# *PESTICIDE SOILS MANAGEMENT PLAN*

# *OHANA MILITARY COMMUNITIES, LLC*
# *PUBLIC-PRIVATE VENTURE HOUSING - HAWAII*

***Prepared for***


**Honolulu, Hawaii**

**February 2008**

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# 1.0 INTRODUCTION

This Pesticide Soils Management Plan (Plan) outlines the actions that must be taken to handle identified pesticides and pesticide residues and to address the use of pesticide-impacted soils at certain Department of the Navy housing communities in Hawaii. The plan also highlights the applicable federal requirements to assist Ohana Military Communities, LLC, the Lessee, in their compliance efforts. The Plan provides guidelines for the safe handling and management of pesticide-impacted soils and provides procedures and practices to minimize exposure to pesticide-impacted soils by construction personnel, maintenance workers, and subcontractors working at and residents living in the Leased Premises and Project.

All activities performed under this Plan shall be performed in accordance with Environmental Laws. "**Environmental Laws**" means any present or future federal, state, or local law, regulation, ordinance, code, plan, order, permit, grant, restriction, certification, or agreement issued, entered, promulgated or approved thereunder, relating to (a) the generation, manufacture, presence, release, discharge, use, storage, handling, transportation or disposal of Environmental Hazard, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C. § 9601, et seq., as amended and Solid Waste Disposal Act, 42 U.S.C. § 6901, et seq., as amended, (b) pollution, (c) environmental protection, (d) human health or occupational safety, (e) endangered or threatened species or (f) the environment.

To the extent this Plan is attached to the Ground Lease, this plan shall be followed by the Manager and Lessee. For the purpose of the Plan, the term "**Manager**"" shall mean the Design-Builder under the Design-Build Agreement, and Construction Manager under the Construction Management Agreement, and Property Manager under the Property Management Agreement and "Lessee" under the Ground Lease. All conflicts between this Plan and the Ground Lease shall be governed by the Ground Lease. The Manager will comply with requirements of this Plan.

Capitalized terms not otherwise defined herein shall have the meanings set forth in the Ground Lease, dated as of even date herewith, by and between the Lessee and the Department of the Navy (the Ground Lease).

This Plan covers the Leased Premises and Project.

## 1.1 BACKGROUND

Surface and subsurface investigations to collect representative data on concentrations of chlorinated pesticides in soil were conducted at the Leased Premises and Project. Concentrations found at each of the housing communities are discussed in Section 2. Details for the currently ongoing Navy Increment I Housing Areas (2004 Project) have previously been reported (PSI, 2004). Details for the Marine Corps Increment II and Navy Increment III Housing Areas (2006 Project) are provided under separate cover in site-specific Phase II Environmental Site Assessments (ESAs) for each neighborhood in which subsurface investigations of pesticides in soil were conducted for the 2006 Project (Parsons, 2006a; 2007a). Details for the Marine Corps Increment IV Housing Areas (2007 Project) are also provided under separate cover in site-specific Phase II ESAs (Parsons, 2007b).

Chlorinated pesticides are synthetic compounds that in the past were legal to apply as insecticides on food crops and as termiticides in and around buildings and homes. Since the mid- to late 1980's, the use and commercial production of certain chlorinated pesticides (e.g., notably chlordane, heptachlor, aldrin, dieldrin, and endrin) have been prohibited in the United

States and many other countries. However, residues from these and other chlorinated pesticides may still be present beneath and around many homes that were treated prior to the mid- to late 1980's.

### 1.1.1 2004 Project

The 2004 Project is providing new construction of Navy Family Housing on Oahu through a Public Private Venture (PPV) between the Department of the Navy and Hawaii Military Communities, LLC (HMC). The 2004 Project is currently ongoing. Prior to demolition and reconstruction, the 2004 Project included surface and subsurface soil investigations for chlorinated pesticides at the 5 housing communities included in the 2004 Project:

- Halsey Terrace
- McGrew Point
- Moanalua Terrace
- Hokulani
- Radford Terrace

Results indicated that the highest pesticide concentrations were immediately adjacent to the foundations of existing structures (PSI, 2004) based on sampling conducted after ground lease signing. As discussed in the following subsections, additional investigations conducted in 2006 and 2007 determined that the maximum pesticide concentrations are generally found under existing concrete foundations and concentrations decrease rapidly with distance from the slabs (Parsons, 2006a; 2007).

### 1.1.2 2006 Project

The 2006 Project is providing new construction and rehabilitation of both Navy and Marine Corps family housing on Oahu through the PPV. Included in the 2006 Project are 22 individual neighborhoods on Oahu, of which demolition and/or new construction will occur at 14 individual neighborhoods (Figure 1):

- Camp Smith
- Camp Stover
- Catlin Park
- Halawa
- Kapoho (Hillside)
- Manana (Navy)
- Manana (Marines)
- Maloelap
- Marine Barracks
- NCTAMS
- Red Hill
- Waikulu-Manning
- Waikulu-NCO Row
- Waikulu-Rainbow

The 2006 Project includes approximately 1,400 individual housing units in a mix of single family homes, duplexes, and multi-family complexes. Approximately 450 buildings are scheduled for demolition. Phase II ESAs for the 2006 Project included subsurface soil investigations for chlorinated pesticides at each of the 14 individual neighborhoods listed above.

The demolition and reconstruction activities associated with the 2006 Project began at the Catlin Park and Manana neighborhoods in early 2007, with work at the additional neighborhoods continuing through 2010. Phase II ESAs for each of the 2006 Project neighborhoods, which include results of testing under building slabs, around slab perimeters, and in common areas, are provided under separate cover (Parsons, 2006a; 2007a). Results and conclusions from all 14 of the 2006 Project neighborhoods are summarized in Section 2.0 of this Plan. Some of the Phase II ESAs, referenced in Exhibit D-2 of the Ground Lease, have been revised to include additional data evaluations requested by the Hawaii Department of Health (HDOH). The additional data evaluations included site-specific risk evaluations for the Manana-Marines neighborhood (Parsons, 2007a) and statistical evaluations of representativeness (as summarized in Section 2.5) for neighborhoods that were determined to not need soil remediation (i.e., Manana-Marines, Kapoho, Waikulu-Manning Court, and NCTAMS).

### 1.1.3 2007 Project

The 2007 Project will provide new construction of Marine Corps family housing on Oahu through the PPV. The 2007 Project includes demolition and new construction at 2 individual neighborhoods, Mololani and Ulupau, at Marine Corps Base Hawaii (MCBH) on Oahu (Figure 1). The demolition and reconstruction activities associated with the 2007 Project are scheduled to begin at the Mololani neighborhood in 2008 and continue through 2012. The 56 units on the south end of Ulupau will be demolished in 2010 as part of the Mololani neighborhood demolition activities, with demolition of the remaining 294 units at Ulupau scheduled to begin in 2014. Subsurface soil investigations at Mololani and Ulupau have been conducted, and summary results are included in Section 2.0 of this updated Pesticide Soils Management Plan.

### 1.1.4 Conceptual Site Model

Results from sampling at the 2004, 2006, and 2007 Projects are consistent with a conceptual site model of historic use of chlorinated pesticides to control termites (as termiticides), using procedures consisting of applying the termiticides to the ground surface prior to slab construction and then subsequently around the immediate edge of the foundation.

The highest pesticide concentrations were found in soil samples collected beneath existing concrete slab foundations and immediately adjacent to the foundations of existing structures. Concentrations decreased rapidly with distance from the slabs, generally below levels of concern at a distance of 2 feet from the foundation. Concentrations also decreased rapidly with depth from the ground surface, generally below levels of concern at a depth of 2 feet below ground surface (bgs). However, during previous 2006 Project investigations at some neighborhoods, pesticide concentrations at some locations remained above levels of regulatory concern at the maximum sampling depth of 2 feet bgs. Subsequently as part of the 2007 Project, the sampling program was modified to include soil sampling as deep as 3 feet bgs, with no significant exceedances noted at 3 feet bgs for the 2 neighborhoods sampled (Mololani and Ulupau).

### 1.1.5 Environmental Action Levels

Included in Section 2.0 of this Plan are the methods and assumptions used to derive site-specific Tier 2 Environmental Action Levels (EALs) for soil for use in decision-making during demolition and construction at Navy and Marine Corps Housing Communities in Hawaii. The Hawaii Department of Health (HDOH) has previously concurred with the use of these Tier 2 EALs and with a previous version of this Plan's details and procedures to address pesticide impacted soils at the 2006 Project neighborhoods (Parsons, 2007c; HDOH, 2007). The Lessee proposes to use these same Tier 2 EALs and this updated Plan at both the 2006 and the 2007 Project neighborhoods.

## 1.2 PESTICIDE HAZARDS

Chlorinated pesticides and pesticides residues identified from the subsurface investigations included chlordane, aldrin, dieldrin, endrin, heptachlor, heptachlor epoxide, DDD, DDE, and DDT. This section provides general information for each of these pesticides as published by the U.S. Department of Health and Human Services (ATSDR, 2006).

### 1.2.1 Chlordane

Chlordane is a man-made chemical that was used as a pesticide in the United States from 1948 to 1988. The specific formulation of chlordane used is known as "technical chlordane", a mixture of pure chlordane and related chemicals, primarily heptachlor. From 1983 to 1988, the only approved use of chlordane was to control termites in homes. Most exposures to chlordane are through inhalation, ingestion or absorption through the skin. The most common source is

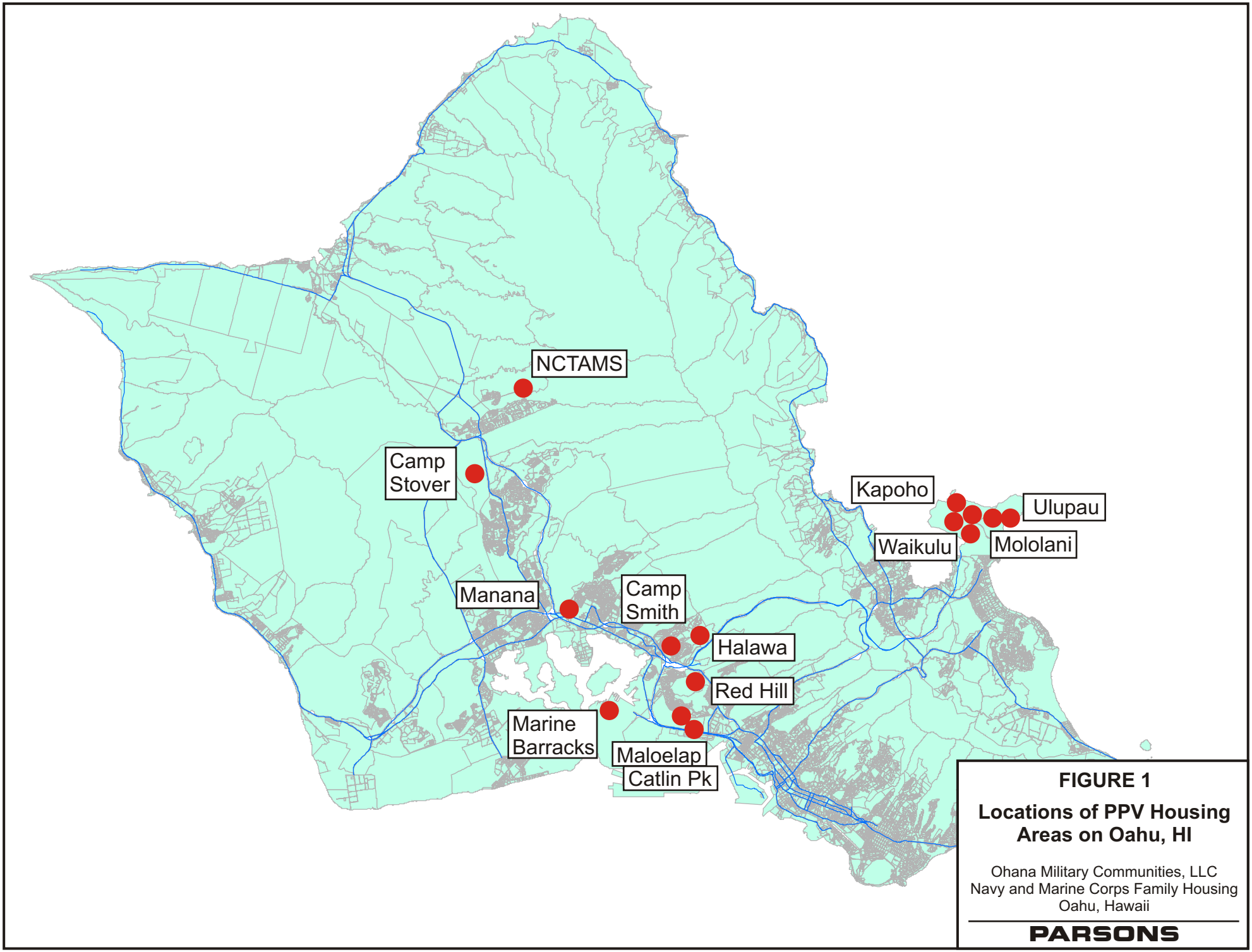



**FIGURE 1**

**Locations of PPV Housing Areas on Oahu, HI**

Ohana Military Communities, LLC
Navy and Marine Corps Family Housing
Oahu, Hawaii

PARSONS

from ingesting chlordane-contaminated food. Swallowing small amounts of chlordane or breathing air containing high concentrations of chlordane vapors can cause headaches, irritation, confusion, weakness, and vision problems. Based on animal studies, the U.S. Environmental Protection Agency (USEPA) has determined that chlordane is a probable human carcinogen. Exposure to high enough amounts can cause adverse effects to the liver.

