DATA QUALITY OBJECTIVES (DQO) PROCESS DOCUMENT
OBJECTIVE OUTPUTS

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East Kapolei Brownfields
Agricultural Property

Targeted Brownfields Assessment and
Phase II Property Assessment

Data Quality Objectives (DQO) Process Document
Objective Outputs

This document is adapted from the East Kapolei Brownfields Agricultural Property DQO Process Document Objective outputs, prepared by Ecology and Environment, Inc., dated February 2006. This revision includes the updated sampling strategy proposed by the State of Hawaii, Department of Health (HDOH) and Tetra Tech EM Inc. (Tetra Tech). Substantive updates are presented in highlights.

1. THE PROBLEM

Background:

The site that is the subject of the Targeted Brownfields Assessment and Phase II Site Assessment is an area located on parcels of land owned by the State of Hawaii and administered by the State of Hawaii's Department of Land and Natural Resources (DLNR). The DLNR is now in the process of transferring the land ownership to Department of Hawaiian Homeland (DHHL). DHHL plans to develop the property into residential housing. The parcels currently are either unused or leased to various agricultural tenants, and the DLNR plans to develop the property into residential housing. The property was acquired in 1993 from Campbell Estate.

- Parcel TMK 1-9-1-017-071 and Parcel TMK 1-9-1-017-088 are two contiguous parcels with a total area of 404.254 acres. The property is wedge-shaped and situated just northwest of the village of Ewa and the Ewa Village Golf Course.

In the northwest portion of Parcel TMK 1-9-1-017-088 is a site referred to as the Oahu Sugar Company (OSC) Pesticide Mixing and Loading Area. This site includes an approximately 0.634-acre area that surrounded by a chain-link fence and the area surrounding it. Historically, this site was used as a primary mixing and loading area for agricultural chemicals, and previous investigations have documented that soil both inside and outside the fenced area is contaminated with dieldrin, arsenic, atrazine, ametryn, pentachlorophenol, trifluralin, polychlorinated dibenzo-dioxins (PCDDs), and polychlorinated dibenzo-furans (PCDFs) at concentrations above current USEPA Region 9 2004 Preliminary Remediation Goals (PRGs) for residential soil and December 2003, Hawaii Department of Heath (HDOH) *Screening For Environmental Concerns At Sites*, Environmental Action Levels (EALs). Contamination by various other semivolatile compounds, organochloropesticides and metals also was detected in soil at concentrations below current USEPA PRGs for residential soil and HDOH EALs. The extent of the contamination beyond the fence line has not yet been determined. The area within the fence line is generally considered to have contaminated soil, although no systematic sampling strategy to determine the distribution of soil contamination has been implemented. This site is situated approximately 70-80 feet above the Pearl Harbor Aquifer.

In addition to the contaminated areas both inside and outside the fence of the OSC Pesticide Mixing and Loading Area, there are one or more areas of potential contamination that are associated with the mixing of pesticides and herbicides. One area was identified in the September 2004, *Phase I Environmental Site Assessment at East Kapolei Brownfield, Kapolei, Hawaii,* prepared by AMEC Earth and Environmental for HDOH, Hazard Evaluation and Emergency Response Office (HEER). This area was identified based on the presence of discarded pesticide containers in those areas.

Based on the historical connection of the OSC Pesticide Mixing and Loading Area with the property being proposed for development, the potential for soil contamination similar to what has been documented in association with the OSC Pesticide Mixing and Loading Area exists throughout this agricultural property.

Based upon these conditions a Phase II assessment should be initiated that will address data gaps that are described later in this document. Once the new Phase II data are generated, a report should be prepared that can be used to address the appropriate corrective action requirements for development of these parcels. For clarity and effective understanding of the problems and assessment design, the objectives and planning documents relating directly with the Oahu Sugar Company (OSC) Pesticide Mixing and Loading Area will be prepared separately from the assessment of the majority of the East Kapolei property. The assessment of the Oahu Sugar Company (OSC) Pesticide Mixing and Loading Area will be referred to as: East Kapolei Brownfields Pesticide Mixing and Loading Areas Investigation. It will include a groundwater investigation. The SAP and DQOs associated with this investigation have been approved by the U.S. EPA and delivered to HDOH.

The assessment of the rest of the property will be referred to as: East Kapolei Brownfields Agricultural Property. What follows is the DQO document for the East Kapolei Brownfields Agricultural Property.

Conceptual Site Model

Surface Soil Throughout the Site

- The media of concern are soil.
- The principal chemicals of potential concern (COPC) are dieldrin, arsenic, atrazine, ametryn, pentachlorophenol, trifluralin, and dioxins above current USEPA PRGs for residential soil and HDOH EALs.
- The soil medium may be contaminated due to legal application of pesticides and herbicides.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

- The media of concern are soil
- The principal COPCs are dieldrin, arsenic, atrazine, ametryn, pentachlorophenol, trifluralin, and dioxins above current USEPA PRGs for residential soil and HDOH EALs.
- The soil medium was contaminated with COPCs due to operational and waste disposal practices. Contamination may also be due to migration of contaminants from OSC Pesticide Mixing and Loading Area.
- The groundwater medium could potentially be contaminated due to migration from overlying or upgradient sources areas.

