Guidance for Soil Stockpile Characterization and Evaluation of Imported and Exported Fill Material

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Hazard Evaluation and Emergency Response Office
Honolulu, Hawaiʻi

NOTE: This guidance document will be updated periodically, as needed. Please send any comments or suggestions for edits or improvements to Roger Brewer at roger.brewer@doh.hawaii.gov *in the Honolulu HEER Office, or to John Peard at* randall.peard@doh.hawaii.gov *in the Hilo HEER Office.*

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Guidance for Stockpile Characterization and Evaluation of Imported and Exported Fill Material

This document provides guidance on the import and export of fill material at chemical contaminant removal or remediation sites that are overseen by the Hawaiʻi Department of Health (HDOH) Hazard Evaluation & Emergency Response Office (HEER Office). However, this guidance is also useful for consideration at general construction projects not under HEER Office oversight when imported fill materials may be used, or where export of fill material is proposed. This guidance may be particularly appropriate for consideration at sites where "sensitive" populations such as children, the infirmed or the elderly reside, or will reside, and could have exposure to imported soils - for example at schools, daycare centers, community gardens, parks, and homes.

Included in this guidance is the HEER Office's definition of "acceptable fill material", an overview of the fill material determination process, sources of fill that should be considered suspect for contamination, and other fill material management considerations. Guidance for the characterization of fill material or soil stockpiles is provided as an update and expansion of Section 4.2.8 of the Hazard Evaluation and Emergency Response (HEER) Office *Technical Guidance Manual* (TGM) – *Collection of Multi Increment* Samples for Stockpiles*. This guidance does not apply to projects involving fill materials that will be placed in State of Hawaiʻi waters (as defined by the Clean Water Act in Title 40 U.S. Code of Federal Regulations Part 232 [40 CFR Part 232]), and does not preclude compliance with any other laws or regulations.

∗ *Multi Increment® is a registered trademark of EnviroStat, Inc.*

1.0 Potential Hazards Related to Fill Material

Fill material that is imported to or exported from sites where significant environmental contamination has been identified, or where cleanup projects are underway, could pose multiple environmental hazards if not appropriately characterized and managed. The import of fill material from a source that has not been evaluated could inadvertently re-contaminate a remediated property, and may be considered illegal dumping. The inadvertent export of contaminated soil or sediments for use as fill material at another property could move human health or ecological risks from one place to another. Contaminated fill material can also pose direct- exposure hazards to workers installing or repairing subsurface utilities.

The construction industry generally characterizes imported or exported fill material with respect to specific geotechnical requirements (e.g., suitability for structural support), but may not include an evaluation of potential environmental hazards. Although importing and exporting fill material is a common practice in the redevelopment process, users may be unaware if contaminated fill material is brought to or removed from their property. Understanding the source of the fill material and the potential for contamination is very important. Laboratory testing is recommended for suspect fill material prior to import or export. Outreach and education efforts are an important element to ensuring property owners and developers understand the potential hazards related to imported or exported fill material.

2.0 Definition of Acceptable Fill Material

Imported or exported fill material could include a variety of materials, including soils, dredged sediments, and construction and demolition debris (e.g., bricks, concrete, etc.). Under typical scenarios for properties where the HEER Office provides oversight, clean or "acceptable fill material" is defined as:

A) Natural materials consisting of soil, clay, sand, volcanic cinder and ash, and rock; or a mixture or combination of such materials, which are:

- Excavated from a quarry, borrow pit or earthen bank; dredged sediment, or from sources such as agricultural settling ponds; *and either*

  1. Not suspected to contain hazardous substances above applicable HEER Office Tier I Environmental Action Levels (EALs) based on the historical use of the fill source area (i.e., as documented by an environmental due diligence review). Includes consideration of chemical contaminants of concern for the site, including past legal use of pesticides; data on natural background chemical concentrations in the area may also be considered, though typically the HEER Office Tier I EALs are above natural background levels.

     Or

  2. Not known to have concentrations of chemical contaminants of concern above applicable HDOH Tier I EALs or appropriate alternative action levels approved by the HEER Office. Chemical concentrations are determined through laboratory testing of representative field samples. Refer to the HEER Office *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* and EAL Surfer Excel File (HDOH 2016a) for further details on HDOH Tier I EALs. Refer to the HEER Office TGM Sections 3, 4, and 5 on strategies and methods for collecting field samples (HDOH 2016b).

B) Construction materials or demolition material exclusive of soil that:

- Are known or tested to be free of paints, coatings, grouts/mortar, or adhering residues containing regulated quantities of hazardous substances such as lead, organochlorine termiticides, or asbestos.
- And meet the definition of "inert fill" under the Solid Waste Pollution statutes (HRS 342H-1) overseen by the HDOH Solid and Hazardous Waste Branch (SHWB). In accordance with HRS 342H-1, inert fill generally means earth, soil, rocks, rock-like materials such as cured asphalt, brick, and clean concrete less than eight inches in

diameter with no steel reinforcing rod. The fill material shall not contain vegetation or organic material or other solid waste. Soil (earth) must meet Tier 1 EAL criteria noted in "A" above for natural materials.

- Except, asphalt is not considered acceptable fill (and should not be used as fill material) on chemical removal or remediation sites overseen by the HDOH HEER Office unless otherwise approved by that office.

Note that lead-based paint, defined as >5,000 mg/kg lead (USEPA 2008), must be removed from asphalt prior to recycling for use as fill material. Lead-based paint striping does not, however, require removal for milled asphalt that is to be reprocessed as asphalt for pavement.

Acceptable fill material should not:

- Be considered a regulated hazardous waste, as determined in a site-specific, hazardous waste designation as described below;
- Be subject to other regulatory requirements for chemicals such as, but not limited to, lead and asbestos abatement requirements;
- Contain mobile, free liquids based on visual inspection;
- Create public nuisances (e.g., odors) to users or at adjacent properties;
- Include a significant amount of construction material or demolition debris other than the
- (uncontaminated) materials noted in the definition of acceptable fill material above, and
- Include street sweepings, asphalt paving, incinerator ash, or similar residential, commercial, or industrial wastes. Using these materials as fill material is not recommended due to the potential variability of their composition, the potential for contamination, and the associated difficulty in accurate sampling and testing.

Figure 1 presents a flow chart of the hazardous waste determination process for soil that is exported or imported to properties overseen by the HEER Office. If the soil is designated for disposal to a landfill or reuse at another off-site location, then the generator must make a hazardous waste determination in accordance with the Hawaiʻi Administrative Rules (HAR) §11-261-2. Making a hazardous waste determination is a step-by-step process. This begins with determining whether the soil meets the definition of a waste and, if so, meets criteria for classification as hazardous waste.

A "waste" is defined under HRS § 342-H as follows:

> "'Waste' means sewage, industrial and agricultural matter, and all other liquid, gaseous, or solid substance, including radioactive substance, whether treated or not, which may pollute or tend to pollute the atmosphere, lands or waters of this State."

A "hazardous waste" is defined under HRS § 342-J as follows:

> "'Hazardous waste' means a solid waste, or combination of solid waste, which because of its

quantity, concentration, or physical, chemical, or infectious characteristics may: (1) Cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating illness; or (2) Pose a substantial existing or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed."

Determining whether a waste is hazardous under RCRA (Resource Conservation and Recovery Act) can be done through one of the following methods:

- Knowledge – see Construction and Demolition Waste Disposal General Guidance (HDOH 2011); and/or
- Testing – Testing the waste according to the methods set forth in subpart C of HAR 11-261.

Soil impacted by chemicals at concentrations equal to or below the HDOH Tier 1 Environmental Action Levels (EALs) for unrestricted land use (HDOH 2016a) is considered "Inert fill material" for the purposes of a hazardous waste determination. This can be used as "generator's knowledge" to exclude the need for additional testing (e.g., TCLP) provided that samples were collected in accordance with the HEER Technical Guidance Manual (HDOH 2016b) and guidance provided in this document.

Soil impacted by chemicals above HDOH Tier 1 Environmental Action Levels (EALs) for unrestricted land use (i.e., residential use; HDOH 2016a) is considered to be "polluted" and therefore meets the definition of a "waste" under HRS § 342-H. Toxicity Characteristic Leaching Procedure (TCLP) tests should be carried out on soil that exceeds Tier 1 EALs and is proposed for offsite disposal or reuse as part of the hazardous waste determination process in accordance with HAR §11-261-24. If concentrations meet or exceed TCLP levels and the soil is designated for offsite disposal or reuse, then the soil is a hazardous waste and must be managed in accordance with HAR §11-261.

Consideration of soil that exceeds Tier 1 action levels for unrestricted land use but meets the HDOH action levels for commercial or industrial land use (see Appendix 1, Table I-2 in HDOH 2016a) for offsite reuse at such sites must be approved by the HEER Office in consultation with the SHWB. This should include preparation of a site-specific, Environmental Hazard Evaluation (EHE) in accordance with Section 13 of the HEER TGM as well as a site-specific Environmental Hazard Management Plan (EHMP) prepared in accordance with Section 18 of the HEER TGM (2016b). The EHMP must present institutional controls for long-term tracking and management of the soil. Synthetic Precipitation Leaching Procedure (SPLP) is required as part of the EHE if Tier 1 action levels for potential leaching concerns are exceeded, in accordance with HDOH (2016c).

A hazardous waste determination must be carried out in accordance with HAR §11-261-24 for soil that exceeds Tier 1 action levels for unrestricted land and is proposed for offsite reuse. This must include TCLP test data if the concentration of the subject chemical in soil in milligrams per kilogram equals or exceeds twenty-times the promulgated TCLP level in milligrams per liter (Table 1). This represents the minimum mass of the subject chemical that must be present in the soil in order for the TCLP level to be potentially reached, assuming 100% extraction of the chemical from the soil during the TCLP leaching procedure. Yellow highlighting indicates chemicals with Tier 1 Soil EALs that exceed twenty times the TCLP level (adjusted to mg/kg) but otherwise do not pose a significant risk to human health and the environment at the concentrations noted. TCLP data *are not required* for onsite or offsite reuse of soils that meet the Tier 1 EALs provided that characterization of the soil was carried out in accordance with the HEER Office *Technical Guidance Manual*.

Comparison of soil data to TCLP limits *is not* part of the EHE process. As indicated in Table 1, soil that meets TCLP limit could still pose significant risk to human health and the environment outside of a regulated, landfill environment. Individual counties might have additional requirements regarding the import or export of fill material. Contact the respective counties regarding fill material use or fill material export issues prior to movement of the material.

Figure 1. Hazardous waste determination process for exported or imported soil.

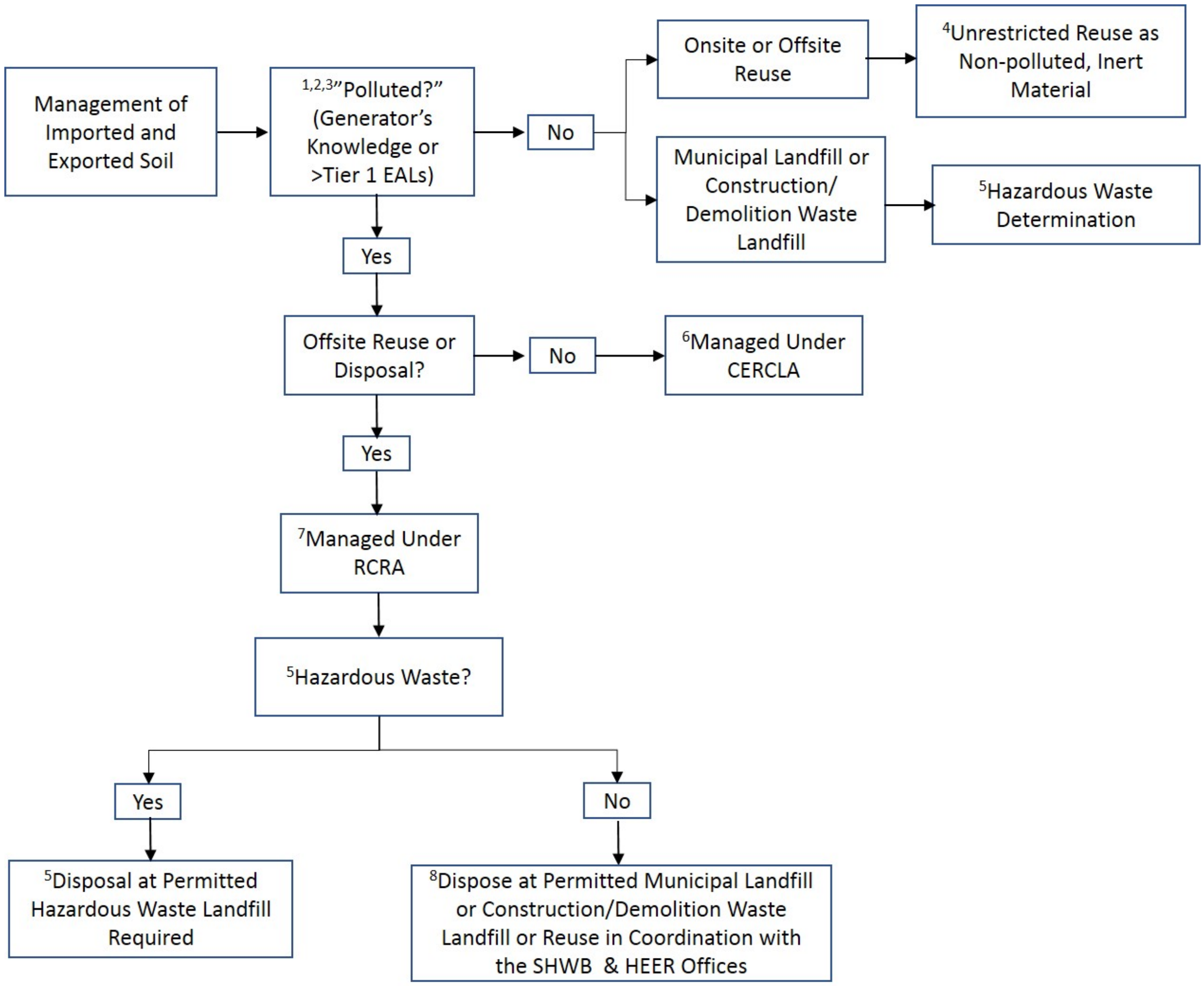


Figure 1 notes:

