

Sample **HAZARD MAPS** for Alternatives Process: Removal Action Alternative for Redevelopment

Hazard Maps are described in Section 13.5.6 of the Hawaii Department of Health Hazard Evaluation and Emergency Response (HEER) Office Technical Guidance Manual (TGM). In general, Hazard Maps should be developed for a release site as part of the Environmental Hazard Evaluation (EHE) after the site has been adequately characterized to determine the nature and extent of the contamination present in various media (soil, soil gas, and groundwater) at the site. Hazards associated with the contaminants at the site are generally one or more of the following:

- Direct Exposure (DE)
- Gross Contamination (GC)
- Leaching
- Vapor Intrusion
- Drinking Water Toxicity
- Terrestrial Ecological Impacts
- Aquatic Ecological Impacts

Simple comparison of contaminant concentrations to the Tier 1 Environmental Action Levels (EALs) and any site-specific EALs may be used to identify the environmental hazards in different areas of the site based on the Site Characterization data. The Tier 1 EALs are calculated based on a default Conceptual Site Model (CSM) of unrestricted land use where the site is located above a current or potential source of drinking water and within 150 meters of a surface water body. Different site-specific EALs have been calculated for general CSM categories including unrestricted or commercial/industrial (C/I) land use at sites which are or are not above a potential drinking water aquifer and which are or are not within 150 meters of a surface water body. Alternatively, site-specific Human Health Risk Assessments and Ecological Risk Assessments may be calculated for a site and presented to the HEER Office for review.

Hazard Maps simply depict which of the above listed hazards are present at the site and in which areas of the site each hazard is present. See Figures 13-6 and 13-7 in the TGM for examples. Ideally, the Hazard Maps will present both the lateral extent of the environmental hazard and the vertical extent. For release sites that are closed out with a completed remedy, but contamination is left in place to be managed with institutional and engineering controls, Hazard Maps are crucial tools to quickly identify the areas where environmental hazards remain that require long-term management. The maps are also important in the event of future redevelopment when a Construction Environmental Hazard Management Plan (C-EHMP) is required, because the Hazard Maps can be compared to the construction plans to quickly identify areas where special management of contaminated media will be required.



For Hazard Maps to be most effective, the nature and extent of contamination at the site should be fully characterized, including lateral and vertical delineation. However, the **Removal Action Alternative for Redevelopment** process was developed to allow for site activities to proceed prior to the completion of full site characterization. Consequently, the EHEs and Hazard Maps for this Alternative Process will need to consider “potential” or “suspect” areas of contamination at the site as well as areas where contamination is adequately characterized (if any). Environmental Hazards at the site will have to be conservatively estimated in the EHE and depicted in the Hazard Maps prepared for the project. Following the completion of additional sampling during the Removal Action, the EHE and Hazard Maps can then be updated with more accurate information based on the final conditions of the site.

To prepare Hazard Maps for the **Removal Action Alternative for Redevelopment** process, complete the following steps:

- Step 1: Review existing environmental data for the site and identify all areas where contamination has been **thoroughly characterized**.
- For soil, the sampling should be conducted following the Decision Unit Multi-increment Sampling (DU-MIS) methodology and the extent of the contamination delineated laterally and, preferably, vertically.
 - For groundwater and soil vapor, sufficient wells and vapor probes should be used to delineate the extent of any plume until the concentrations fall to below Tier 1 EALs.

This information will go onto a map of “**Known Areas of Contamination**” (see enclosed **Figure 1a**). This information will also be incorporated into a *Preliminary* EHE for the site.

- Step 2: Review existing environmental data for the site to identify any areas of potential or suspected contamination that have not been thoroughly investigated. This may include areas where individual discrete soil samples were collected and areas where single points of soil vapor or groundwater contamination were identified but where sufficient sampling was not conducted to delineate the entire plume. This may also include historical site information collected from Phase I Environmental Site Assessments of other sources that identify potential contamination, such as historical fuel or chemical storage areas and historic industrial activities in areas that were not previously investigated. This should also include evaluation of potential historic application of pesticides under buildings, flaking lead paint around buildings, historic use of contaminated backfill material, and general historic C/I activities that may have resulted in the accumulation of contaminants in surface soil (e.g., in work truck and equipment parking areas).



