SITE INVESTIGATION REPORT AND ENVIRONMENTAL HAZARD EVALUATION

43 Ahui Street
Honolulu, Oahu, Hawaii
TMK (1) 2-1-060: Parcel 013

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TABLE OF CONTENTS

TABLES

ATTACHMENTS

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 regulations, 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 of ETC's Client, exclusively for the project site indicated. The scope of services performed in execution of this project 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 unauthorized and at the sole risk of said user.

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Prepared By: ______________________________
Damon Hamura
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Date: October 2010

2.0 INTRODUCTION AND PURPOSE

EnviroServices & Training Center (ETC), LLC was contracted by Ocean Investments, LLC to conduct a site investigation at the project site identified as Tax Map Key (TMK) (1) 2-1-060: Parcel 13 and located at 43 Ahui Street in the Kakaako Community Development District (also referred to as the Kakaako Makai District) in Honolulu, Hawaii.

The purpose of the site investigation was to satisfy a request made by the Hawaii Department of Health (DOH) Hazard Evaluation and Emergency Response (HEER) Office in a July 30, 2010 letter to Ocean Investments, LLC regarding a *Recommendation for the Special Management Area (SMA) Use Approval Application for Restaurant and Multi-Use Assembly and Hospitality Uses with Parking and Other Support Activity Uses, TMK 2-1-060:013* to assess the project site for contaminant impacts. The DOH HEER Office suspected that soil within the project site may be impacted by contaminants associated with incinerator ash and other landfill-related debris based on environmental data for other properties in the general vicinity.

This Site Investigation Report and Environmental Hazard Evaluation (SIR-EHE) provides a detailed description of the objectives of the investigation, sampling design and rationale, methodology/procedures used to collect environmental samples, observations made during sample collection, data quality evaluation parameters, analytical data received from the laboratory, evaluation of data in comparison to applicable and available risk-based action levels, and conclusions drawn from the data evaluation, particularly any environmental hazards that may exist as a result of chemical impact to site media. The conclusions made in this SIR-EHE will be used to determine whether additional investigation, corrective action, and/or special management of impacted media would be warranted.

3.0 BACKGROUND

3.1 Site Description and Land Area

The Property consists of approximately 37,241 square feet (0.885 acres) of commercial waterfront land located at 43 Ahui Street and falls within the Kakaako Community Development District (also referred to as the Kakaako Makai District) in Honolulu, Hawaii (see Appendix I, Figure 1). The State of Hawaii is the current landowner and Ocean Investments, LLC has been the lessee since 2007 and maintains the lease rights for the Property through 2042. Prior to 2007, the Property was leased by Basin Project Inc., the entity that developed the current structures.

Currently, the John Dominis Restaurant occupies the site. The facility consists of two commercial structures, the restaurant with adjoining chapel and a two-story office, with an existing floor area of 18,654 square feet. The John Dominis Restaurant/chapel structure has an irregular shape that cantilevers approximately 40 feet out over the channel water within an air rights easement. The remaining areas of the site consist of an asphalt paved parking lot and landscaping. A recent aerial photograph of the property is presented in Appendix I, Figure 2.

The Property is relatively flat with a slight gradient towards Ahui Street and is situated at an elevation of approximately 10 to 12-feet above mean sea level (msl). Areas adjacent to the Property include a 3,600 square foot parcel abutting the northwestern corner leased to Salem Media of Hawaii with an approximate 300-foot tall broadcasting tower, the University of Hawaii’s Pacific Biosciences Research Center (PBRC) adjacent to the south, and other former commercial/industrial lots that are currently undeveloped.

3.2 Climatologic Conditions

The main features of Oahu’s climate include mild temperatures throughout the year ranging from 88˚F (31˚C) to 74˚F (23˚C) and moderate humidity of 53% during the day. The northeasterly trade winds generated by a high pressure center north of the islands are the dominant factor that governs the climate in Hawaii. Two mountain ranges on Oahu, the Koolau Mountains which extend along the northeastern side of the island and the Waianae Mountains which extend along the southwestern side of the island, influence every aspect of the climate. Both mountain ranges serve to block the trade wind moisture and as a result, showers occur almost daily on the windward side while on the leeward side showers are light. The trade winds are generally strongest during the summer (May through October) and are periodically disrupted by storms in the winter (October through April), which result in heavy rain and thunderstorms throughout the island. At the site, the average annual rainfall reported by the U.S. Department of Agriculture is between 10 to 40 inches, most of which occurs during the winter months.

3.3 Site Geology

Oahu is formed by the erosional remnants of two shield volcanoes. These are the Waianae range to the west and the Koolau range to the east. The Waianae volcano is estimated to have formed 2.4 to 3.6 million years before present. It consists of a tholeiitic lava shield with a thick cap of transitional to alkalic rock. Rejuvenation-stage volcanics of undifferentiated age occur in Kolekole Pass and on the south flank of the Waianae shield. Dike orientations define northwest and southwest rift zones (Macdonald, et al., 1983).

The Koolau volcano is estimated to have formed 1.8 to 2.6 million years before the present (Macdonald, et al., 1983). It consists of a tholeiitic lava shield and lacks an alkalic cap. It has well defined major dike complex trending northwest-southwest. A third, minor rift zone referred to as the Kaau rift trends southward from Kaau crater, near the upland crest of the Koolau Ridge. After a long dormant period and periods of deep erosion, the Koolau volcano developed abundant and scattered rejuvenation-stage vents, typically aligned on northeast-striking fissures (Macdonald, et al., 1983).

The soil at the property is mapped as mixed fill land, which consists of areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources. Fill land occurs primarily near Pearl Harbor and in Honolulu, adjacent to the ocean. Average annual rainfall in the area is less than 200 cm per year. This land type is generally used for urban development including airports, housing areas, and industrial facilities (USDA, 1972).

As further described in Section 3.6, prior to 1913, the southern coastline of Honolulu generally followed the present location of Ala Moana Boulevard. Artificial fill was used to expand the coastline seaward starting in 1913. Artificial fill used to create the current property included municipal waste and municipal incinerator ash.

Physical observations made during boring advancement activities indicated that soil at the site is consistent with fill land, with various soil types observed. In addition, layers of suspect incinerator ash and ash-related materials were observed throughout the project site in soil cores obtained during sample collection.

3.4 Site Hydrogeology

The primary drinking water in the Hawaiian Islands is drawn from basal groundwater. Basal groundwater is formed by rainwater percolating down through the residual soils and permeable volcanic rock. The portion of the island situated below sea level, except within rift zones of the volcanoes, is saturated with ocean salt water and thus forms a basal lens called the "Ghyben-Herzberg" lens. A zone of transition between the fresh groundwater and the ocean salt water occurs due to the constant movement of the interface as a result of tidal fluctuations, seasonal fluctuations in recharge and discharge and aquifer development (Macdonald, et al., 1983).

Downward percolation of rainwater may be stopped by impermeable layers such as dense lava flows, alluvial clay layers and volcanic ash. The groundwater then forms a perched or high level aquifer, which is not in contact with salt water. Recharge of the aquifer occurs in areas of high rainfall, which are the interior mountainous areas. The groundwater flows from the recharge areas to the areas of discharge along the shoreline. Frictional resistance to groundwater flow causes it to pile up within the island until it attains sufficient hydraulic head to overcome friction. Thus, basal groundwater tends to slope toward the shoreline.