1. Imported or exported soil initially defined as a potential "waste" under HRS §342H-1 (Solid Waste Pollution). "Waste" defined as a "substance … which may pollute the atmosphere, lands or waters or Hawaii."

2. "Polluted" or "contaminated" soil defined as a soil with one or more potentially hazardous substances at a concentration that exceed HDOH Tier 1 EALs for unrestricted land use (HDOH 2016a; Tier 1 EALs for soil within 150m of a surface water body and situated over groundwater that is a source or potential source of drinking water).

3. Soil should be characterized in accordance with Decision Unit and Multi Increment Sample investigation methods described in the HEER *Technical Guidance Manual* (www.hawaiidoh.org) if testing is required due to insufficient generator knowledge of contamination potential.

4. "Inert Waste" includes "earth… which will not cause a leachate of environmental concern" (HAR §11-58.1, Solid Waste Management) *and* meets HDOH Tier 1 EALs for unrestricted land use.

5. Hazardous Waste Determination must include testing for Toxicity Characteristic Leaching Procedure if concentration of contaminant in soil (mg/kg) exceeds HDOH Tier 1 EALs for unrestricted land use AND is equal to or greater than 20 times the TCLP level (mg/L) for that chemical. TCLP data are not required as part of a hazardous waste determination if the concentration of the contaminant in soil is less than 20 times the TCLP level under any scenario. Soil cannot be disposed of at a municipal landfill or construction/demolition waste landfill if determined to be a hazardous waste under HAR §11-261 (Hazardous Waste Management). The soil must either be managed onsite under 128D through the HEER Office or disposed of at a permitted, hazardous waste landfill under the oversight of the SHWB.

6. Soil managed on-site under HRS §128-D (Environmental Response Law).

7. Soil managed for offsite reuse or disposal under HAR §11-261 (Environmental Response Law).

8. Offsite reuse of soil from a HEER project site that fails Tier 1 EALs for unrestricted land use but meets action levels for commercial/industrial land use *and* is not a hazardous waste must be carried out in coordination with the HEER Office and the Solid Waste Section of the SHWB. Land use restrictions and preparation of an Environmental Hazard Management for long-term management of the soil will be required under most circumstances.

Table 1. Comparison of Tier 1 Soil EALs with “20X TCLP” minimum concentration of chemical in soil necessary to require TCLP test data prior to disposal of soil in a municipal or construction/demolition waste landfill.

USEPA Hazardous Waste Number	Contaminant	CAS No. 2	[1]Regulatory Level (mg/L)	[2]20X Equivalent in Soil (mg/kg)	[3]HDOH Tier 1 Soil EAL (mg/kg)
D004	Arsenic	7440-38 -2	5.0	100	23
D005	Barium	7440-39 -3	100.0	2,000	1000
D018	Benzene	71 -43 -2	0.5	10	0.30
D006	Cadmium	7440-43 -9	1.0	20	14
D019	Carbon tetrachloride	56 -23 -5	0.5	10	0.10
D020	Chlordane	57 -74 -9	0.03	0.6	17
D021	Chlorobenzene	108-90 -7	100.0	2,000	1.5
D022	Chloroform	67 -66 -3	6.0	120	0.026
D007	Chromium	7440-47 -3	5.0	100	1000
D023	o -Cresol	95 -48 -7	200	4,000	-
D024	m -Cresol	108-39 -4	200	4,000	-
D025	p -Cresol	106-44 -5	200	4,000	-
D026	Cresol		200	4,000	-
D016	2,4-D	94 -75 -7	10.0	200	0.34
D027	1,4-Dichlorobenzene	106-46 -7	7.5	150	0.055
D028	1,2-Dichloroethane	107-06 -2	0.5	10	0.023
D029	1,1-Dichloroethylene	75 -35 -4	0.7	14	1.1
D030	2,4-Dinitrotoluene	121-14 -2	0.13	2.6	0.024
D012	Endrin	72 -20 -8	0.02	0.4	3.8
D031	Heptachlor (and its epoxide)	76 -44 -8	0.008	0.16	0.071
D032	Hexachlorobenzene	118-74 -1	0.13	2.6	0.22
D033	Hexachlorobutadiene	87 -68 -3	0.5	10	0.041
D034	Hexachloroethane	67 -72 -1	3.0	60	0.023
D008	Lead	7439-92 -1	5.0	100	200
D013	Lindane	58 -89 -9	0.4	8.0	0.029
D009	Mercury	7439-97 -6	0.2	4.0	4.7
D014	Methoxychlor	72 -43 -5	10.0	200	16
D035	Methyl ethyl ketone	78 -93 -3	200.0	4,000	6.2
D036	Nitrobenzene	98 -95 -3	2.0	40	0.0053
D037	Pentrachlorophenol	87 -86 -5	100.0	2,000	0.098
D038	Pyridine	110-86 -1	5.0	100	-
D010	Selenium	7782-49 -2	1.0	20	78
D011	Silver	7440-22 -4	5.0	100	78
D039	Tetrachloroethylene	127-18 -4	0.7	14	0.098
D015	Toxaphene	8001-35 -2	0.5	10	0.49
D040	Trichloroethylene	79 -01 -6	0.5	10	0.089
D041	2,4,5-Trichlorophenol	95 -95 -4	400.0	8,000	0.50
D042	2,4,6-Trichlorophenol	88 -06 -2	2.0	40	0.31
D017	2,4,5-TP (Silvex)	93 -72 -1	1.0	20	0.87
D043	Vinyl chloride	75 -01 -4	0.2	4.0	0.036

Table 1 notes.

1. Promulgated TCLP level for determination of soil as a hazardous waste. If the result of a TCLP test meets or exceeds the level noted for the subject chemical, then the soil is classified as a "hazardous waste" and cannot be disposed of in a municipal landfill or construction/demolition waste landfill.

2. Minimum concentration of the subject chemical that must be present in the soil (mg/kg) in order for the TCLP level (mg/L) to be potentially reached, assuming 100% extraction of the chemical from the soil during the TCLP leaching procedure. TCLP data are required for disposal of the soil at a municipal landfill or construction/demolition waste landfill if the concentration of the chemical in soil exceeds HDOH Tier 1 EALs for unrestricted land use AND is equal to or greater than twenty-times the TCLP level noted in the Table 1. TCLP data are not required for onsite or offsite reuse of soils that meet the Tier 1 EALs provided that characterization of the soil was carried out in accordance with the HEER Office *Technical Guidance Manual*.

3. HDOH Tier 1 Soil Environmental Action Level for unrestricted land use, including residential, schools, medical facilities, parks, etc., where children and other sensitive populations might be present on a regular basis.

3.0 Fill Determination Process

The purpose of the fill determination process is to determine if proposed fill material meets the HEER Office definition of acceptable fill material. Determination of the presence or absence of contamination above action levels in proposed fill material will help ensure that using the fill material will not adversely impact human health or the environment. Options to complete the fill determination process include:

Option 1 – An environmental due diligence review of the fill source property that concludes there is no evidence of past releases that could pose an environmental hazard(s) (as described in HDOH 2016a) or evidence of any other Recognized Environmental Condition (REC) (as defined in ASTM 2005) that suggests the proposed fill material could contain chemical contaminants above applicable HDOH Tier I EALs. This includes consideration of past legal use of pesticides. See Section 3.1.

Note: Obtaining fill material from a quarry that documents their fill material is acceptable based on an environmental due diligence review of their fill source property and the considerations noted in Option 1 would be a suitable determination for those using the fill. A copy of the quarry's environmental due diligence report should be available for reference and documentation, and it is important to verify with the quarry that the area from which the fill material was obtained is included in environmental due diligence report.

Option 2 – A fill material characterization report that summarizes representative analytical data for the proposed fill material from the fill source operator, fill importer, or fill exporter. See Section 3.2.

3.1 Environmental Due Diligence Review

This fill determination option involves conducting an environmental due diligence evaluation of the fill source area or property. One method to accomplish this is to conduct a Phase I Environmental Site Assessment (ESA) of the fill source area or property in accordance with ASTM Standard Practice E 1527-05 (ASTM 2005) and the U.S. EPA's *Final Rule on Standards for Conducting All Appropriate Inquiry* (AAI) (USEPA 2005). If the findings of the Phase I ESA indicate that there is no evidence of a significant release of a hazardous material at the fill source property (including petroleum products), then the material can be managed as acceptable fill material. If requested, the Phase I ESA report for the fill source property should be provided to the HEER Office for inclusion in the site file, otherwise citation to the Phase I ESA indicating no evidence of a chemical release should be included in reports. Preparation and submittal of a formal, Phase I ESA should be considered for sites where a significant amount of fill material is to be imported and spread over a large area that will remain exposed after development (e.g., large residential redevelopment). A formal Phase I ESA is generally not necessary for the import of small volumes of fill material from known source areas, especially if past evaluations of the fill source property are available to document that the fill material is not suspect for contamination. Final documentation judged appropriate should be incorporated into the Removal or Remedial Action report for the site for review by the HEER Office and inclusion as part of the public record.

If the findings of an environmental due diligence evaluation suggest a potential that chemical contaminants are present above environmental action levels (e.g., in excess of HDOH Tier I EALs for unrestricted land use), then representative sampling and analytical testing of the fill material should be conducted.

3.2 Fill Material Characterization

This fill determination option involves representative sampling and analysis of the proposed fill material and preparation of a fill material characterization report. A qualified environmental consultant contracted by the fill material provider, importer, or exporter should carry out testing and analysis. Preparing a fill material characterization report facilitates the review process by the HEER Office. Information that should be provided in the fill material characterization report includes:

Intended use of the fill material and land use/zoning or planned future land use at the site where it will be utilized;

- Quantity of fill material to be imported, exported, or relocated on-site;
- Description of the fill material's original nature (i.e., undisturbed native condition) including the source property address, tax map key (TMK) number, and owner contact information;
- Fill material source property historic usage (i.e., industrial, residential, agricultural, etc.), and citation to Phase I ESA report, if applicable;
- Previous fill material use(s) when the material is other than undisturbed native material;
- Summary of sampling methodology and analytical results from the sampling of the fill material, including:

    1. Identification of decision units (DUs) (e.g., horizontal and vertical dimensions);
    2. Number of DUs per volume of fill material;
    3. Number of sampling increments in DUs;
    4. Number and location of replicate samples;
    5. Summary of laboratory analytical results and copy of laboratory data reports;
    6. Chain of custody documentation; and
    7. Any additional information that may be necessary to assess the fill material contamination status.

- Evaluation of sample data with respect to potential environmental hazards (e.g., comparison to HDOH Tier I EALs using the HDOH EAL Surfer Excel File (HDOH 2016a); and
- Identity/signature by party responsible for evaluation of each source of fill material.