### 1.2.2 Aldrin and Dieldrin

Aldrin and dieldrin are the common names of two structurally similar compounds that were once used as insecticides and termiticides. The two chemicals are discussed together because aldrin readily changes into dieldrin once it enters the environment or the human body. From the 1950s to the 1970s, aldrin and dieldrin were used as insecticides on crops such as corn and cotton. From 1972 through 1987, aldrin and dieldrin were used to control termites. Most exposures to aldrin and dieldrin are through inhalation, ingestion or dermal exposure to impacted soil. Exposure to moderate levels of aldrin/dieldrin for a long time causes headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. Based on animal studies, the USEPA has determined that aldrin and dieldrin are probable human carcinogens. Exposure to high enough amounts can cause adverse effects to the liver.

### 1.2.3 Endrin

Endrin was used as a pesticide to control insects, rodents, and birds. Endrin has not been produced or sold for general use in the United States since 1986. Endrin ketone is a breakdown product of endrin when endrin is exposed to light. Exposure to endrin mostly occurs through incidental ingestion, inhalation, or dermal exposure to impacted soil and eating contaminated food. Endrin has not been classified by the USEPA as a carcinogen, but exposure to high enough amounts can cause non-cancer health effects, such as kidney or liver damage.

### 1.2.4 Heptachlor and Heptachlor Epoxide

Heptachlor is a manufactured chemical that was used up until 1988 in the formulation of “technical chlordane” and as an insecticide in homes, buildings, and on food crops. Bacteria and animals break down heptachlor to form heptachlor epoxide. Heptachlor is EPA registered today to control fire ants in power transformers. The most common sources of exposure to heptachlor are through inhalation, ingestion, and absorption through the skin. Based on animal studies, the USEPA has determined that heptachlor and heptachlor epoxide are probable human carcinogens. Exposure to high enough amounts can cause adverse effects to the liver.

### 1.2.5 DDT, DDD and DDE

DDT is a pesticide once widely used to control insects and insects that carry diseases such as malaria. Its use in the United States was banned in 1972. DDD was also used to kill pests and its use has also been banned. DDD and DDE enter the environment as breakdown products of DDT. Although these chemicals breakdown in air rapidly, they adhere to soil strongly. DDT in soil is broken down slowly to DDE and DDD by microorganisms in 2 to 15 years, depending on the soil type.

Exposure to DDT, DDD and DDE is through ingestion (of contaminated food) and inhalation, may result in tremors and seizures, and may affect the nervous and reproductive systems. The USEPA has determined that DDT, DDD, and DDE are probable human carcinogens based on animal studies. Exposure to high enough amounts can cause adverse effects to the liver.

# 2.0 REGULATORY COMPARISON CRITERIA AND SUMMARY OF INVESTIGATION RESULTS

The purpose of this section is to briefly summarize the regulatory comparison criteria previously used during the Navy Increment I (2004 Project) and then describe the methods and assumptions used to derive site-specific Tier 2 Environmental Action Levels (EALs) for soil for use during demolition and construction at the Marine Corps Increment II and Navy Increment III Housing Areas (2006 Project). HDOH has previously concurred with the use of these Tier 2 EALs for the 2006 Project (HDOH, 2007), and the Lessee proposes to use these same Tier 2 EALs at the Marine Corps Increment IV Housing Areas (2007 Project).

## 2.1 REGULATORY CRITERIA USED FOR NAVY INCREMENT I (2004 PROJECT)

As part of the subsurface investigations conducted at Halsey Terrace, Hokulani, McGrew Point, and Radford Terrace for the Navy Increment I 2004 Project, maximum concentrations and reasonable maximum exposure concentrations (RME) were estimated for these housing communities (PSI, 2004). Many of the values exceeded the residential Preliminary Remediation Goals (PRG) published by USEPA Region 9. As a result, a screening risk assessment was conducted to identify receptors and pathways to the chlorinated pesticide-impacted soil and to subsequently calculate soil screening levels (SSL) as action levels at the sites. For the sampled communities included in the Navy Increment I 2004 Project, the maximum concentrations, RMEs, PRGs, and SSLs for residents, construction workers, and off-site residents were used as regulatory criteria.

## 2.2 REGULATORY CRITERIA FOR MARINE CORPS INCREMENT II AND NAVY INCREMENT III (2006 PROJECT) AND MARINE CORPS INCREMENT IV (2007 PROJECT)

### 2.2.1 Background and Objectives

Phase I ESAs for the 2006 Project and the 2007 Project were completed (Parsons, 2006b; 2007e) to investigate the "presence or likely presence of hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property" (American Society for Testing and Materials [ASTM] Standard Practice E 1527-05). The Phase I ESAs concluded that chlorinated pesticide residues in soil may exist in soil near or beneath foundations of homes in the housing communities and is a recognized environmental concern (REC).

The objectives of the subsequent Phase II ESAs were:

1) Address Phase I ESA RECs prior to demolition and reconstruction;
2) Characterize nature and extent of pesticide residues in soil;
3) Collect representative samples spatially distributed within individual neighborhoods; and,
4) Verify the Conceptual Site Model (CSM) that pesticide residues in soil of concern are beneath (or very near) the building foundations, but not in common areas or yards, and that their vertical extent is limited due to their strong adsorption properties.

Sampling strategies and sampling results from the Phase II ESA activities are summarized in this section. Detailed results for the Marine Corps Increment II and Navy Increment III Housing Areas (2006 Project) are provided under separate cover in the site-specific Phase II ESAs for each neighborhood in which subsurface investigations of pesticides in soil were conducted (Parsons, 2006a; 2007a). Detailed results for the Marine Corps Increment IV Housing Areas (2007 Project) are also provided under separate cover in the site-specific Phase II ESAs (Parsons, 2007b).

### 2.2.2 Phase II ESA Sampling Strategy and Methods (2006 Project)

For the 2006 Project, the Phase II ESA sampling strategy was to collect shallow soil samples from a statistically representative number of buildings that were areally distributed throughout each of the neighborhoods. Overall, approximately 22% of the total number of buildings proposed for demolition were sampled (approximately 100 buildings sampled out of approximately 450 buildings planned for demolition). On an individual neighborhood basis, between 14% and 100% of buildings were sampled, with higher percentages used for neighborhoods with fewer buildings. The target percentages were based on guidance provided by the Department of Housing and Urban Development (HUD, 1997) for the minimum number of targeted dwellings to be sampled among similar dwellings. Target percentages ranged from 15% (Manana-Marines) to 27% (Rainbow) to 100% (Marine Barracks), varying depending on the number of buildings, number of units within the building, similar housing type and construction date to other neighborhoods, and the overall neighborhood size.

For each building selected for sampling, soil samples were collected from three (3) group locations:

1) under the foundation ("sub-slab samples");
2) along the outside perimeter of the foundation ("perimeter samples"), generally at a distance of approximately 1 to 3 feet from the foundation; and,
3) in the front and/or back yards ("common area samples").

At each single family home or duplex selected for sampling, soil samples were collected from a total of approximately seven (7) individual sampling locations ("pushes") within the above three group locations, as follows:

- 2 locations under the foundation;
- 3 locations along the outside perimeter of the foundation; and,
- 2 locations in the front and/or back yards.

At each multi-family complex building selected for sampling, soil samples were collected from a total of approximately twelve (12) individual sampling locations within the three group locations:

- 3 locations under the foundation;
- 6 locations along the outside perimeter of the foundation; and,
- 3 locations in the front and/or back yards.

At each individual sampling location or push, discrete samples were collected at two (2) depths: approximately one (1) foot (ft) below ground surface (bgs) and approximately 2 ft bgs. Separate, individual samples in 4 oz. jars were collected at each unique physical location and depth, assigned a unique sample ID, placed in the cooler, and shipped to the lab.

Shallow soil samples (less than 1 ft bgs) were not collected within the common areas for the 2006 Project based on previous shallow soil sampling results from the 2004 Project (PSI, 2004).

During the 2004 Project, an extensive shallow soil sampling investigation was conducted in undisturbed common areas at 5 housing communities. More than 80 shallow soil samples (within 0.5 ft of ground surface) were analyzed. A review of the 2004 Project results showed that pesticide concentrations in only 4 of the 80 shallow soil samples were above their respective HDOH Tier 1 EAL and none of these 4 shallow soil samples had more than one pesticide above its Tier 1 EAL. In addition, only 1 sample had a detected pesticide concentration that exceeded its Tier 2 EAL (discussed in Section 2.2.3) -- a shallow soil sample collected at Radford Terrace, in which a concentration of 11 mg/kg chlordane was detected compared to the Tier 2 EAL for chlordane of 5.7 mg/kg. The 2004 Project results are consistent with the conceptual site model that the chlorinated pesticides were used as termiticides applied beneath and immediately adjacent to foundations and pesticide residues are no longer present at any significant concentration from possible historical application in shallow soils in common areas and yards.

After the samples were collected at each building, all of the related samples from the same group location and the same depth were submitted to a fixed-based laboratory for compositing and subsequent pesticide and lead analyses. For normal non-duplicate samples, compositing was performed at the laboratory based on instructions provided on the chain-of-custody form using the following procedures:

a) homogenization of individual samples (each location - depth) to create a uniform sample of particles less than 1/8-inch in size;
b) pulling a representative, equal aliquot of 30 grams from each individual sample in the composite group;
c) homogenization of the aliquots in a new sample container;
d) assignment of a new, unique sample ID for the composite group sample; and,
e) subsequent extraction & analysis of a single aliquot from the composite group sample.

As a result, each building sampled resulted in approximately 6 representative samples analyzed by the laboratory (i.e. from 3 group locations at 2 depths each) from a total of 14 sub-samples collected from single-family homes/duplexes and 24 sub-samples collected from multi-family complex buildings. All soil samples were analyzed for pesticides and total lead by EPA methods 8081A and SW6010B, respectively.

### 2.2.3 Phase II ESA Sampling Strategy and Methods (2007 Project)

During the 2007 Project, the Phase II ESA sampling strategy and methods were similar to those used during the 2006 Project, as described above in Section 2.2.2, with some modifications as detailed in the 2007 Project Work Plan (Parsons, 2007f). The strategy and methods are summarized below.

Sampling was planned to be conducted in two stages. Stage 1 consisted of sampling approximately 5% of the total number of buildings in each neighborhood (20 buildings at Mololani and 4 buildings at Ulupau). The number of buildings and samples collected during Stage 1 was used to determine if pesticides are generally present in soils in each neighborhood above the regulatory criteria (i.e., Tier 2 EALs). If Stage 1 results indicated pesticides are generally present in soils above Tier 2 EALs, then a conservative decision would be made to mitigate soils at all buildings in the neighborhood (whether sampled or not sampled). This conservative approach was used due to the logistics, cost, and schedule needed to sample a large number of occupied buildings. Based on the CSM and previous 2004 and 2006 Project results, any additional sampling would have been unlikely to lead to a no mitigation decision and would, therefore, not be cost-effective.

If Stage 1 results indicated pesticides are not present in soils above action levels, then Stage 2 sampling would then be conducted. Stage 2 would consist of sampling an additional 5% of the total number of buildings in each neighborhood. The objective of the Stage 2 sampling would be to increase the number of buildings sampled in order to provide a robust, statistically representative sampling population. Prior to concluding that the soils have not been impacted and making a no mitigation decision, results obtained from both Stage 1 and Stage 2 sampling would be used to determine if results are representative of all buildings in the respective neighborhood.

For each building selected for sampling, soil samples were collected from four (4) group locations:

1) under the foundation ("sub-slab samples");
2) adjacent to the foundation ("near-slab samples"), within a distance of 2 feet from the foundation;
3) along the perimeter of the foundation ("perimeter samples"), at a distance of between 2 and 4 feet from the foundation; and,
4) in the front and/or back yards ("common area samples").

At each building selected for sampling, soil samples were collected from a total of approximately 19 individual sampling locations within the above 4 group locations, as follows:

- 3 locations under the foundation;
- 4 locations adjacent to the foundation;
- 6 locations along the perimeter of the foundation; and,
- 6 locations in the front and/or back yards.

