5
S-8	0-0.25	1700	NA	0.09
S-9	0-0.25	1500	NA	nd<0.363
S-10	0-0.25	1700	NA	nd<1.874
SDa,b,c	0-1	1400	nd<8.7	nd<8.7
SF-1	0-1	64	nd<1.8	nd<1.8
SF-2	0-1	89	nd<1.8	nd<1.8
SF-3	0-1	84	nd<1.9	nd<1.9
SF-4	0-1	207	nd<1.8	nd<1.8
SM-1	0-1	94300	0.57	17
	1-2	3600	NA	310
	2-3	1300	NA	NA
SM-2	0-1	44400	0.36	7.5
	1-2	360	NA	nd<0.399
	2-3	640	NA	NA
SM-3	0-1	98000	nd<9	1.7
	1-2 ⁽¹⁾	2900	NA	14
	2-3 ⁽¹⁾	2000	NA	NA
SM-4	1-2	2900	NA	14
	2-3	2000	NA	NA
SP-1	0-1	4800	nd<3.6	nd<3.6
SP-2	0-1	10900	nd<3.9	nd<3.9
	1-2	2300	NA	nd<0.388
	2-3	900	NA	NA
SP-3	0-1	8500	nd<3.7	nd<3.7
SP-4	1-2	1900	NA	nd<0.384
	2-3	220	NA	NA
SP-6	1-2	270	NA	nd<0.359
	2-3	370	NA	NA
EALs		450	3.3	3

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m
 NA = not analyzed

Table 7: Discrete Soil Sample Data, ETC 2006

Sample Location	Sample ID	TEQs (ng/kg)	Arsenic (mg/kg)	Diuron (mg/kg)	Atrazine (mg/kg)	Simazine (mg/kg)	Ametryn (mg/kg)	SPLP Atrazine (mg/l)	SPLP Simazine (mg/l)	SPLP Ametryn (mg/l)	Dieldrin (mg/kg)	Trifluralin (mg/kg)	PCP (mg/kg)	2,3,4,6-Tetrachlorophenol (mg/kg)
MW-1, 0' bgs	2010-1-0	50.94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CAS Kelso			7.5											
MW-1, 3' bgs	2010-1-3	1.28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-2, 0' bgs	2010-2-0	522.05	NA	<i>0.055</i>	<i>0.077</i>	<i>0.077</i>	<i>0.023</i>	NA	NA	NA	NA	NA	35	35
CAS Kelso			8.5											
MW-2, 3' bgs	2010-2-3	1238.36	23.1	<i>0.055</i>	<i>0.076</i>	<i>0.076</i>	<i>0.044</i>	NA	NA	NA	NA	NA	35	35
MW-2, 6' bgs	2010-2-6	1.53	0.19	<i>0.064</i>	NA	NA	NA	NA	NA	NA	NA	NA	2.1	2.1
MW-3, 0' bgs	2010-3-0	13.40	<i>0.22</i>	<i>0.054</i>	<i>0.074</i>	<i>0.074</i>	<i>0.018</i>	NA	NA	NA	NA	NA	87	87
MW-3, 3' bgs	2010-3-3	3.50	2.6	<i>0.052</i>	<i>0.069</i>	<i>0.069</i>	<i>0.069</i>	NA	NA	NA	NA	NA	84	84
MW-4, 0' bgs	2010-4-0	NA	NA	<i>0.063</i>	<i>0.081</i>	<i>0.081</i>	<i>0.011</i>	NA	NA	NA	<i>0.0041</i>	0.032	2.0	2.0
CAS Kelso			6.7											
MW-4, 3' bgs	2010-4-3	NA	<i>0.24</i>	<i>0.059</i>	<i>0.076</i>	<i>0.076</i>	<i>0.076</i>	NA	NA	NA	<i>0.0038</i>	<i>0.00076</i>	1.9	1.9
SB-1, 0' bgs	2010-5-0	563.14	NA	<i>0.052</i>	<i>0.072</i>	<i>0.072</i>	<i>0.018</i>	<i>0.0022</i>	<i>0.0022</i>	<i>0.0022</i>	NA	NA	1.7	1.7
SB-1, 3' bgs	2010-5-3	96.00	NA	<i>0.036</i>	<i>0.080</i>	<i>0.080</i>	<i>0.037</i>	<i>0.0022</i>	<i>0.0022</i>	<i>0.00048</i>	NA	NA	1.9	1.9
SB-1, 6' bgs	2010-5-6	137.38	NA	<i>0.061</i>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-1, 9' bgs	2010-5-9	101.54	NA	<i>0.061</i>	NA	NA	NA	NA	NA	NA	NA	NA	2.0	2.0
SB-2, 0' bgs	2010-6-0	5.73	1.5	<i>0.055</i>	<i>0.069</i>	<i>0.069</i>	<i>0.025</i>	<i>0.0024</i>	<i>0.0024</i>	<i>0.00093</i>	<i>0.034</i>	0.260	89	89
CAS Kelso			12.5											
SB-2, 3' bgs	2010-6-3	2.96	0.9	<i>0.060</i>	<i>0.079</i>	<i>0.079</i>	<i>0.020</i>	<i>0.0023</i>	<i>0.0023</i>	<i>0.0023</i>	<i>0.0040</i>	<i>0.00079</i>	1.9	1.9
SB-3, 0' bgs	2010-7-0	20.85	NA	<i>0.055</i>	<i>0.068</i>	<i>0.068</i>	0.087	<i>0.0024</i>	<i>0.0024</i>	<i>0.0017</i>	NA	NA	87	87
SB-3, 3' bgs	2010-7-3	1.32	NA	<i>0.062</i>	<i>0.081</i>	<i>0.081</i>	<i>0.081</i>	<i>0.0022</i>	<i>0.0022</i>	<i>0.0022</i>	NA	NA	2.0	2.0
DOH EALs		450	20	4.5	2.1	0.25	11				0.03	32	3	3.3