Some of the information for the fill material characterization report may be available from a Phase I ESA or the laboratory analytical data reports from any previous investigation of the proposed fill material source.

As discussed in Section 5 of this document, the effort necessary to characterize a fill source is dependent on a number of site-specific factors. For example, the proposed use of comingled, existing stockpiles of unknown origin will require a more detailed investigation than proposed fill material from a single, known source (e.g., fill material from a former agricultural field). Proposed fill material that could be contaminated by highly mobile, volatile or leachable contaminants will require a more detailed sampling and characterization (due to vapor intrusion and groundwater protection concerns) than proposed fill material where targeted contaminants are limited to low-mobility chemicals (e.g., Polychlorinated biphenyls (PCB), dioxins, arsenic, lead, etc.).

Exceptions to the need for a fill material characterization report, as noted above, should be discussed with the HEER Office on a case-by-case basis. Citation to the environmental due diligence review, alternative documentation (i.e., brief overview of the fill source and potential for contamination), or a copy of the fill material characterization report should be included in the final Removal or Remedial Action report for the site (see Sections 14 and 16 of the HEER Office TGM).

4.0 Suspect Fill Material Sources

Certain property and land uses are at a higher risk for the possible presence of contaminated soil (Table 2). Fill material originating from these areas should be considered "suspect" and will generally require site-specific, representative sample data to make an acceptable fill determination.

Table 2 – Suspect Fill Sources

Commercial & Residential Sites	Industrial Sites	Agricultural & Other Sites
• Fuel stations • Automotive repair or maintenance shops • Junkyards or recycling facilities • Dry cleaners • Photographic processing facilities • Painting facilities • Sites where hazardous materials or hazardous wastes were used, stored, or generated • Sites where environmental cleanup activities have not achieved HEER Office Tier 1 EALs for unrestricted use • Rail lines • Former building sites where buildings were painted with lead-based paints, or were treated with persistent termiticides	• Landfills or disposal facilities • Metal processing plants • Bulk petroleum facilities or oil refineries • Waste treatment plants • Wood treatment facilities • Manufacturing facilities • Sites where hazardous materials or hazardous wastes were used, stored, or generated • Sites where environmental cleanup activities have not achieved HEER Office Tier 1 EALs for unrestricted use • Rail lines • Former building sites where buildings were painted with lead-based paints, or were treated with persistent termiticides	• Agricultural fields (current or former) • Pesticide storage or mixing areas • Pesticide container disposal areas • Seed dipping areas • Settling ponds • Bagasse piles • Former plantation housing areas • Rail lines • Area with existing fill • Dredged sediments from heavily developed areas (e.g., canals, harbors, etc.) • Military sites

Former agricultural fields are a common potential source of fill material in Hawai'i (e.g., former sugarcane and pineapple lands). For example, refer to map of estimated lands in sugarcane production in the HEER Office Fact Sheet *Arsenic in Hawaiian Soils: Questions and Answers on Health Concerns* (HDOH 2010a). The past use of pesticides on agricultural lands makes these areas suspect for potential contamination. Sections 3 and 4 of the HEER Office TGM discuss approaches for the investigation of former field areas. Section 9 of the HEER Office TGM provides an overview of past pesticide use in Hawai'i and includes guidance on the selection of contaminants of potential concern (COPC) for former sugarcane and pineapple lands.

As discussed below, proposed fill material suspected of contamination by volatile or highly leachable chemicals requires a more detailed and expensive evaluation before use as fill material. Using fill material that could include small but heavily contaminated pockets of volatile or highly leachable chemicals is strongly discouraged (e.g. greater than or equal to 20 cubic yards [yd^3] in volume). A summary of volatile and highly leachable chemicals listed in the current HEER Office Environmental Action Levels lookup tables is included as Appendix 1 to this document.

5.0 Fill Material Sampling Strategies and Methods

Scenarios where sampling proposed fill material is recommended include:

- Fill source where the findings of a Phase I ESA indicate that there is evidence or likelihood of a significant release of a hazardous material (i.e., could result in contamination above applicable action levels),
- Fill source where background information is unavailable, or
- Fill source where some chemical sampling data is available, but data is not representative for the material to be used, or does not include all contaminants of concern for the site.

Representative sampling must be conducted to ensure appropriate decision-making for use as fill material. Refer to the relevant sections of the HEER Office TGM for detailed guidance on designation of DUs (Section 3, as well as the collection and evaluation of Multi Increment (MI) soil samples (Section 4). A DU is a targeted area and volume of soil from which samples are to be collected and decisions made based on the resulting data. A MI sample is collected within each DU and analyzed to estimate the representative (i.e., mean) concentration of each targeted contaminant. The collection of discrete soil samples is usually discouraged. Alternative sampling approaches should be discussed with the HEER Office on a case-by-case basis.

5.1 Decision Unit Designation and Characterization

The level of effort necessary to characterize a fill source is dependent on a number of factors, including:

- Anticipated homogeneity or heterogeneity of large-scale contaminant distribution (e.g., potential presence of spill areas greater than 20 to 100 yd3);

- Anticipated mobility of targeted contaminants and associated, potential environmental hazards;
- Intended use of the fill material (e.g., residential versus commercial or industrial property);
- Size of receiving area and anticipated average depth of fill material; and
- Size and depth of the source area and the volume of fill material to be exported.

A site-specific sampling strategy could involve single or multiple DUs to generate representative data.

To avoid contamination of previously remediated sites or sites not known to be contaminated, the HEER Office strongly recommends that all sampling activities of proposed fill material be completed prior to delivery at the receiving site. It is important to include the time required to collect, analyze, and evaluate data for proposed fill material in the initial project budget and schedule.

5.1.1 Designation of Decision Unit Volume at the Fill Source Based on the Receiving Area

One approach for testing fill material before it is delivered to a receiving site is to designate "exposure area" DUs at the receiving site, estimate the volume of fill material to be placed in each DU, and then test a similar volume of soil at the source area. This approach is generally applicable only to fill sources where the suspect COPCs have been identified as "low mobility" contaminants, and not for fill sources where volatile or highly leachable COPCs are suspect (see Appendix 1).

For example, assume that a one-acre commercial/industrial site is subdivided into two, approximately 20,000 square feet (ft^2) "exposure area" DUs. The average thickness of fill material to be placed at the site is two feet. Each DU will therefore contain approximately 1,500 $yd^3$of soil. An equal DU volume of soil can then be designated at the fill material source area, whether it is an *in-situ* or stockpiled source. Whatever the volume selected under this approach, remember that representative sampling of that volume of fill is required, so the entire DU volume (at the fill source) must be accessible for possible increment collection, and multiple increments will need to be collected throughout the entire depth or height of the DU.

This approach is likely to be more efficient and cost-effective at sites where more than six-inches of fill material are to be placed, as assumed in the source-area DU designation approaches described below. Potential disadvantages are 1) using a larger DU associated with certain land use categories may not allow subsequent use or reuse for a land use category with a smaller DU recommendation without conducting additional sampling, and 2) reuse of the fill material at future sites, where the initial level of testing was not adequate to clear the soil if spread in a thinner layer over a broader area (e.g., six inches). Consultants should use their professional judgment based on the initial test results and knowledge of the source area to determine if these are potentially significant issues.

5.1.2 Source Area Characterization of In-situ Soil

Sections 3 and 4 of the HEER Office TGM provide guidance on the characterization of *in-situ* soil. In many cases, material that is intended to be excavated and used for fill material will be most efficiently sampled *in-situ*. Excavated and stockpiled fill material can be more difficult to access for representative sampling unless a large amount of space is available to store and flatten large stockpiles. Excavated soil that is subsequently determined to be contaminated may require additional assessment, remediation, or containment.

As discussed in Section 3 of the HEER Office TGM, known or suspect spill areas should be individually investigated as separate DUs. This includes but is not limited to:

- Former pesticide storage and mixing areas;
- Soil around the perimeter of buildings potentially contaminated with lead-based paint;
- Soil around or under buildings suspected to be contaminated with persistent insecticides (e.g., organochlorine termiticides); and
- Obvious or suspected spill areas associated with underground storage tanks (USTs), aboveground storage tanks (ASTs), pipelines, PCB-containing transformers, and other commercial or industrial operations.

Dividing the fill source area into Exposure Area DUs is appropriate for sites where localized spill areas are not anticipated and the soil is not suspected to be contaminated with volatile or highly leachable chemicals.

Proposed fill source areas that are not suspected to include localized spill areas should be divided into Exposure Area DUs, as described in Section 3 of the TGM (i.e., primary environmental hazard is direct-exposure to soil). A summary of recommended, default DU areas, DU volumes, and sampling depth for the *in-situ* characterization of proposed fill material source areas is provided in Table 3. Fill sources that are flagged for possible contamination concerns but are not suspected to include localized spill areas should be sampled and characterized at a DU size of 5,000 ft^2 for unrestricted use. This is the default residential home exposure area, to a depth of 6 inches below ground surface.

A DU area of 20,000 ft^2 (approximately one-half acre) is acceptable to characterize a fill source area for use in large, high-density residential redevelopments or schools. Larger DU sizes may be acceptable for source areas that are to be used only for commercial or industrial fill material. Recommended DU numbers in Table 3 include a minimum of 18 DUs (rather than 15 DUs) to achieve a minimum 60% level of confidence that 95% of the entire site is “clean” at the scale of these large-sized DUs (see also Table 6). While potentially acceptable for some sites and land uses, characterizing a fill material source area at DU sizes larger than recommended for unrestricted use of the fill material can limit future use of the property where the fill material is placed. Characterization of fill material source areas should be discussed with the HEER Office on a case-by-case basis to help ensure appropriate objectives will be met.

Depending on the depth and volume of fill material to be excavated, *in-situ* sampling may need to be done in successive lifts or at incremental depths to allow access for representative sampling. Borings, trenches, or test pits can be used to access and characterize deeper soils as necessary, depending on the nature of the site and the proposed soil removal depth. For borings, the entire core from a targeted depth interval is the DU layer “increment” for that boring. Sending the full increment to the lab for subsampling and analysis may be impractical for long cores. As an alternative, the targeted interval of a core can be subsampled by collecting a representative core-wedge sample or MI sample (e.g., using a small core sub-sampling device, refer to Section 5 of the HEER Office TGM). This approach will reduce the overall mass of the samples collected. It is recommended that the HEER Office be consulted when designing a subsurface sampling strategy for characterization of DU layers of varying thickness and depth.

When soil is going to be moved off-site for disposal or proposed reuse prompting the need for a hazardous waste determination under Hazardous Waste rules (HAR 11-262-11), *ex-situ* sampling of the soil (e.g., from excavated stockpiles) is generally preferred over *in-situ* sampling, to ensure the sampling is representative of the specific material designated to be moved off-site.

Table 3 – Default DU Area for *In Situ* Characterization of Proposed Fill Material Source Areas

[Assumes Only Low-Mobility Contaminants Present, and Absence of Known Spill Areas or Pockets of Volatile or Highly Leachable Contaminants]

Receiving Site Land Use Category	[1]Recommended DU Area/Volume/Depth	Comments
Unrestricted Use[2]	5,000 ft^2 /100 yd^3/6 in.	Default DU area for unrestricted land use.
Schools and High-Density Residential Developments[2]	20,000 ft^2/400 yd^3/6 in.	Based on an assumed exposure area of approximately 0.5 acre.
Commercial or Industrial use only (formerly developed fill source)[2,3]	20,000 ft^2/400 yd^3/6 in.	Based on an assumed exposure area of approximately 0.5 acre.
Commercial or Industrial use only[3] (agricultural field fill source)[2]	Minimum 18 DUs/soil volume will vary/6 in.	Proposed source area divided into a minimum of 18 DUs for characterization of fill material.

Notes:
DU Decision Unit
ft^2 square feet
1. Using DU sizes larger than recommended for unrestricted fill source areas may require retesting of property where fill material is placed if proposed for more sensitive land use in the future (e.g., residential).
2. Larger volumes may be acceptable on a case-by-case basis. DU volumes up to 400 yd^3 acceptable for unrestricted reuse on site-by-site basis if prior knowledge and a thorough Phase I indicates low potential for contamination above Tier 1 EALs. Collect triplicate MI samples in 10% of DUs (minimum one set).
3. Multiple vertical depths may need to be sampled, depending on volume of fill material being characterized. Refer to Section 5.1.1 for the option of basing the DU volume of the fill source on the planned use of fill at the receiving site.