At each individual sampling location, discrete subsamples will be collected at 3 depths, measured below ground surface (bgs):

- approximately 0.5 feet bgs;
- approximately 1.5 feet bgs; and,
- approximately 3.0 feet bgs.

Therefore, a total of 57 subsamples were planned from each building (19 subsamples from each of 3 depths).

At the laboratory, subsamples were composited based on group location and depth. Subsamples from the same group location and depth were composited together using the compositing method of Ramsey and Suggs (2001) to ensure that the sample analyzed was representative of the soil from the entire composite group. As a result, generally a total of 12 samples per building were analyzed - 1 sample at each of 3 depths from the 4 group locations - from the total of 57 subsamples collected from each building.

Based on the Stage 1 sampling results at Mololani and Ulupau, it was determined that pesticides are generally present in soils above the action levels at both neighborhoods. Therefore, Stage 2 sampling was not conducted.

### 2.2.4 Sampling Summary for the 2006 and 2007 Projects

For the 16 sampled neighborhoods in the 2006 and 2007 Projects, a summary by neighborhood of the number of buildings scheduled for demolition, number of sampled buildings, and number of laboratory samples collected and analyzed is provided in Table 1.

**TABLE 1**
**SAMPLING SUMMARY 2006 AND 2007 PROJECTS**

| | Buildings | | | No. of Sub-Samples Collected | | | Samples |
|---|---|---|---|---|---|---|---|
| **Neighborhood** | **Total** | **Sampled** | **%** | **Sub-Slab** | **Perimeter** | **Common** | **Analyzed** |
| Camp Smith | 9 | 3 | 33% | 12 | 18 | 12 | 18 |
| Camp Stover | 26 | 10 | 38% | 36 | 66 | 36 | 60 |
| Catlin Park | 84 | 15 | 18% | 84 | 156 | 84 | 90 |
| Halawa | 22 | 8 | 36% | 46 | 84 | 46 | 48 |
| Kapoho (Hillside) | 7 | 2 | 29% | 8 | 12 | 8 | 12 |
| Manana (N/M) | 153 | 21 | 14% | 76 | 114 | 76 | 126 |
| Maloelap | 22 | 5 | 23% | 24 | 36 | 24 | 30 |
| Marine Barracks | 2 | 2 | 100% | 10 | 18 | 10 | 12 |
| NCTAMS | 26 | 8 | 31% | 42 | 78 | 42 | 48 |
| Red Hill | 8 | 3 | 38% | 12 | 18 | 12 | 18 |
| Waikulu-Manning | 9 | 3 | 33% | 18 | 36 | 18 | 18 |
| Waikulu-NCO Row | 4 | 3 | 75% | 16 | 24 | 16 | 18 |
| Waikulu-Rainbow | 81 | 17 | 21% | 76 | 144 | 76 | 102 |
| Mololani | 425 | 21 [a/] | 5% | 132 | 143 / 216 [b/] | 366 | 182 |
| Ulupau | 77 | 4 | 5% | 36 | 48 / 72 | 72 | 59 |
| OVERALL: | 955 | 125 | 22% / 5% | 628 | 1,283 | 898 | 841 |

a/ Subslab samples were collected from 16 buildings; near-slab and perimeter samples were collected from 13 buildings; and common area samples were collected from 21 buildings.

b/ For the 2007 Project, perimeter samples included samples within 2 feet of the slab and between 2 and 4 feet from the slab, shown respectively.

## 2.3 DEVELOPMENT OF TIER 2 ENVIRONMENTAL ACTION LEVELS

Phase II ESA soil sampling results are compared with Tier 1 or 2 EALs, consistent with Hawaii Department of Health (HDOH, 2005) "*Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater."* EALs are conservative screening concentrations that can be used to assess the potential risks to humans or the environment. It can be assumed that the COPCs do not pose a significant threat to human health or the environment when concentrations are less than EALs. However, COPC concentrations greater than EALs do not necessarily indicate unacceptable risks, but typically indicate the need for further evaluation. Under "Tier 1" site data are compared directly with HDOH generic Tier 1 EALs. However, HDOH (2005) also supports the development of Tier 2 EALs:

> *"In a Tier 2 risk assessment, a selected component(s) of the Tier 1 EAL is modified with respect to site-specific considerations. An example may be the adjustment of a screening level for direct exposure with respect to an approved, alternative target risk level…This provides an intermediate but still relatively rapid and cost-effective option for preparing more site-specific risk assessments."*

Tier 1 EALs are designed to be protective of human health (i.e., direct-exposure) and other potential environmental concerns (e.g., future soil-to-groundwater impacts and urban ecological impacts). Human health Tier 1 soil EALs for pesticides were derived based on the following common assumptions (refer to HDOH [2005] for details on all other input assumptions): 1) unrestricted (i.e., residential) land use; 2) exposure to COPCs in soil via incidental ingestion, dermal contact, and inhalation of volatiles/particulates; 3) a target cancer risk and noncancer hazard of one-in-one million (i.e., 1E-06) and one, respectively; and 4) exposure for 350 days/yr for 30 years as a child/adult.

Site-specific Tier 2 EALs for the target pesticides were derived from HDOH (2005) human health direct exposure Tier 1 values based on an alternative target cancer risk level of 1E-05 and the potential for cumulative cancer effects from exposure to multiple pesticides. All other Tier 2 residential EAL human health (i.e., direct exposure) exposure assumptions were the same as those used by HDOH for Tier 1 EALs. The justifications for the alternative target cancer risk level of 1E-05 and the adjustment for potential cumulative effects are provided below. The equation and input parameters used to derive Tier 2 EALs, along with a table listing Tier 1 and 2 EALs are also provided below.

**Alternative Target Cancer Risk Level.** The justification for using an alternative target cancer risk level of 1E-05 to derive Tier 2 EALs for pesticides is based on the following:

- Although HDOH (2005) derived the majority of the unrestricted (i.e., residential) human health direct exposure Tier 1 EALs using a target cancer risk level of 1E-06, they used a target risk of 1E-05 to derive Tier 1 direct exposure EALs for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and trichloroethylene (TCE). HDOH (2005) justified a Tier 1 EAL target risk level of 1E-05 for these groups of chemicals based on their ubiquitous nature or uncertainties in toxicity factors:

  > *"Low levels of PAHs in soil are ubiquitous in urban environments due to auto exhaust and the use of asphalt… Use of PCBs in transformers, capacitors and other electrical equipment was widespread in the 1960sand 1970s… In order to again help focus attention on sites where significant releases of PCBs occurred, a target excess cancer risk of $10^{-5}$ was used to develop direct-exposure action levels for soil. … Due to ongoing uncertainties and debate over use of the slope factors, a target excess cancer risk of $10^{-5}$ was used to develop the soil, groundwater and indoor-air action levels for TCE presented in this document."*

  Pesticides are also ubiquitous in urban (and rural) environments. The organochlorine pesticides (e.g., aldrin, dieldrin, chlordane, and heptachlor) have been used extensively and broadly as insecticides and for controlling termites around and beneath building foundations in the United States from as early as the mid-1940's (ATSDR, 1994, 2002, and 2005; USEPA, 1997). Given their persistence, these pesticides often remain in the environment and anthropogenic background levels are expected.

- Although toxicity factors for the organochlorine pesticides are listed in USEPA's (2006) Integrated Risk Information System (IRIS), there are uncertainties in the selected oral

cancer slope factors ($CSF_{oral}$) for these chemicals as they are based on the geometric means of a range of slope factors. For example, per USEPA (2006) IRIS, the $CSF_{oral}$ of 0.35 per mg/kg-day for chlordane is the geometric mean of five slope factors ranging from 0.114 per mg/kg-day to 0.858 per mg/kg-day; the $CSF_{oral}$ of 17 per mg/kg-day for aldrin is the geometric mean of three slope factors ranging from 12 to 23 per mg/kg-day; and the dieldrin $CSF_{oral}$ of 16 per mg/kg-day is the geometric mean of 13 slope factors ranging from 7.1 to 55 per mg/kg-day.

- A target cancer risk of 1E-05 is consistent with HDOH (2005), U.S. Department of Defense (DoD) Defense Environmental Restoration Program (DERP) (DoD, 2001), U.S. Navy (2001) Human Health Risk Assessment Guidance, and the USEPA National Contingency Plan (NCP) acceptable excess lifetime cancer risk range of 1E-06 to 1E-04. As stated in HDOH (2005), "*For sites where the estimated risk is between 1E-04 and 1E-06, the need for active remediation or risk management is evaluated on a site-specific basis (i.e., risks within this range are 'potentially acceptable,' depending on site-specific considerations).*"
- There is an apparent historical trend for use of greater acceptable target risk levels (www.epa.gov/OUST/rbdm/sctrlsgw.htm) as the conservative nature (i.e., health-protectiveness) of the exposure and toxicity assumptions used in risk assessment calculations has become better understood and recognized. Examples of target risks associated with existing regulatory standards are provided below:
  - The U.S. Food and Drug Administration (FDA) began using 1E-06 as a risk-based standard in 1977 for food residues of animal drugs and assumes this represents essentially zero risk.
  - Travis *et al.* (1987) reviewed more than 132 Federal regulatory decisions and concluded that excess cancer risks greater than 4E-03 triggered a regulation. Regulatory action was never taken for cancer risks below 1E-06, whereas decisions to regulate between 4E-03 and 1E-06 were based on the size of exposed population, technical feasibility, and costs.
  - An acceptable risk range of 1E-04 to 1E-06 was codified in the final NCP for Superfund (USEPA, 1990a). The decision to use a range rather than a specific target level (e.g., 1E-06) was reaffirmed in subsequent USEPA (1991) guidance.
  - The starting target risk level for most Maximum Contaminant Levels (MCLs) developed under the Safe Drinking Water Act is 1E-06. However, many MCLs exceed the 1E-06 target for practical and economic reasons. For example, the USEPA (2004) MCL for chlordane is 2 µg/L, which represents a potential excess cancer risk of 1E-05 (estimated based on the USEPA Region 9 [2004] tap water preliminary remediation goal [PRG] of 0.2 µg/L).
  - A survey of states participating in the USEPA/American Society for Testing of Materials (ASTM) Risk-Based Corrective Action (RBCA) Training Initiative indicated that approximately one-third of the 14 states responding to the 1995 survey used target risks in the range of 1E-05 to 1E-04 (Conner *et al.*, 1997).
  - USEPA (1990b) selected a target risk level of 1E-05 as part of the revisions to the Hazardous Waste Management System Toxicity Characteristics and states that "due to the conservative nature of the exposure scenario and the underlying health criteria," a 1E-05 target is the highest risk level that is likely to be experienced by an exposed population.

  - Under the USEPA (1990c) Clean Air Act Amendments, USEPA considers all relevant risk factors and a presumptive risk of approximately 1E-04 in making acceptable risk decisions.
  - The National Council on Radiation Protection and Management adopted a remediation action level corresponding to a lifetime risk of 2.8E-02 in order to balance risk and feasibility. A lower level would have resulted in "a great societal cost."
- Although a target cancer risk level of 1E-05 is recommended for individual COPCs, the Tier 2 EALs have been adjusted downward to ensure that potential cumulative effects would also not exceed a target level of 1E-05 (discussed below).

**Potential Cumulative Cancer Risks and Cancer-Based Tier 2 EALs.** Per HDOH (2005), "*Use of EALs for single chemicals is limited to the extent that the action levels remain protective of human health should other chemicals with similar health effects also be present. Soil EALs are considered to be adequate for use at sites where no more than three carcinogenic chemicals are present… This is based on a combination of conservative exposure assumptions and target risk factors in direct-exposure models.*" The fact that HDOH (2005) assumes that Tier 1 EALs are "considered to be adequate for use at sites where no more than three carcinogenic chemicals are present" indicates that a cumulative target cancer risk of 1E-05 or greater is acceptable.

The chemical-specific cancer-based Tier 2 EALs were calculated, as presented herein, using an individual target cancer risk of 1E-05 and were adjusted downward to account for potential cumulative effects resulting from up to three carcinogenic chemicals being detected at a single location. The assumption that up to three chemicals may be present in a single sampling location was based on previous experience prior to Phase II sampling activities; however, the assumption has held true throughout the Phase II sampling program to date.