NA = not analyzed

Dioxin/furan TEQs calculated based on 2005 World Health Organization TEFs

Blue, italicized values indicate result below reporting limit, reporting limit provided.

Pink values indicate an estimated value.

Boldfaced value indicates concentration exceeds EAL.

Shaded value indicates reporting limit exceeds EAL.

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

Table 8: Multi-Increment Soil Sample Data, ETC 2006

Sample Location	Sample ID	TEQs (ng/kg)	Adjusted TEQ Values (ng/kg)	Arsenic (mg/kg)	Diuron (mg/kg)	Atrazine (mg/kg)	Simazine (mg/kg)	Ametryn (mg/kg)	Dieldrin (mg/kg)	Trifluralin (mg/kg)	PCP (mg/kg)	2,3,4,6-Tetrachlorophenol (mg/kg)
Ring 1, DU1	2010-01-1	57.80	70.41	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU2	2010-01-2	38.97	47.48	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU3	2010-01-3	51.87	63.19	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU4	2010-01-4	146.22	178.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU5	2010-01-5	52.59	64.07	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU6	2010-01-6	47.39	57.72	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU7	2010-01-7	156.04	190.09	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU8	2010-01-8	369.82	450.51	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU9	2010-01-9	484.75	590.52	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU10	2010-01-10	819.30	998.07	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU11	2010-01-11	190.12	231.60	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU12	2010-01-12	80.27	97.79	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU13	2010-01-13	69.94	85.20	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU14	2010-01-14	67.86	82.67	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU15	2010-01-15	74.01	90.16	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU16	2010-01-16	83.74	102.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU17	2010-01-17	77.57	94.50	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU18	2010-01-18	79.41	96.73	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 1, DU19	2010-01-19	285.64	347.97	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phase I ESA Area	2010-03-1	15.70	19.13	4.4	0.022	0.055	0.067	0.067	0.0034	0.00067	1.7	1.7
Replicate, Ring 1, DU1	2010-04-1	37.26	45.39	NA	NA	NA	NA	NA	NA	NA	NA	NA
Replicate, Ring 1, DU1	2010-04-2	53.25	64.86	NA	NA	NA	NA	NA	NA	NA	NA	NA
Replicate, Ring 1, DU18	2010-05-01	84.37	102.77	NA	NA	NA	NA	NA	NA	NA	NA	NA
Replicate, Ring 1, DU18	2010-05-02	91.98	112.05	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 2, DU11	2010-02-11	172.36	209.97	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 2, DU12	2010-02-12	353.37	430.48	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ring 2, DU13	2010-02-13	141.44	172.30	NA	NA	NA	NA	NA	NA	NA	NA	NA
Replicate, Ring 2, DU13	2010-08-1	144.86	176.47	NA	NA	NA	NA	NA	NA	NA	NA	NA
DOH EALs		450	450	20	4.5	2.1	0.25	11	0.03	32	3	3.3

NA = not analyzed

Dioxin/furan TEQs calculated based on 2005 World Health Organization TEFs

Adjusted TEQ Values = TEQ values plus highest calculated RSD (21.82%).