5.1.3 Source Area Characterization of Stockpiled Fill Material

A general approach for the investigation of stockpiles is summarized in Table 4. Multiple factors need to be considered when developing a sampling strategy for stockpiled soil being considered for potential fill material, including but not limited to:

- Specific composition or type of fill materials in the stockpile;

- Number of source areas associated with the stockpile;
- Historical use of the fill source property or properties, if known;
- COPCs and associated environmental hazards;
- Existing fill material analytical data, if available;
- Planned use of the fill materials;
- Volume of fill to be imported or exported; and
- Scheduling of sampling activities.

Stockpiles of proposed fill material from different source properties with the potential for different types or degrees of contamination should be characterized separately. This will help avoid the need to re-segregate and characterize otherwise large volumes of acceptable fill material due to the inclusion of a relatively small volume of heavily contaminated soil. Similarly, stockpiles or significant portions of stockpiles (i.e., greater than 20 yd^3 in volume) that are suspected to contain pockets of heavy contamination ("spill areas") should be isolated and characterized separately. Proposed fill material from small but heavily contaminated stockpiles should not be deliberately mixed with "clean" or less contaminated stockpiles to dilute overall contaminant concentrations.

The approach described assumes that all fill material originating from a single fill source property will be used for the same purpose at the receiving site. If the fill material will be used for multiple purposes, it may be necessary to form individual stockpiles segregated by use. The HEER Office should be consulted prior to sampling for sites where fill will be used for multiple purposes.

Table 4 – General Approach for Sampling Stockpiled Fill Material

Steps/Activities
1. Segregate stockpiles of proposed fill material from different fill source properties.
2. Segregate volumes of proposed fill material from "spill areas."
3. Select appropriate DU volume(s) based on proposed land use and contaminants of concern.
4. Choose a sampling strategy and tools that will provide access to sampling points throughout each DU.
5. Collect triplicate Multi Increment samples in 10 percent of DUs (minimum one set).
6. Consult with HEER Office if proposed fill material from a single fill source property will be used for multiple purposes at the receiving site to determine if alternative sampling strategies need to be implemented.
7. Consider the specific timing of the sampling activities – sampling during stockpile formation is preferred to sampling after stockpile formation.

5.1.3.1 Stockpile Decision Unit Designation

Table 5 summarizes the DU volume recommended for characterization of fill material in stockpiles. Decision units for stockpiles should generally be designated in terms of volume, rather than area. The appropriate DU volume for a stockpile is based on a number of factors, including:

- Targeted contaminants and associated environmental hazards;
- Proposed use of fill material at receiving site (e.g., residential versus commercial or industrial property, etc.); and
- Total volume of fill material to be characterized.

Appendix 1 categorizes chemicals listed in the HEER Office Environmental Hazard Evaluation (EHE) and Environmental Action Limit (EAL) guidance (HDOH 2016a) in terms of volatility and leachability. As discussed below, these characteristics are used to flag chemicals that may pose significant vapor intrusion or leaching hazards that could require a more detailed characterization of the proposed fill material.

Table 5 – Summary of Default Stockpile DU Volumes Based on Targeted Contaminants of Concern

Targeted Contaminants of Concern[1]	Receiving Site Land Use Category	[1]Default Stockpile Decision Unit Volume	Example COPCs[2]	Associated Environmental Hazards
Volatile Compounds	Any	20 yd^3	TPHg, TPHd, BTEX, naphthalene, PCE, TCE, mercury	Potential vapor intrusion hazards
Highly Leachable, Non-Volatile Contaminants	Any	20 yd^3	Triazines (e.g., atrazine), chlorinated herbicides, perchlorate, explosives	Potential leaching and surface runoff or groundwater contamination hazards
Low Mobility Contaminants[2,3,4,5]	Unrestricted Use	100 yd^3	PCBs, dioxins, arsenic, lead, PAHs, Technical Chlordane, DDT	Primarily pose direct exposure hazards
	Schools and High-Density Residential Developments	400 yd^3		
	Commercial or Industrial use only (formerly developed fill source)	400 yd^3		
	Commercial or Industrial use only (agricultural field fill source)	Minimum 18 DUs		
	Beaches (replenishment projects)	800 yd^3		

Notes:

COPCs	contaminants of potential concern
BTEX	benzene, toluene, ethylbenzene, and xylenes
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	perchloroethylene
TCE	trichloroethylene
TPHg	total petroleum hydrocarbons as gasoline
TPHd	total petroleum hydrocarbons as diesel
yd^3	cubic yards
1	See text for description of contaminant categories, and Appendix 1 for a list of chemicals in these categories. DU volume recommended for volatile or highly leachable chemicals applies to remediated sites known to be contaminated above Tie 1 EALs and subsequently remediated (vs general site screening).
2	Collect triplicate MI samples in 10% of DUs (minimum one set).
3	Include SPLP batch tests for metals if Tier 1 EALs exceeded (HDOH 2016c).
4	Larger volumes may be acceptable on a case-by-case basis. DU volumes up to 400 yd^3 acceptable for unrestricted reuse on site-by-site basis if prior knowledge and a thorough Phase I indicates low potential for contamination above Tier 1 EALs. Using DU sizes larger than accepted for unrestricted fill source areas may require retesting of property where fill material is placed if property is proposed for more sensitive land use in the future (e.g., residential).
5	Using soil with potential pockets of low volatility and relatively immobile heavy oil as fill material not recommended due to gross contamination concerns (see also HDOH HEER Office, 2016a).

5.1.3.2 Stockpiled Fill Material Potentially Contaminated with Volatile Organic Compounds

A chemical is considered to be "volatile" if its Henry's Law constant is greater than 0.00001 atm m^3/mole and molecular weight is less than 200 (HDOH 2016a; refer to Table H in Appendix 1). Consideration of fill material from sites previously known to be contaminated with volatile compounds is not recommended, due to the high cost of testing and potential vapor intrusion hazards for nearby or future buildings if residual contamination is inadvertently missed. This includes gasoline and diesel fuels or chlorinated solvents (e.g., perchloroethylene [PCE], trichloroethylene [TCE], etc.). Mercury should be considered a volatile chemical, although volatility can decrease over time for releases to soil. Volatile contaminants also pose leaching and groundwater contamination hazards. Due to these concerns, characterization of stockpiles possibly contaminated with volatile organic compounds (VOCs) typically requires relatively small DU volumes.

If using the soil for fill material is still desired, then the HEER Office recommends a sample frequency of one DU per 20 yd^3. For reference, this DU volume equates to approximately 6 inches of fill material under a default 1,000 ft^2 building floor – the default building size in vapor intrusion models (HDOH 2016a). Individual increments should be collected using a VOC-specialized sampling device (e.g., Core N' One, Terra Core, Encore, etc.) and extruded into a container with a premeasured volume of preservative such as methanol. A minimum of a 1:1 ratio of sample preservative to sample media is recommended. "In-field preservation" of the increments is preferred to minimize loss of VOCs. Alternatively, the individual increments (stored in the VOC-specialized sampling device) can be frozen and submitted to the laboratory for combination into a Multi Increment sample. Refer to Section 4.2.7 of the HEER Office TGM (HDOH 2016b) for additional guidance on multi- increment sampling for VOCs. Note that this recommended DU volume does not apply for general screening of soil otherwise not anticipated to contaminated with VOCs or highly leachable chemicals (see below) as part of a due diligence investigation.

Petroleum-contaminated soil poses potential gross contamination concerns (e.g., buildup of explosive gases, general odor and aesthetic concerns, etc.), as well as leaching and vapor intrusion hazards. Using petroleum- contaminated soil as fill material is not recommended. The analytical costs of sampling the proposed fill material for lighter weight fuels (e.g., gasoline and diesel fuels) and chlorinated solvents may also be cost prohibitive. Although heavier petroleum oils are not considered significantly volatile or leachable, the potential for gross contamination concerns generally negates using soil that has potential pockets of heavy oil contamination from being used as fill material. Refer to HEER Office guidance for long-term management of petroleum-contaminated soil for additional information (HDOH 2007; see also Section 18 in HDOH 2016b). Incidental leaks and minor soil contamination associated with normal operations of equipment are generally not significant enough to trigger petroleum and other chemicals as COPCs (e.g., small leaks of oil from heavy equipment in a quarry).

5.1.3.3 Stockpiled Fill Material Potentially Contaminated with Highly Leachable, Nonvolatile Contaminants

For this guidance, a chemical is assumed to be highly leachable if the sorption coefficient (koc) is less than or equal to 1,000 cm^3/g (HDOH 2016a). This reflects a default Kd model value of 1.0 assuming a total organic carbon content in the soil of 0.1% (refer to Table H in Appendix 1). Consideration of fill material from sites that were known to be contaminated with highly leachable, non- volatile contaminants is not recommended (e.g., excess soil from former pesticide mixing areas or munitions disposal areas). As is the case for soils contaminated with volatile chemicals, the added analytical costs of sampling needed to clear the soil for use as fill material is likely to exceed the cost of the fill material itself.

Common COPCs that are considered highly leachable include (see also Appendix 1; HDOH 2016a):

- Triazine herbicides (e.g. ametryn, atrazine, and simizine);
- Organophosphate pesticides;
- Chlorinated herbicides (e.g. 2,4-D and 2,4,5-T, dalapon);
- 1,4 Dioxane;
- Perchlorate; and
- Explosive-related compounds (e.g., HDX, RDX, PETN, etc.).

Refer to Section 9 of the HEER Office TGM for more details on pesticide contaminants that could be a concern for certain sites. Leaching of these COPCs from fill material could pose a significant threat to groundwater resources. If using the proposed fill material is still desired, then the HEER Office recommends a sample frequency of one DU per 20 yd^3. This is assumed to represent the minimum size of a spill area that could pose potentially significant leaching hazards. If the reported concentration of a chemical exceeds HDOH leaching based action levels, then a site-specific soil leaching test can be carried out and an alternative action level developed (HDOH 2016c).

The mobility of metals in soil is generally assumed to be low, but should be evaluated on a site-by-site basis. If needed, potential metal mobility should be evaluated by a batch test in accordance with HEER Office guidance (refer to HDOH 2016c).

As discussed in Section 9.1 of the HEER Office TGM, former agricultural fields do not need to be tested for chlorinated herbicides and other pesticides with low persistence to clear these areas for redevelopment or to clear the soil in the fields for use as fill material. Sampling should instead focus on persistent, non-mobile, and potentially toxic chemicals such as arsenic, dioxins, and organochlorine pesticides. Testing of stockpiles for these types of chemicals is discussed in the following section.

5.1.3.4 Stockpiled Fill Material Potentially Contaminated with Low Mobility, Nonvolatile Contaminants

Characterization of stockpiled soil that is not suspected to be contaminated with volatile or otherwise highly mobile contaminants for use as fill material is not cost-prohibitive in most cases. Nonvolatile COPCs like metals, PCBs, organochlorine pesticides, dioxins, and PAHs primarily pose direct exposure hazards. Evaluating potential direct-exposure hazards in proposed fill material can be done using DUs of larger volume in comparison to the DU volumes recommended for soil that might be contaminated with VOCs or highly mobile chemicals. The HEER Office recommends a sample frequency of one DU per 100 yd^3 of soil for unrestricted use of stockpile soil as fill material (see Table 5), with one Multi Increment sample per DU (plus replicates). This DU volume equates to the approximate volume of soil needed to cover a hypothetical, 5,000 ft^2 residential yard (default residential exposure area) 6 inches deep (default depth for evaluation of surface soil, direct exposure concerns).

If proposed fill material is to be used at a school, a high-density residential development (e.g., townhomes, apartment buildings, etc.) or a commercial or industrial site, then a default sample frequency of one DU per 400 yd^3 is recommended. This DU volume equates to the approximate volume of soil needed to cover a hypothetical, 20,000 ft^2 area 6 inches deep (default exposure area).

Larger DU volumes may be appropriate for large dredging projects if the source is expected to be relatively homogeneous. For example, dredge material is often used to replenish beaches. An exposure area size of 1 acre is generally appropriate for this type of setting. Assuming a depth of 6 inches, this equates to a stockpile DU volume of approximately 800 yd^3. Using dredged material as fill material for commercial or industrial areas, and in particular residential developments, should be discussed with the HEER Office on a case-by-case basis.

Section 3 of the HEER Office TGM includes additional information and options for selecting DUs for residential development projects.

5.1.3.5 Collection of Multi Increment Samples from Stockpiles

As described in Section 4 of the HEER Office TGM (HDOH 2016b), it is important to have equal and unbiased access to all parts of a soil stockpile during the collection of Multi Increment (MI) samples. An MI sample collected from a stockpile DU must be representative of the entire, three-dimensional mass of the stockpile. Sampling only the outer surface of a large stockpile is generally not acceptable.