**Cancer-Based Site-Specific Tier 2 EALs.** The site-specific Tier 2 EALs for the cancer-based pesticides were calculated:

1) using an alternative excess target cancer risk level of 1E-05;
2) assuming that a resident may be simultaneously exposed to up to three carcinogens;
3) assuming future soil-to-groundwater impacts for the relatively immobile (ATSDR, 1994, 2002, 2005) pesticide COPCs is an incomplete/insignificant pathway; and,
4) incorporating all remaining HDOH (2005) default inputs. Specifically, the cancer-based site-specific Tier 2 EALs were calculated using the following equation:

$$TIER\ 2\ EAL_{cancer} = \frac{\left(HDOH\ TIER\ 1\ EAL_{cancer}\right) \times \frac{\left(TIER\ 2\ TARGET\ \ RISK\right)}{\left(TIER\ 1\ TARGET\ \ RISK\right)}}{\left(NUMBER\ OF\ \ CARCINOGENS\right)}$$

Where:

| | | |
|---|---|---|
| Tier 1 $EAL_{cancer}$ | = | Human direct exposure cancer-based Tier 1 EAL (Table B-1; HDOH, 2005) |
| Tier 2 Target Risk | = | Excess lifetime target cancer risk level of 1E-05 |
| Tier 1 Target Risk | = | Excess lifetime target cancer risk level of 1E-06 |
| Number of Potential Carcinogens | = | Three (3). |

The assumption that soil-to-groundwater impacts are incomplete/insignificant for the target pesticides is addressed through fate-and-transport modeling in the site-specific Phase II ESAs (Parsons, 2007a; 2007b).

**Noncancer-Based Site-Specific Tier 2 EALs.** The noncancer-based residential Tier 2 EALs are equivalent to HDOH (2005) noncancer-based residential Tier 1 direct exposure EALs. Consistent with HDOH (2005) Tier 1 EALs, noncancer-based pesticide Tier 2 EALs have not been adjusted downward for cumulative effects (refer to HDOH [2005] for the rationale).

Tier 1 and Tier 2 soil EALs, along with the basis for each EAL (e.g., direct human exposure and cancer/noncancer endpoint, or potential soil-to-groundwater impacts), are shown in Table 2. The list of COPCs was based on: 1) the organochlorine pesticide target analyte list for USEPA SW846 Method 8081A, which is consistent with the target analyte list in the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (Final Version 3; January 2006); 2) the pesticides that were sampled and analyzed previously for the 2004 Project (Increment I) at Radford Terrace, Halsey Terrace, and McGrew Point; and 3) general concerns about the use of lead-based paint, as recommended in the Phase I ESAs.

The Tier 1 EALs listed in Table 2 are provided for comparison and are for sites where groundwater is not used as a drinking water source and the nearest surface water body is at least 150 meters away. Refer to the relevant tables in HDOH (2005) guidance for Tier 1 EALs if groundwater is potentially used as a drinking water source or if the nearest surface water body is closer than 150 meters. Tier 2 EALs in Table 2 were based on direct soil exposure routes and are independent of groundwater use or distance to the nearest surface water body. However, regardless of the current/future groundwater use or the distance to the nearest surface water body, the potential for other endpoints (e.g., soil-to-groundwater impacts) to be significant must be considered when using the Tier 2 soil EALs listed in Table 2.

In addition to the pesticides listed in Table 2, lead is one of the COPCs being targeted during the environmental investigations. Lead cleanup levels will be based on those recommended under Section 403 of the Toxic Substances Control Act (TSCA) (*Identification of Dangerous Levels of Lead; Final Rule*. 40 CFR Part 745, January 5, 2001) and referenced by the Department of Housing and Urban Development (HUD) in "*Requirements for Notification, Evaluation and Reduction of Lead-Based Paint Hazards in Federally Owned Residential Property and Housing Receiving Federal Assistance; Final Rule*" (24 CFR Part 35; September 15, 1999). Specifically, lead cleanup values of 400 mg/kg for soil will be used for sites undergoing demolition and/or rebuild. For sites that are only undergoing renovation (e.g., replacement of utilities), lead cleanup values of 400 mg/kg in play areas and 1,200 mg/kg for soil in the remainder of the yard will be used. Note that the HUD recommended cleanup value of 400 mg/kg is consistent with the HDOH (2005) human health direct exposure EAL for lead (Table B-1; HDOH, 2005).

The Tier 2 EAL for endrin is the only COPC listed in Table 2 with a direct exposure-based Tier 2 EAL that is higher than the urban ecotoxicity (plant phytotoxicity) endpoint listed in HDOH (2005). The potential significance of the plant phytotoxicity (i.e., urban ecotoxicity) endpoint for endrin is assessed in the site-specific Phase 2 ESAs (Parsons, 2007a; 2007b).

**TABLE 2**
**TIER 1 AND 2 ENVIRONMENTAL ACTION LEVELS (EALs)**

| | Residential Environmental Action Level (EAL) (mg/kg) | | | |
|---|---|---|---|---|
| **Chemical** | **Tier 1** [a/] | **Basis** [b/] | **Tier 2** | **Basis (Direct Exposure)** [c/] |
| 4,4'-DDD | 2.4 | Direct Exposure (cancer) | 8.1 | Cancer |
| 4,4'-DDE | 2.4 | Direct Exposure (cancer) | 8.1 | Cancer |
| 4,4'-DDT | 1.7 | Direct Exposure (cancer) | 5.7 | Cancer |
| | 36 | Direct Exposure (noncancer) | | |
| Aldrin | 0.029 | Direct Exposure (cancer) | 0.095 | Cancer |
| | 1.8 | Direct Exposure (noncancer) | | |
| BHC (Lindane) | 0.098 | Groundwater Protection | 1.5 | Cancer |
| | 0.44 | Direct Exposure (cancer) | | |
| | 21 | Direct Exposure (noncancer) | | |
| Chlordane (Technical) | 1.6 | Direct Exposure (cancer) | 5.4 | Cancer |
| | 35 | Direct Exposure (noncancer) | | |
| Dieldrin | 0.030 | Direct Exposure (cancer) | 0.10 | Cancer |
| | 3.1 | Direct Exposure (noncancer) | | |
| Endosulfan | 0.018 | Groundwater Protection | 370 | Noncancer |
| | 370 | Direct Exposure (noncancer) | | |
| Endrin | 0.010 | Groundwater Protection | 18 | Noncancer |
| | 18 | Direct Exposure (noncancer) | | |
| Heptachlor | 0.11 | Direct Exposure (cancer) | 0.36 | Cancer |
| | 31 | Direct Exposure (noncancer) | | |
| Heptachlor epoxide | 0.053 | Direct Exposure (cancer) | 0.18 | Cancer |
| | 0.79 | Direct Exposure (noncancer) | | |
| Methoxychlor | 19 | Groundwater Protection | 310 | Noncancer |
| | 310 | Direct Exposure (noncancer) | | |
| Toxaphene | 0.40 | Direct Exposure (cancer) | 1.3 | Cancer |

a/ Taken from Table B-1 of HDOH (2005), assuming nonpotable groundwater and the nearest surface water body is >150 m, and Table I-1 for applicable direct exposure scenarios (cancer and/or noncancer).

b/ The most sensitive endpoint is shown first and includes cancer or noncancer toxicologic endpoints, where applicable (HDOH, 2005).

c/ Tier 2 EALs were based on direct human exposure (refer to text); the most sensitive endpoint (cancer or noncancer) is shown.

## 2.4 SUMMARY OF RESULTS FROM 2006 AND 2007 PROJECTS

This section provides a general overview and summary of the results from the Phase II ESA investigations in comparison to the Tier 1 and Tier 2 EALs, which were used to develop overall recommendations for management of pesticide-impacted soils discussed in Section 3.0 and the CSM described in Section 1.1.4. Detailed sampling results, conclusions, and recommendations for individual neighborhoods are contained in the site-specific Phase II ESAs for each neighborhood (Parsons, 2006a; 2007a, 2007b).

Table 3 provides a summary of Tier 1 and Tier 2 EAL exceedances by neighborhood and pesticide. It is important to note that this summary table does not make any distinction among sample groups (i.e. where the sample was collected, as discussed in Section 2.2), the number of the samples that exceeded the respective EAL, nor the magnitude of the exceedance.

Nevertheless, some general observations are apparent from this type of data summary of the 16 neighborhoods:

- Two neighborhoods did not have any Tier 1 EAL exceedances: Kapoho and Manning Court;
- One neighborhood did not have any Tier 2 EAL exceedances: NCTAMS;
- Specific pesticides that exceeded the EALs were different in different neighborhoods; for example, chlordane was a pesticide of concern in only 6 of the 16 neighborhoods;
- Dieldrin and aldrin were the pesticides most often detected above their respective Tier 2 EAL, in 11 out of 16 neighborhoods and 8 out of 16 neighborhoods, respectively.

Table 4 provides a summary of Tier 2 EAL exceedances by neighborhood and sample group (i.e. where the exceedances occurred: subslab, perimeter, or common area samples) and also provides a calculation of the overall percentage of sample detections above the Tier 2 EAL for each sample group throughout all neighborhoods. Observations from this type of data summary include:

- The majority of the Tier 2 EAL exceedances were from subslab samples;
- Tier 2 EAL exceedances in perimeter samples generally occurred in those neighborhoods where samples were collected within 1 to 1.5 feet from the slab edge, but not in those neighborhoods where samples were collected 2 feet or more from the slab edge; and,
- No significant exceedances occurred within the common areas/yards throughout a neighborhood.

## 2.5 REPRESENTATIVENESS OF SAMPLING DESIGN

Per USEPA (2006), representativeness is an important data quality indicator and "*addresses the extent to which measurements actually reflect the sampling unit from which they were taken, as well as the degree to which samples actually represent the target population*." One critical component of representativeness includes justifying an adequate number of samples. As discussed in USEPA (1989, 1992, 2000, and 2006), the following factors should be considered when justifying the number of samples: 1) the investigative area(s); 2) statistical performance; and 3) practical considerations of logistics and cost.

As discussed previously, the investigative areas included soils beneath/near a subset of buildings/yards from each neighborhood. Logistics, cost, and schedule were factors when developing the sampling strategy. The purpose of this section is to present information to support the conclusion that the results obtained from a subset of buildings (soils beneath/near 22% of the total number of buildings for the 2006 Project) were representative of all buildings in the respective neighborhoods.

## TABLE 3
## SUMMARY OF TIER 1 AND 2
## CHEMICAL-SPECIFIC EAL EXCEEDANCES

| Neighborhood | Chlordane | Heptachlor | Heptachlor Epoxide | Aldrin | Dieldrin | Endrin | Endosulfan | DDD | DDE | DDT |
|---|---|---|---|---|---|---|---|---|---|---|
| Camp Smith | | | | ● [33/0/0] | ● [33/33/0] | ○ [33/0/0] | | | | |
| Camp Stover | | | | ● [100/30/10] | ● [100/40/10] | ○ [80/0/10] | | | | |
| Catlin Park | ● [20/0/0] | ● [7/0/0] | ● [20/0/0] | ● [40/7/0] | ● [40/0/0] | ○ [33/0/0] | ○ [7/7/0] | | | |
| Halawa | ● [63/13/0] | ● [75/13/0] | ● [0/25/0] | ● [0/13/0] | ● [25/100/0] | ○ [0/13/0] | | | | |
| Kapoho | (no exceedances) | | | | | | | | | |
| Manana (Navy) | ● [60/0/0] | ● [50/0/0] | ● [60/0/0] | | ○ [0/20/0] | | | | | |
| Manana (Marines) | | | | | ● [9/0/9] | | | | | |
| Maloelap | | | | ● [40/0/0] | ● [40/40/0] | ○ [40/20/0] | | ● [20/0/0] | ● [20/0/0] | ● [40/0/0] |
| Marine Barracks | | | ○ [0/100/0] | | ● [0/50/0] | | | | | |
| NCTAMS | | | | | ○ [13/13/0] | | | | | |
| Red Hill | | | ○ [0/20/0] | | | | | ● [20/0/0] | ● [20/0/0] | ● [40/0/0] |
| Waikulu (Manning) | (no exceedances) | | | | | | | | | |
| Waikulu (NCO Rw) | | | ○ [33/0/0] | | ● [33/33/0] | | | | | |
| Waikulu (Rainbow) | ● [50/11/0] | ● [50/11/0] | ● [6/11/0] | ● [33/11/0] | ● [50/61/0] | ○ [39/11/0] | | | | |
| Mololani | ● [0/15/0] | | | ● [6/0/0] | ● [13/38/0] | | | | | |
| Ulupau | ● [25/0/0] | | | ● [0/25/0] | ● [50/50/0] | ○ [25/25/0] | | | | |

○ at least one sample exceeds Tier 1 EAL
● at least one sample exceeds Tier 2 EAL
(no symbol indicates that neither the Tier 1 nor Tier 2 EAL was exceeded)
[xx/x/x] percentage of sampled buildings in the neighborhood with a Tier 1/2 EAL exceedance, for each of the following sample groupings: sub-slab / perimeter / common area

## TABLE 4
## SUMMARY OF TIER 2 EAL EXCEEDANCES BY LOCATION

| Neighborhood | Sub-Slab | Perimeter | Common Area |
|---|---|---|---|
| Camp Smith | ● 33% | ● 33% | |
| Camp Stover | ● 100% | ● 36% | ● 5% |
| Catlin Park | ● 54% | ● 3% | |
| Halawa | ● 63% | ● 88% | |
| Kapoho (Hillside) | | (no exceedances) | |
| Manana (Navy) | ● 50% | | |
| Manana (Marines) | ● 4% | | ● 4% |
| Maloelap | ● 56% | ● 30% | |
| Marine Barracks | | ● 25% | |
| NCTAMS | | (no exceedances) | |
| Red Hill | ● 60% | | |
| Waikulu (Manning Ct) | | (no exceedances) | |
| Waikulu (NCO Row) | ● 10% | ● 20% | |
| Waikulu (Rainbow) | ● 72% | ● 55% | |
| 2006 Project: Overall Percent of Samples with Detects > Tier 2 EALs | 43% (93/214) | 22% (46/212) | < 1% (2/204) |
| Mololani | ● 9% | ● 25% | |
| Ulupau | ● 47% | ● 43% | ● 7% |
| 2007 Project: Overall Percent of Samples with Detects > Tier 2 EALs | 19% (11/58) | 30% (15/50) | 2% (1/55) | 0% (0/78) |

Notes:

1. For 2006 Project Neighborhoods, samples were collected at both 1 and 2 feet bgs in each respective group location; perimeter samples collected at distances between 1 and 3 feet from the foundation, depending on neighborhood.
2. For 2007 Project Neighborhoods, samples were collected at 0.5, 1.5, and 3 feet bgs in each respective group location; perimeter samples included samples within 2 feet of the slab and between 2 and 4 feet from the slab, shown respectively.