According to Mink & Lau, 1990, the property is underlain by the Nuuanu Aquifer System, which is part of the Honolulu Aquifer Sector on the island of Oahu. The aquifer is classified with the system identification number 30102116 (13321). This system includes an unconfined basal aquifer in sedimentary (nonvolcanic) lithology. The groundwater in this aquifer is described as being currently used as well as ecologically important, but is not a direct drinking water source. The groundwater contains a moderate salinity (1,000 to 5,000 mg/l Cl^-) and is described as replaceable with a high vulnerability to contamination (Mink and Lau, 1990). The site is further underlain by a second aquifer of the same system. The aquifer is a confined, basal aquifer in flank compartments, and is classified with the system identification number 30102121 (11113). The lower aquifer is described as a currently used drinking water source containing groundwater with a fresh salinity (<250 mg/l Cl^-). It is described as irreplaceable with a low vulnerability to contamination (Mink and Lau, 1990).

A previous geotechnical engineering soil investigation identified groundwater at depths ranging from 7.75 feet below ground surface (bgs) to 13.25 feet bgs. The depth to groundwater could not be definitively measured during this site investigation.

3.5 Surface Water Bodies/Drinking Water Wells/Ecological Habitats

The nearest surface water bodies are the Kewalo Basin, located adjacent and to the east, which is contiguous with Mamala Bay. Review of the underground injection control (UIC) line maps and the August 26, 1993 *Hawaii Ground Water Index and Summary* indicated that the property is located approximately 0.25 to 0.5 miles below the UIC line. The closest drinking water wells, 1849-10, 1849-13, 1849-14, 1849-15, and 1849-16 are located above the UIC line approximately 1.75 miles east of the site. There are no wells located downgradient of the site and the land use of the neighboring properties is recreational and commercial/industrial. No ecological habitats were identified at the property. However, the adjacent Kewalo Basin and Mamala Bay support coral reefs and local bird populations.

3.6 Historical Land Use

The original southern coastline of Honolulu generally followed the present location of Ala Moana Boulevard and the Kakaako Makai District was previously situated at or below sea level. Between 1913 and 1927, a seawall was constructed and artificial "fill" materials were deposited behind the seawall. The fill material consisted of ash from the burning of municipal refuse, unburned refuse, construction debris, household debris, automobile batteries, and other miscellaneous refuse items. The deposited fill material caused the coastline to move south and thereby established new land for development in the Kakaako Makai District. In 1930, the first of two incinerators was built on the southeast portion of Ahui Street. In the mid 1940's, a second incinerator was also constructed in the area (Noda and Cotton, 1997). From the late 1940's until the 1960's, land areas seaward of both incinerators were expanded to the south with fill material and ash from the incinerators.

The first record of development on the site was in 1978, when the current John Dominis Restaurant was constructed. There has been no other documented use of the property.

3.7 Current and Future Land Use

Currently, the property is used as a restaurant and chapel. Plans for future development will maintain the use of the property for a restaurant and multi-use assembly and hospitality facility. Due to the age and existing condition of the structures, renovation for long term use has been deemed economically infeasible. A site plan depicting the planned replacement structure has been included in Appendix I, Figure 3. This plan shows the outline of the existing structures and the floor plan for the new, replacement structure.

3.8 Contaminants of Potential Concern

The contaminants of potential concern (COPC) established for this investigation were based on data obtained for adjacent commercial/industrial properties. These contaminants include:

- Total petroleum hydrocarbons (TPH)
  - TPH as diesel-range organics (TPH-D)
  - TPH as oil-range organics (TPH-O)
- Polynuclear aromatic hydrocarbons (PAHs) – 16 DOH PAHs plus methylnaphthalenes
- Organochlorine pesticides (particularly technical chlordane and dieldrin)
- Eight Resource Conservation and Recovery Act (RCRA8) metals
  - arsenic
  - barium
  - cadmium
  - chromium
  - lead
  - mercury
  - selenium
  - silver
- Copper
- Zinc

3.9 Conceptual Site Model

A conceptual site model (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.

3.9.1 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.

Future Site Users

Current plans identify continued commercial use of the property. In 2006, the State of Hawaii mandated by law that the Kakaako Makai District could not be used for residential purposes (Hawaii Revised Statutes §206E-31.5). As such, future use of the property will remain restricted to non-residential purposes and should be taken into consideration when identifying potential receptors. The exposure pathways identified for future users of the commercial site include inhalation of particulates from surface soil, dermal contact with soil, and incidental ingestion of soil.

Site Construction Worker

Current plans 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 particulates from surface soil, dermal contact with soil, and incidental ingestion of soil.

Aquatic Ecological Receptors

Due to the proximity of the site to the Kewalo Basin, 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).

Other Off-Site Receptors

One of the primary concerns associated with potential contaminated soil at the site is management of any soil that may be excavated for foundation construction, underground utility installment/maintenance, and/or other activities that may create excess soil. If not managed properly, such soil may be inadvertently used at sites where restrictions on residential use are not applicable. Exposure pathways similar to those identified for future site users would exist in these cases; however such exposures may be amplified due to the frequency and/or length of assumed exposure to the soil.

3.9.2 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.

Soil Exposure Pathway

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

Air Exposure Pathway

Air exposure pathways become potential routes of exposure when COPC enter the air via volatilization or via adsorption to fugitive dust particles. Volatilization occurs when COPC 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 anticipated to be a concern due to the semi- to non-volatile nature of the suspect COPC.

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.

Sediment Exposure Pathway

Receptors may be exposed to COPC 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 COPC through feeding within the sediment. As a secondary transport mechanism, COPC may accumulate in ecological receptors (i.e., fish, shellfish), then be ingested by human receptors.

Groundwater Exposure Pathway

Groundwater beneath the site may have been impacted through leaching from impacted soils. Receptors may be exposed to COPC in the groundwater by direct contact or by inhaling volatile COPC emitted from the groundwater to air. 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.

For this site, groundwater impacts are not anticipated to be significant based on data obtained from investigations at surrounding properties and due to the nature of the suspect contaminants (i.e., fill material used to create the existing land area, no suspected releases based on historic land use). Such material has existed at the site for an extensive period of time and it is suspected that chemical equilibrium has generally been achieved.

3.10 Project Action Levels

The action levels used for data comparison and evaluation are the DOH Environmental Action Levels (EALs) for sites where a current or potential drinking water source is not threatened and the nearest surface water body is less than 150 meters from the site. The default (lowest) EALs for unrestricted land use were initially utilized to identify potential environmental hazards associated with existing site soils. In instances where EALs do not exist for a particular chemical, US EPA Regional Screening Levels (RSLs) for direct exposure hazards were used for comparison.