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Exposure Scenario

Surface Soil Throughout the Site

- Concerns based on current conditions appear to be minimal due to current land use.
- The conditions at the site may pose an additional threat to human health during development of the property. Direct and airborne exposure of human and/or environmental receptors to COPC-contaminated soil and soil-derived particulate may be of concern during development.
- The excess soil generated during site development may pose a threat to human health during transportation and disposal.
- Development of the property without investigation and associated remedial action to address discovered contamination could potentially expose human and/or environmental receptors to COPCs in the soil.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

- Concerns based on current conditions include direct exposure of human and/or environmental receptors to COPCs in soil and exposure to contaminated soil that has migrated as particulate matter or soil due to dust and water runoff.
- The conditions at the site may pose an additional threat to human health during development of the property. Direct and airborne exposure of human and/or environmental receptors to COPC-contaminated soil and soil-derived particulate are of concern during development.
- The excess soil generated during site development may pose a threat to human health during transportation and disposal.
- Development of the property without investigation and associated remedial action to address contamination would potentially expose human and/or environmental receptors to COPCs in soil.
- Concerns include exposure of human and/or environmental receptors to contaminated groundwater, which could migrate into the drinking water aquifer.

The designated decision-makers for the HDOH and Hawaii DLNR are responsible for overall project direction, plan review, and plan approval. They will be the ultimate users of the data and are responsible for decisions regarding risk and corrective action on the property.

Planning Team:

Ms. Melody G. Calisay, HDOH Project Manager
Mr. Davis Bernstein, HDOH
Ms. Fenix Grange, HDOH
Mr. Morris Atta, Hawaii DLNR
Ms.Carolyn Douglas, USEPA Task Monitor
Ms. Gail Jones, USEPA Quality Assurance Officer
Mr. Alex Globerson, Tetra Tech Task Leader
Mr. Jason Brodersen, Tetra Tech Program Manager

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The roles and responsibilities for this investigation are the following:

- Gail Jones, USEPA Region 9 QA Office representative (or designee) will provide independent quality assurance oversight to ensure that planning and plan implementation are in accordance with USEPA regional quality assurance/quality control (QA/QC) protocol. She will provide technical direction concerning QA/QC as needed to the USEPA Task Monitor.

- Ms. Melody G. Calisay, Mr. Davis Bernstein, and Ms. Fenix Grange, HDOH, will be responsible for planning and are the decision-makers regarding state regulatory requirements. HDOH will ultimately decide what data are needed in order to make recommendations, set requirements and/or grant approvals regarding the development of the property.

- Mr. Morris Atta, Hawaii DLNR, will assist with planning, is the point of contact with the DLNR. The DLNR will decide on how the generated data and the associated recommendations and HDOH requirements will affect redevelopment.

- Mr. Alex Globerson and Mr. Jason Brodersen will oversee the preparation of the sampling and analysis plan (SAP) amendment and all other deliverables for HDOH for this project. Mr. Alex Globerson will oversee day-to-day activities associated with planning, field sampling, and reporting. Mr. Jason Brodersen will provide overall project quality assurance and management support.

- The responsibility for implementation of the SAP, coordination of project tasks, coordination of field sampling, project management, and completion of all preliminary and final reporting will be the responsibility of the HDOH.

Other Considerations and Constraints related to problem and resources:

- The property and areas of concern are situated above the Pearl Harbor Aquifer and which is classified as a currently used drinking water source.

- The actual locations of Potential Contamination Source Areas will need to be identified during phase II assessment sampling.

- Soil analyses available for assessment are not always useful to determine disposal and remediation costs. Additional waste testing of excavated soil is usually necessary. Contamination not found during the soil investigation might be revealed during development.

- The development plans related to this property has not yet been determined.

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2. THE DECISION

Principal Study Questions:

Principal Study Question: What are the risks and corrective action recommendations for this property?

In order to answer the principal study question, the following two primary study questions must first be resolved:

Primary Study Question #1: Previous property investigations indicate that the property is associated with pesticide and herbicide application. What is the estimated average concentration of COPCs within the property?

Primary Study Question #2: Previous property investigations indicate that due to the size of the property and its agricultural history there may be other areas on the property that may be associated with pesticide mixing. These unidentified areas potentially have elevated concentrations of COPCs. Where are the areas? What is the estimated concentration of COPCs within each of the identified areas?

Actions that could result from resolution of the study questions:

For Primary Study Question #1 (regarding *Surface Soil Throughout the Property*):

> If it is resolved that the concentration of COPCs in soil within a parcel is below action levels, then no further action will be required at that parcel.
>
> If it is resolved that the concentration of COPCs in soil within a parcel is above action levels, then the information will be used to determine risk and additional investigation that may be required at that parcel.