The HEER Office recommends that a Multi Increment sample be collected from each stockpile DU, with each sample typically consisting of at least 30 to 75 increments, depending in part on the nature of the contaminant of concern (refer to Section 4.2.2 of the HEER TGM). Increments are typically collected and physically combined in the field into a single Multi Increment sample for laboratory analysis, though individual increments could be sent to and combined in the laboratory into a single MI sample. For non-volatile chemical samples, the less than 2-millimeter particle size fraction obtained by sieving the entire sample through a $\leq$ 2mm sieve, should be sub-sampled by the laboratory using a sectorial splitter or MI sampling methods and analyzed unless otherwise directed by the HEER Office. Multi Increment samples should be sub-sampled wet (or wet-sieved) for certain semi-volatile contaminants (see Semi-Volatile Chemicals in Appendix 1), but can be air dried and dry-sieved for some other "low mobility" semi-volatiles (and all non-volatile contaminants). Refer to Section 4 of the HEER Office TGM. Separation of the less than 0.25 mm particle size fraction is required for bioaccessible arsenic and lead analysis.

5.1.3.6 Sampling During Stockpile Formation

If sampling the proposed fill material *in-situ* is not practical, consider collecting MI samples as the fill material is being excavated and placed into stockpiles. Collecting samples from the soil while it is being transferred from the source area to a stockpile permits equal and unbiased access to the entire mass of soil and the preparation of representative samples. The collection of samples while heavy equipment is being used to form stockpile could pose safety issues. Close coordination with equipment operators is therefore very important.

Appropriate DU areas and volumes are established in the field in the same manner as done for an *in-situ* investigation. DUs are then excavated one at a time and sampled as the soil is being transferred to or placed in the stockpile. When implementing this approach, the individual increments can be collected directly from heavy equipment (e.g., front-end loader buckets) at appropriate intervals based on the designated DU volume as the stockpile is being formed.

For example, at a source property using 20-ton trucks to export fill material and with a target DU volume of 100 yd^3, ten increments of the proposed fill material could be randomly collected from five truckloads of material (total of 50 increments in the MI sample). Alternatively, at a source property using 20-ton trucks to export fill material and with a target DU volume of 1,000 yd^3, a single increment of the proposed fill material could be collected from each of 50 truckload-amount of material (total 50 increments in the MI sample).

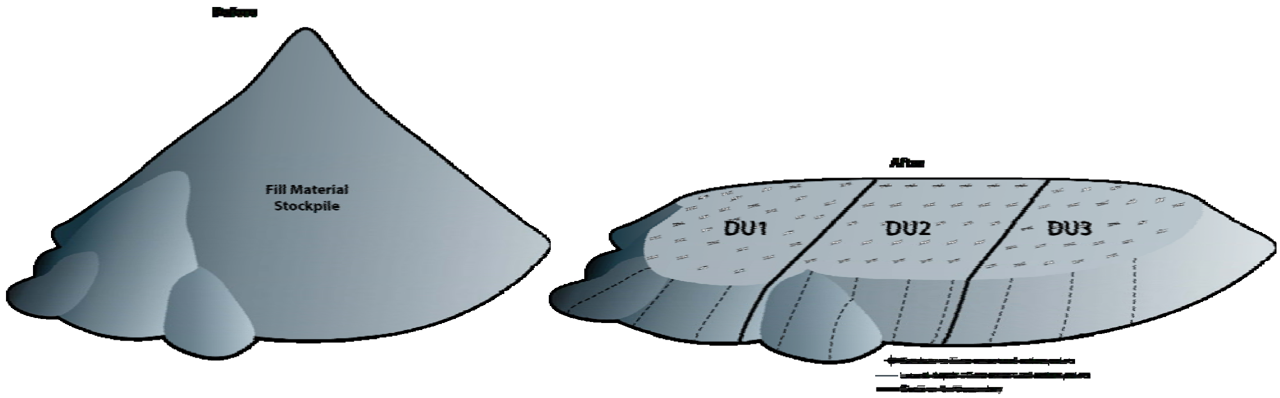
The proposed fill material stockpile(s) should be kept separate from other stockpiles at the source property and clearly marked until receipt of the analytical data confirms the fill material is acceptable for its intended use.

5.1.3.7 Sampling After Stockpile Formation

Sampling existing stockpiles presents a number of access and safety issues that may affect sample data quality. Where access or safety issues are significant concerns in collecting representative samples from existing stockpiles, the HEER Office should be consulted on options for alternate sampling strategies. A description of common approaches to sampling existing stockpiles is described below. If the soil is to be tested for volatile contaminants, increments should be collected from deeper than 6 to 12 inches below the surface of the stockpile using a VOC-specialized sampling device and preserved in methanol in the field (refer to Section 4.2.7 of the HEER Office TGM).

If room permits, existing stockpiles can be flattened or spread out sufficiently, so that the interior of the pile can be accessed with a hand coring tool or other device (see Figure 2; and refer to Section 5 of the HEER Office TGM). Another option is to move the stockpile to an adjacent or nearby location. As the fill material is being moved, individual increments can be collected directly from the heavy equipment (e.g., front-end loader buckets) at appropriate intervals (based on the designated DU volume). In essence, this is the same method as described for sampling during stockpile formation. If an existing soil stockpile is relatively large, the stockpile should be subdivided into multiple DU volumes as it is being moved. As the stockpile is being subdivided, individual increments can be collected directly from the heavy equipment (e.g., front-end loader buckets) at appropriate intervals (based on the designated DU volume).

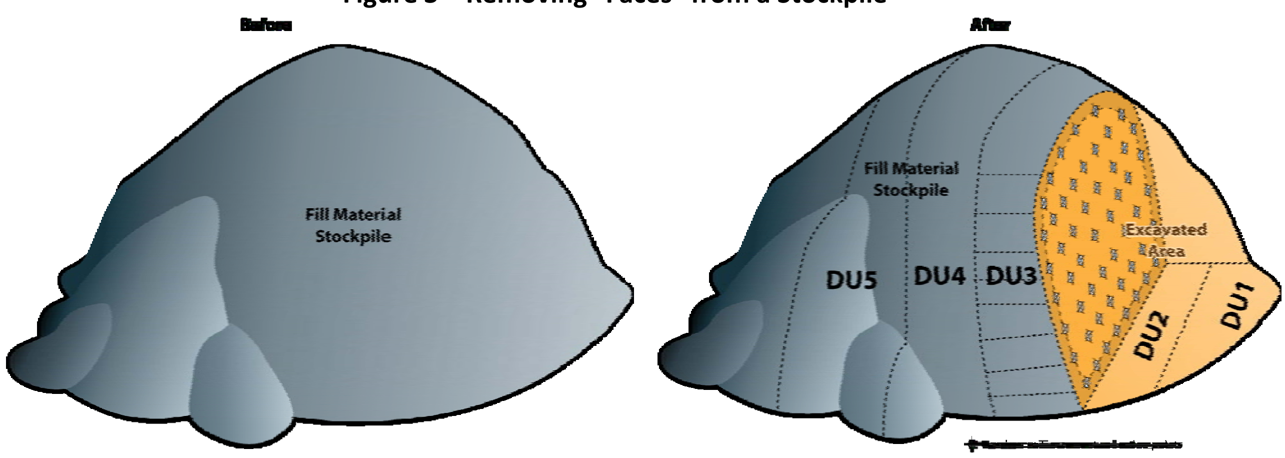
Figure 2 – Flattening or Spreading a Stockpile



The existing fill material stockpile (left) is too large to safely access. By flattening or spreading the stockpile (right), the fill material can be safely accessed and a representative MI sample can be collected from the surface using manual sampling techniques (e.g., hand coring tool).

If a stockpile cannot be moved or flattened, the interior of the stockpile can be accessed by successively removing a "face" of the stockpile and collecting increments from the newly exposed material (see Figure 3), or using manual sampling techniques to access the interior of the stockpile. This approach may require removing multiple faces of the stockpile to collect a representative MI sample.

Figure 3 – Removing "Faces" from a Stockpile



If an existing fill material stockpile (left) is too large to flatten or move, increments may be collected from the initially accessible portions of the stockpile. Then a "face" can be removed (right) to expose the previously inaccessible inner portions. Collect additional increments from each successive face of the stockpile and combine them to form an MI sample. Take appropriate safety precautions when using this approach.

5.1.4 Selecting DUs for Very Large Source Areas or Stockpile Volumes

Testing the entire area or volume of very large, *in-situ* or stockpiled sources of fill material at the default DU sizes (Tables 3 and 5) may not be practical due to feasibility issues and/or costs. An alternative is to test a select number of DUs within the entire population of potential DUs and base conclusions on acceptability of the results. Section 3 of the HEER Office TGM recommends use of a non-parametric, one-sided tolerance interval test to select an appropriate number of DUs from a large population based on a target confidence level, as summarized in Table 6 (also see USEPA 1989), similar to the approach used to test very large, agricultural fields (see TGM Section 3.4.8.2).

Table 6 – Selecting Number of DUs for Very Large Source Areas

Confidence in Concluding Source Area is Clean[1]	Number of DUs That Must be Tested
99%	90
95%	59
90%	46
80%	32
60%	18

Notes:

1. Assumes proportion of site that is clean is 95%, and all DUs tested are found below applicable action limits

Table 6 reflects the degree of confidence that the concentration of a contaminant in DUs that were not tested (across the entire large area or large stockpile volume) will be at or below the maximum-reported value for tested DUs at least 95% of the time. Clearance of the entire area or volume of soil requires that none of the tested DUs exceed target soil action levels. The HEER office TGM recommends the collection of a minimum 59 samples (DUs of the appropriate size with MI samples) from a large source area or stockpile in order to receive formal clearance from HDOH for unrestricted use. A smaller number of DUs and may be acceptable based on knowledge of the source area, sampling objectives, and professional judgment, although formal concurrence by the HEER Office should be agreed on ahead of time. Testing of a minimum of 18 DUs (plus triplicate samples collected in 10 percent of the DUs) to allow for a minimum 60% confidence level is recommended under any circumstance, and typically for only an industrial or commercial land use scenario. It is important to note that such a minimal degree of characterization may require institutional controls and an Exposure Hazard Management Plan for a property that specifies retesting of the receiving property before it can be converted to a more sensitive land use in the future.

DUs should be systematically, randomly selected within the subject source area or stockpile and tested for targeted COPC. All portions of the subject area or stockpile should have an equal opportunity for access and sampling.

If reported levels of COPCs in all DUs sampled are below applicable HDOH Tier I EALs, then the entire source area or stockpile should be considered cleared to the applicable confidence interval based on number of DUs selected. If the reported concentration of COPCs in one or more DU exceeds the applicable HDOH Tier I EALs, then additional subdivision and testing of the fill material will be needed in order to isolate acceptable and unacceptable soil for use as fill material. The HEER Office should be consulted on evaluation or additional sampling strategies in these cases.

There may also be some cases for very large stockpiles of soil (e.g., thousands to tens of thousands of cubic yards) where the generator knows the origin and history of the soil well, and previous testing or knowledge about the site indicates that chemical contaminants do not exceed applicable environmental action levels. In these cases, only a minimal amount of testing is desired (by generator) to confirm the presence or absence of significant contamination and the generator is typically not seeking a "clean" concurrence letter from the HEER Office for unrestricted use. This is similar to informal screening of a very large former agricultural field with a smaller number of one-acre DUs than the 59 required to get a clean concurrence letter from the HEER Office (see Section 3.5 of the HEER Office TGM). For these cases, a maximum DU volume of 800 yd^3 (from a single fill source) is recommended. This is based on the volume of soil required to cover a one-acre area of land to a depth of six inches. An area of one acre is commonly used in risk assessments as an upper size limit for evaluation of direct exposure hazards posed by soil contaminants. Such soil data should be used as one of multiple lines of evidence regarding the potential for significant contamination to be present in the soil and for final decision-making.

6.0 Comparison to HDOH Soil Action Levels

Soil data should initially be compared to HEER Office Tier I Environmental Action Levels for soil under an unrestricted (e.g., residential) land use, assuming sites are situated within 150 meters of a surface water body and overlying groundwater that is a potential or current drinking water source (HDOH 2016a). Refer to that guidance document for additional information on case-specific evaluation of risk to human health and the environmental and development of potential alternative screening levels.