4.0 SUMMARY OF INVESTIGATION HISTORY

No environmental investigations have been performed at the Property, with the exception of a May 24, 2007 *Phase I Environmental Site Assessment* (Phase I ESA) prepared by ENPRO Environmental for Ocean Investments, LLC. The Phase I ESA identified two recognized environmental conditions, both of which stem from historical filling with debris and ash from the former municipal waste incinerators. There were no other indications of recognized environmental conditions identified by ENPRO.

Environmental investigations were performed at adjacent properties identified as Kakaako Brownfields Project Units 2 (TMK 2-1-60: Parcel 2), 4 (TMK 2-1-60: Parcel 1) and 8 (TMK 2-1-58: Parcels 41, 82 to 86, and 91). Existing data for these properties, as well as other properties in the immediate vicinity of the 43 Ahui Street property, were summarized and evaluated in the June 2009 *Environmental Hazard Evaluation, Kakaako Makai District, Honolulu, Oahu, Hawaii* prepared by The Limtiaco Consulting Group and ETC. The COPC selected for this investigation were based on contaminants of concern associated with the retained environmental hazards described in the report.

5.0 SUMMARY OF DATA QUALITY OBJECTIVES

This investigation was driven by a request from the DOH HEER Office in a July 30, 2010 letter to Ocean Investments, LLC pertaining to its Special Management Area (SMA) use approval application. The DOH HEER Office identified concerns with potential impacted soils within the property based on area-wide data. In particular, the DOH HEER Office suspected that contaminants similar to those found on other properties in the Kakaako Makai District associated with incinerator ash landfilling practices would also be located on the 43 Ahui Street property. Since there is no existing environmental data for the site, the DOH HEER Office requested that an investigation and assessment of the site be performed.

The data quality objectives (DQO) process is typically described in a work plan prepared prior to site sampling activities to define the criteria for environmental data collection operations. The DQOs are 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. For this project, the DQOs were generally discussed with the DOH HEER Office prior to commencement of site activities. The following is a brief description of the DQOs used for this investigation.

5.1 Problem Statement

Previous environmental investigations in the vicinity of the site indicated the presence of certain contaminants in soils and groundwater that were likely due to historic filling of the majority of the Kakaako Makai District using incinerator ash and other landfill debris. Since there is no data specific to the project site, an environmental investigation was requested by the DOH HEER Office to determine whether impacts to the site soils exist. Therefore, the primary goal for this investigation was to obtain representative data for the project site to determine whether impacts associated with incinerator ash/landfill debris exist and the magnitude of the impact. As such, for the purposes of the investigation activities described herein, the problem statement was formulated:

"In order to determine whether environmental hazards exist at the 43 Ahui Street property, representative data for suspect contaminants are needed to identify appropriate actions necessary to handle and manage site media."

5.2 Decision Making

A decision statement was 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 statement for this project was identified as follows:

"Determine whether mean COPC concentrations in near surface and subsurface soil within the property exceed project Action Levels (ALs) and may require specific handling and management requirements to mitigate exposure pathways; if no then no significant environmental hazards exist at the property."

5.3 Decision Inputs

The inputs to the decision were identified as new data obtained through 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 accessible areas within the Property. The investigation was not considered to be constrained by temporal boundaries since the COPC 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* mean COPC concentrations in surface and/or subsurface soil 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 at the Property are below the ALs, *then* no additional activities will need to be performed and the exposure pathways 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

In order to minimize the occurrence of decision errors, a statistics-based sampling design was selected to generate data that provides an effective representation of existing mean COPC concentrations within the Property. The objective of the sampling design is to provide sufficient data to resolve the Decision Statement described in Section 5.2.

A multi-increment sampling approach for collection and analysis of soil samples was selected. Multi-increment sampling is a method employed to obtain representative samples that exhibit mean concentrations of the material being sampled and that account for the variability of concentrations within that particular material. Such a method was developed to provide accurate (closeness of the sample value to its actual value) and precise (closeness of repeated sample values, or repeatability) data. If data is considered sufficiently accurate and precise, then the data can be considered reliable estimates of the true concentrations.

Sampling accuracy is usually achieved by some type of random sampling. In random sampling, every unit in the population has a theoretically equal chance of being sampled and measured. Consequently, statistics generated by the sample (i.e., mean and standard deviation of the mean) are unbiased (accurate) estimators of true population parameters – in other words, the sample is representative of the population.

Sampling precision is commonly achieved by taking an appropriate amount of samples from the population. By looking at the equation for the standard deviation of the mean of a sample (standard error of the mean), precision increases (variability decreases) as the number of samples increase, although it is not a one-to-one relationship. Another method to increase the sampling precision is to increase the physical size (weight or volume) of the samples that are collected and analyzed. This technique has the effect of minimizing between-sample variation and decreasing the standard deviation of the mean of the sample. Increasing the number of samples collected and/or the size of the samples from a population not only increases sampling precision, it also has the secondary effect of increasing sampling accuracy.

The multi-increment sampling technique takes into account the need for sufficiently accurate and precise sample data. The technique includes requirements for: 1) collection of random samples; 2) collection of a larger number of samples; and 3) collection of a physically larger sample volume than standard discrete sampling techniques.

The multi-increment sampling approach will provide mean COPC concentrations for the specific decision unit that the sample is meant to represent. Therefore, defining the appropriate decision units is essential for meeting the project DQOs.

For the 43 Ahui Street Property, there are no known sources of contamination other than the original material used to create the land area (incinerator ash, landfill debris, and fill material). Therefore, three decision units were established encompassing the accessible areas of the property (i.e., areas where there are no structures or underground utility lines). The first decision unit represents the top 2 feet of soil within the property (0 to 2-foot depth layer). The second decision unit represents the next 3 feet of soil within the property (3- to 5-foot depth layer). The third decision unit represents the next 3 feet of soil within the property (5- to 8-foot depth layer). The objective in selecting these decision unit layers was to obtain mean COPC concentrations at varying depths for the entire site.

6.0 INVESTIGATION 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

As previously described in Section 5.7, three decision units were identified for the project site. The areal extent of each decision unit was comprised of all accessible of the Property (i.e., areas where there are no structures or underground utility lines). The decision units were differentiated by the depth layer from which soil increments were collected. Specifically, the decision units were established to represent the 0- to 2-foot bgs depth layer, the 2- to 5-foot bgs depth layer, and the 5- to 8-foot bgs depth layer.

6.2 Soil Sampling Activities

Prior to commencing soil sample collection, ETC personnel mobilized to the site to identify thirty boring locations that would comprise the multi-increment samples. The boring locations were situated in a systematic random manner to ensure that samples would be collected from the various accessible areas of the Property. Marking paint was then used to provide a physical indicator of each boring location. Once the boring locations were identified, GeoTek Hawaii, Inc. (GTH) personnel used electromagnetic instrumentation to scan for underground utility lines in the vicinity of each proposed borehole. In addition, ETC contacted the Hawaii One Call Center to have the various utility agencies identify underground lines in the vicinity of each borehole. Boring locations were then adjusted based on findings by both GTH and the various utility agencies.