Blue, italicized values indicate result below reporting limit, reporting limit provided.

Pink values indicate an estimated value.

Boldfaced value indicates concentration exceeds EAL.

Table 9: Groundwater Sample Data, ETC 2006

Sample Location	Sample ID	Dissolved Arsenic (mg/l)	Diuron (mg/l)	Atrazine (mg/l)	Simazine (mg/l)	Ametryn (mg/l)	Dieldrin (mg/l)	Trifluralin (mg/l)	PCP (mg/l)	2,3,4,6-Tetrachlorophenol (mg/l)	Glyphosate (mg/l)
MW-2	2010-2	<i>0.0020</i>	<i>0.0010</i>	<i>0.0019</i>	<i>0.0019</i>	<i>0.0019</i>	<i>0.000096</i>	<i>0.000019</i>	<i>0.054</i>	<i>0.054</i>	<i>0.0046</i>
MW-3	2010-3	<i>0.0020</i>	0.0014	0.00096	<i>0.0019</i>	<i>0.0019</i>	<i>0.000096</i>	<i>0.000019</i>	<i>0.052</i>	<i>0.052</i>	<i>0.0046</i>
MW-4	2010-4	<i>0.0020</i>	<i>0.0010</i>	0.00093	<i>0.0019</i>	<i>0.0019</i>	<i>0.000096</i>	<i>0.000019</i>	<i>0.050</i>	<i>0.050</i>	<i>0.0046</i>
Replicate MW-3	2010-7	<i>0.0020</i>	0.0013	0.00088	<i>0.0019</i>	<i>0.0019</i>	<i>0.000096</i>	<i>0.000019</i>	<i>0.053</i>	<i>0.053</i>	<i>0.0046</i>
Development Water	2010-8	0.0011	0.00062	0.00069	<i>0.0019</i>	<i>0.0019</i>	<i>0.000094</i>	<i>0.000019</i>	<i>0.048</i>	<i>0.048</i>	<i>0.0046</i>
DOH EALs		0.069	0.2	0.35	0.01	0.15	0.00071	0.02	0.013	0.01	0.6

Blue, italicized values indicate result below reporting limit, reporting limit provided.

Pink values indicate an estimated value.

Shaded value indicates reporting limit exceeds EAL.

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

Table 10: Multi-Increment Soil Sample Data, DOH 2007

Sample ID	SL01	SL02	SL03	Default EAL
Pentachlorophenol	11	ND	8.3	3
2,3,4,6-Tetrachlorophenol	ND	ND	ND	3.3
Diuron	0.46	0.51	0.57	4.5
Chlorinated Herbicides (mg/kg)				
2,4-D	ND	ND	400	0.98
2,4-DB	ND	ND	ND	
2,4,5-T	ND	ND	ND	
2,4,4,5-TP	ND	ND	ND	
Dalapon	ND	ND	ND	1.4
Dicamba	ND	ND	ND	
Dichloropropene	ND	ND	ND	
Dinoseb	ND	ND	ND	
MCPA	ND	ND	ND	
MCPP	ND	ND	ND	
Dioxins TEQ (ppb)	144.95	NA	NA	0.45
Trifluralin	49	58	63	32
Atrazine	8	33	41	2.1
Ametryn	9	27	35	11
Dieldrin	ND	ND	ND	0.03
Simazine	ND	ND	ND	0.25

Table 11: SPLP Soil Sample Data and K_d Values, DOH 2007

Sample ID	SL01	K_d (SL01)	SL02	K_d (SL02)	SL03	K_d (SL03)	Composite	K_d (Composite)
SPLP ($\mu\text{g/l}$)								
Pentachlorophenol	ND		ND		ND			
Diuron	0.013	15	0.014	16	0.0041	120	5.1	86
Dieldrin	ND<0.0095		ND<0.004		ND<0.010			
Trifluralin	0.012	4100	0.0043	13000	0.012	5200	12	5000
Ametryn	0.0077	1100000	0.0076	3500	0.78	25	600	30
Simazine	0.002		0.0011		0.002			
Atrazine	0.33	3	0.13	230	0.79	32	1300	6.9