As described above, HEER Office guidance on leaching of contaminants from soil can be used to evaluate this potential concern if initial action levels are exceeded (HDOH 2016a). This may be a frequent issue for soil contaminated with trace amounts of semi-mobile pesticides such as dieldrin, endrin, and endosulfan. Laboratory batch tests typically determine that aged pesticides are essentially immobile in soil (e.g., Kd >20). This allows the leaching based action levels to be ignored, with a subsequent focus on (typically much higher) direct- exposure action levels for these chemicals (refer to Table I series in HEER Office EHE guidance, HDOH 2016a). Alternative soil action levels (e.g., alternative target risks, exposure assumptions, etc.) should be discussed with the HEER office on a case-by-case basis. Note that alternative action levels may restrict future, offsite reuse of the soil and require preparation of an Environmental Hazard Management Plan for long-term management of the soil. In some cases, a formal deed covenant that restricts offsite use of the soil may also be required.

7.0 Fill Material Categories

Fill material characterized under the environmental action level guidance presented above is placed into four categories (Table 7):

Table 7 – Fill Material Categories and Use Considerations

Fill Material Category	Use Considerations
Class A	**Background – Unrestricted Use.** Within range of expected background conditions in non-agricultural and non-industrial areas. Class A fill material is likely to be limited to quarries and similar sites where there is minimal likelihood of anthropogenic contamination. No use restrictions.
Class B	**Minimally Impacted – Unrestricted Use.** Contaminants exceed expected background concentrations of contaminants but below[1] Tier I soil EALs for unrestricted land use (or acceptable alternatives). Most fill material from developed areas as well as former agricultural fields is anticipated to fall within into this category. No use restrictions.
Class C	**Moderately Impacted – Commercial/Industrial Land Use Only.** Contaminants exceed Tier I soil EALs for unrestricted land use but do not pose leaching, vapor intrusion or gross contamination hazards and concentrations do not exceed direct-exposure action levels for commercial/industrial land use. (Refer to Appendix 1, Table I-2 of EHE guidance (HDOH HEER Office 2016) and Tier II guidance for dioxins and arsenic (HDOH HEER Office, 2010b, HDOH HEER Office, 2010c). Fill material from former industrial areas or areas where fill material is impacted with incinerator ash may fall into this category. Use restricted to commercial/industrial areas only or as interim cover at a regulated landfill. These sites typically require institutional controls and an EHMP (see Sections 19.6 and 19.7 of the HEER Office TGM). TCLP tests must be carried out as part of a hazardous waste determination of offsite reuse or disposal.
Class D	**Heavily Impacted – Use As Fill not Recommended.** Exceeds Tier I soil EALs (or acceptable alternatives) and poses unacceptable risks to human health and the environment under any land use scenario. Use as fill material not recommended.

Notes:

1. Tier 1 EALs for unrestricted land use, for sites situated within 150m of a surface water body and overlying groundwater that is a potential or current source of drinking water.

8.0 Other Fill Material Management Considerations

Using Class A or Class B fill material (see Table 7) does not require a permit or long-term management practices. However, using fill materials is subject to other State of Hawaiʻi environmental laws and regulations (e.g., erosion and sediment control [county-specific grading ordinances], stormwater pollution prevention [HDOH Clean Water Branch – Hawaiʻi Administrative Rules Title 11 Chapter 55], etc.).

Using Class C fill material requires long-term management practices, an EHMP, and coordination with both the HEER Office and the SHWB. A hazardous waste determination that includes TCLP data must also be carried out (refer to Section 2 and Figure 1). Whenever "earthwork" occurs in Class C fill areas or the site use changes, the EHMP must be followed, as applicable, or the work/changes conducted under HEER Office oversight. In addition, the site EHMP may have to be updated as a result of any changes. The HEER Office should be consulted if Class C fill is proposed to be moved to another location for reuse. Since the receiving site land use category dictates the sampling needs for characterization, analytical data from larger DUs may not be appropriate to make determinations for a land use with smaller DU requirements (Table 3).

Landowners or developers are strongly encouraged to maintain the appropriate documentation supporting the fill determination process (e.g. the latest Phase I ESA, or fill material characterization report). The HEER Office will also maintain any submitted documentation in the site records in perpetuity. These documents will be made available for future environmental due diligence reviews or public file requests.

If earthen material under or directly adjacent to existing structures is planned for use as fill material, best management practices must be followed to remove materials such as lead-based paint, asbestos, canec, and other structure-related hazardous materials (e.g., mercury switches and light ballasts, PCB-containing equipment, etc.) prior to demolition. Take care to avoid cross-contamination to the underlying earthen materials.

It is important to recognize that soil adjacent to and under the foundations and slabs of pre-1990 buildings or building sites in Hawaiʻi may have been treated for termites with technical chlordane, aldrin, dieldrin, or other persistent and potentially toxic pesticides, as discussed in the HEER Office fact sheet on termiticides (HDOH 2011e). Soil under and adjacent to these buildings or at these former building sites should be considered suspect unless otherwise demonstrated to be "clean" by knowledge or by sampling and analytical testing (see sampling guidance for termiticides in HDOH 2011b). Testing of soils and plans for proper management should be initiated early in the planning stages of a redevelopment project.

All landfills in Hawaiʻi are prohibited from accepting regulated hazardous waste. Each landfill has its own acceptance procedures to ensure that they comply with this requirement. Generators should contact the specific landfill to ensure compliance with the landfill's acceptance criteria and operational procedures. Landfill owners/operators have the prerogative to implement requirements that are more strict than state regulations.

The HEER Office suggests using the Commercial/Industrial receiving site land use category (Table 3) in determining recommended DU size (e.g., 400 yd^3) when testing soils for suitability as landfill daily/interim/ intermediate/ final cover. Some landfills accept soils with contaminant concentrations over Tier I EALs but less than Commercial/Industrial land use EALs for use as landfill daily cover. If soils are being tested for hazardous waste determination and/or suitability as landfill cover, the maximum recommended DU size should be considered, and verified as necessary with the HDOH Solid and Hazardous Waste Branch and/or with the landfill operator.

In some cases, the HEER Office allows capping and long-term management of contaminated soil on a property. The HEER Office recommends that utility trenches that could be periodically accessed for maintenance or other purposes be backfilled with acceptable fill material (Class A or Class B Fill, Table 7). This will minimize exposure to trench and utility workers to contaminated soil in the future, as well as help prevent the inadvertent reuse of excavated contaminated soil at another location. The use of Class C fill material is not recommended, as it will require additional health, safety, and environmental considerations (and possible HEER Office oversight) whenever trench work is performed in the future.

8.1 Excavation Activities on Sites with Environmental Hazard Management Plans

Excavation activities at sites with contaminated soil that is governed by a long-term environmental hazard management plan (EHMP) need to follow the site-specific procedures and precautions outlined in the EHMP (e.g., sub-surface utility or repair work in contaminated areas, refer to Section 19 of the TGM). If specific procedures or precautions for excavation are not detailed in the EHMP, the HEER Office should be consulted to review and approve the planned excavation. Any potentially contaminated soil proposed to be relocated to the surface, taken off-site, or moved to alternate locations other than those locations specified in the EHMP must be handled or tested, as appropriate. Actions related to the disturbance of contaminated soil will need to be documented, including making appropriate revisions or addendums to the EHMP, and submitting them to the HEER Office.

9.0 References

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Appendix 1: Chemical Mobility Categories

Chemical Categories and Relative Mobility

[1]Physiochemical Category	CHEMICAL	Physical State		Molecular Weight	[2]Vapor Pressure mm Hg (25C)	Sorption Coefficient K_{oc} (cm^3/g)	Henry's Law Constant H ($atm\text{-}m^3/mol$)
[2]Highly Volatile Chemicals	ACETONE	V	L	58	2.3E+02	1.98E+00	3.90E-05
	BENZENE	V	L	78	9.5E+01	1.66E+02	5.61E-03
	BIS(2-CHLOROISOPROPYL)ETHER	V	L	171	1.6E+00	6.10E+01	1.13E-04
	BROMODICHLOROMETHANE	V	L	164	5.0E+01	3.50E+01	2.12E-03
	BROMOFORM	V	S	253	5.4E+00	3.50E+01	5.37E-04
	BROMOMETHANE	V	G	95	1.6E+03	1.43E+01	6.34E-03
	CARBON TETRACHLORIDE	V	L	154	1.2E+02	4.86E+01	2.68E-02
	CHLOROBENZENE	V	L	113	1.2E+01	2.68E+02	3.17E-03
	CHLOROETHANE	V	G	65	1.0E+03	2.37E+01	1.10E-02
	CHLOROFORM	V	L	119	2.0E+02	3.50E+01	3.66E-03
	CHLOROMETHANE	V	G	50	4.3E+03	1.43E+01	8.78E-03
	CHLOROPHENOL, 2-	V	L	129	2.5E+00	4.43E+02	1.12E-05
	DIBROMOCHLOROMETHANE	V	S	208	5.5E+00	3.50E+01	7.80E-04
	DIBROMOETHANE, 1,2-	V	S	188	1.1E+01	4.38E+01	6.59E-04
	DICHLOROBENZENE, 1,2-	V	L	147	1.4E+00	4.43E+02	1.90E-03
	DICHLOROBENZENE, 1,3-	V	L	147	2.2E+00	6.17E+02	1.90E-03
	DICHLOROBENZENE, 1,4-	V	S	147	1.7E+00	4.34E+02	2.41E-03
	DICHLOROETHANE, 1,1-	V	L	99	2.3E+02	3.50E+01	5.61E-03
	DICHLOROETHANE, 1,2-	V	L	99	7.9E+01	4.38E+01	1.17E-03
	DICHLOROETHYLENE, 1,1-	V	L	97	6.0E+02	3.50E+01	2.68E-02
	DICHLOROETHYLENE, Cis 1,2-	V	L	97	2.0E+02	4.38E+01	4.15E-03
	DICHLOROETHYLENE, Trans 1,2-	V	L	97	3.3E+02	4.38E+01	9.27E-03
	DICHLOROPROPANE, 1,2-	V	L	113	5.3E+01	6.77E+01	2.93E-03
	DICHLOROPROPENE, 1,3-	V	L	111	3.4E+01	8.08E+01	3.66E-03
	DIOXANE, 1,4-	V	L	88	3.8E+01	1.00E+00	4.88E-06
	ETHANOL	V	L	46	5.9E+01	3.09E-01	6.29E-06
	ETHYLBENZENE	V	L	106	9.6E+00	5.18E+02	7.80E-03
	METHYL ETHYL KETONE	V	L	72	9.1E+01	3.83E+00	5.61E-05
	METHYL ISOBUTYL KETONE	V	L	100	2.0E+01	1.09E+01	1.37E-04
	METHYL TERT BUTYL ETHER	V	L	88	2.5E+02	5.26E+00	5.85E-04
	METHYLENE CHLORIDE	V	L	85	4.4E+02	2.37E+01	3.17E-03
	STYRENE	V	L	104	6.4E+00	5.18E+02	2.68E-03
	tert-BUTYL ALCOHOL	V	L	74	4.1E+01	3.70E+01	1.17E-05
	TETRACHLOROETHANE, 1,1,1,2-	V	L	168	4.6E+00	9.66E+01	2.41E-03
	TETRACHLOROETHANE, 1,1,2,2-	V	L	168	4.6E+00	1.07E+02	3.66E-04
	TETRACHLOROETHYLENE	V	L	166	1.9E+01	1.07E+02	1.76E-02
	TOLUENE	V	L	92	2.8E+01	2.68E+02	6.59E-03
	TPH (gasolines)	V	L	108	6.8E+02	5.00E+03	7.20E-04
	TRICHLOROETHANE, 1,1,1-	V	L	133	1.2E+02	4.86E+01	1.71E-02
	TRICHLOROETHANE, 1,1,2-	V	L	133	2.3E+01	6.77E+01	8.29E-04
	TRICHLOROETHYLENE	V	L	131	6.9E+01	6.77E+01	9.76E-03
	TRICHLOROPROPANE, 1,2,3-	V	L	147	3.7E+00	1.31E+02	3.41E-04
	TRICHLOROPROPENE, 1,2,3-	V	L	145	3.7E+00	5.10E+01	2.80E-02
	VINYL CHLORIDE	V	G	63	3.0E+03	2.37E+01	2.68E-02
	XYLENES	V	L	106	8.0E+00	4.34E+02	7.07E-03