On September 13 and 14, 2010, ETC personnel mobilized to the site with GTH to conduct boring advancement and soil sample collection. GTH utilized a Geoprobe direct push rig equipped with stainless steel core samplers to advance the soil borings. At each of the thirty boring locations, the core samplers were driven into the ground and soil increments from each depth layer (0- to 2-feet, 2- to 5-feet, and 5- to 8-feet) were extracted from the soil cores in a manner that provided a representative aliquot of the soil from the targeted interval. Each increment from the 0- to 2-foot depth layer consisted of six approximate 5-gram "plugs" of soil, with one plug collected for every 4 inches of soil to represent the entire depth layer. Each increment from the 2- to 5-foot depth layer and from the 5- to 8-foot depth layer consisted of a "wedge" of soil removed from the core length-wise in order to represent the soil from the entire depth layer.

All soil increments were placed into new, resealable polyethylene bags dedicated to each multi-increment sample. For example, plugs collected from the 0- to 2-foot depth layer in each boring were placed into one bag designated for the 0- to 2-foot depth layer multi-increment sample.

Prior to handling any soil, ETC personnel donned a new pair of disposable gloves (latex/vinyl/nitrile). Gloves were interchanged prior to collection of each multi-increment sample.

All sample containers were labeled with the project name, sample identification number, date/time of sample collection, and sampler's initials. The samples were kept in a sample cooler with ice pending delivery to the contracted laboratory.

6.3 Decontamination and Investigation-Derived Waste

Re-useable sampling tools, such as stainless steel corers, were decontaminated by washing with a brush and potable water - Alconox™ solution, rinsing with potable water, then rinsing with distilled water. Decontamination fluids were left to evaporate on-site over relatively impermeable surfaces.

Any disposable sample collection equipment (i.e., used PPE, acetate sleeves used in stainless steel corers) were containerized at the end of each work day and disposed as solid waste.

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

6.4 Summary of Environmental Samples

A total of five multi-increment soil samples were collected from the site. Each sample was comprised of soil from 30 different boreholes spread across the accessible areas of the Property. Of the five samples, three were primary samples representing the 0- to 2-foot bgs depth layer, the 2- to 5-foot bgs depth layer, and the 5- to 8-foot bgs depth layer. The two remaining samples were field replicate samples for quality control purposes. The field replicate samples were collected from the 0- to 2-foot bgs depth layer and were obtained collected in the same manner as the primary sample – each consisted of soil increments from each of the 30 boreholes. The samples are described below:

- Sample 2017.SS1 – primary sample from 0- to 2-foot bgs depth layer
- Sample 2017.SS2 and 2017.SS3 – field replicate samples from 0- to 2-foot bgs depth layer
- Sample 2017.SS4 – primary sample from 2- to 5-foot bgs depth layer
- Sample 2017.SS5 – primary sample from 5- to 8-foot bgs depth layer

7.0 SAMPLE CONTROL PROCEDURES

This section provides information regarding specific control procedures utilized during site activities to maintain control over sample management.

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.

2017.SSX where:

2017 = ETC project number
X = depth layer (1 to 3 for 0- to 2-foot layer, 4 for 2- to 5-foot layer, 5 for 5- to 8-foot layer)

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 was maintained to track possession of the samples. All samples collected during the investigation were recorded on chain of custody forms. Information 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 (TA-H) 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 TA-H 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 1 below summarizes these requirements.

Table 1: Sample Handling and Preservation

Analyte	Analytical Method	Sample Container Size, Type	Preservation	Holding Time
TPH-D, TPH-O	EPA 8015 mod	1-gallon resealable polyethylene bag	Cool, 4° C	14 days
PAHs	EPA 8270C	1-gallon resealable polyethylene bag	Cool, 4° C	14 days
Metals	EPA 6010B/7471	1-gallon resealable polyethylene bag	none	6 months
Organochlorine pesticides	EPA 8081	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.

7.4 Laboratory Analytical Methods

ETC delivered a total of three primary multi-increment samples and two field replicate multi-increment samples to TA-H in Aiea, Hawaii with completed chain of custody documentation. TA-H performed multi-increment subsampling in accordance with the US 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 TPH-D and TPH-O via EPA Method 8015 modified, PAHs via EPA Method 8270C, RCRA8 metals (plus copper and zinc) via EPA Method 6010B/7471, and organochlorine pesticides via EPA Method 8081.

8.0 FIELD OBSERVATIONS

Physical observations made during advancement of the thirty borings were documented in boring logs that have been attached as Appendix II. In general, suspect incinerator ash and landfill debris was observed at depths ranging from as shallow as 6 inches bgs to as deep as 8 feet bgs (end of each boring). Material observed included black/gray ash (glass-like structure, suspect bottom ash) and brick-like materials. Various types of fill material were also observed at intervals, including clays, corals, sands, gravel, and basalt rock. No definitive observations of a groundwater table were observed. Moisture in the soil cores retrieved from the borings varied in depth throughout the site.

9.0 DATA QUALITY

Data obtained from an investigation should be of sufficient quality to ensure that site investigation 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. 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.

9.2 Field Quality Control

The data obtained through collection of multi-increment field replicate samples were used for field quality control purposes. 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.

For this project, only one set of triplicate samples were collected. These samples were collected from the 0- to 2-foot bgs depth layer and labeled 2017.SS1 through 2017.SS3. Table 2 below presents the reported concentrations, means, standard deviations, and relative standard deviations for the triplicate samples.

9.3 Data Quality Assessment

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, the standard deviations were calculated from the triplicate samples collected during the investigation for each COPC (see Table 2 below). The 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 2, RSDs were relatively low (below 35%) for the majority of the COPC. The exceptions were for the organochlorine pesticides 4,4'-DDD (52%), heptachlor (50%), and methoxychlor (87%). These elevated RSDs indicate that there may be some uncertainty with the data, however such uncertainty would not affect the overall decision-making process for these particular COPC since the concentrations detected were well below the lowest EALs.

The calculated standard deviations shown in Table 2 were added to the reported concentrations for each COPC and presented as "adjusted" concentrations. The adjusted concentrations were then used to make decisions regarding whether COPC concentrations present a specific environmental hazard for the decision unit. The data tables showing the adjusted concentrations are presented and discussed in Section 10.

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.

Table 2: Field Replicate Calculations

Analyte	Sample ID			Mean	SD	RSD
	2017.SS1	2017.SS2	2017.SS3			
TPH-D	87.1	89.0	121	99.0333	19.0474	19%
TPH-O	810	753	844	802.3333	45.9819	6%
Acenaphthene	0.0279	0.0186	0.0359	0.0275	0.0087	32%
Acenaphthylene	0.101	0.0756	0.107	0.0945	0.0167	18%
Anthracene	0.0777	0.0514	0.102	0.0770	0.0253	33%
Benzo(a)anthracene	0.571	0.392	0.628	0.5303	0.1231	23%
Benzo(a)pyrene	1.01	0.682	1.04	0.9107	0.1986	22%
Benzo(b)fluoranthene	1.16	0.714	1.12	0.9980	0.2468	25%
Benzo(g,h,i)perylene	1.24	0.752	0.861	0.9510	0.2561	27%
Benzo(k)fluoranthene	0.321	0.203	0.330	0.2847	0.0709	25%
Chrysene	0.784	0.527	0.783	0.6980	0.1481	21%
Dibenzo(a,h)anthracene	0.133	0.0894	0.134	0.1188	0.0255	21%
Fluoranthene	1.54	1.00	1.57	1.3700	0.3208	23%
Fluorene	0.0409	0.0260	0.0447	0.0372	0.0099	27%
Indeno(1,2,3-cd)pyrene	0.844	0.527	0.641	0.6707	0.1606	24%
1-Methylnaphthalene	0.0156	0.00932	0.0107	0.0119	0.0033	28%
2-Methylnaphthalene	0.0213	0.0129	0.0172	0.0171	0.0042	25%
Naphthalene	0.0422	0.0222	0.0356	0.0333	0.0102	31%
Phenanthrene	0.585	0.328	0.595	0.5027	0.1513	30%
Pyrene	2.02	1.35	1.95	1.7733	0.3683	21%