K_d values < 20 cm^3/g indicate potential leaching hazards

Table 12: Discrete Soil Sample Data - Arsenic, Lead, Dioxins, EPA January 2009

Samples Collected at 1-foot

Sample ID	Dioxin TEQ	Arsenic	Lead
EK-01	160	10	12
EK-02	110	8	16
EK-03	70	8	15
EK-04	84	11	14
EK-05	58	9	22
EK-06	73	8	15
EK-07	27	8	8
EK-08	83	20	8
EK-09	180	8	8
EK-10	210	11	8
EK-11	400	25	13
EK-12	31	9	23
EK-13	64	9	18
EK-14	46	9	23
EK-15	41	9	23
EK-16	94	9	15
EK-17	61	9	26
EK-18	99	10	19
EK-19	170	9	21
EK-20	470	12	30
EK-21	120	16	14
EK-22	28	9	8
EK-23	340	7	8
EK-24	6.1	11	8
EK-25	16	64	8
EK-26	56	6	8
EK-27	34	8	8
EK-28	54	24	27
EK-29	46	8	8
EK-30	42	6	8
EK-31	300	15	35
EK-32	90	6	7
EK-33	22	6	8
EK-34	13	9	8
EK-35	43	6	14
EK-36	17	6	8
EK-37	31	7	8
EK-38	330	55	8
EK-39	23	6	8
EK-40	12	7	7
EK-41	6.4	25	12
EK-42	9.2	8	7
EK-43	34	8	16
EK-44	76	9	29
EK-45	94	7	17
EK-46	280	20	21
Mean	101.17	12.39	14.24
Std Dev	111.61	11.34	7.46
EALs	450	20	200

Samples Collected at 2-feet

Sample ID	Dioxin TEQ	Arsenic	Lead
EK-01	48	19	11
EK-02	110	9	20
EK-03	37	9	18
EK-04	44	8	23
EK-05	27	13	16
EK-06	75	9	21
EK-07	63	90	9
EK-08	73	56	18
EK-09	280	95	15
EK-10	210	10	15
EK-11	480	30	14
EK-21	50	14	10
EK-22	70	30	8
EK-23	200	7	11
EK-24	8	519	80
EK-25	8.4	202	12
EK-26	360	7	8
EK-27	15	8	7
EK-28	8	12	18
EK-29	18	19	8
EK-30	62	16	9
EK-31	39	--	--
EK-32	10	21	7
EK-33	5	7	8
EK-34	13	7	12
EK-35	15	11	44
EK-36	110	44	9
EK-37	40	14	8
EK-38	130	67	8
EK-39	63	43	8
EK-40	18	105	14
EK-41	15	112	128
EK-42	6.6	308	203
EK-43	80	8	17
EK-44	65	10	21
EK-45	9.5	8	18
EK-46	880	20	27
Mean	101.23	54.64	24.80
Std Dev	167.58	100.71	38.66
EALs	450	20	200

Dioxin TEQ results in ng/kg

Blue, italicized values indicate result below reporting limit, reporting limit provided.

Table 13: Multi-Increment Soil Sample Data, DOH 2009

Sample Location	TEQs (ng/kg)	DDT (mg/kg)	PCP (mg/kg)
Boiler Room 1	447180	<i>0.701</i>	<i>89.4</i>
Boiler Room 2	1814480	<i>0.701</i>	20.3
Boiler Room 3	868080	0.883	28.4
Spill Area 1	427480	4.04	21.5
Spill Area 2	581720	3.56	20.4
Spill Area 3	371360	2.41	32.7
DOH EALs	450	1.7	3

Collected by DOH HEER to be used in thermal desorption treatability study.

Dioxin/furan TEQs calculated based on 2005 World Health Organization TEFs

Blue, italicized values indicate result below reporting limit, reporting limit provided.

Boldfaced value indicates concentration exceeds EAL.