For Primary Study Question #2 (regarding the *Previously Unidentified Areas* of Potential Agricultural Chemical Mixing and Loading):

> If it is resolved that there are no elevated concentrations of COPCs in soil, then the associated area(s) will require no further action.
>
> If it is resolved that the concentration of COPCs in soil is above action levels, then the information will be used to determine risk and additional investigation that may be required at that area(s).

Decision Statement(s)

For the *Surface Soil Throughout the Site:* Determine the concentration of contaminations on the property in order to evaluate whether the area requires further sampling, further risk assessment, or further remedial option assessments.

For *Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading*: Determine if contamination exists in these areas in order to evaluate whether the areas require further assessments.

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3. DECISION INPUTS

New Environmental Data Required to Resolve the Decision Statements:

Surface Soil Throughout the Site

- COPC data for soils between 0 and 6 inches are required. Data are needed to estimate the surface concentration of contamination in the parcels.
- Geospacial data for the areas and associated sampling locations are needed.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading:

- COPC data for soils between 0 and 6 inches beneath the parcel are required only if any such areas are identified during field activities. Data would be needed to estimate the surface concentration of contamination in the parcels.
- Geospacial data for the areas and associated sampling locations would be needed.

Sources of information to resolve the decision statements:

- Visual survey data and global positioning station (GPS) data for Other Areas of Potential Agricultural Chemical Mixing and Loading.
- Analytical data from proposed sampling.
- Previously generated analytical data.
- GPS location data from proposed sampling.
- Risk-based action levels for detected analytes.

Information Needed To Establish Action Level:

The following benchmarks exist for COPCs:

- October 2004 EPA Preliminary Remediation Goals - Industrial Soil for direct contact.
- October 2004 EPA Soil Screening Levels for migration to groundwater.
- May 2005 HDOH Screening For Environmental Concerns At Sites With Contaminated Soil and Groundwater.
- April 2006 *HDOH Sampling Memorandum* regarding evaluation of dioxin.

Collection methods:

Soil samples can be collected using a trowel, hand auger, Geoprobe or other direct push technology.

Measurement methods:

Collected soil samples can be analyzed to determine COPC concentrations using the following methods:

- Inorganic metals, arsenic only by EPA Method 6010B. Soil samples where arsenic values exceed the screening level will be re-analyzed through physiologically-based extraction tests to measure the bioaccessibility of the arsenic that is present.

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- Dioxin/Furans by XDS-Calux Bioassay and EPA Method 8290A GC/MS for 25 split samples
- Organophosphorus Pesticides by EPA Method 8141
- Organochlorine Pesticides by EPA Method 8082
- Chlorinated Herbicides by EPA Method 8151

Confirm that appropriate (analytical) methods exist to provide the necessary data:

All indicated methods have sufficient sensitivity, accuracy, precision and other quality parameters to generate necessary data, provided the data are not needed in a time-critical time frame. Results of XDS-Calux Bioassay will be compared to split samples evaluated by EPA Method 8141.

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4. STUDY BOUNDARIES

Specific characteristics that define population being studied

Surface Soil Throughout the Site

- The COPC concentrations in soil within the specified spatial and temporal boundaries.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

- The COPC concentrations in soil within the specified spatial and temporal boundaries.

Spatial boundaries: New data will be generated from samples collected from the areas designated as:

Surface Soil Throughout the Site

The boundary shall encompass all areas within the legal boundary of each parcel to a depth of not more than 6 inches below ground surface, with the exclusion of any areas identified as *Areas of Potential Agricultural Chemical Mixing and Loading*.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

Suspect areas will be located and delineated during sampling. The boundary shall encompass the entire area within field delineated perimeters with a depth of not more than 6 inches bgs.

Temporal boundaries:

The decisions will apply to determinations of risk associated with long-term exposure to contaminated surface soil from direct exposure. However, the decision may also apply to short-term (acute) exposure to contaminated soil due to development activities.

Metals, dioxins, pesticide and herbicides of concern are environmentally persistent, migrate slowly, and will not greatly vary in concentration in soil over time. Given the location and relative inaccessibility of potential contamination, the threat to groundwater, surface water and present communities is not expected to be immediate or imminent. However, the threat will be increased due to the development activities, since the contamination, if present, will be exposed. Further, a residential development will establish a community in close proximity to contamination. Additionally the data are needed in order for the development project to proceed.

The following assessment time-frame has been proposed:

- The revised sampling plan will be submitted to USEPA and HDOH by June 30, 2007, and should be reviewed and revised by July 10, 2006.
- Sample collection will take place following sample plan approval by the USEPA and HDOH, currently scheduled for mid July 2006.

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- All preliminary data should be reported within 3 weeks of sample delivery to the laboratory.
- Data packages and final data should be reported to project management approximately 3 to 5 weeks after sample delivery to the laboratory.
- Decision statement resolutions are expected to take place 2 to 3 months after sampling and should take place prior to development decisions.
- Development is not expected to commence any sooner than late 2006.