Table 2: Field Replicate Calculations, Cont'd

Analyte	Sample ID			Mean	SD	RSD
	2017.SS1	2017.SS2	2017.SS3			
Arsenic	4.61	5.59	5.21	5.1367	0.4941	10%
Barium	203	246	207	218.6667	23.7557	11%
Cadmium	0.0803	0.0754	0.0784	0.0780	0.0025	3%
Chromium	52.6	60.2	58	56.9333	3.9107	7%
Copper	96.4	176	112	128.1333	42.1812	33%
Lead	150	245	201	198.6667	47.5430	24%
Mercury	0.109	0.117	0.116	0.1140	0.0044	4%
Selenium	1.89	1.71	2	1.8667	0.1464	8%
Silver	2.01	2.39	2.33	2.2433	0.2043	9%
Zinc	215	266	222	234.3333	27.6466	12%
4,4'-DDD	0.00239	0.00689	0.00815	0.0058	0.0030	52%
4,4'-DDE	0.0161	0.0222	0.0292	0.0225	0.0066	29%
4,4'-DDT	0.0325	0.0452	0.0518	0.0432	0.0098	23%
Aldrin	0.0015	0.00149	0.00149	0.0015	0.0000	0%
alpha-BHC	0.00179	0.00179	0.00179	0.0018	0.0000	0%
beta-BHC	0.00169	0.00169	0.00169	0.0017	0.0000	0%
delta-BHC	0.00375	0.00642	0.00649	0.0056	0.0016	28%
Dieldrin	0.0217	0.0228	0.0283	0.0243	0.0035	15%
Endosulfan I	0.0015	0.00149	0.00149	0.0015	0.0000	0%
Endosulfan II	0.000797	0.000795	0.000795	0.0008	0.0000	0%
Endosulfan sulfate	0.000997	0.000993	0.000993	0.0010	0.0000	0%
Endrin	0.000997	0.000993	0.000993	0.0010	0.0000	0%
Endrin aldehyde	0.00429	0.00493	0.00606	0.0051	0.0009	18%
Endrin ketone	0.00169	0.00169	0.00169	0.0017	0.0000	0%
gamma-BHC (Lindane)	0.0012	0.00119	0.00119	0.0012	0.0000	0%
Heptachlor	0.0014	0.00242	0.00401	0.0026	0.0013	50%
Heptachlor epoxide	0.014	0.0141	0.018	0.0154	0.0023	15%
Methoxychlor	0.0223	0.00139	0.0352	0.0196	0.0171	87%
Technical chlordane	0.685	0.754	0.808	0.7490	0.0617	8%
Toxaphene	0.0498	0.0497	0.0497	0.0497	0.0001	0%

10.0 ANALYTICAL RESULTS AND DISCUSSION

Sampling activities were performed to assess whether the near surface and subsurface soil at the 43 Ahui Street property contained elevated concentrations of contaminants identified in neighboring sites and generally suspected to be associated with the use of incinerator ash and landfill debris used to create the land area. A total of three primary multi-increment samples from three separate depth intervals and two field replicate multi-increment samples were collected from thirty borings situated throughout the accessible areas of the Property. Analytical data provided by TA-H have been summarized in Tables 3 to 5 below. Laboratory reports are included in Appendix III.

Table 3: Analytical Data – TPH and PAHs

Analyte	**Sample ID**					**Default DOH EAL**
	2017.SS1	**2017.SS2**	**2017.SS3**	**2017.SS4**	**2017.SS5**	
TPH-D	87.1	89.0	121	212	207	500
TPH-O	**810**	**753**	**844**	**965**	**1030**	500
Acenaphthene	0.0279	0.0186	0.0359	0.306	0.240	23
Acenaphthylene	0.101	0.0756	0.107	0.485	0.315	13
Anthracene	0.0777	0.0514	0.102	0.588	0.485	2.5
Benzo(a)anthracene	0.571	0.392	0.628	**2.71**	**2.16**	1.5
Benzo(a)pyrene	**1.01**	**0.682**	**1.04**	**4.58**	**3.34**	0.15
Benzo(b)fluoranthene	1.16	0.714	1.12	**4.67**	**3.34**	1.5
Benzo(g,h,i)perylene	1.24	0.752	0.861	6.37	4.39	27
Benzo(k)fluoranthene	0.321	0.203	0.330	1.73	4.26	15
Chrysene	0.784	0.527	0.783	3.53	2.92	14
Dibenzo(a,h)anthracene	0.133	0.0894	0.134	**0.588**	**0.402**	0.15
Fluoranthene	1.54	1.00	1.57	7.88	7.21	40
Fluorene	0.0409	0.0260	0.0447	0.293	0.209	7.3
Indeno(1,2,3-cd)pyrene	0.844	0.527	0.641	**4.18**	**2.95**	1.5
1-Methylnaphthalene	0.0156	0.00932	0.0107	0.127	0.0518	1.1
2-Methylnaphthalene	0.0213	0.0129	0.0172	0.175	0.0734	1
Naphthalene	0.0422	0.0222	0.0356	0.287	0.118	0.46
Phenanthrene	0.585	0.328	0.595	3.86	3.38	11
Pyrene	2.02	1.35	1.95	10.3	8.30	56

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
Boldfaced, shaded value exceeds default DOH EAL
Samples 2017.SS1 through 2017.SS3 collected from 0- to 2-feet bgs
Sample 2017.SS4 collected from 2- to 5-feet bgs
Sample 2017.SS5 collected from 5- to 8-feet bgs

Table 4: Analytical Data – Metals

Analyte	Sample ID					Default DOH EAL
	2017.SS1	2017.SS2	2017.SS3	2017.SS4	2017.SS5	
Arsenic	4.61	5.59	5.21	10.6	13.1	20
Barium	203	246	207	460	417	750
Cadmium	*nd<0.0803*	*nd<0.0754*	*nd<0.0784*	1.3	4.87	12
Chromium	52.6	60.2	58.0	72.1	70.4	500
Copper	96.4	176	112	**411**	**716**	230
Lead	150	**245**	**201**	**989**	**1730**	200
Mercury	0.109	0.117	0.116	0.453	0.476	4.7
Selenium	1.89	1.71	2.00	1.98	1.72	10
Silver	2.01	2.39	2.33	4.37	4.74	20
Zinc	215	266	222	**1120**	**1240**	600