These areas should be depicted on a separate “**Areas of Suspect Contamination**” figure (see **Figure 1b**). These areas should also be included in the *Preliminary* EHE and identified as suspect or potential areas of contamination.

For the purposes of the Alternative Removal Action Work Plan, the suspect media in these areas will all be considered “presumed” contaminated and must be treated the same as the known contaminated media at the site until or unless future sampling confirms that it is not contaminated or otherwise does not pose a potential environmental hazard. For disposal or re-use purposes, presumed contaminated soil should be segregated and stockpiled separately from known contaminated soil and from clean soil, and should not be re-used or disposed of until it has been adequately characterized.

This map will be used to identify areas that must have additional site characterization conducted concurrent with or prior to the implementation of the “pre-selected” Removal Action. The Sampling and Analysis Plan (SAP) included in the Removal Action Work Plan (RAWP) appendix should include a strategy to characterize the actual conditions in each of the areas depicted on this figure.

- Step 3: Evaluate the hazards associated with the “Known Areas of Contamination” and depict them on a “**Known Hazard Areas**” Hazard Map (see **Figure 2a**). This Hazard Map should only depict known environmental hazards in the areas that have had adequate characterization completed. Areas with only limited data points (e.g., discrete soil sample data, incomplete groundwater data, etc.) will be addressed in the “Known and Presumed Environmental Hazard Areas” Hazard Map (see Step 4).
- Step 3(b): If desired, a separate, *site-specific* hazards map may also be prepared that depicts only the known environmental hazards present under current land use conditions may also be prepared (see **Figure 2b**). This map may be useful in evaluating potential exposure hazards to site workers during redevelopment and determining where additional remediation may be required.
- Step 4: Create a combined “**Known and Presumed Environmental Hazard Areas**” Hazard Map (see **Figure 2c**). This map should depict all known and presumed environmental hazards at the site. This map should be used to evaluate the protectiveness of the pre-selected remedy and it should also be used in the preparation of the C-EHMP in the RAWP appendix. As additional site characterization data is collected over the course of the project, this figure may be modified and subsequently, the pre-selected remedy and C-EHMP may be adjusted or amended with approval from the HEER Office.