Chemical Categories and Relative Mobility

[1]Physiochemical Category	CHEMICAL	Physical State		Molecular Weight	[2]Vapor Pressure mm Hg (25C)	Sorption Coefficient K_{oc} (cm^3/g)	Henry's Law Constant H ($atm\text{-}m^3/mol$)
[3]Highly Leachable Chemicals	AMETRYN	NV	S	227	2.7E-06	4.45E+02	2.39E-09
	AMINO,2- DINITROTOLUENE,4,6-	NV	S	197	-	1.01E+02	1.61E-10
	AMINO,4- DINITROTOLUENE,2,6-	NV	S	197	-	1.01E+02	1.61E-10
	ATRAZINE	NV	S	216	2.9E-07	2.30E+02	2.34E-09
	BIS(2-CHLOROETHYL)ETHER	SV	L	143	8.5E-01	1.50E+01	1.71E-05
	CHLOROANILINE, p-	NV	S	128	7.1E-02	7.25E+01	1.15E-06
	CYCLO-1,3,5-TRIMETHYLENE-2,4,6-TRINITRAMINE (RDX)	NV	S	222	4.1E-09	1.95E+02	6.34E-08
	DALAPON	NV	L	143	1.9E-01	2.74E+00	9.02E-08
	DIBROMO,1,2- CHLOROPROPANE,3-	SV	L	236	5.8E-01	1.31E+02	1.46E-04
	DIMETHYLPHENOL, 2,4-	SV	S	122	1.0E-01	7.18E+02	9.51E-07
	DICHLOROPHENOL, 2,4-	NV	S	163	9.0E-02	7.18E+02	2.20E-06
	DICHLOROPHENOXYACETIC ACID (2,4-D)	NV	S	221	8.3E-08	2.94E+01	3.41E-08
	DIETHYLPHTHALATE	NV	S	222	2.1E-03	1.26E+02	6.10E-07
	DIMETHYLPHTHALATE	NV	S	194	3.1E-03	1.40E+02	1.05E-07
	DINITROBENZENE, 1,3-	NV	S	168	2.0E-04	2.20E+02	4.88E-08
	DINITROPHENOL, 2,4-	NV	S	184	3.9E-04	3.64E+02	8.54E-08
	DINITROTOLUENE, 2,4- (2,4-DNT)	NV	S	182	1.5E-04	3.64E+02	5.37E-08
	DINITROTOLUENE, 2,6- (2,6-DNT)	NV	S	182	5.7E-04	3.71E+02	7.56E-07
	DIURON	NV	S	233	6.9E-08	1.36E+02	5.12E-10
	GLYPHOSATE	NV	S	169	9.8E-08	1.88E+01	4.15E-19
	HEXACHLOROBUTADIENE	NV	S	261	2.2E-01	9.94E+02	1.02E-02
	HEXACHLOROETHANE	NV	S	237	4.0E-01	2.25E+02	3.90E-03
	HEXAZINONE	NV	S	252	2.3E-07	6.14E+02	2.24E-12
	ISOPHORONE	NV	L	138	4.4E-01	5.83E+01	6.59E-06
	NITROBENZENE	SV	L	123	2.5E-01	1.91E+02	2.39E-05
	NITROGLYCERIN	NV	L	227	2.0E-04	1.31E+02	9.76E-08
	NITROTOLUENE, 4-	NV	S	137	1.6E-01	3.09E+02	5.61E-06
	NITROTOLUENE, 2-	SV	S	137	1.9E-01	3.16E+02	1.24E-05
	NITROTOLUENE, 3-	SV	S	137	2.1E-01	3.33E+02	2.39E-05
	PENTAERYTHRITOLTETRANITRATE (PETN)	NV	S	316	1.4E-07	1.51E+02	1.20E-11
	PERCHLORATE	NV	S	117	-	-	-
	PHENOL	NV	S	94	3.5E-01	2.68E+02	3.41E-07
	SIMAZINE	NV	S	202	2.2E-08	1.49E+02	9.51E-10
	TERBACIL	NV	S	217	4.7E-07	7.78E+01	1.20E-10
	TRICHLOROBENZENE, 1,2,4-	SV	S	181	4.6E-01	7.18E+02	1.41E-03
	TRICHLOROPHENOXYACETIC ACID, 2,4,5- (2,4,5-T)	NV	S	255	<7.5E-5	4.86E+01	4.63E-08
	TRICHLOROPHENOXYPROPIONIC ACID, 2,4,5- (2,4,5-TP)	NV	S	270	9.7E-07	8.04E+01	9.02E-09
[4]Semi-Volatile Chemicals	ACENAPHTHENE	SV	S	154	2.2E-03	6.12E+03	1.80E-04
	ACENAPHTHYLENE	SV	S	152	6.7E-03	2.50E+03	1.45E-03
	ANTHRACENE	SV	S	178	6.6E-06	2.04E+04	5.61E-05
	BIPHENYL, 1,1-	SV	S	154	8.9E-03	6.25E+03	3.17E-04
	CYANIDE (Free)	SV	S	27	1.0E+00	-	-
	FLUORENE	SV	S	166	3.2E-04	1.13E+04	9.51E-05
	MERCURY	SV	S	201	2.0E-03	-	-
	METHYLNAPHTHALENE, 1-	SV	S	142	6.7E-02	3.04E+03	5.12E-04
	METHYLNAPHTHALENE, 2-	SV	S	142	5.5E-02	2.98E+03	5.12E-04
	NAPHTHALENE	SV	S	128	8.5E-02	1.84E+03	4.39E-04
	PHENANTHRENE	SV	S	178	1.2E-04	1.40E+04	3.93E-05
	PYRENE	SV	S	202	4.5E-06	6.94E+04	1.20E-05
	TPH (middle distillates)	SV	L	170	2 to 26	5.00E+03	7.20E-04

Chemical Categories and Relative Mobility

[1]Physiochemical Category	CHEMICAL	Physical State		Molecular Weight	[2]Vapor Pressure mm Hg (25C)	Sorption Coefficient K_{oc} (cm^3/g)	Henry's Law Constant H ($atm\text{-}m^3/mol$)
[5]Low Mobility Organic Chemicals	ALDRIN	NV	S	365	1.2E-04	1.06E+05	4.39E-05
	BENZO(a)ANTHRACENE	NV	S	228	5.0E-09	2.31E+05	1.20E-05
	BENZO(a)PYRENE	NV	S	252	5.5E-09	7.87E+05	4.63E-07
	BENZO(b)FLUORANTHENE	NV	S	252	5.0E-07	8.03E+05	6.59E-07
	BENZO(g,h,i)PERYLENE	NV	S	276	-	1.60E+06	1.44E-07
	BENZO(k)FLUORANTHENE	NV	S	252	9.7E-10	7.87E+05	5.85E-07
	BIS(2-ETHYLHEXYL)PHTHALATE	NV	S	391	1.4E-07	1.65E+05	2.68E-07
	CHLORDANE (TECHNICAL)	NV	S	410	9.8E-06	8.67E+04	4.88E-05
	CHRYSENE	NV	S	228	6.2E-09	2.36E+05	5.12E-06
	DIBENZO(a,h)ANTHTRACENE	NV	S	278	9.6E-10	2.62E+06	1.22E-07
	DICHLOROBENZIDINE, 3,3-	NV	S	253	2.6E-07	7.49E+03	5.12E-11
	DICHLORODIPHENYLDICHLOROETHANE (DDD)	NV	S	320	1.4E-06	1.53E+05	6.59E-06
	DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	NV	S	318	6.0E-06	1.53E+05	4.15E-05
	DICHLORODIPHENYLTRICHLOROETHANE (DDT)	NV	S	354	1.6E-07	2.20E+05	8.29E-06
	DIELDRIN	NV	S	381	5.9E-06	1.06E+04	1.00E-05
	DIOXINS (TEQ)	NV	S	356	1.5E-09	2.57E+05	2.20E-06
	ENDOSULFAN	NV	S	407	1.7E-07	2.20E+04	6.59E-05
	ENDRIN	NV	S	381	9.2E-06	1.06E+04	6.34E-06
	FLUORANTHENE	NV	S	202	9.2E-06	7.09E+04	8.78E-06
	HEPTACHLOR	NV	S	373	4.0E-04	5.24E+04	2.93E-04
	HEPTACHLOR EPOXIDE	NV	S	389	2.0E-05	5.26E+03	2.10E-05
	HEXACHLOROBENZENE	NV	S	285	4.9E-05	3.38E+03	1.71E-03
	HEXACHLOROCYCLOHEXANE (gamma) LINDANE	NV	S	291	4.2E-05	3.38E+03	5.12E-06
	INDENO(1,2,3-cd)PYRENE	NV	S	276	1.2E-10	2.68E+06	3.41E-07
	METHOXYCHLOR	NV	S	346	4.2E-05	4.26E+04	2.02E-07
	PENTACHLOROPHENOL	NV	S	266	1.1E-04	3.38E+03	2.44E-08
	POLYCHLORINATED BIPHENYLS (PCBs)	NV	S	326	7.7E-05	7.56E+04	2.93E-04
	PROPICONAZOLE	NV	L	342	1.0E-06	5.56E+03	4.15E-09
	TETRACHLOROPHENOL, 2,3,4,6-	NV	S	232	4.2E-03	2.00E+03	8.78E-06
	TETRANITRO-1,3,5,7-TETRAAZOCYCLOOCTANE (HMX)	NV	S	296	2.4E-08	1.85E+03	8.54E-10
	TOXAPHENE	NV	S	414	6.7E-06	9.93E+04	6.10E-06
	TRICHLOROPHENOL, 2,4,5-	NV	S	198	-	1.19E+03	1.61E-06
	TRICHLOROPHENOL, 2,4,6-	NV	S	198	-	1.19E+03	2.68E-06
	TRIFLURALIN	NV	S	335	4.6E-05	9.68E+03	1.02E-04
	TRINITROBENZENE, 1,3,5-	NV	S	213	6.4E-06	1.09E+03	3.17E-09
	TRINITROPHENYLMETHYLNITRAMINE, 2,4,6- (TETRYL)	NV	S	287	1.2E-07	2.14E+03	2.68E-09
	TRINITROTOLUENE, 2,4,6- (TNT)	NV	S	227	8.0E-06	1.83E+03	4.63E-07
[6]Assumed Low-Mobility Metals	ANTIMONY	NV	S	122	-	-	-
	ARSENIC	NV	S	75	-	-	-
	BARIUM	NV	S	137	-	-	-
	BERYLLIUM	NV	S	9	-	-	-
	BORON	NV	S	14	-	-	-
	CADMIUM	NV	S	112	-	-	-
	CHROMIUM (Total)	NV	S	52	-	-	-
	CHROMIUM III	NV	S	52	-	-	-
	CHROMIUM VI	NV	S	52	-	-	-
	COBALT	NV	S	59	-	-	-
	COPPER	NV	S	64	-	-	-
	LEAD	NV	S	207	-	-	-
	METHYL MERCURY	SV	S	216	-	-	-
	MOLYBDENUM	NV	S	96	-	-	-
	NICKEL	NV	S	59	-	-	-
	SELENIUM	NV	S	81	-	-	-
	SILVER	NV	S	108	-	-	-
	THALLIUM	NV	S	204	-	-	-
	VANADIUM	NV	S	51	-	-	-
	ZINC	NV	S	67	-	-	-

Notes:

1. References: Appendix 1, Table H of HEER office EHE guidance (HDOH 2016a). Vapor Pressures from National Library of Medicine TOXNET or ChemID databases.

Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S - solid, L - liquid, G - gas). Koc: Organic Carbon Partition Coefficient; H: Henry's Law Constant

2. Chemical considered to be "volatile" vapor pressure >1 mm Hg. Volatile chemicals pose potential vapor intrusion hazards. Volatile chemicals can also pose potential leaching hazards and direct-exposure hazards (due to vapor emissions at ground surface).

3. Chemicals with a sorption coefficient (koc) less than 1,000 g/cm^3 pose potential leaching hazards. Some highly leachable compounds are also semi-volatile and could pose vapor intrusion hazards at high source strengths.

4. Chemical considered to be "semi-volatile" if vapor pressure <1 mm Hg but Henry's number (atm m3/mole) >0.00001 and molecular weight <200. Semi-volatile chemicals can pose vapor intrusion hazards at sufficiently high concentrations and source strength (e.g., free product present) and can also pose potential direct exposure hazards. Most compounds in middle distillate fuels are semi-volatile, especially in aged releases.

5. Chemical considered to be "Low Mobility" if non-volatile and not significantly leachable. Low-mobility chemicals primarily pose potential direct-exposure hazards.