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
Boldfaced, shaded value exceeds default DOH EAL

Table 5: Analytical Data – Organochlorine Pesticides

Analyte	Sample ID					Default DOH EAL
	2017.SS1	2017.SS2	2017.SS3	2017.SS4	2017.SS5	
4,4'-DDD	0.00239	0.00689	0.00815	0.00705	0.454	2
4,4'-DDE	0.0161	0.0222	0.0292	0.0231	**2.71**	1.4
4,4'-DDT	0.0325	0.0452	0.0518	*nd<0.000689*	**4.09**	1.7
Aldrin	*nd<0.0015*	*nd<0.00149*	*nd<0.00149*	*nd<0.00148*	***nd<0.0364***	0.029
alpha-BHC	*nd<0.00179*	*nd<0.00179*	*nd<0.00179*	nd<0.00203	*nd<0.0437*	0.077*
beta-BHC	*nd<0.00169*	*nd<0.00169*	*nd<0.00169*	*nd<0.00167*	*nd<0.0413*	0.27*
delta-BHC	0.00375	0.00642	0.00649	0.00492	*nd<0.00155*	-
Dieldrin	**0.0217**	**0.0228**	**0.0283**	**0.029**	***nd<0.034***	0.0033
Endosulfan I	*nd<0.0015*	*nd<0.00149*	*nd<0.00149*	*nd<0.00148*	*nd<0.0364*	0.032
Endosulfan II	*nd<0.000797*	*nd<0.000795*	*nd<0.000795*	0.00252	*nd<0.0194*	0.032
Endosulfan sulfate	*nd<0.000997*	*nd<0.000993*	*nd<0.000993*	0.0111	*nd<0.0243*	0.032
Endrin	*nd<0.000997*	*nd<0.000993*	*nd<0.000993*	*nd<0.000984*	***nd<0.0243***	0.004
Endrin aldehyde	**0.00429**	**0.00493**	**0.00606**	**0.00921**	***nd<0.017***	0.004
Endrin ketone	*nd<0.00169*	*nd<0.00169*	*nd<0.00169*	**0.00666**	***nd<0.0413***	0.004
gamma-BHC (Lindane)	*nd<0.0012*	*nd<0.00119*	*nd<0.00119*	*nd<0.00118*	*nd<0.0291*	0.045
Heptachlor	*nd<0.0014*	0.00242	0.00401	*nd<0.00138*	*nd<0.034*	0.11
Heptachlor epoxide	**0.014**	**0.0141**	**0.018**	**0.012**	***nd<0.0267***	0.0031
Methoxychlor	0.0223	*nd<0.00139*	0.0352	0.0722	*nd<0.034*	26
Technical chlordane	0.685	0.754	0.808	0.611	0.972	16
Toxaphene	*nd<0.0498*	*nd<0.0497*	*nd<0.0497*	*nd<0.0492*	***nd<1.21***	0.44

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
* = No DOH EAL, EPA Regional Screening Level used for comparison
Boldfaced, shaded value exceeds default DOH EAL

As discussed in Section 9.3 above, the field replicate samples 2017.SS1 through 2017.SS3 collected from the 0- to 2-foot depth layer were used to calculate standard deviations and relative standard deviations for each COPC. The standard deviations were then applied to all reported laboratory results. For the 0- to 2-foot depth layer, the mean of the field replicate samples was used to assess COPC concentrations in that layer. The resultant adjusted concentrations (i.e., reported concentration plus the standard deviation) are presented in Tables 6 to 8 below.

Table 6: Adjusted Data – TPH and PAHs

Analyte	Sample ID						Default DOH EALs
	Mean SS1,SS2,SS3	Adjusted	2017.SS4	Adjusted	2017.SS5	Adjusted	
TPH-D	99.03	118.08	212	231.05	207	226.05	500
TPH-O	**802.33**	**848.32**	**965**	**1010.98**	**1030**	**1075.98**	500
Acenaphthene	0.0275	0.0361	0.306	0.3147	0.240	0.2487	23
Acenaphthylene	0.0945	0.1112	0.485	0.5017	0.315	0.3317	13
Anthracene	0.0770	0.1023	0.588	0.6133	0.485	0.5103	2.5
Benzo(a)anthracene	0.5303	0.6535	**2.71**	**2.8331**	**2.16**	**2.2831**	1.5
Benzo(a)pyrene	**0.9107**	**1.1093**	**4.58**	**4.7786**	**3.34**	**3.5386**	0.15
Benzo(b)fluoranthene	0.9980	1.2448	**4.67**	**4.9168**	**3.34**	**3.5868**	1.5
Benzo(g,h,i)perylene	0.9510	1.2071	6.37	6.6261	4.39	4.6461	27
Benzo(k)fluoranthene	0.2847	0.3555	1.73	1.8009	4.26	4.3309	15
Chrysene	0.6980	0.8461	3.53	3.6781	2.92	3.0681	14
Dibenzo(a,h)anthracene	0.1188	0.1443	**0.588**	**0.6135**	**0.402**	**0.4275**	0.15
Fluoranthene	1.3700	1.6908	7.88	8.2008	7.21	7.5308	40
Fluorene	0.0372	0.0471	0.293	0.3029	0.209	0.2189	7.3
Indeno(1,2,3-cd)pyrene	0.6707	0.8312	**4.18**	**4.3406**	**2.95**	**3.1106**	1.5
1-Methylnaphthalene	0.0119	0.0152	0.127	0.1303	0.0518	0.0551	1.1
2-Methylnaphthalene	0.0171	0.0213	0.175	0.1792	0.0734	0.0776	1
Naphthalene	0.0333	0.0435	0.287	0.2972	0.118	0.1282	0.46
Phenanthrene	0.5027	0.6540	3.86	4.0113	3.38	3.5313	11
Pyrene	1.7733	2.1416	10.3	10.6683	8.30	8.6683	56

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
Boldfaced, shaded value exceeds default DOH EAL

Table 7: Adjusted Data – Metals

Analyte	Sample ID						Default DOH EALs
	Mean SS1,SS2,SS3	Adjusted	2017.SS4	Adjusted	2017.SS5	Adjusted	
Arsenic	5.14	5.63	10.6	11.09	13.1	13.59	20
Barium	218.67	242.42	460	483.76	417	440.76	750
Cadmium	0.08	0.08	1.3	1.30	4.87	4.87	12
Chromium	56.93	60.84	72.1	76.01	70.4	74.31	500
Copper	128.13	170.31	**411**	**453.18**	**716**	**758.18**	230
Lead	198.67	**246.21**	**989**	**1036.54**	**1730**	**1777.54**	200
Mercury	0.11	0.12	0.453	0.46	0.476	0.48	4.7
Selenium	1.87	2.01	1.98	2.13	1.72	1.87	10
Silver	2.24	2.45	4.37	4.57	4.74	4.94	20
Zinc	234.33	261.98	**1120**	**1147.65**	**1240**	**1267.65**	600

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
Boldfaced, shaded value exceeds default DOH EAL