● indicates at least one sample exceeded one or more Tier 2 EAL(s)
(no symbol indicates that the Tier 2 EAL was not exceeded)
43% percent of samples exceeding one or more Tier 2 EAL(s)

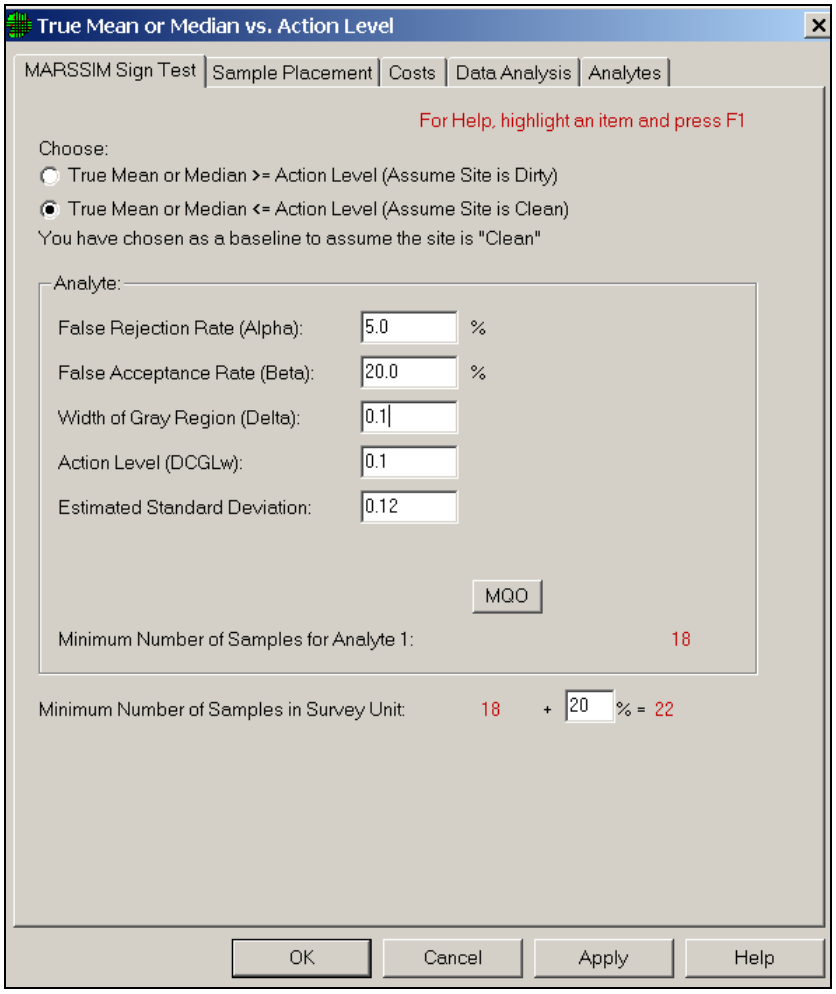
Ultimately, the relationship between the number of samples and representativeness is controlled by variability in the measured concentrations and the assumptions about certainty and power. Certainty and power are controlled by minimizing the likelihood of making incorrect conclusions or decisions, defined as false negative (i.e., "alpha" or "Type I") and false positive (i.e., "beta" or "Type II") errors. USEPA's (1996) *Soil Screening Guidance: User's Guide* recommends starting values of 0.05 for the false negative decision error limit and 0.20 for the false positive decision error limit.

The Phase II ESA soils data were used to estimate the variability of pesticide concentrations for those neighborhoods (e.g., Manana - Marines) where significant impacts were not anticipated. These variability estimates were then used, along with assumptions about certainty and power, to determine whether an adequate number of samples were collected from neighborhoods where it was concluded that the soils have not been significantly impacted and the data are representative. Summary statistics (e.g., frequency and range of detections; range of detection limits; mean, and standard deviation) for all samples collected at the Manana - Marines neighborhood are shown in Table 5.

The Manana - Marines neighborhood was selected since it was concluded that soils beneath or near all buildings have not been significantly impacted and mitigation is not needed. Summary statistics are also shown (Table 6) for yard/common area soil samples collected in all of the 2006 Project neighborhoods. Data from the yard/common area samples are shown for all neighborhoods in order to increase the total number of samples/detections used to estimate variability (particularly for dieldrin) since impacts in these open areas were not expected. Note that one-half the detection limits were used when calculating summary statistics (mean, and standard deviation).

Dieldrin and 4,4'-DDT were used as "worst-case" scenario compounds when determining if an adequate number of samples were collected at neighborhoods where soils likely have not been significantly impacted above Tier 2 EALs (e.g., Manana - Marines) based on: 1) the relatively low Tier 2 EAL (e.g., dieldrin); and/or 2) concentrations in select samples were near the respective EALs (dieldrin and 4,4'-DDT). Visual Sample Plan (VSP) (Hassig, *et al.*, 2005; Version 4.6 [2006]), a statistically-based public software tool supported by several offices within the USEPA, DoD, and the Department of Energy, was used to predict the number of samples based on: 1) assumed standard deviations of 0.043 to 0.12 for dieldrin and 0.13 to 0.14 for 4,4'-DDT (see Table 5 and Table 6); 2) the USEPA (1996) recommended false negative (Type I) and positive (Type II) decision error limits of 5-percent and 20-percent, respectively; 3) an assumption that false negative and positive errors are not significant until the Tier 2 EAL is exceeded by a factor of two or more; and 4) dieldrin and 4,4'-DDT concentrations are non-parametrically distributed.

The results of this analysis indicated that between 9 and 22 samples would be sufficient at neighborhoods without anticipated impacts above Tier 2 EALs based on the measured variability associated with dieldrin in order to confidently conclude that the true mean or median is less-than or equal to the Tier 2 EAL (an example VSP screen shot is provided below). The results based on the variability associated with 4,4'-DDT indicated that a minimum of 9 samples would be needed. Therefore, once again using the Manana - Marines neighborhood as an example, the 66 samples collected (Table 5) were sufficient to adequately conclude that soils were not significantly impacted above Tier 2 EALs and the data are representative for all buildings/areas within this neighborhood.




For those neighborhoods with soils beneath or near buildings assumed to have been impacted above an EAL in one or more samples, a review of the Phase II soil sampling results showed consistent spatial trends in sub-slab, perimeter, and common area soil sampling results. For example, one or more pesticides were detected above their corresponding Tier 1 EAL in sub-slab/perimeter samples from 72 (i.e., 95-percent) of the 76 buildings sampled from neighborhoods where it has initially been concluded that mitigation will be needed. Therefore, the confidence is high that the results from beneath a subset of buildings (22% of all buildings scheduled for demolition were sampled during the 2006 Project) are representative of the soils beneath or immediately adjacent to all of the buildings within a particular neighborhood. In other words, a review of the data from these neighborhoods indicates that there is a 95-percent probability of detecting at least one pesticide above its corresponding Tier 1 EAL when the soil has been impacted. It is important to note that there were approximately 500 soil samples analyzed from beneath or near the 76 buildings from these neighborhoods, which represents a robust statistical population from which to draw these conclusions. It is also important to note that the soils beneath all buildings (sampled or not sampled) in a particular neighborhood will be handled the same based on the sampling results from that neighborhood, which is likely conservative (e.g., health-protective) for those neighborhoods where soil impacts above Tier 2 EALs have been observed.

## TABLE 5
## MANANA MARINES - ALL SOIL SAMPLE TYPES

| | Detection Frequency | | | Range of values (mg/kg) Detected | | Detection Limits | | Mean | Standard | Tier 2 Environmental Action Level |
|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Detects | Total | Percent | Minimum | Maximum | Minimum | Maximum | (mg/kg) | Deviation | (mg/kg) |
| 4,4'-DDD | 7 | 66 | 11 | 0.00082 | 0.029 | 0.00029 | 0.0034 | 0.0008 | 3.6E-03 | **8.1** |
| 4,4'-DDE | 41 | 66 | 62 | 0.00049 | 0.66 | 0.0003 | 0.00063 | 0.018 | 8.4E-02 | **8.1** |
| 4,4'-DDT | 49 | 66 | 74 | 0.00016 | 1 | 0.00015 | 0.0017 | 0.023 | 1.3E-01 | **5.7** |
| Aldrin | 16 | 66 | 24 | 0.000155 | 0.0023 | 0.00013 | 0.0028 | 0.00028 | 4.3E-04 | **0.095** |
| alpha-Chlordane | 6 | 66 | 9 | 0.000535 | 0.0048 | 0.00023 | 0.0052 | 0.00038 | 7.7E-04 | **5.4** |
| beta-BHC | 1 | 63 | 2 | 0.00054 | 0.00054 | 0.00013 | 0.00073 | 0.0001 | 8.5E-05 | **1.5** |
| delta-BHC | 4 | 66 | 6 | 0.00089 | 0.0025 | 0.000072 | 0.0016 | 0.00016 | 3.9E-04 | **1.5** |
| Dieldrin | 9 | 66 | 14 | 0.000515 | 0.93 | 0.00025 | 0.0054 | 0.018 | 1.2E-01 | **0.1** |
| Endrin | 2 | 65 | 3 | 0.0024 | 0.0029 | 0.00032 | 0.0038 | 0.00035 | 5.2E-04 | **18** |
| gamma-Chlordane | 12 | 66 | 18 | 0.00053 | 0.0072 | 0.00017 | 0.0038 | 0.00050 | 1.2E-03 | **5.4** |
| Heptachlor | 3 | 63 | 5 | 0.00071 | 0.001 | 0.00018 | 0.001 | 0.00016 | 1.8E-04 | **0.36** |
| Heptachlor epoxide | 2 | 65 | 3 | 0.00029 | 0.00089 | 0.00012 | 0.0014 | 0.00012 | 1.5E-04 | **0.18** |

Note: Summary statistics (mean, standard deviation, and coefficient of variation) were calculated assumed one-half the detection limit for non-detects.

## TABLE 6
## ALL NEIGHBORHOODS - YARD/COMMON AREA SAMPLES

| | Detection Frequency | | | Range of values (mg/kg) Detected | | Detection Limits | | Mean | Standard | Coefficient of Variation |
|---|---|---|---|---|---|---|---|---|---|---|
| Chemical | Detects | Total | Percent | Minimum | Maximum | Minimum | Maximum | (mg/kg) | Deviation | (unitless) |
| 4,4'-DDT | 142 | 206 | 69 | 0.00016 | 1.6 | 0.00014 | 0.032 | 0.023 | 1.4E-01 | **5.7** |
| Dieldrin | 54 | 206 | 26 | 0.00033 | 0.61 | 0.00012 | 0.027 | 0.005 | 4.3E-02 | **0.1** |

Note: Summary statistics (mean, standard deviation, and coefficient of variation) were calculated assumed one-half the detection limit for non-detects.

# 3.0 PESTICIDE SOILS MANAGEMENT – DEMOLITION AND CONSTRUCTION ACTIVITIES

## 3.1 INTRODUCTION AND OBJECTIVES

The purpose of this section is to outline the objectives and management options that will be used to reduce exposures of residents in the housing communities and construction workers to pesticides and pesticide residues during demolition and construction activities. The Lease prohibits the pumping or use of groundwater in the 2004 Project, 2006 Project, and 2007 Projects. The primary exposure pathways are ingestion, dermal contact and fugitive dust inhalation. Therefore, the overall objective for pesticide soils management is to eliminate these exposure pathways and/or reduce contact with impacted soils that are above levels designed to be protective (i.e., the Tier 2 EALs discussed in Section 2.3).