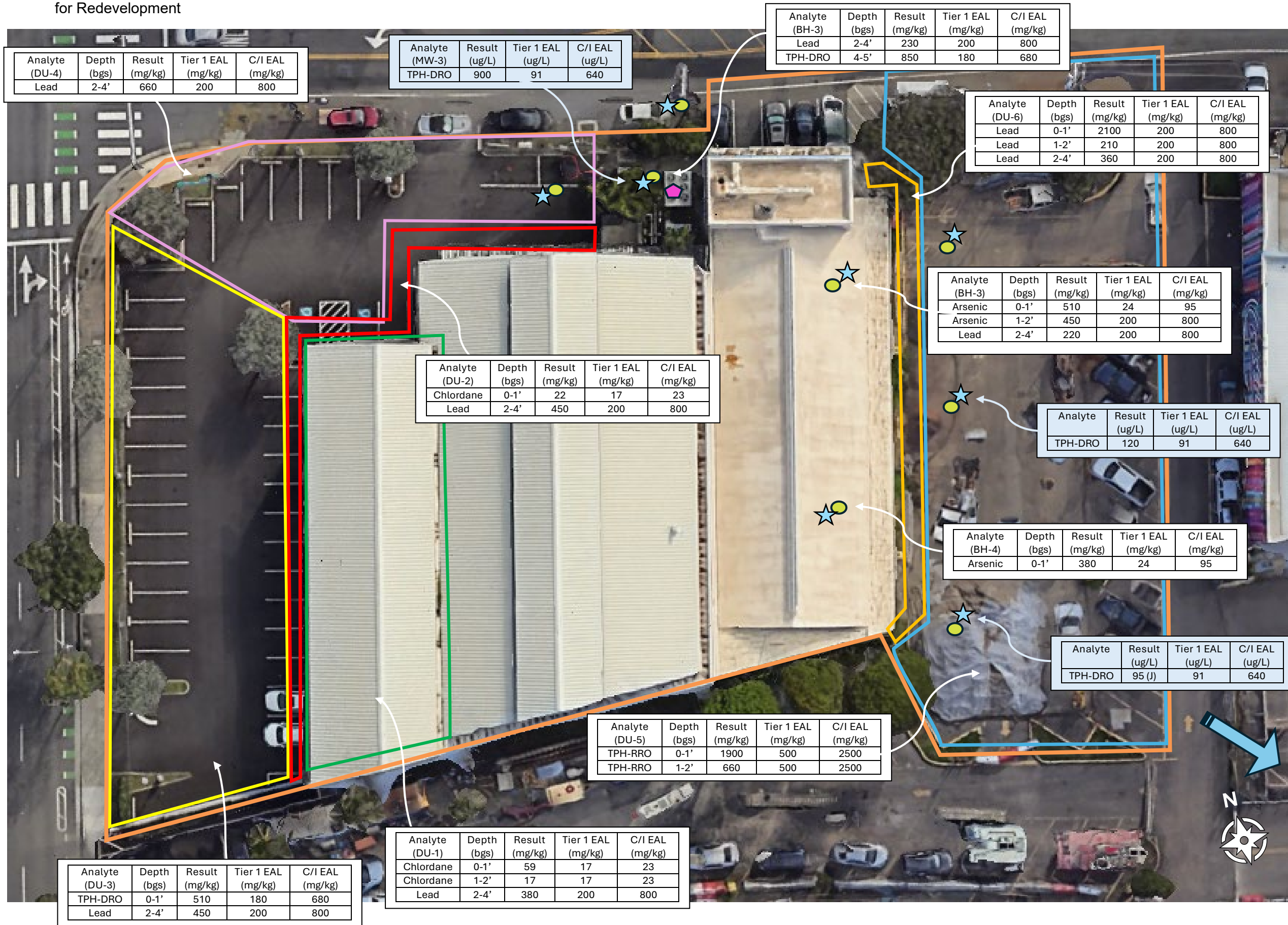


Figure 1a
Known Areas of Contamination
DU-MI and Discrete Soil Sampling and Groundwater Analytical Results Exceeding Tier 1 EALs

Notes

1. Tier 1 EAL: EAL where land use is unrestricted, groundwater is a drinking water source, and there is less than 150 meters to a surface water body.
2. Commercial/Industrial EAL: EAL where land use is commercial/industrial, groundwater is not a drinking water, and there is less than 150 meters to a surface water body.