Scale of decision-making:

Surface Soil Throughout the Site

The sampling strategy is based characterizing surface soil concentrations at 59 decision units at the site. Each decision unit will be approximately 5,000 square feet in area to represent the estimated dimensions of a residential home lot. The 59 decision units will be determined as follows:

1. The entire 400-acre site will be divided into 59 strata or grids of approximately 7 acres in size
2. Within each grid, one geographic point will be identified by a random number generator
3. Each point will serve as the center of a 5,000 square foot decision unit

The result is 59 decision units located in a stratified random pattern throughout the entire site. Special consideration will be made to those decision units which are located within or near the boundaries of the Contingency Reserve Area (CRA). The CRA is monitored by the Department of Land and Natural Resources Division of Forestry and Wildlife (Forestry and Wildlife) due to the presence of endangered plants on the property. If a decision unit is located within this area, Forestry and Wildlife personnel have requested that prior to the scheduling of the sampling events a representative from Forestry and Wildlife conduct a brief training session to help the sampling individuals or teams identify the endangered plants and avoid disturbing them.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

The scale of decision-making concerning these areas will cover the entire delineated area for each potential source area. Each decision unit for delineated areas should not exceed approximately 5,000 square feet.

Practical constraints on data collection:

<u>Physical Constraints:</u>

- Sampling of decision units will be constrained to physical access to the property, if any.

<u>Other Constraints On Data Collection</u>

- Specific data may be qualified or rejected due to QA review.

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5. DECISION RULE

Statistical Parameter

Surface Soil Throughout the Site

Soil will be compared to the established benchmarks. If sample results exceed the concentrations at any decision unit, then the site will not have passed the screening level evaluation. No statistics are proposed currently to evaluate the data.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

The estimated concentration of the contaminants within a composite sample are the parameter of concern.

Action Level:

Refer to Table 1 for potential site action levels.

Decision Rule:

Surface Soil Throughout the Site

- If the new data indicate that the average contaminant concentrations in soils on the properties are below the action levels, then the decision-maker will report data and make no recommendations regarding corrective actions for the property.

- If the new data indicate that the average contaminant concentrations in soils on the properties are above the action levels, then the decision-maker will report data, assess risks and make recommendations regarding additional investigation or corrective actions required for the area as part of the development.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

- If the new data indicate that the contaminant concentrations in soil samples collected from the delineated areas are below the action levels, then the decision-maker will report data and make no recommendations regarding corrective actions for the property

- If the new data indicate that the contaminant concentrations in soil samples collected from the delineated areas are above the action levels, then the decision-maker will report data, assess risks and make recommendations regarding additional investigation or corrective actions required for the area as part of the development.

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Table 1 **Potential Soil Action Levels** All units milligrams per kilogram (mg/kg)			
	USEPA PRGs Residential Direct Exposure[1]	**HDOH EALs[2]**	**Elevated Range Detected at source area**
Arsenic	0.39 mg/kg or above background	22 mg/kg	16-160 mg/kg
Dieldrin	0.03 mg/kg	.003 mg/kg	0.049 mg/kg
Pentachlorophenol	3 mg/kg	69 mg/kg *	13-310 mg/kg
Atrazine	2.2 mg/kg	3.1 mg/kg *	86-3,472 mg/kg
Trifluralin	63 mg/kg	Na	190 mg/kg
Ametryn	550 mg/kg	Na	17,664 mg/kg
All units micrograms per kilogram (µg/kg)			
(PCDD/PCDF) TEQ	0.0039 µg/kg	0.0039 µg/kg	0.64-334 µg/kg

[1] R-PRG = USEPA Region 9 2004 Preliminary Remediation Goals (PRGs) for residential soil.
[2] May 2005 *HDOH Screening For Environmental Concerns At Sites.* Environmental Action Levels (EALs). Soil samples where arsenic values exceed the screening level will be re-analyzed through physiologically-based extraction tests to measure the bioaccessibility of the arsenic that is present.
* EALs shown in this table for pentachlorophenol and atrazine were computed by Mr. Roger Brewer with HDOH. Per direction by HDOH, these values were added to the East Kapolei Affordable Housing Project Memorandum and the DQOs.

na = EALs for these analytes are not yet available.

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6. LIMITS ON DECISION ERRORS

Range of the parameter(s) of interest: For all investigation areas and parameters, the range of interest for COPCs is anything above the action levels. Quantitatively precise and accurate determinations of contaminant concentrations that are significantly above (i.e., >100 times) the action level are not necessary.

Based upon the property use, the contaminant concentrations at the *Surface Soil Throughout the Site* are expected to be below the action levels.

Based upon visual information, the contaminant concentrations associated with any *Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading* are expected to be above action levels

Baseline Condition *(The Null Hypothesis)*

Surface Soil Throughout the Site

The contaminant concentrations in soils are greater than or equal to action levels.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

The contaminant concentrations in soils are greater than or equal to action levels.