This section presents the recommendations to mitigate soils impacted with pesticides above the Tier 2 EALs in conjunction with the planned construction activities in the housing communities. All work will be done in accordance with all applicable laws.

## 3.2 IDENTIFYING PESTICIDE-IMPACTED SOILS

All housing communities undergoing demolition and construction must either be previously assessed for pesticide-impacted soils (as described in Section 2.0) or, in the absence of any previous testing, conservatively assumed to contain pesticide-impacted soils in locations based on the CSM discussed in Section 1.1.4.

### 3.2.1 Previously Assessed Neighborhoods

Each housing community currently included in the 2006 Project and 2007 Projects (i.e., the 16 neighborhoods specifically identified in Section 1.0) has been previously assessed, and specific locations of pesticide-impacted soils requiring mitigation (if any) are identified in the site–specific Phase II ESAs for those neighborhoods (Parsons, 2006a; 2007a, 2007b).

For the purposes of this Pesticide Soils Management Plan, “pesticide-impacted soils” in these neighborhoods are defined as soils with documented pesticide concentrations above the Tier 2 EALs (discussed in Section 2.3) and identified in the site–specific Phase II ESAs.

### 3.2.2 Uninvestigated Neighborhoods

In the absence of any previous testing, neighborhoods should be conservatively assumed to contain pesticide-impacted soils beneath all existing foundations, within a distance of 2 feet from the foundation, and to a depth of 2 feet bgs. These conservative assumptions for uninvestigated neighborhoods are based on the CSM (Section 1.1.4) and the results developed from testing at other neighborhoods, as described in Section 2.0.

For the purposes of this Pesticide Soils Management Plan, “pesticide-impacted soils” in uninvestigated neighborhoods are defined as all soils beneath all existing foundations, within a distance of 2 feet from the foundation, and to a depth of 2 feet bgs. If these uninvestigated neighborhoods are undergoing demolition/reconstruction and removal of foundations, then soils in these areas are considered “pesticide-impacted” and must be mitigated using the same management procedures as for previously assessed neighborhoods, as described in the remainder of this section and Section 4.

If these uninvestigated neighborhoods are <u>not</u> undergoing demolition/reconstruction (i.e. no foundations will be removed), then only those soils within 2 feet of the existing foundations need to be managed as pesticide-impacted soils and then only during intrusive work (e.g., subsurface

excavation and trenching). During such intrusive work, the Best Management Practices (BMPs) and Institutional Controls (ICs) of Section 3.3.3 must be followed.

## 3.3 MANAGEMENT OF IMPACTED SOILS DURING CONSTRUCTION AND DEMOLITION

To minimize the potential for construction delays and maximize flexibility of new construction designs, several options are proposed for managing and handling pesticide-impacted soils, both during demolition and construction and in the future:

1) soil left in place and use of adequate clean soil cover;
2) soil removal and on-site reuse, with adequate cover, in appropriate areas (e.g., berming, under central common areas, within commercial areas, or under parking lots);
3) soil removal and off-site disposal;
4) best management practices (BMPs), to reduce the potential for exposure during soil handling; and,
5) institutional controls (ICs), to reduce the potential for exposure in the future.

Any or all of these options can be used in combination; for example, when significant additional clean fill is required by the new design to reach final grade, management could include removal and on-site reuse of a minimum amount of soil that still achieves adequate clean soil cover at final grade, while leaving deeper impacted soil in place.

### 3.3.1 Use of Clean Soil for Cover

To prevent direct contact or exposure to pesticide-impacted soils, clean soil must be present as cover above pesticide-impacted soils, whether left in place, removed and transported for reuse, or some combination of the two (e.g., partial surface soil removal up to a particular depth). Unless otherwise covered by asphalt or concrete, this clean soil must also be vegetated at the surface and maintained, in order to minimize erosion and surface water runoff.

Impacted soils (above Tier 2 EALs) that are left in place or reused must be covered with an adequate amount of clean fill using the following guidelines for the minimum clean soil cover thickness, based on land use, frequency of use, and surface cover:

1) all backyards, fenced yards, designated play areas, athletic fields, tot lots, and any areas for which a resident is responsible for grounds maintenance as defined in the resident lease:
   minimum 18 inches of clean soil and vegetated cover
2) landscaped areas not specifically listed in item #1 (e.g., unfenced front yards, greenbelts, pedestrian walking areas, bermed soil):
   minimum 6-inches of clean soil and vegetated cover
3) asphalt and/or concrete covered areas (e.g., parking lots, roadways, building pads, carports, driveways, athletic courts):
   no minimum; no clean soil cover requirement

It must be emphasized that the clean cover thickness required is with respect to the final grade and depth of the impacted soil, which may be different than the original grade and depth of the impacted soil. For example, if 18 inches of impacted soil is removed and 6 inches of impacted soil is left in place, but the design of the final grade is 6 inches less than the original grade, an adequate amount of cover is not being provided (in this example, 6 more inches [a total of 2.0 ft] of soil would need to be removed so that 18 inches of clean cover is provided). In a

counterexample, if the design of the final grade calls for 1.5 ft of non-expansive, clean soil to be placed on top of the existing grade, then no soil would need to be removed because the imported soil is providing the clean cover (even though its primary purpose is to meet requirements for soil engineering properties).

It is recommended that a permeable, but protective barrier be placed between pesticide-impacted soils and the clean soil cover when only the minimum amount of clean soil cover is used and intrusive work is likely in the near future. Use of this protective barrier is optional, except in the following specific circumstance: the protective barrier is required whenever less than 24 inches of clean soil cover is provided over pesticide-impacted soils located in a fenced backyard or any other areas for which a resident is responsible for grounds maintenance as defined in the resident lease. The protective barrier requirement for this specific situation can be avoided by providing an additional 6 inches of clean cover above the required minimum 18 inches of clean cover (i.e. a total of 24 inches of clean cover).

In areas where use of protective barrier is optional, a higher priority should be given to its use in areas where future intrusive work (e.g., trenching) is likely and in areas where soil is excavated and consolidated without asphalt/concrete cover. For site and maintenance workers, the protective barrier acts as an engineering control to provide a simple early warning signal prior to encountering pesticide-impacted soils so that appropriate measures can be taken to prevent leaving these soils exposed at the surface when work is completed. Awareness training for site and maintenance workers for these types of barriers is easy to implement. Possible barrier materials could include commercial weed cloth, shade cloth, Geogrid, or other suitable polypropylene materials that are designed for subsurface use, adequately permeable, have an adequate lifetime, and provide some resistance to manual digging tools.

Imported soils used for cover will be certified to be “clean” from hazardous substances (i.e. below Tier 1 EALs), either by the supplier, or through sampling and testing of the materials. Supplier testing or other testing of off-site cover materials will include, but not be limited to, pesticides, petroleum hydrocarbons, and heavy metals.

An alternative to supplier certification is representative sampling and testing of source materials prior to transporting to the communities. In the absence of any specific regulatory guidance in the State of Hawaii, the recommended frequency for the testing of an imported clean fill stockpile or borrow area is: one sample per 250 cubic yards ($yd^3$) for the first 1,000 $yd^3$, then one sample per additional 500 $yd^3$ up to 5,000 $yd^3$, and then one sample per additional 1,000 $yd^3$, based on guidance provided by the State of California, Department of Toxic Substances Control (DTSC, 2001). Collection of samples for non-volatiles analysis (e.g., pesticides, metals) should be performed by compositing representative subsamples for each single sample submitted for laboratory analysis (e.g., 5 subsamples per sample analyzed).

Clean soils may also refer to on-site soils that are documented as not containing concentrations of pesticides or lead above the project-specific Tier 2 EALs (Section 2.3). Unless otherwise identified as a REC in the site-specific Phase I ESA report, other contaminants, such as petroleum hydrocarbons or metals, do not require certification testing in order for on-site soils to be used as clean cover.

### 3.3.2 Management of Impacted Soil

Preference will be given to avoiding leaving impacted soils in place in, or transporting soils for reuse to, areas which have a high potential to be uncovered in the future and/or re-exposed at the surface during temporary intrusive activities (e.g., excavations and trenching).

Examples of areas to avoid leaving impacted soils in place include, but are not limited to:

- around the perimeter of building pads
- along roadways or other areas near existing or new underground utilities

The following is a list of management options, in order of preference, for soils that have been impacted with pesticides above their respective Tier 2 EALs. The magnitude of Tier 2 EAL exceedances by neighborhood, based on the maximum concentrations, are shown for reference in Table 7.

1) Excavation and reuse onsite in centralized areas beneath asphalt/concrete cover, preferably in areas where future excavation or trenching is unlikely (e.g., parking lots, athletic courts, large building pads). If future excavation or trenching is likely beneath or near the selected asphalt/concrete covered areas (e.g., roadways, building pads), use of a soil barrier should be strongly considered to mitigate against re-exposing these soils at the surface in the future.
2) Excavation and reuse onsite in centralized, landscaped common areas (e.g., greenbelts, pedestrian walking areas, bermed soil), preferably in areas where future excavation or trenching is unlikely. If future excavation or trenching is likely beneath these vegetated areas (e.g., due to subsurface utilities), use of a soil barrier should be strongly considered to mitigate against re-exposing these soils at the surface in the future.
3) Excavation and reuse onsite in de-centralized, easily recognizable areas beneath asphalt/concrete cover (e.g., new residential building pads). If future excavation or trenching is likely beneath or near the selected asphalt/concrete covered areas, use of a soil barrier should be strongly considered to mitigate against re-exposing these soils at the surface in the future.
4) Soil left in place, with an adequate amount of vegetated clean soil cover. By definition, it is likely that these areas would be de-centralized areas of former residential building pads which may coincide with new fenced backyards or other areas for which a resident is responsible for grounds maintenance as defined in the resident lease. Therefore, a stronger preference should be given to use of a protective soil barrier, in addition to the BMPs and institutional/land use controls described in Section 3.3.1 and 3.3.3.

   Also, as noted in Section 3.3.1, use of the protective soil barrier is <u>required</u> whenever less than 24 inches of clean soil cover is provided over pesticide-impacted soils located in a fenced backyard or other areas for which a resident is responsible for grounds maintenance as defined in the resident lease. The protective barrier requirement for this specific situation can be avoided by providing an additional 6 inches of clean cover above the required minimum 18 inches of clean cover (i.e. a total of 24 inches of clean cover).

Therefore, in general, it is recommended that priority be given to excavation and centralized soil reuse beneath large asphalt/concrete covered areas and large landscaped common areas, before reuse beneath building pads and roadways (where it is more likely a utility worker might re-expose soils at the surface during trenching or other intrusive activities). In neighborhoods where this type of reuse is either infeasible or cost prohibitive, stronger emphasis must be placed on BMPs, engineering controls (e.g., protective barriers), and institutional/land use controls, as described in Section 3.3.1 and 3.3.3.

As discussed in Section 2.3, concentrations of pesticides in soil that is excavated and reused onsite must also be below levels that are protective of the soil-to-groundwater pathway at the new location and depth (i.e. to prevent leaching of contaminants into groundwater). Based on

previous fate-and-transport modeling (Parsons, 2007a; 2007b), this evaluation is particularly important at sites where dieldrin is present above Tier 1 EALs and groundwater is shallower than 5 feet bgs and/or where endrin is present above Tier 1 EALs and groundwater is shallower than 15 feet bgs.

**TABLE 7**
**MAGNITUDE OF TIER 2 EAL EXCEEDANCES BY NEIGHBORHOOD**

| Neighborhood | Chemical with Largest Tier 2 EAL Exceedance | Maximum Concentration (mg/kg) | Respective Tier 2 EAL (mg/kg) | Magnitude of Tier 2 EAL Exceedance |
|---|---|---|---|---|
| Maloelap | Aldrin | 250 | 0.095 | 2,600 |
| Camp Stover | Aldrin | 160 | 0.095 | 1,700 |
| Catlin Park | Aldrin | 56 | 0.095 | 590 |
| Waikulu (Rainbow) | Aldrin | 26.5 | 0.095 | 280 |
| Ulupau | Dieldrin | 17 | 0.10 | 170 |
| Camp Smith | Dieldrin | 11 | 0.10 | 110 |
| Halawa | Heptachlor | 23 | 0.36 | 64 |
| Manana (Navy) | Heptachlor | 19 | 0.36 | 53 |
| Red Hill | 4,4'-DDT | 190 | 5.7 | 33 |
| Mololani | Dieldrin | 1.6 | 0.10 | 16 |
| Manana (Marines) | Dieldrin | 0.93 | 0.10 | 9.3 |
| Marine Barracks | Dieldrin | 0.53 | 0.10 | 5.3 |
| Waikulu (NCO Row) | Dieldrin | 0.295 | 0.10 | 3.0 |
| Waikulu (Manning Ct) | (no Tier 2 EAL exceedances) | | | |
| Kapoho (Hillside) | (no Tier 2 EAL exceedances) | | | |
| NCTAMS | (no Tier 2 EAL exceedances) | | | |

An alternative to the fate-and-transport modeling approach for the soil-to-groundwater pathway evaluation is recent HDOH guidance on using the Synthetic Precipitation Leachate Procedure (SPLP) test for excavated soil samples and SPLP test results interpreted in accordance with the HEER Office technical guidance on Tier 2 soil leaching evaluations (HDOH, 2006). An advantage to the SPLP approach over the fate-and-transport modeling approach is that it is more site-specific to the pesticide concentrations, distribution, and soil type for excavated soil at a particular neighborhood. Therefore, the SPLP approach could yield results that would permit soil reuse in deeper excavations and/or at sites with very shallow groundwater (i.e. allow a smaller thickness of clean soil between pesticide-impacted soil and groundwater, a smaller "buffer zone").