Legend

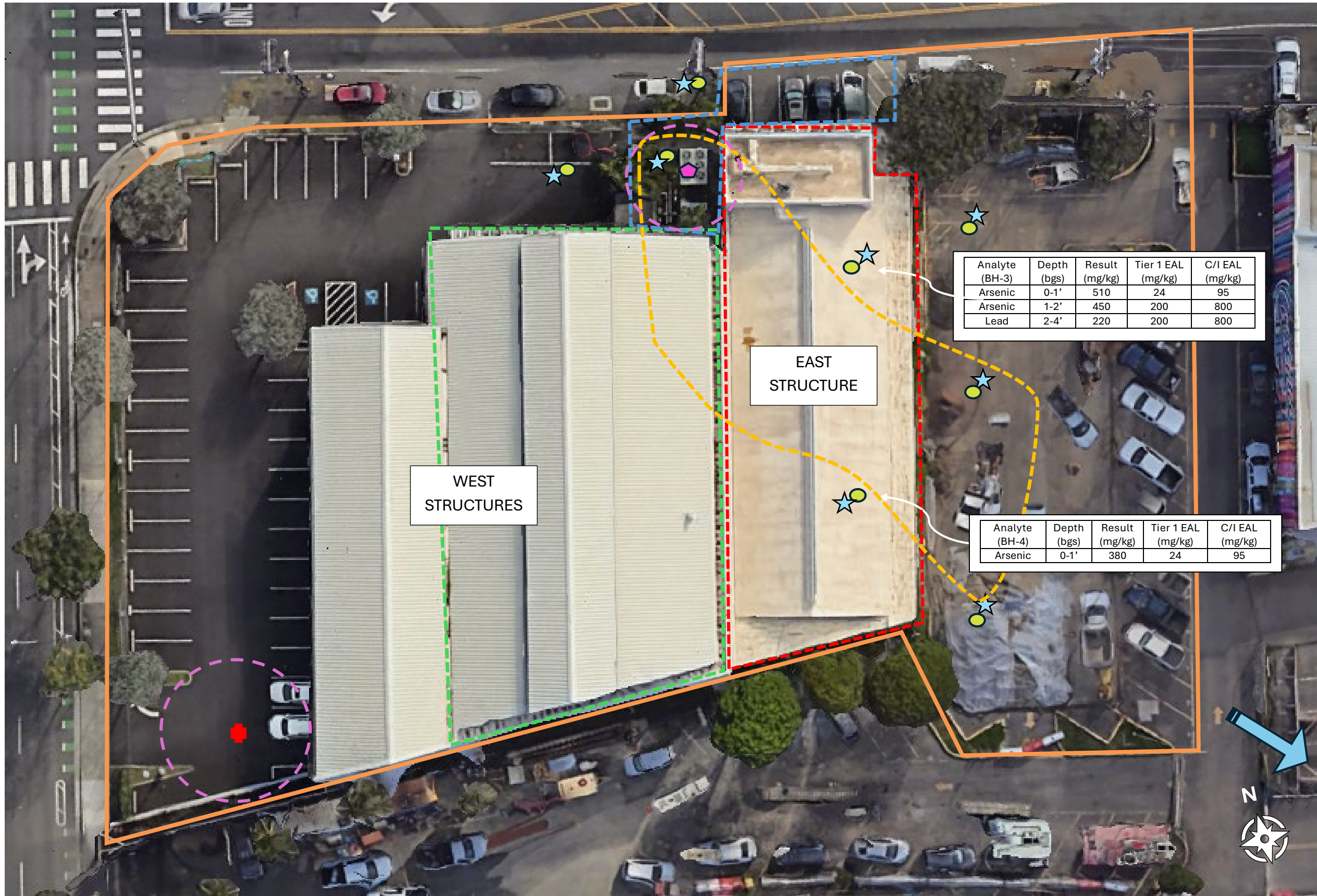
- DU-1
- DU-2
- DU-3
- DU-4
- DU-5
- DU-6
- Site Boundary
- Discrete Soil Boring
- ★ Groundwater Well
- ◆ Former UST
- ➔ Presumed GW Flow

This map serves as an example and does not represent a real site

Figure 1b

Areas of Suspect Contamination

Areas Not Investigated or Only Limited Sampling Conducted



Analyte (BH-3)	Depth (bgs)	Result (mg/kg)	Tier 1 EAL (mg/kg)	C/I EAL (mg/kg)
Arsenic	0-1'	510	24	95
Arsenic	1-2'	450	200	800
Lead	2-4'	220	200	800

Analyte (BH-4)	Depth (bgs)	Result (mg/kg)	Tier 1 EAL (mg/kg)	C/I EAL (mg/kg)
Arsenic	0-1'	380	24	95

- Notes**
1. Discrete soil sample results only show EAL exceedances
 2. Presumed groundwater (GW) flow to southeast
 3. Depth to groundwater approximately 5 feet bgs
 4. Former heating oil above ground storage tank (AST) in west corner of site
 5. East structure construction date approximately 1945 [potential.arsenic.(As).used.as.pesticide.under.building]
 6. West structures construction dates 1970-1976 [potential.organochlorine.pesticides.(OCP).contamination.beneath.buildings]
 7. Lead (Pb) contamination suspected in fill soil beneath western and central portion of property at 2-4' bgs
 8. Historic UST release documented but not previously characterized