Alternative Condition *(The Alternative Hypothesis)*

Surface Soil Throughout the Site

The contaminant concentrations in soils are less than action levels.

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

The contaminant concentrations in soils are less than action levels.

Soil Decision Error Limit Goals:

DECISION ERROR ***Surface Soil Throughout the Site***		
Decision Error	Deciding that the property is contaminated and requires restriction, mitigation or additional investigation when the property is not contaminated.	Deciding that the property is not contaminated and requires no restrictions, mitigation or additional investigation when the property is contaminated.
True Nature of Decision Error	The sample concentrations are either not representative or are biased low.	The sample concentrations are either not representative or are biased high.

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The Consequence of Error	1) Development of property will have restrictions and will either undergo additional investigation or area may undergo additional mitigating activities. These situations would cost additional resources of time, money and manpower.	1) Workers could be directly exposed to contaminants during development. 2) The contaminated soil could potentially migrate throughout the area due to development activities. 3) The contamination could migrate from soil to air (as dust) during development. 4) The contaminant would become exposed and accessible to the community following development.
Which Decision Error Has More Severe Consequences near the action level?	**LESS SEVERE** to human health, but with more appreciable economic consequences.	**MORE SEVERE** since the contaminated soil may pose risks to human health and/or the environment.
Error Type Based on Consequences	**False Rejection Decisions** A decision that the area is contaminated when it is not.	**False Acceptance Decisions** A decision that the area is not contaminated when it is.

Null Hypothesis = The contaminant concentrations in soils are less than action levels.

Definitions

False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false.

False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true.

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Decision Errors

DECISION ERROR ***Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading***		
Decision Error	Deciding that the area is contaminated and requires restriction, mitigation or additional investigation when the area is not contaminated.	Deciding that the area is not contaminated and requires no restrictions, mitigation or additional investigation when the area is contaminated.
True Nature of Decision Error	The sample concentrations are either not representative or are biased low.	The sample concentrations are either not representative or are biased high.
The Consequence of Error	1) Development of property will have restrictions and will either undergo additional investigation or area may undergo additional mitigating activities. These situations would cost additional resources of time, money and manpower.	1) Workers could be directly exposed to contaminants during development. 2) The contaminated soil could potentially migrate throughout the area due to development activities. 3) The contamination could migrate from soil to air (as dust) during development. 4) The contaminant would become more exposed and more accessible to the community following development.
Which Decision Error Has More Severe Consequences near the action level?	**LESS SEVERE** to human health, but with appreciable economic consequences.	**MORE SEVERE** since the contaminated soil may pose risks to human health and/or the environment.
Error Type Based on Consequences	**False Acceptance Decisions** A decision that the area is contaminated when it is not.	**False Rejection Decisions** A decision that the area is not contaminated when it is.
Null Hypothesis = The contaminant concentrations in soils are greater than or equal to action levels. **Definitions** False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false. False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true.		

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Decision Error Limits Goals *Surface Soil Throughout the Site*			
True Average Concentration of Property (% of Action Level [AL])	**Decision Error**	**Decision Error Probability Goals (Based on Professional Judgement)**	**Type of Decision Error**
<75 %	A decision that the property is contaminated when it is not.	1 %	False Rejection (alpha)
75 to <100 % AL	A decision that the property is contaminated when it is not.	Gray Area [1]	False Rejection Gray Area (delta)
100 to 125 % AL	A decision that the property is not contaminated when it is.	10 % [2]	False Acceptance (beta)
> 125 %	A decision that the property is not contaminated when it is.	less than 1 %	False Acceptance

The goals in this table are based on professional judgment as relevant to a Phase II Assessment.

[1] Gray Area is where relatively large decision errors are acceptable.

[2] Note that relatively large decision errors are expected when the true contaminant concentrations are between 100 and 125 % of the action level.

Sigma value is unknown.

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Decision Error Limits Goals
Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

True Average Concentration of Sample (% of Action Level [AL])	Decision Error	Decision Error Probability Goals (Based on Professional Judgement)	Type of Decision Error
<75 %	A decision that the area is contaminated when it is not.	5 %	False Acceptance(beta)
50 to <100 % AL	A decision that the area is contaminated when it is not.	Gray Area [1]	False Rejection Gray Area (delta)
100 to 150 % AL	A decision that the area is not contaminated when it is.	10 % [2]	False Rejection (alpha)
> 150 %	A decision that area is not contaminated when it is.	less than 1 %	False Rejection

The goals in this table are based on professional judgment as relevant to a Phase II Assessment.

[1] Gray Area is where relatively large decision errors are acceptable.

[2] Note that relatively large decision errors are expected when the true contaminant concentrations are between 100 and 150 % of the action level.

Sigma value is unknown.