Excess pesticide-impacted soils from one neighborhood may be transported for reuse in another neighborhood also undergoing construction as long as all of the following conditions are met:

- no public roadways are used (e.g., allowed between neighborhoods within Marine Corps Base Hawaii – Kaneohe, but not allowed between Catlin Park and Manana);

- tracking and documentation of where pesticide-impacted soils are reused in another neighborhood are maintained;
- all provisions of this Plan are implemented (i.e., the soils are provided with adequate clean cover, documentation is maintained, etc…); and,
- any and all requirements of the HDOH Solid & Hazardous Waste Branch are met, to include either prior agreement or demonstration, through TCLP testing, that pesticide-impacted soils proposed for transport do not meet the definition of a hazardous waste.

Where impacted soil remains in place in areas where excavations and trenches may occur, the following requirements will be implemented:

1) a permit approval process for any intrusive activities prior to beginning such work, as described in the ICs listed in Section 3.3.3.
2) documentation and maintenance of records of where pesticide-impacted soils are reused or remain in place, as described in the ICs in Section 3.3.3. These records will include maps, pesticide concentrations, and depth-specific information maintained in a searchable system similar to that used during the Phase II ESAs.
3) training and notification for construction workers on recognizing areas where pesticide-impacted soil may be present and the importance of eliminating uncontrolled surface releases by following procedures contained in this Pesticide Soils Management Plan.
4) during site work, control and management of soil removed from the trench/excavation and subsequently replaced, using the following procedures:
    a. during soil removal, segregation of clean soil at the surface (i.e. the clean soil cover) in a separate stockpile from impacted soil below the clean soil cover;
    b. placement on and covering of the impacted soil stockpile on impermeable material (e.g., visqueen or equivalent);
    c. suitable marking and/or signage of the impacted soil stockpile;
    d. following site work, replacement of pesticide-impacted soil in the bottom of the trench/excavation, the top of which is not to rise above the minimum clean soil cover thickness specified in Section 3.3.1;
    e. recognition of and replacement of any existing soil barrier materials; and,
    f. replacement of the stockpiled clean soil cover above the impacted soils at the minimum clean soil cover thickness specified in Section 3.3.1.

### 3.3.3 Best Management Practices and Institutional Controls

BMPs and institutional controls are critical to ensuring that pesticide-impacted soils are not re-exposed and uncontrollably released at the ground surface, either during the near-term demolition and construction activities for housing or during any future intrusive activities. Based on the expected limited duration of these activities and calculated estimates of neighborhood-specific exposure point concentrations (EPCs) — using the 95-percent upper confidence limit (UCL) on the arithmetic mean (USEPA, 1989) of sampling results from the Phase II ESAs — a comparison of EPCs with the HDOH Tier 1 EALs for construction workers (provided for reference in Table 8) indicated that there are no risks for the construction workers themselves.

The primary objective of the following BMPs and ICs are to prevent construction workers from bringing soils to the surface which may pose risks to longer-term residents.

**TABLE 8**
**TIER 1 EALs FOR CONSTRUCTION/TRENCH WORKERS**

| Chemical | Tier 1 EAL (mg/kg) [a/] | Basis [b/] |
|---|---|---|
| 4,4'-DDD | 1,200 | Direct Exposure (cancer) |
| 4,4'-DDE | 1,200 | Direct Exposure (cancer) |
| 4,4'-DDT | 870 | Direct Exposure (cancer) |
| | 1,500 | Direct Exposure (noncancer) |
| Aldrin | 12 | Direct Exposure (cancer) |
| | 60 | Direct Exposure (noncancer) |
| BHC (Lindane) | 210 | Direct Exposure (cancer) |
| | 830 | Direct Exposure (noncancer) |
| Chlordane (Technical) | 790 | Direct Exposure (cancer) |
| | 1,300 | Direct Exposure (noncancer) |
| Dieldrin | 12 | Direct Exposure (cancer) |
| | 100 | Direct Exposure (noncancer) |
| Endosulfan | 12,000 | Direct Exposure (noncancer) |
| Endrin | 600 | Direct Exposure (noncancer) |
| Heptachlor | 44 | Direct Exposure (cancer) |
| | 1,000 | Direct Exposure (noncancer) |
| Heptachlor epoxide | 22 | Direct Exposure (cancer) |
| | 26 | Direct Exposure (noncancer) |
| Methoxychlor | 10,000 | Direct Exposure (noncancer) |
| Toxaphene | 180 | Direct Exposure (cancer) |

a/ Taken from Table I-3 (HDOH, 2005) for applicable direct exposure scenarios (cancer and/or noncancer).
b/ The most sensitive endpoint is shown first, including cancer or noncancer toxicologic endpoints where applicable (HDOH, 2005).

The following BMPs will be implemented in pesticide-impacted areas as part of the management of pesticide-impacted soil:

1) Any soil brought to the surface during intrusive work will be managed as if it was impacted and handled according in Sections 3.3.1 and 3.3.2.
2) Clean fill will be used to replace soil in trenches or excavations unless the pesticide-impacted soil is segregated appropriately from the clean soil cover during excavation and backfilling using the procedures described in Section 3.3.2.
3) Pesticide-impacted soil that is stockpiled prior to reuse will be covered with 6-mil polyethylene sheeting, and appropriate runoff control and preventative measures will be implemented, as described in Section 3.5.2.
4) Mitigation measures will be implemented to prevent fugitive dust, soil spillage, and site worker exposures, as described in Sections 3.4 and 3.5.
5) Appropriate signage and barriers will be used during soil handling and stockpiling activities, as described in Section 3.5.
6) Environmental oversight and inspections of the construction subcontractor and their work will be implemented to ensure that this soils management plan is followed.

The following ICs will be implemented as part of the management of pesticide-impacted soil:

1) A record of where pesticide-impacted soils are reused or remain in place will be maintained by the Lessee. This record will include detailed maps, including surveyed perimeters of remaining areas of pesticide-impacted soil and depth-specific information. Tracking and maintenance of the records will be the responsibility of the Lessee. These records also will be provided to the Department of the Navy.
2) A permit or work order approval process for any intrusive activities will be implemented by the Lessee, and the approval process will include a permit or work order review by property management against the records described in IC #1.
3) Training and oversight of maintenance workers will be provided by the property manager in the form of site-specific BMPs (SSBMPs), hazard communication, recognition of soil barriers (if used), documentation of pesticide-impacted areas, and the permit approval process, as described in Sections 3.5.3 and 4.2.
4) This Pesticide Soils Management Plan (including any updates) and the records maintained as part of ICs will be provided to the HDOH's Hazard Evaluation & Emergency Response (HEER) Office upon their request to the Lessee and/or as required by law or agreement.

### 3.3.4 Disposal of Impacted Soil

When cost effective, or when site conditions prevent the onsite reuse or leaving in place of pesticide-impacted soils, they may be disposed of in accordance with applicable federal, state, and local laws and regulations. Pesticides or pesticide-impacted material will not be disposed off-site on federal government property. Impacted soils will not be transported to locations not permitted by the HDOH's Office of Solid Waste Management for acceptance of such materials. Copies of any disposal manifests will be provided to the Department of the Navy as required.

Excess pesticide-impacted soils may need to be transported off-site to PVT Landfill in Nanakuli or other approved local landfills. The Lessee will contact PVT Landfill or other approved local landfills and meet its acceptance criteria prior to hauling to the landfill. Pesticide-impacted soils from housing communities on Oahu with levels below the USEPA Region IX Industrial Preliminary Remediation Goals (PRGs), which are based on direct exposure contact, may also be transported as landfill cover material to Waimanalo Gulch Landfill, subject to acceptance by the landfill. USEPA Region IX PRGs for pesticides and lead are provided for reference in Table 9.

**TABLE 9**
**USEPA REGION IX INDUSTRIAL PRGs and**
**HDOH SOIL ACTION LEVELS FOR LEACHING CONCERNS**

| Chemical | PRG (mg/kg) [a/] | Soil Leaching EALs (mg/kg) [b/] |
|---|---|---|
| 4,4'-DDD | 10 | 750 |
| 4,4'-DDE | 7.0 | 1,100 |
| 4,4'-DDT | 7.0 | 4.3 |
| Aldrin | 0.10 | 11 |
| BHC (Lindane) | 1.7 | 0.098 |
| Chlordane (Technical) | 6.5 | 15 |
| Dieldrin | 0.11 | 0.87 |
| Endosulfan | 3,700 | 0.018 |
| Endrin | 180 | 0.010 |
| Heptachlor | 0.38 | 0.19 |
| Heptachlor epoxide | 0.19 | 0.20 |
| Methoxychlor | 3,100 | 19 |
| Toxaphene | 1.6 | 0.44 |
| Lead | 800 | (site-specific) |

[a/] PRGs dated 2004, downloadable from: http://www.epa.gov/region09/waste/sfund/prg/

[b/] Taken from Table E-1 (HDOH, 2005), assuming nonpotable groundwater and the nearest surface water body is >150 m.

## 3.4 MANAGEMENT OF FUGITIVE DUST FROM IMPACTED SOILS

Acute inhalation of chlorinated pesticide vapor is unlikely because of low vapor pressure at ordinary temperatures; however, chlorinated pesticides are semi-volatile and may volatilize in hot environments. The odor threshold for chlorinated pesticides is about 10 times lower than the OSHA PEL; however, odor may not provide an adequate warning for prolonged exposures because olfactory fatigue may occur. Toxic effects can occur after acute inhalation of a spray or mist containing pesticides and after chronic inhalation, usually by occupants of contaminated houses. With pesticide formulations, toxicity may also occur from inhalation of the solvents used in pesticides.

During the handling of pesticide-impacted soils, any fugitive dust created is a concern for off-site residents, although not for construction workers (based on the expected duration of construction activities and comparison of results with Tier 1 EALs for construction workers). To prevent/minimize dust impacts to off-site residents, fugitive dust control measures will be implemented during pesticide-impacted soil excavation and handling.

### 3.4.1 Fugitive Dust Control Measures

The following measures will be implemented during pesticide-impacted soil excavation and handling to prevent/minimize the generation of fugitive dust:

- Non-permeable perimeter fencing along the perimeter of the construction area.
- Prevention of visible fugitive dust from spreading beyond the property line bordering the source of the fugitive dust.

- Reduction of dust levels to no visible emissions beyond the construction site.
- Application of water or dust suppressant material regularly and frequently to exposed soils to minimize dust. Plastic sheeting of appropriate thickness may be used as an alternative for dust control.
- Vehicular traffic and speeds kept to a minimum to minimize dust generation.
- Designation of an onsite stockpile location that does not pose a health threat to the public or onsite personnel.
- Securing all stockpile locations behind locked fencing. The stockpile areas will be properly identified with appropriate signage. The stockpile areas will be covered with 6 mil polyethylene sheeting and appropriate runoff preventative measures will be implemented.
- Cover or tarps on trucks that transport soil to minimize dust generation. Exceptions to the cover or tarp requirements may be made when soils are not transported off-site and soils are sufficiently moist that dust generation is improbable. Cover or tarp requirements will be followed regardless of soil moisture when soils are transported off-site on public roads.
- Preventing soil spills or mixing of soils with surface soils when transporting surplus soil across the site. Any such spillage will be identified in the onsite activity log and immediately reported to the Manager for instructions on how to proceed with handling the spill.

### 3.4.2 Air Monitoring

The following air monitoring program has been developed to assess the effectiveness of the dust suppression controls within designated controlled work areas to prevent/minimize off-site migration of pesticides and/or exposure of pesticides to residents. The focus of the soil mitigation plan is source release control from known areas of pesticide-impacted soil. Therefore, air monitoring during activities that are not directly associated with pesticide-impacted soils are not planned, nor is general offsite ambient monitoring or other types of general periodic air monitoring. Air monitoring was previously conducted during the 2004 Project. Results indicated that levels requiring respiratory protection were never exceeded, and all samples were either not detected (ND) or only detected slightly above the laboratory reporting limit.