DOH EAL = Summer 2008 (October 2008 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

APPENDIX III

**SUMMARY OF TEQ CALCULATIONS &
LABORATORY REPORTS**

Dioxins/Furans TEQ Calculations

EPA Method 8290 Modified

All results in picograms per gram (pg/g) = nanograms per kilogram (ng/kg) = parts per trillion (ppt)

Sample ID	Lab Sample ID	2,3,7,8-TCDD	1,2,3,7,8-PentaCDD	1,2,3,4,7,8-HexaCDD	1,2,3,6,7,8-HexaCDD	1,2,3,7,8,9-HexaCDD	1,2,3,4,6,7,8-HeptaCDD	1,2,3,4,6,7,8,9-OctaCDD	2,3,7,8-TetraCDF	1,2,3,7,8-PentaCDF	2,3,4,7,8-PentaCDF	1,2,3,4,7,8-HexaCDF	1,2,3,6,7,8-HexaCDF	2,3,4,6,7,8-HexaCDF	1,2,3,7,8,9-HexaCDF	1,2,3,4,6,7,8-HeptaCDF	1,2,3,4,7,8,9-HeptaCDF	1,2,3,4,6,7,8,9-OctaCDF	Total TEQ
TEFs		1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	
SA1.A	HTA0029-03	2200 2200	10000 10000	26000 2600	110000 11000	51000 5100	6500000 65000	41000000 12300	3500 350	13000 390	11000 3300	300000 30000	48000 4800	29000 2900	31000 3100	580000 5800	110000 1100	7500000 2250	162190
SA1.B	HTA0030-01	100 100	1100 1100	2800 280	15000 1500	6200 620	630000 6300	11000000 3300	460 46	1250 37.5	1000 300	34000 3400	6500 650	4900 490	5400 540	150000 1500	8300 83	760000 228	20475
SA1.C	HTA0030-02	250 250	1250 1250	1250 125	1400 140	1250 125	43000 430	940000 282	250 25	1250 37.5	1250 375	4500 450	820 82	1500 150	970 97	14000 140	1250 12.5	38000 11.4	3982
SA1.D	HTA0030-03	44 44	1250 1250	320 32	850 85	460 46	35000 350	370000 111	250 25	1250 37.5	1250 375	2600 260	380 38	260 26	310 31	8400 84	550 5.5	33000 9.9	2810
SA2.A	HTA0029-04	1100 1100	24000 24000	82000 8200	330000 33000	140000 14000	1300000 130000	2000000 6000	8000 800	34000 1020	29000 8700	800000 80000	130000 13000	61000 6100	110000 11000	610000 6100	350000 3500	1300000 3900	350420
SA2.B	HTA0032-01	290 290	4800 4800	20000 2000	140000 14000	45000 4500	750000 75000	3900000 11700	1400 140	1250 37.5	3900 1170	230000 23000	23000 2300	2550 255	26000 2600	210000 21000	99000 990	1300000 3900	167683
SA2.C	HTA0032-02	250 250	1250 1250	2300 230	20000 2000	3500 350	130000 13000	1500000 4500	95 9.5	1250 37.5	1250 375	25000 2500	1800 180	2300 230	1250 125	340000 3400	12000 120	250000 750	29307
SA2.D	HTA0032-03	250 250	1250 1250	1250 125	3400 340	560 56	160000 1600	1600000 480	74 7.4	1250 37.5	1250 375	6500 650	1250 125	830 83	990 99	45000 450	5700 57	240000 72	6057
SA2.E	HTA0029-05	1500 1500	30000 30000	97000 9700	430000 43000	180000 18000	1500000 150000	7900000 23700	10000 1000	54000 1620	45000 13500	1000000 100000	170000 17000	120000 12000	150000 15000	660000 6600	530000 5300	1700000 5100	453020