7. Optimized Design for Obtaining Data

General:

All sampling, analytical and quality assurance activities will proceed under a USEPA-approved Sampling and Analysis Plan (SAP). A record of sampling activities and deviation from the SAP must be documented in a bound field log book. Prior to sample collection, all project sampling personnel will review relevant sampling procedures and relevant quality assurance and control (QA/QC) requirements for selected analytical methods.

Decision Error Minimization:

Contamination Hot Spot Locations

In order to minimize a decision error related to data uncertainty for sampling data from discrete , data from a sampling location or locations that are above the action level and are relatively greater (i.e., >3 times) in contaminant concentrations than adjacent sampling locations should be considered as a potential contamination hot spot and evaluated separately.

Data from Individual Sample locations

The decision-maker should consider data uncertainty when making decisions based upon sampling data and associated estimated values based upon a single location. An individual data value reported between below the action level may potentially be biased low, while a data value reported above of the action level may potentially be biased high. The probability of decision error increase at COPC concentrations around the action level due to both data uncertainty and data bias.

For any reported values near the method detection limit, the uncertainty of any given value is even greater. Thus the probability of decision error is greatly increased at COPC concentration near detection limits. The uncertainty for estimated data (i.e., data based on extrapolations and interpolations) is typically greater than for actual data. Therefore the probability of decision error is greatly increased for extrapolated data.

Specific Design Optimization Based Upon Objectives and Cost:

Based upon the project goals and objectives, the planning team considered the follow design elements as necessary to achieve DQOs:

Surface Soil Throughout the Site

- The collection and analysis of soil samples for all COPCs.
- The collection of soil samples within each decision unit property excluding source and potential source areas
- Representative soil sampling over the entire decision unit
- Generation of average concentration for COPC within each decision unit of property through the collection of 40 subsamples.
- Generation of variance data.

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Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

- The collection and analysis of soil samples for all COPCs.
- The collection of soil samples within each delineated suspect area.
- Representative soil sampling over the areas.
- Generation of average concentration for COPC within each delineated area.
- Generation of variance data.

Six soil sampling designs for *Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading* and for *Surface Soil Throughout the Site* are evaluated in Table 3b. The sampling designs include:

- Discrete sampling at systematic locations within each decision unit.
- Discrete sampling at random locations within each decision unit.
- A composite sample collected from systematic locations within each decision unit.
- A composite sample collected from random location within each decision unit.
- A multiple-increment sample collected from systematic locations within each decision unit..
- A multiple-increment sample collected from random location within each decision unit.

Three analysis designs for the site were evaluated in Table 4b. The designs include:

- Analysis of all collected samples by definitive analyses.
- Analysis of all collected samples by definitive analyses combined with field analyses of outer perimeter samples to establish whether the extent of contamination has been resolved.
- Field analysis of all samples with 10 percent confirmation analysis by definitive analyses.

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SAMPLING DESIGN SELECTION **Soil** **Table 3b**						
	Discrete sampling at systematic locations within each Decision unit	**Discrete sampling at random locations within each Decision unit**	**A composite sample collected from systematic locations within each Decision unit**	**A composite sample collected from random location within each Decision unit**	**A multi-increment sample collected from systematic locations within each Decision unit**	**A multi-increment samples collected from random location within each Decision unit**
Sampling Cost	moderate	moderate	moderate	moderate	**moderate**	**moderate**
Representative sampling	Yes	Yes	Yes	Yes	**Yes**	**Yes**
Statistical Data Generated	Yes	Yes	No	No	**Yes**	**Yes**
Analytical Cost	High	High	low	low	**low-moderate**	**low-moderate**
Meet project objectives	Yes	Yes	Maybe but there is no way to verify.	Maybe but there is no way to verify.	**Yes**	**Yes**
Design addresses Decision Error	Yes	Yes	Yes	Yes	**Yes**	**Yes**
Conclusion	Not selected due to high analytical cost.		Not selected since the design will not yield statistical data for decision area and thus gives the assessor no way to evaluate project.		Either can be selected due to lower cost and potential more statistically representative of entire decision unit	

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ANALYSIS DESIGN SELECTION
Soil
Table 4b

	Analysis of all collected samples by definitive analyses	Field analysis of all perimeter samples to establish whether the extent of contamination has been resolved combined with analysis of all collected samples by definitive analyses	Field analysis of all samples with 10 % confirmation analysis by definitive analysis.
Analysis Cost	**High**	Highest	Moderate
Analytical Sensitivity Sufficient	**Yes**	Yes	Potentially not
Analytical errors and uncertainty adequate.	**Yes**	Yes	Varies
All final data is definitive	**Yes**	Yes	No
Allows for sampling modification based on generated data.	**No**	Yes	Yes
Data will help eliminate need for additional investigation	**No**	Potentially	Yes
Design Reduces Decision Error	**Yes**	Yes	No
Practical	**Yes**	No - Design would require additional research and the use of three to five field	No - Design would require additional research and the use of three to five field

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ANALYSIS DESIGN SELECTION Soil Table 4b			
	Analysis of all collected samples by definitive analyses	**Field analysis of all perimeter samples to establish whether the extent of contamination has been resolved combined with analysis of all collected samples by definitive analyses**	**Field analysis of all samples with 10 % confirmation analysis by definitive analysis.**
		methods.	methods.
Conclusion	**Selected since most criteria has been met.**	Not selected since use of field analytical is impractical based on the number and types of COPC	Not selected due to perceived need for definitive data and the increased likelihood of additional decision error based on the use of non-definitive methods.