- Legend**
- Site Boundary
 - - - Suspect Pb and As
 - - - Suspect Pb and OCP
 - - - Suspect Pb
 - - - Suspect TPH-D
 - ⊕ Historic AST Fuel Tank
 - Discrete Soil Boring
 - ★ Groundwater Well
 - ⬠ Former UST
 - Estimated TPH-DRO in GW Plume
 - ➔ Presumed GW Flow

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Figure 2a

Hazard Map

Known Hazard Areas
UNRESTRICTED LAND USE



- Notes**
1. Tier 1 EAL: EAL where land use is unrestricted, groundwater is a drinking water source, and there is less than 150 meters to a surface water body.
 2. Commercial/Industrial (C/I) EAL: EAL where land use is C/I, groundwater is not a drinking water source, and there is less than 150 meters to a surface water body.
 3. Presumed groundwater (GW) flow to southeast

Legend

- DU-1, Direct Exposure (DE) Hazard (0-1', and 2-4') and Leaching Hazard (0-1')
- DU-2, DE Hazard (0-1' and 2-4')
- DU-3, DE Hazard (0-1' and 2-4') and Leaching* and Gross Contamination (GC) Hazard (0-1')
- DU-4, DE Hazard (2-4')
- DU-5, GC Hazard (0-2') and DE and Leaching Hazards (0-1')
- DU-6, DE Hazard (0-4') and GC Hazard (0-1')
- Estimated TPH-DRO in GW plume
- Discrete Soil Boring
- Groundwater Well
- Former UST
- Presumed GW Flow

*Leaching Hazard Only if Drinking Water Aquifer Potentially Impacted

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Figure 2b
Hazard Map
Known Hazard Areas
SITE-SPECIFIC
COMMERCIAL/INDUSTRIAL (C/I)
LAND USE

Notes

1. Commercial/Industrial (C/I) EAL: EAL where land use is C/I, groundwater is not a drinking water source, and there is less than 150 meters to a surface body of water.
2. Presumed groundwater flow to southeast

- Legend**
- DU-1 and DU-5 Leaching Hazard (0-1')
 - DU-6, C/I DE Hazard (0-1')
 - Estimated TPH-DRO in GW plume
 - Discrete Soil Boring
 - Groundwater Well
 - Former UST
 - Presumed GW Flow

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Figure 2c
Hazard Map
Known and Presumed
Environmental Hazard Areas
COMBINED



Notes

1. Presumed Arsenic (As) and Lead (Pb) contamination beneath East Structure
2. Presumed Chlordane and Pb contamination beneath West Structures
3. Presumed TPH-DRO shallow soil contamination at former AST location (west corner of property)
4. Presumed TPH-DRO in soil and GW at former UST location
5. Presumed site-wide Pb contamination at 2-4' bgs except in DU-5
6. Presumed groundwater (GW) flow to southeast

Legend

- DU-3, DE, Leaching* and GC Hazards from TPH-DRO (0-1')
- DE Hazard (Presumed and Confirmed) from Lead in Fill (2-4')
- DE and Potential Leaching Hazards (Presumed and Confirmed) from Chlordane, As and Pb (0-4')
- DU-5, DE, Leaching, and GC Hazards (0-1') and GC (1-2') from TPH-RRO
- DU-6, DE Hazard (0-4') and GC and C/I DE Hazards (0-1') from lead
- Potential DE and GC from TPH-DRO AST Release (0-2')
- Potential DE and GC from TPH-DRO UST Release (3-5')
- Estimated TPH-DRO in GW plume
- Discrete Soil Boring
- Groundwater Well
- Former UST
- Presumed GW Flow

*Leaching Hazard Only if Drinking Water Aquifer Potentially Impacted

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