Based on these previous results, additional periodic air monitoring using personal air sampling equipment will be performed only on a case-by-case basis during pesticide-impacted soils handling activities within designated controlled work areas (i.e. fenceline borders of sensitive receptors such as schools, child care areas, play areas). In general, air samples will be collected upwind and downwind of pesticide-impacted soils handling areas. Sampling and analysis will be conducted using the National Institute for Occupational Safety and Health (NIOSH) methods or equivalent.

## 3.5 OTHER MITIGATION MEASURES DURING DEMOLITION AND CONSTRUCTION

### 3.5.1 Use of Personal Protective Equipment

Contractors are responsible for developing and implementing their own Health and Safety Plans and to protect their workers. Available information suggests that ingestion and dermal exposure pathways for construction workers are minimized through personal protective clothing, dust control, and good work hygiene practices. Personal protective equipment (PPE) will be

selected which will protect personnel from the hazards and potential hazards they are likely to encounter during the handling of pesticide-impacted soils.

Based on a task hazard analysis, PPE will only be required during handling of pesticide-impacted soils, as identified in Section 3.2 and the site-specific Phase II ESAs for each neighborhood. Based on the expected duration of these activities and comparison of sampling results from the Phase II ESAs with the HDOH Tier 1 EALs for construction workers, construction workers themselves are not at risk when handling pesticide-impacted soils, as discussed in Section 3.3.3. However, to minimize incidental off-site transport of pesticide-impacted soil, the required PPE for workers performing these tasks will be coveralls or disposable clothing (e.g., Tyvek), sleeved shirts, long pants, gloves, hard hats, and safety vests. This PPE will be required at the site at all times during handling of pesticide-impacted soils. The need for respiratory protection will be based on air monitoring results performed as part of worker exposure assessment as described in Section 3.4.2.

Smoking or eating will NOT be allowed in pesticide-impacted soil handling areas. Good hygiene practices will be promoted and followed, including hand washing when leaving the area, to minimize dermal contact and ingestion.

Although dust control is also a mechanism to minimize ingestion and dermal exposure, these control measures are addressed under management of fugitive dust (Section 3.4).

The contractor will maintain a logbook, including drawings, indicating areas where impacted soils have been deposited (either through relocation/reuse or if left in place). Upon completion of their work, the contractor will be required to submit the drawings to the Lessee showing the locations and depths where pesticide-impacted soils have been deposited. These drawings will be submitted to the Department of the Navy upon termination of the Ground Lease.

### 3.5.2 Control of Runoff from Impacted Soils

All appropriate procedures will be implemented to prevent storm and other runoff from the construction area. Construction activities will comply with applicable laws, Ohana Military Communities, LLC's Storm Water Management Plan, specific permit requirements contained in site-specific National Pollutant Discharge Elimination System (NPDES) permits, and the storm water site-specific best management practices (BMPs) plan for the family housing areas.

### 3.5.3 Worker Health and Safety

Contractors are responsible for the health and safety of their personnel. As such, contractors will prepare health and safety plans that encompass both physical and environmental potential hazards for personnel handling pesticide-impacted soil. At a minimum, the plan will include:

- All workers performing soil-handling activities in areas where chlorinated pesticides are suspected to have impacted soils must have satisfied the training requirements of the Occupational Safety and Health Administration's (OSHA) Hazard Communication regulation, 29 Code of Federal Regulations (CFR) 1910.1200. The training program will also address topics such as minimizing soil disturbance and dust control, good housekeeping, good hygiene, material management practices, BMPs and ICs, air monitoring, placement of soil barriers, and documentation of pesticide impacted areas.
- A provision for weekly safety meetings conducted by the construction contractors ("tailgate meetings") to review the plan. A site safety manager and/or safety personnel will be on site during construction activities.
- Clear designation of the pesticide-impacted soil areas.

- Eating, drinking, or smoking will not be allowed in the pesticide-impacted soil areas.
- Notifications will be provided to all subcontractors working on the site in areas where contact may occur with soils suspected of being impacted with pesticides.
- Either coveralls or disposable clothing (e.g., Tyvek) will be worn in the designated pesticide-impacted soil areas when contact with pesticide-impacted soils may occur. This clothing will be kept at the job site and/or deposited at the jobsite for disposal prior to leaving the project area.

### 3.5.4 Hazardous Waste

No hazardous wastes are expected to be generated, nor are any wastes that require disposal offsite at an off-island disposal facility expected to be generated.

## 3.6 ACTIVITY CLOSURE REPORTING

Upon completion of construction activities, an activity closure report will be prepared by the Lessee and maintained by the Lessee for the duration of the Ground Lease. The activity closure report will be submitted to the Department of the Navy. The report will include any sampling results, a description of institutional controls to remain in place, drawings showing the locations and depths where pesticide-impacted soils have been deposited, and any updates to mitigation measures needed based on the new baseline conditions. In addition, any soil disposal records or waste characterization efforts performed prior to disposal will be included. Upon termination of the Ground Lease, the activity closure report will be provided to the Department of the Navy.

The information in the activity closure report may also be used to support any revisions to this Pesticide Soils Management Plan.

# 4.0 PESTICIDE SOILS MANAGEMENT – OPERATIONS AND MAINTENANCE OF HOUSING AREAS

## 4.1 PLAN IMPLEMENTATION

Pesticide-impacted soils in the housing areas will be managed throughout the lease period or until pesticide concentrations in soil have degraded to below the Tier 2 EALs. This plan will be used as part of the normal course of construction management and operation and maintenance activities in these communities.

This Pesticide Soils Management Plan will be reviewed annually at a minimum and, as needed, modified accordingly to conditions, changes in use, or laws and/or regulations. The Lessee will obtain approval, if required, from the Department of the Navy for any Plan modifications. In addition to this section, Section 3.0 addresses specific activities that will be implemented during demolition and construction activities. All activities will be conducted in accordance with local, state, and federal laws and regulations.

## 4.2 TRAINING OF MAINTENANCE PERSONNEL

Maintenance personnel responsible for implementing activities identified in this Plan will be adequately trained and capable of carrying out their work with pesticide-impacted soil in a manner that minimizes their exposure and the exposures of residents, visitors, and employees of the site to pesticides. The Maintenance Manager will implement periodic training, such that all appropriate facility personnel are familiar with this Plan. In addition to training, this Plan, along with the Storm Water Management Plan, the Spill Prevention, Countermeasures and Control Plan, the Partners Plan for Pest Control, and the Hazardous Materials Management Plan will be presented and reviewed by the Maintenance Manager. Notification of the availability for review of these documents will be made to all maintenance personnel and subcontractors that may manage or handle potentially pesticide-impacted soil prior to conducting work for the housing communities.

The training program will include, as a minimum, satisfying the training requirements of OSHA's Hazard Communication regulation, 29 CFR 1910.1200. The training program will also address topics such as minimizing soil disturbance and dust control, good housekeeping, good hygiene, material management practices, BMPs and ICs, recognition of soil barriers (if used), documentation of pesticide impacted areas, and the permit approval process, as described in Section 3.0.

## 4.3 MAINTENANCE ACTIVITIES

Trained maintenance personnel will be responsible for the following activities in areas where soil may be impacted with pesticides:

- Planting, landscaping or future activities that require excavation or soil disturbance in areas suspected of or documented to contain pesticide-impacted soils. Appropriate cover must be maintained in these areas to minimize exposure to dust, ingestion, or personal contact.
- Identification of known pesticide-impacted soils, including soils placed under foundations, in construction drawings. Location maps and drawings of known pesticide-impacted soil mapped during construction will be provided to maintenance personnel as part of hazard communication. Soil disturbance activity in

pesticide-impacted areas (i.e., landscaping, etc.) will also be maintained by maintenance personnel. These records will be maintained at a central location and will be available to property management personnel.

- Soccer fields, parks, and designated community playgrounds in areas suspected of or documented to contain pesticide-impacted soils will be visually monitored by property management personnel to identify and prevent soil exposure due to wear and tear or overuse. Appropriate measures will be taken to minimize exposure to these soils. The required clean soil vegetative cover, as described in Section 3.3.1, will be maintained and re-vegetated as needed. If exposed soil is observed during routine inspection in areas suspected of or documented as containing soils impacted with pesticides, use of the area will be discontinued until appropriate measures are taken to prevent exposure to these soils. As an alternative, soil sampling and testing may be conducted to assess the presence of pesticides at these locations. If pesticides are not present above Tier 2 EALs, then mitigation measures may not be warranted and portions of the plan may be waived. If pesticides are present at or above Tier 2 EALs, then the appropriate mitigation measures will be implemented.
- Subsurface utility repair in areas suspected of or documented to contain pesticide-impacted soils will be conducted by trained personnel or contractor. Soil disturbance in these areas will be limited to the area of repair. The exposed soil in these areas will be covered with plastic sheeting until the utility line is repaired. Appropriate BMPs and measures will be taken during utility repair and backfilling to prevent and/or minimize surface exposure of the impacted soils, as described in Sections 3.3.2 and 3.3.3.
- All work areas or areas under repair that require disturbing soils in areas suspected of or documented to contain pesticide-impacted soils will be secured in such a manner to keep tenants and children from entering the work area.
- Eating, drinking, or smoking will not be allowed within immediate work areas suspected of or documented to contain pesticide-impacted soils to prevent ingesting contaminated material.
- Maintenance personnel will wash their hands before leaving work areas suspected of containing soils impacted with pesticides to minimize dermal contact and ingestion.
- Maintenance workers are not at risk when handling pesticide-impacted soils. However, to minimize incidental off-site transport of pesticide-impacted soil, either coveralls or disposable clothing (e.g., Tyvek) will be worn when digging or contacting soils suspected of being impacted with pesticides, in order to prevent/minimize transferring the soils from the work area onto worker clothing, to the surface, and/or off-site. Soiled disposable coveralls used when working in these areas will be deposited on site for disposal to minimize transport of impacted clothing to worker homes.

## 4.4 EVALUATION AND INSPECTION

Maintenance personnel will inspect, on regular intervals, for exposed soil and soil disturbance in areas suspected of or documented to contain pesticide-impacted soils. Appropriate measures will be implemented to prevent exposure to these soils.

## 4.5 USE OF PERSONAL PROTECTIVE EQUIPMENT

As discussed in Section 3.5.1, maintenance and construction workers are not at risk when handling pesticide-impacted soils. However, to minimize incidental off-site transport of pesticide-impacted soil, it may be necessary at times to wear PPE when handling or disturbing pesticide-impacted soils. In addition, ingestion and dermal exposure pathways for maintenance personnel are minimized through personal protective clothing, dust control, and good work hygiene practices. Selection of the appropriate PPE will be made by the site safety manager and/or safety personnel based on a task hazard analysis, monitoring data, and the action levels listed in the onsite health and safety plan.

Protective clothing, such as coveralls and gloves, must be worn whenever personnel may come into contact with pesticide-impacted soils. Soiled disposable coveralls used while working in pesticide-impacted areas will be deposited on site for disposal to prevent transport of the impacted clothing to worker homes.

Examples of work that may occur in areas suspected of or documented to contain pesticide-impacted soils include:

- Soil disturbance beneath protective ground cover, protective clean soil cover, or soil barriers (i.e., digging, trenching, or excavations);
- Subsurface utility repair; and,
- Construction or demolition activities around foundations of existing residences.

## 4.6 DISPOSAL OF PESTICIDE-IMPACTED SOILS

When cost effective, or when site conditions prevent the onsite reuse or leaving in place of pesticide-impacted soils, they may be disposed of in accordance with applicable federal, state, and local laws and regulations. Pesticides or pesticide-impacted material will not be disposed off-site on federal government property. Impacted soils will not be transported to locations not permitted by the HDOH's Office of Solid Waste Management for acceptance of such materials. Copies of any disposal manifests will be provided to the Department of the Navy as required.

No hazardous wastes are expected to be generated nor are any wastes that require disposal offsite at an off-island disposal facility expected to be generated.

Detailed requirements and procedures for the disposal of pesticide-impacted soils are provided in Section 3.3.4.

## 4.7 NOTIFICATIONS

Written notifications will be provided by the Lessee where residents or contractors may contact soils impacted with pesticides.

# 5.0 RELIANCE LANGUAGE

## 5.1 USE BY THIRD PARTIES

This report was prepared for Ohana Military Communities, LLC, its Managing Member and other Members of Ohana Military Communities, LLC. It may be relied upon by Ohana Military Communities, LLC, its Managing Member and other Members of Ohana Military Communities, LLC, the United States of America, Department of the Navy, Ohana Military Communities, LLC's lenders, including, without limitation, Merrill Lynch & Co., the Bank of New York Trust Company, N.A., the Master Trustee under that certain Master Indenture (the "Indenture"), Trimont Real Estate Advisors, Inc., the Bondholder Representative under the Indenture, and each of their respective officers, directors, employees, affiliates, successors, assigns, legal counsel and advisors.

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