SA2.F	HTA0029-06	1500 1500	25000 25000	68000 6800	310000 31000	130000 13000	1200000 120000	6000000 18000	8300 830	36000 1080	31000 9300	700000 70000	100000 10000	82000 8200	97000 9700	440000 4400	300000 3000	1200000 3600	335410
SA3.A	HTA0029-07	3100 3100	45000 45000	130000 13000	790000 79000	270000 27000	1500000 150000	7500000 22500	20000 2000	80000 2400	82000 24600	1600000 160000	230000 23000	130000 13000	230000 23000	1500000 150000	680000 68000	1900000 5700	615100
SA3.B	HTA0032-04	270 270	3500 3500	10000 1000	41000 4100	18000 1800	200000 20000	2100000 6300	1200 120	2400 72	3600 1080	91000 9100	14000 1400	12000 1200	14000 1400	300000 30000	19000 190	1900000 570	55102
SA3.C	HTA0032-05	250 250	830 830	420000 42000	260000 26000	46000 4600	1400000 140000	6400000 19200	890 89	1250 37.5	1250 375	280000 28000	1250 125	1250 125	1250 125	510000 51000	240000 2400	2100000 6300	321457
SA3.D	HTA0032-06	250 250	1250 1250	2500 250	22000 2200	4100 410	170000 17000	2100000 6300	110 11	1250 37.5	1250 375	28000 2800	1500 150	780 78	1250 125	440000 4400	19000 190	3600000 1080	36907
IA1	HSL0151-01	11 11	89 89	190 19	690 69	400 40	25000 2500	280000 84	14 1.4	40 1.2	48 14.4	270 27	130 13	100 10	4.8 0.48	6900 69	350 3.5	45000 13.5	715
IA2	HSL0151-02	25 25	60 60	130 13	700 70	340 34	26000 2600	290000 87	15 1.5	57 1.71	68 20.4	470 47	160 16	86 8.6	11 1.1	7300 73	570 5.7	22000 6.6	731
IA3	HSL0151-03	16 16	130 130	290 29	1200 120	640 64	52000 5200	590000 177	19 1.9	66 1.98	80 24	620 62	260 26	150 15	13 1.3	13000 130	630 6.3	68000 20.4	1345
IA4	HSL0151-04	19 19	49 49	87 8.7	380 38	190 19	19000 1900	180000 54	7.4 0.74	32 0.96	39 11.7	310 31	120 12	61 6.1	4.8 0.48	3600 36	260 2.6	15000 4.5	484
IAT1.A	HTA0012-01	51 51	440 440	1000 100	2900 290	1800 180	65000 650	540000 162	43 4.3	170 5.1	220 66	1300 130	600 60	460 46	30 3	18000 180	840 8.4	35000 10.5	2386
IAT1.B	HTA0041-01	4 4	34 34	67 6.7	260 26	140 14	13000 1300	130000 39	3.6 0.36	14 0.42	18 5.4	160 16	64 6.4	49 4.9	3 0.3	3200 32	110 1.1	11000 3.3	324
IAT1.C	HTA0041-04	0.43 0.43	3.3 3.3	6.2 0.62	23 2.3	13 1.3	830 8.3	7300 2.19	0.73 0.073	1 0.03	1 0.3	7.4 0.74	4.6 0.46	3.5 0.35	1.15 0.115	160 1.6	8.6 0.086	520 0.156	22
IAT1.D	HTA0041-02	11 11	110 110	180 18	470 47	320 32	19000 1900	160000 48	7.4 0.74	19 0.57	23 6.9	180 18	120 12	81 8.1	2.7 0.27	3800 38	160 1.6	10000 3	545