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Specific Design Optimization Based Upon Decision Error Limits Goals

Surface Soil Sampling Throughout the Site

Since there is no sampling data for the study areas, there is no information on the expected sample variance. Therefore the sigma or standard deviation of the sampling mean is unknown. Since a sigma value is necessary to determine total sample number for both measurement and compositing; a sigma value must be estimated.

Thus a value of 0.80 (standard deviation/mean) was selected as a very environmentally conservative sigma value and is used to establish the number of incremental samples necessary for collection needed to estimate true mean concentration for each property area. With this estimation of “s” and with the alpha, beta and delta values indicated in step 6:

- False rejection rate of not more than1% (e.g. alpha);
- False acceptance rate of not more than 10% (e.g. beta); and
- A gray area (e.g. delta) for true values between 75%-100% of the Action Level (i.e. where false acceptance decisions are considered acceptable).

The data from the multiple-increment samples can be used to determine the 95% UCL and will generate a estimation of sigma which can be used to assess the effectiveness of the sampling (i.e. Environmental Data Assessment).

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

Since there is also no sampling data for any newly identified areas, there is also no information on the expected sample variance. Therefore the sigma or standard deviation of the sampling mean is unknown. Since a sigma value is necessary to determine total sample number for both measurement and compositing; a sigma value must be estimated.

In this situation, decisions are being made for small areas that could be a hot spot by comparing analytical measurement(s) of a representative sample with action limits. The determination of the number of incremental samples is for generation of a representative sample. Nonetheless, the value of 0.80 (standard deviation/mean) was also used to establish the number of incremental samples necessary for collection needed to estimate true mean concentration for each property area With this estimation of “sigma” and with the alpha, beta and delta values indicated in step 6:

- False acceptance rate of not more than10% (e.g. alpha);
- False rejection rate of not more than 5% (e.g. beta); and
- A gray area (e.g. delta) for true values between 50%-100% of the Action Level (i.e. where false acceptance decisions are considered acceptable).

A need for between 20 and 30 incremental samples is derived using either student’s t test or the Wilcoxon test. The 30 samples can be used to indicate that 95% confidence that 90 % of the population is below a limit (Cental Limit Theorem for the Sample Proportion). It is believed by START that 30 samples collected in three 10-sample increment composites should be sufficient to generate representative COPC measurements for each identified area.

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Final Design

Neither background nor reference soil samples need to be collected. Replicates and equipment blanks should be collected. Data review, independent of the laboratory, should be performed on all analytical data that may be used in decision making. The Global Positioning System (GPS) coordinate (latitude and longitude) of each decision unit will be determined and documented during sampling.

Surface Soil Sampling Throughout the Site

The sampling strategy is based characterizing surface soil concentrations at 59 decision units at the site. Each decision unit will be approximately 5,000 square feet in area to represent the estimated dimensions of a residential home lot. The 59 decision units will be determined as follows:

4. The entire 400-acre site will be divided into 59 strata or grids of approximately 7 acres in size
5. Within each grid, one geographic point will be identified by a random number generator
6. Each point will serve as the center of a 5,000 square foot decision unit

The result is 59 decision units located in a stratified random pattern throughout the entire site. Special consideration will be made to those decision units which are located within or near the boundaries of the Contingency Reserve Area (CRA). The CRA is monitored by the Department of Land and Natural Resources Division of Forestry and Wildlife (Forestry and Wildlife) due to the presence of endangered plants on the property. If a decision unit is located within this area, Forestry and Wildlife personnel have requested that prior to the scheduling of the sampling events a representative from Forestry and Wildlife conduct a brief training session to help the sampling individuals or teams identify the endangered plants and avoid disturbing them.

Decision units will be identified in the field through coordinates located with a hand-held global positioning system (GPS) unit.

Sampling Protocol

One multi-increment surface soil sample will be collected from each of the 59 decision units. The multi-increment soil sample consists of 40 subsamples collected from 0 to 6 inches below ground surface (bgs) within each decision unit. The multi-increment sampling will maximize the goal of obtaining sufficient material over the decision unit to account for both compositional and distributional heterogeneity. The sampling protocol will follow these steps:

1. The field sampler will begin at a corner of the decision unit and begin sampling in an orthogonal pattern, either moving from north to south, or east to west, to collect subsamples from 40 locations within each decision unit. The locations of the subsamples are not critical as long as they are distributed throughout the decision unit.
2. The 40 subsamples will be mixed to form one composited, multi-increment sample
3. The composited sample will be allowed to air dry and then be sieved through a #10 sieve. Any material larger than the #10 sieve size will be placed aside for later return to the decision unit of origin.
4. The sieved soil will be redistributed into a 1-inch thick uniform layer within a disposable container.
5. Forty incremental subsamples of the sieved soil will be randomly collected from across the

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breadth of the container and placed into a sample jar. If more than one sample jar is to be submitted to the laboratory from a single decision unit, then the soil remaining in the container will be re-leveled each time a sample jar is filled. Re-leveling will consist of gently redistributing the entire contents of the pan to reestablish a uniform depth and maintain a homogenous grain size distribution.