Table 8: Adjusted Data – Organochlorine Pesticides

Analyte	Sample ID						Default DOH EALs
	Mean SS1,SS2,SS3	Adjusted	2017.SS4	Adjusted	2017.SS5	Adjusted	
4,4'-DDD	0.0058	0.0088	0.00705	0.0101	0.454	0.4570	2
4,4'-DDE	0.0225	0.0291	0.0231	0.0297	**2.71**	**2.7166**	1.4
4,4'-DDT	0.0432	0.0530	*nd<0.000689*	0.0105	**4.09**	**4.0998**	1.7
Aldrin	0.0015	0.0015	*nd<0.00148*	0.0015	***nd<0.0364***	**0.0364**	0.029
alpha-BHC	0.0018	0.0018	0.00203	0.0020	*nd<0.0437*	0.0437	0.077*
beta-BHC	0.0017	0.0017	*nd<0.00167*	0.0017	*nd<0.0413*	0.0413	0.27*
delta-BHC	0.0056	0.0071	0.00492	0.0065	*nd<0.00155*	0.0031	-
Dieldrin	**0.0243**	**0.0278**	**0.029**	**0.0325**	***nd<0.034***	**0.0375**	0.0033
Endosulfan I	0.0015	0.0015	*nd<0.00148*	0.0015	***nd<0.0364***	**0.0364**	0.032
Endosulfan II	0.0008	0.0008	0.00252	0.0025	*nd<0.0194*	0.0194	0.032
Endosulfan sulfate	0.0010	0.0010	0.0111	0.0111	*nd<0.0243*	0.0243	0.032
Endrin	0.0010	0.0010	*nd<0.000984*	0.0010	***nd<0.0243***	**0.0243**	0.004
Endrin aldehyde	**0.0051**	**0.0060**	**0.00921**	**0.0101**	***nd<0.017***	**0.0179**	0.004
Endrin ketone	0.0017	0.0017	**0.00666**	**0.0067**	***nd<0.0413***	**0.0413**	0.004
gamma-BHC (Lindane)	0.0012	0.0012	*nd<0.00118*	0.0012	*nd<0.0291*	0.0291	0.045
Heptachlor	0.0026	0.0039	*nd<0.00138*	0.0027	*nd<0.034*	0.0353	0.11
Heptachlor epoxide	**0.0154**	**0.0176**	**0.012**	**0.0143**	***nd<0.0267***	**0.0290**	0.0031
Methoxychlor	0.0196	0.0367	0.0722	0.0893	*nd<0.034*	0.0511	26
Technical chlordane	0.7490	0.8107	0.611	0.6727	0.972	1.0337	16
Toxaphene	0.0497	0.0498	*nd<0.0492*	0.0493	***nd<1.21***	**1.2101**	0.44

Notes: Default DOH EAL = lowest DOH EAL assuming unrestricted land use for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
* = No DOH EAL, EPA Regional Screening Level used for comparison
Boldfaced, shaded value exceeds 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 any proposed response activities to be undertaken and evaluated. 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 Magnitude and Extent of Contamination

The COPC concentrations in the soil samples collected during the site investigation were considered to be representative of the concentrations throughout the entire property at the depth layers sampled. Therefore, COPC concentrations that exceed default DOH EALs were considered to be consistent throughout the lateral extent of the property. The findings of the site investigation shown in Tables 6 through 8 above include the following:

- Adjusted concentrations of TPH-O, benzo(a)pyrene, lead, dieldrin, endrin aldehyde, and heptachlor epoxide in the 0- to 2-foot soil depth layer exceed default DOH EALs.
- Adjusted concentrations of TPH-O, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, copper, lead, zinc, dieldrin, endrin aldehyde, endrin ketone, and heptachlor epoxide in the 2- to 5-foot soil depth layer exceed default DOH EALs.
- Adjusted concentrations of TPH-O, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, copper, lead, zinc, DDE, DDT, aldrin, dieldrin, endosulfan I, endrin, endrin aldehyde, endrin ketone, heptachlor epoxide, and toxaphene in the 2- to 5-foot soil depth layer exceed default DOH EALs.

11.2 Comparison to DOH EALs

The COPC listed in Section 11.1 were associated with concentrations detected in the multi-increment soil samples that exceed the default DOH EALs. These default EALs are the lowest EALs assuming unrestricted land use, groundwater beneath the site is not a current or potential drinking water source, and the nearest surface water body is less than 150 meters from the site. A comparison of COPC concentrations that exceed default DOH EALs to all existing DOH EALs are presented in Table 9.

Table 9: Comparison of Adjusted Concentrations to DOH EALs

Analyte	Sample ID			EALs - Unrestricted					EALs - Commercial/Industrial				
	Adjusted SS1,SS2,SS3	Adjusted SS4	Adjusted SS5	DE	VI	TE	GC	LE	DE	VI	TE	GC	LE
TPH-O	**848.32**	**1010.98**	**1075.98**	2300	-	-	**500**	**1000**	31000	-	-	2500	**1000**
Benzo(a)anthracene	0.6535	**2.8331**	**2.2831**	**1.5**	-	40	500	13	21	-	40	1000	13
Benzo(a)pyrene	**1.1093**	**4.7786**	**3.5386**	**0.15**	-	40	500	7.6	**2.1**	-	40	1000	7.6
Benzo(b)fluoranthene	1.2448	**4.9168**	**3.5868**	**1.5**	-	-	500	12	21	-	-	1000	12
Dibenzo(a,h)anthracene	0.1443	**0.6135**	**0.4275**	**0.15**	-	-	500	220	2.1	-	-	1000	220
Indeno(1,2,3-cd)pyrene	0.8312	**4.3406**	**3.1106**	**1.5**	-	40	500	41	21	-	40	1000	41
Copper	170.31	**453.18**	**758.18**	**630**	-	**230**	1000	-	8200	-	**230**	2500	-
Lead	**246.21**	**1036.54**	**1777.54**	**400**	-	**200**	1000	-	**800**	-	-	2500	-
Zinc	261.98	**1147.65**	**1267.65**	4700	-	**600**	1000	-	61000	-	**600**	2500	-
4,4'-DDE	0.0291	0.0297	**2.7166**	**1.4**	-	4	500	37	5.1	-	4	1000	37
4,4'-DDT	0.0530	0.0105	**4.0998**	**1.7**	-	4	1000	7.3	7	-	4	2500	7.3
Aldrin	0.0015	0.0015	**0.0364**	**0.029**	-	0.35	1000	11	0.1	-	0.35	2500	11
Dieldrin	**0.0278**	**0.0325**	**0.0375**	**0.03**	-	4	1000	**0.0033**	0.11	-	4	2500	**0.0033**
Endosulfan I	0.0015	0.0015	**0.0364**	73	-	-	500	**0.032**	740	-	-	1000	**0.032**
Endrin	0.0010	0.0010	**0.0243**	3.7	-	0.06	500	**0.004**	37	-	0.06	1000	**0.004**
Endrin aldehyde	**0.0060**	**0.0101**	**0.0179**	3.7	-	0.06	500	**0.004**	37	-	0.06	1000	**0.004**
Endrin ketone	0.0017	**0.0067**	**0.0413**	3.7	-	0.06	500	**0.004**	37	-	0.06	1000	**0.004**
Heptachlor epoxide	**0.0176**	**0.0143**	**0.0290**	0.053	-	-	1000	**0.0031**	0.19	-	-	2500	**0.0031**
Toxaphene	0.0498	0.0493	**1.2101**	**0.44**	-	-	500	330	1.6	-	-	1000	330