Dioxins/Furans TEQ Calculations

EPA Method 8290 Modified

All results in picograms per gram (pg/g) = nanograms per kilogram (ng/kg) = parts per trillion (ppt)

Sample ID	Lab Sample ID	2,3,7,8-TCDD	1,2,3,7,8-PentaCDD	1,2,3,4,7,8-HexaCDD	1,2,3,6,7,8-HexaCDD	1,2,3,7,8,9-HexaCDD	1,2,3,4,6,7,8-HeptaCDD	1,2,3,4,6,7,8,9-OctaCDD	2,3,7,8-TetraCDF	1,2,3,7,8-PentaCDF	2,3,4,7,8-PentaCDF	1,2,3,4,7,8-HexaCDF	1,2,3,6,7,8-HexaCDF	2,3,4,6,7,8-HexaCDF	1,2,3,7,8,9-HexaCDF	1,2,3,4,6,7,8-HeptaCDF	1,2,3,4,7,8,9-HeptaCDF	1,2,3,4,6,7,8,9-OctaCDF	Total TEQ
TEFs		1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	
IAT1.E	HTA0041-03	2.7	23	51	170	98	7400	80000	2.6	8.6	12	94	39	31	1.5	1700	63	6200	
		2.7	23	5.1	17	9.8	74	24	0.26	0.258	3.6	9.4	3.9	3.1	0.15	17	0.63	1.86	196
IAT2.A	HTA0012-02	54	670	1500	4600	2700	140000	600000	32	190	240	2000	910	590	41	31000	1600	46000	
		54	670	150	460	270	1400	180	3.2	5.7	72	200	91	59	4.1	310	16	13.8	3959
IAT2.B	HTA0067-03	17	140	200	1200	580	73000	590000	12	39	49	270	210	170	10	14000	320	55000	
		17	140	20	120	58	730	177	1.2	1.17	14.7	27	21	17	1	140	3.2	16.5	1505
IAT2.C	HTA0067-04	32	320	440	3900	1200	200000	2100000	24	97	130	390	520	460	210	58000	2100	310000	
		32	320	44	390	120	2000	630	2.4	2.91	39	39	52	46	21	580	21	93	4432
IAT3.A	HTA0012-03	240	1900	4000	24000	11000	610000	580000	240	1500	2000	19000	6900	5200	300	210000	13000	59000	
		240	1900	400	2400	1100	6100	174	24	45	600	1900	690	520	30	2100	130	17.7	18371
IAT3.B	HTA0067-01	11	120	310	1300	590	70000	990000	14	44	59	450	220	180	13	13000	460	85000	
		11	120	31	130	59	700	297	1.4	1.32	17.7	45	22	18	1.3	130	4.6	25.5	1615
IAT3.C	HTA0067-02	0.48	4.4	9.1	78	24	3700	57000	3.1	4.2	28	12	8.7	0.91	850	41	5700	0	
		0.48	4.4	0.91	7.8	2.4	37	17.1	0.31	0.126	8.4	1.2	0.87	0.091	85	0.41	57	0	223
IAT4.A	HTA0012-04	200	2900	7200	21000	10000	370000	730000	170	1200	1400	12000	5200	2900	550	110000	8700	140000	
		200	2900	720	2100	1000	3700	219	17	36	420	1200	520	290	55	1100	87	42	14606
IAT4.B	HTA0062-01	15	140	260	2000	640	110000	1500000	22	160	170	1800	450	220	57	3000	1300	110000	
		15	140	26	200	64	1100	450	2.2	4.8	51	180	45	22	5.7	30	13	33	2382
IAT4.C	HTA0062-02	115	200	1200	24000	3200	1500000	15000000	120	290	340	5400	1000	670	550	350000	13000	2300000	
		115	200	120	2400	320	15000	4500	12	8.7	102	540	100	67	55	3500	130	690	27860
IAT5.A	HTA0012-05	63	820	2500	14000	4400	430000	770000	140	960	1300	13000	3500	2400	450	100000	7500	110000	
		63	820	250	1400	440	4300	231	14	28.8	390	1300	350	240	45	1000	75	33	10980
IAT5.B	HTA0062-03	15	160	430	2300	1000	84000	1100000	26	120	150	1700	540	380	37	25000	960	110000	
		15	160	43	230	100	840	330	2.6	3.6	45	170	54	38	3.7	250	9.6	33	2328
IAT5.C	HTA0062-04	9.7	130	300	2700	810	98000	1100000	33	170	220	2400	650	490	53	26000	1100	150000	
		9.7	130	30	270	81	980	330	3.3	5.1	66	240	65	49	5.3	260	11	45	2580
IAT5.D	HTA0029-02	250	330	940	3300	1600	190000	2300000	71	290	380	6300	1250	1250	1250	42000	2300	260000	
		250	330	94	330	160	1900	690	7.1	8.7	114	630	125	125	125	420	23	78	5410
IAT5.E	HTA0029-01	250	700	2100	9700	3700	640000	7900000	220	930	920	19000	3000	2900	4300	110000	5000	770000	
		250	700	210	970	370	6400	2370	22	27.9	276	1900	300	290	430	1100	50	231	15897

The World Health Organizations' 2005 Toxic Equivalency Factor (TEF) scheme was used to weight each compound according to its relative toxicity for cancer risk evaluations.

Toxic Equivalencies (TEQs) were calculated using the TEFs.

DOH EAL = Summer 2008 (March 2009 Update) Hawaii Department of Health, Default Tier 1 Environmental Action Levels, NDW, >150m

Blue, italicized values indicate result below method detection limit (MDL), 1/2 MDL value shown and used to calculate adjusted concentrations.

Pink values indicate an estimated value.