Sample preparation, handling, and transport will be conducted according to the existing sampling plan. Quality control (QC) samples will be collected according to the methodology and protocols presented in the SAP, with the exception of the field duplicates. Six field duplicate samples (10 percent) will be collected randomly during the field investigation. The field duplicate will be collected according to the steps identified above; however, in the first step, the field sampler will begin sampling at a different corner of the decision unit. Results of the field duplicates will be used to estimate the representativeness of the multi-increment sampling for the decision units at the site.

Twenty five additional split samples will be prepared for dioxin/furan analysis by EPA Method 8290A gas chromatography mass spectrometry (GC/MS).

Analysis

The following chemicals of concern were identified in the SAP previous investigations in the vicinity of the Agricultural Area:

- Dieldrin
- Arsenic
- Atrazine
- Ametryn
- Pentachlorophenol (PCP)
- Trifluralin
- Polychlorinated dibenzo-dioxins/furans (PCDD/PCDF reported as TCDD Total TEQ)

Due to the presence of these contaminants at the adjacent Pesticide Mixing and Loading (PML) site, analyses for these constituents are proposed for the agricultural fields. During the site visit, Tetra Tech identified the current use of pesticides or herbicides within the site boundaries. As a result, the complete suite of pesticides is recommended for analysis. The following laboratory analyses are proposed to determine the extent of contamination of the project area that may have been influenced by historical use:

- Inorganic metals, arsenic only by EPA Method 6010B. Soil samples where arsenic values exceed the screening level will be re-analyzed through physiologically-based extraction tests to measure the bioaccessibility of the arsenic that is present.
- Dioxin/Furans by XDS-Calux Bioassay and EPA Method 8290A GC/MS for 25 split samples
- Organophosphorus Pesticides by EPA Method 8141
- Organochlorine Pesticides by EPA Method 8082
- Chlorinated Herbicides by EPA Method 8151

One of the goals for the East Kapolei project area investigation is to determine the correlation coefficient between the use of the Calux Screening Method and EPA Method 8290A GC/MS for dioxin/furan analysis. To accomplish this, the 25 split samples will be sent to two laboratories with one laboratory utilizing the Calux Method and one laboratory utilizing the GC/MS Method. The information provided by this comparison of methods could be used for future site assessments where dioxin/furan

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contamination is suspected. Future laboratory costs for such assessments may potentially be reduced if a higher correlation of coefficient is observed between the Calux Method and the GC/MS Method since the former is approximately one-half the cost.

Establishing Background Levels for Dioxin

In addition to evaluating soil conditions suitable for possible residential reuse, soil sample results will also be evaluated to establish background dioxin levels for the project area and the PML site. The proposed strategy is to use the Calux method for 65 samples (59 decision unit locations and 6 field duplicates) and to collect 25 additional split samples for confirmation analysis by EPA Method 8290A GC/MS. The Calux method will present TCDD Total TEQ results for dioxin/furan without the identification of specific congeners. Method 8290A GC/MS will present results for individual congeners. This process will meet the objectives of determining dioxin levels acceptable for use under a residential scenario (390 nanograms per kilogram [ng/kg]).

Previously Unidentified Areas of Potential Agricultural Chemical Mixing and Loading

The property will be visually surveyed during sampling to locate any previously unidentified areas of potential agricultural chemical mixing or handling. The design objective is to identify areas of potential concern greater than 100 square feet in area. Once an area is identified, the area will be delineated with markers and the GPS information will be documented. Potential area greater than 1/8 acre should be divided into smaller areas. Each delineated area sampled at 3 ten-increment sampling locations that are evenly distributed throughout the delineated area. Samples from each random location will be collected at intervals between 0 to 6 inches using a trowels, hand augers, shovels or direct push samplers. All samples collected in the field will be analyzed by a laboratory using definitive analysis methods.

Analysis

All samples will be analyzed by the following methods.

- Inorganic metals, arsenic only by EPA Method 6010B. Soil samples where arsenic values exceed the screening level will be re-analyzed through physiologically-based extraction tests to measure the bioaccessibility of the arsenic that is present.
- Dioxin/Furans by XDS-Calux Bioassay and EPA Method 8290A GC/MS for 25 split samples
- Organophosphorus Pesticides by EPA Method 8141
- Organochlorine Pesticides by EPA Method 8082
- Chlorinated Herbicides by EPA Method 8151

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