Notes: EALs = DOH EALs for areas where a current or potential drinking water source is not threatened and where the nearest surface water body is less than 150 meters from the site.
DE = direct exposure hazard
VI = vapor intrusion hazard
TE = terrestrial ecotoxicity hazard
GC = gross contamination hazard
LE = leaching to groundwater hazard
Boldfaced, yellow-shaded value exceeds DOH EAL
Boldfaced, light blue shaded value = specific EAL exceeded by adjusted concentration
Adjusted SS1,SS2,SS3 = Adjusted mean concentrations for samples 2017.SS1 through 2017.SS3 collected from 0- to 2-feet bgs
Adjusted SS4 = Adjusted concentration for sample 2017.SS4 collected from 2- to 5-feet bgs
Adjusted SS5 = Adjusted concentration for sample 2017.SS5 collected from 5- to 8-feet bgs

Considering that the planned future use of the site is for commercial waterfront use and that in 2006, the State of Hawaii mandated by law that the Kakaako Makai District could not be used for residential purposes, the DOH EALs associated with commercial/industrial land use would apply to this site. Therefore, the primary environmental concerns at the site would be for environmental hazards associated with commercial/industrial land use. As such, a summary of COPC concentrations that exceed the commercial/industrial EALs is provided below:

- 0- to 2-feet Depth Layer: TPH-O, benzo(a)pyrene, lead, dieldrin, endrin aldehyde, and heptachlor epoxide.

- 2- to 5-feet Depth Layer: TPH-O, benzo(a)pyrene, copper, lead, zinc, dieldrin, endrin aldehyde, endrin ketone, and heptachlor epoxide.

- 5- to 8-feet Depth Layer: TPH-O, benzo(a)pyrene, copper, lead, zinc, dieldrin, endosulfan I, endrin, endrin aldehyde, endrin ketone, and heptachlor epoxide.

Copper and zinc concentrations in samples collected from the 2- to 5-foot depth layer and 5- to 8-foot depth layer only exceeded the commercial/industrial DOH EAL associated with terrestrial ecotoxicity hazards. Since the site is located in a developed urban area and sensitive terrestrial ecological populations are not present, the elevated concentrations of copper and zinc in site soils would not constitute a significant terrestrial ecotoxicity hazard. However, there may be concerns with runoff of soil from the site entering into the adjacent surface water body (Kewalo Basin). Controls should be established at the site, particularly during construction, to eliminate discharge of any runoff directly into Kewalo Basin.

The DOH EALs associated with the leaching to groundwater hazard were identified as the most common DOH EALs exceeded. TPH-O and organochlorine pesticides (dieldrin, endosulfan I, endrin, endrin aldehyde, endrin ketone, and heptachlor epoxide) concentrations in samples collected from various depth layers exceeded this EAL (values are same regardless of whether projected land use is unrestricted or commercial/industrial). Typically, the leaching to groundwater hazard is significant due to potential impacts associated with groundwater use and/or discharge. For this site, groundwater is not considered a current or potential drinking water source and there is no known mechanism in the adjacent areas that may draw the groundwater up to the surface (e.g., irrigation wells, natural springs, etc.). Therefore, groundwater use is not a significant concern. However, discharge of groundwater to the adjacent Kewalo Basin/Pacific Ocean may occur, either through natural discharge or by mechanical means (e.g., construction dewatering). Such discharge of chemically-impacted groundwater may affect aquatic flora and fauna populations.

Since it is believed that the most significant (and possibly only) contribution to COPC impacts to site soils stem from the historic filling operations performed to create the land areas makai of Ala Moana Boulevard, these COPC have likely existed in site soils for an extensive period of time. Therefore, chemical equilibrium has likely occurred through years of tidal influence and storm water infiltration/subsurface flow. As such, existing COPC concentrations identified in site soils at concentrations exceeding DOH EALs associated with leaching to groundwater hazards are not anticipated to have additional impacts to the aquatic ecosystem.

Finally, benzo(a)pyrene and lead concentrations in samples collected from the 2- to 5-foot depth layer and the 5- to 8-foot depth layer exceeded the commercial/industrial DOH EALs associated with direct human exposure. Under current conditions, the soil impacted with benzo(a)pyrene and lead are not available for direct human contact and do not pose a current environmental hazard. However, planned site development will likely impact soil at depths of 2 feet and beyond. Therefore, the direct exposure hazard associated with benzo(a)pyrene and lead were retained, and measures to mitigate potential environmental impacts from these soils should be implemented.

11.3 Summary of Environmental Hazards

Based on review of the data obtained from the site investigation and comparison of COPC concentrations to applicable DOH EALs, the retained environmental hazard for the site is the direct exposure hazard resulting from elevated benzo(a)pyrene and lead concentrations in soils at depths of 2- to 8-feet bgs associated with commercial/industrial land use.

12.0 CONCLUSIONS

The site investigation described herein was performed to assess the project site for contaminant impacts. The DOH HEER Office suspected that soil within the project site may be impacted by contaminants associated with incinerator ash and other landfill-related debris based on environmental data for other properties in the general vicinity.

The multi-increment samples collected from the site were intended to represent mean concentrations throughout the entire property at three depth layers (0- to 2-feet bgs, 2- to 5-feet bgs, and 5- to 10-feet bgs). As such, the data obtained provides mean concentrations of COPC for use in evaluating potential environmental concerns.

The analytical data indicated that a number of COPC were detected at concentrations exceeding default DOH EALs. These COPC were evaluated further considering the future commercial/industrial land use of the site. Based on the findings of the EHE, benzo(a)pyrene and lead concentrations in soil at depths of 2- to 8-feet bgs exceeding the DOH EALs associated with direct exposure concerns were the only environmental hazards retained for consideration.

In order to address benzo(a)pyrene and lead impacts in the subsurface soil at the site, management practices should be implemented during site development and through future operations. Specifically, such management practices should be accounted for in the site design and described in an Environmental Hazard Management Plan (EHMP) prepared specifically for the project site. Such management practices should be implemented with the goal of minimizing interim and future exposure to contaminated soils through work practices, engineering controls, and/or institutional controls.

Although not considered to be a significant environmental hazard, copper and zinc concentrations in soils at depths of 2- to 8-feet bgs exceeded the DOH EALs associated with terrestrial ecotoxicity hazards. The primary concern regarding copper and zinc is associated with runoff of COPC-impacted sediment into the adjacent Kewalo Basin and/or Pacific Ocean, particularly during site construction, rather than any potential impacts to terrestrial ecological receptors. This concern would be most prevalent during site development activities. Addressing the direct exposure hazards identified in subsurface soil at the site will in turn address potential sediment runoff concerns posed by elevated copper and zinc concentrations. Therefore, no specific controls would be warranted to directly address terrestrial ecotoxicity hazards.

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