6. Metals primarily pose direct-exposure hazards. Evaluate metal mobility using batch tests as necessary (HDOH 2016a).

Appendix 2: Construction and Demolition Waste Disposal General Guidance

Guidance for

Construction & Demolition (C&D) Waste Disposal

State of Hawaii, Department of Health

2013

Background Information

This C&D waste disposal guidance supersedes the previous letter dated May 24, 1996. Although the waste composition varies from project to project, C&D wastes generally consist of concrete, wood, metal, glass, plastic, asphalt, tile, drywall, roofing and insulation material. These wastes are often bulked as one waste stream when sent for disposal. With advance planning, most of these wastes can be reused on the job site and/or salvaged for recycling opportunities.

Another type of C&D waste stream sometimes generated from a construction project is excavated soil. If the C&D waste is designated for disposal to a landfill or to any other off-site location, the contractor must make a hazardous waste determination in accordance with the Hawaii Administrative Rules (HAR) §11-262-11. Making a hazardous waste determination is a step-by-step process, and should start with determining whether the waste is excluded, then if listed, and finally if characteristic. Determining whether a waste is hazardous under RCRA (Resource Conservation and Recovery Act) can be done through one of the following methods:

Testing

Test the waste according to the methods set forth in subpart C of HAR 11-261.

Knowledge

Collecting a representative sample of the bulk C&D waste or excavated soil waste is crucial to characterizing environmental samples. If a sample is not representative, there are legal and environmental consequences. Each generator would be responsible for its own sampling plan. We advise contractors to work with experienced environmental companies and labs for guidance and implementation.

Note - *Construction wastes with lead-based paint may be exempt from HAR §11-262-11. Provided wastes: were from a residential structure; and from renovation, remodeling or abatement work; and contain no other listed constituents – refer to HAR §§11-261-20 and 11-261-30.*

- In some cases, a generator can use his/her knowledge of a waste to make a determination as to whether the waste is a characteristic hazardous waste. In order to use knowledge to characterize the waste, the generator must consider the raw materials that constitute the waste or the **process(es)** that result in the waste being generated.

  In considering the materials that make up the waste, the generator needs to examine the specific chemical and physical characteristics of the waste material. Information such as Material Safety Data Sheets (MSDSs) can be a helpful resource. However, while MSDSs can provide useful information regarding ignitability (flash point), corrosivity (pH), and reactivity, they tend to be less useful when it comes to identifying the toxic characteristics of waste. MSDSs are not required to list all of the ingredients in a certain material, but only those that make up greater than 1% of the total constituents of that material. This means that a waste may contain a toxic constituent exceeding the regulatory limit (making it a hazardous waste), but this constituent may not necessarily be included on the MSDS. Generators should also be aware that MSDSs are representative of raw materials; the MSDS may not accurately represent a waste material that is generated by the use of a particular raw material.

Knowledge

In considering the **process** that generates the waste, the generator needs to ask himself/herself: How does the operation/process affect the waste? For example, does the process make the waste ... more concentrated? ... more dilute?... contain free liquids?... become contaminated? ...etc.

One critical factor in using knowledge to characterize waste is that the knowledge must be applied appropriately. In other words, the knowledge that is applied must be valid and verifiable. A generator should not just assume that a waste is non-hazardous without providing some type of supporting, verifiable information to justify that conclusion. Using knowledge of the waste to conduct a hazardous waste determination involves a well thought out process in which the waste materials or the process generating the waste are considered. It should be noted that, more often than not, it is easier to use knowledge of the waste to characterize it as hazardous than it is to characterize it as non-hazardous.

- In many cases knowledge alone is inadequate to properly characterize the waste, specifically in those cases where the waste is cross-contaminated or inherently non-homogeneous. If you are generating a waste and your knowledge of the waste is insufficient to completely and accurately characterize it, you will need to get the waste tested by a lab that is certified to perform the tests that need to be conducted on the waste. Generators that use knowledge of process in waste determinations must be able to demonstrate the basis for their claim.
- An initial characterization must be done on each waste stream and a re-characterization must be performed at least every twelve months, or whenever there is a process change. It is recommended that MSDSs and other "knowledge of process" information be specifically reviewed during re-characterizations to ensure that neither the raw materials nor the process associated with the waste have changed.
- According to 40 CFR 262.40, a generator must keep records of any test results, waste analysis, or other determinations made in accordance with 40 CFR 262.11 for at least three years from the date that the waste was last sent to on-site or off-site treatment, storage, or disposal. Generators that use knowledge of process in waste determinations must be able to demonstrate the basis for this claim.

Appendix 3: Cover Letter (October 6, 2017)

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In reply, please refer to:
File: RB-261-2017

Date: October 6, 2017

To: Steve Chang, Chief
Solid and Hazardous Waste Branch (SHWB)

Fenix Grange, Program Manager
Hazard Evaluation and Emergency Response (HEER)

Through: Lene Ichinotsubo, Supervisor
SHWB - Solid Waste Section

Paul Kalaiwa'a, Acting Supervisor
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Steve Mow, Supervisor
HEER Site Discovery & Response

Kathy Ho, Deputy Attorney
HEER

Wade Hargrove, Deputy Attorney
SHWB

From: Roger Brewer, PhD
Hazard Evaluation and Emergency Response

Subject: Updates to joint, HEER-SHWB 2011 document *Guidance for the Evaluation of Imported and Exported Fill Material, Including Contaminant Characterization of Stockpiles*

This technical memorandum serves as a cover letter to the October 2017 update of the joint, HEER-SHWB document *Guidance for the Evaluation of Imported and Exported Fill Material, Including Contaminant Characterization of Stockpiles* ("Clean Fill" guidance). The document was re-titled *Guidance for Soil Stockpile Characterization and Evaluation of Imported and Exported Fill Material* as part of the 2017 update. Signature by the above recipients denotes concurrence with these updates.

The 2011 version of the Clean Fill guidance document was updated to clarify issues related to the following topics:

1. Removal of lead-based paint striping for asphalt to be used as inert fill material; and
2. Discussion of salinity concerns related to the reuse of dredged sediment from coastal areas; and
3. Clarification on use of HDOH Tier 1 Soil Environmental Action Levels for unrestricted land (Tier 1 EALs) use as part of the hazardous waste determination process.

The need to remove lead-based paint from asphalt to be recycled for unrestricted reuse includes input from Solid Waste Section Supervisor and is relatively straight forward, as are added notes regarding plant toxicity concerns for dredge material that has a high salinity. Refer to the updated guidance document for additional information.

Use of HDOH Tier 1 EALs (HDOH 2016a) as part of the hazardous waste determination process is based on the following points (see Figure 1):

1. HDOH soil Tier 1 EALs, in use and regularly updated since 1995, are protective of human health and the environment under any land use scenario, including use for residences, parks and schools, and are also protective of leaching and potential impacts to underlying groundwater;

2. A conclusion by the HEER Office that "No Further Action" is required for a contaminated property that has been remediated to meet Tier 1 EALs is reasonably intended to relieve the property owner and/or responsible parties of further oversight by the state and allow unrestricted onsite and offsite use of the subject soil;

3. Consideration of soil that *exceeds* HDOH Tier 1 EALs to be "polluted" under HRS § 342-H and meets the intent of that statute;

4. A requirement that Toxicity Characteristics Leaching Procedure (TCLP) test data be included as part of a hazardous waste determination under HRS § 342-J for disposal and/or offsite reuse of soil that exceeds HDOH Tier 1 EALs is reasonable and meets the intent of that statute (TCLP test not required if concentration of chemical is less than twenty-times the TCLP level; Table 1);

5. Soil that is not classifiable as a hazardous waste under HRS § 342-J by meeting the "20X" *di minimis* concentration limit or by meeting TCLP limits for disposal at a municipal landfill can still exceed HDOH Tier 1 EALs and pose a potential risk to human health and the environment and must be managed accordingly (refer to Table 1).

Determinations regarding the potential risk to human health and the environment posed by chemicals in soil should carried out in accordance with the HDOH guidance document *Screening for Environmental Concerns at Sites with contaminated Soil and Groundwater* and predicated on sample data collected in accordance with the HEER Office *Technical Guidance Manual* (http://eha-web.doh.hawaii.gov/eha-cma/Org/HEER/). Additional information is provided in the attached update to the HEER Office *Clean Fill* guidance.

Attachment:

Ocotber 2017 update to HEER "Clean Fill" guidance

Figure 1. Flow chart depiction of the hazardous waste determination process for soil that is exported or imported to properties overseen by the HEER Office.

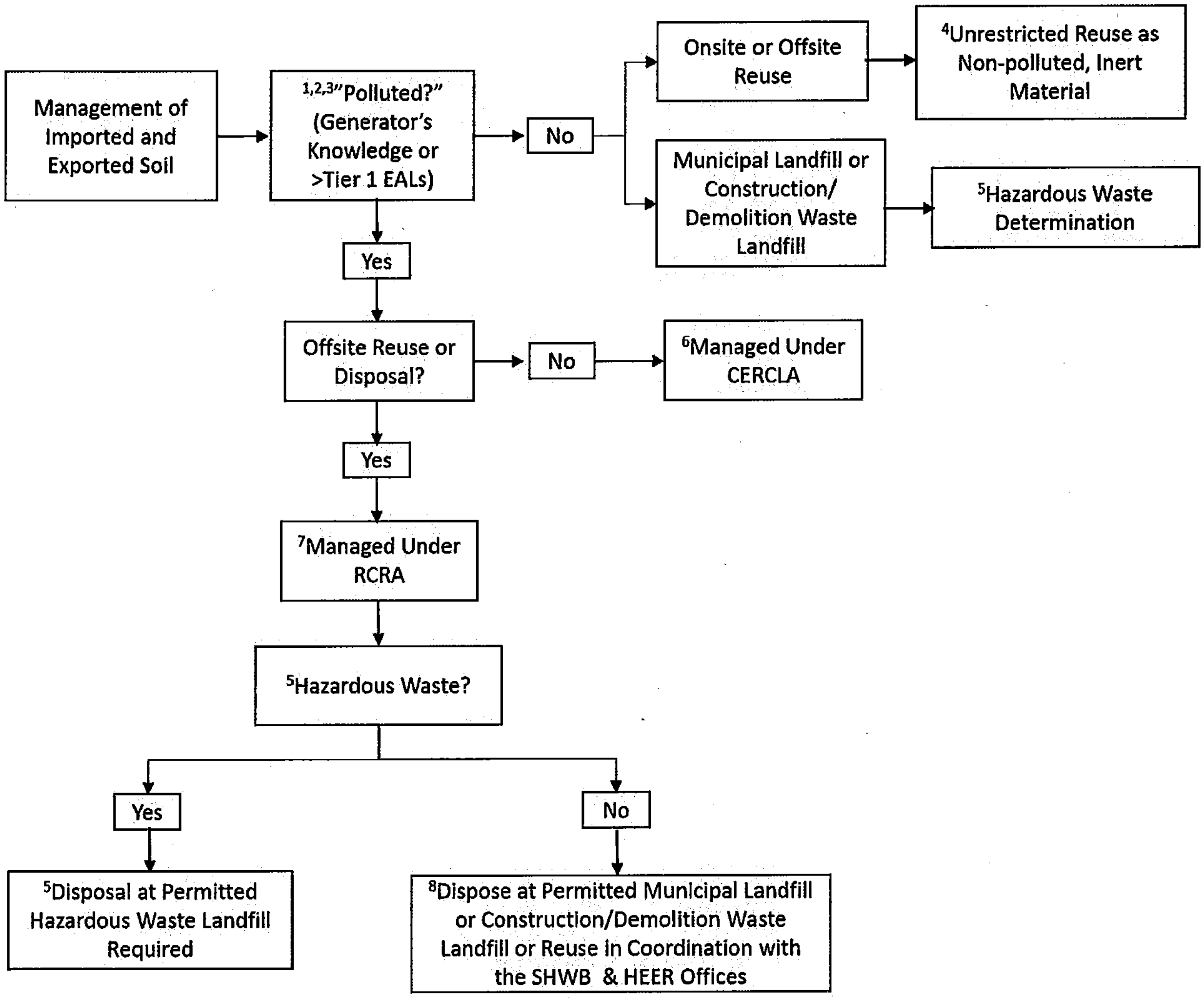

Figure 1 notes:

1. Imported or exported soil initially defined as a potential "waste" under HRS §342H-1 (Solid Waste Pollution). "Waste" defined as a "substance … which may pollute the atmosphere, lands or waters or Hawaii."

2. "Polluted" or "contaminated" soil defined as a soil with one or more potentially hazardous substances at a concentration that exceed HDOH Tier 1 EALs for unrestricted land use (HDOH 2016a; Tier 1 EALs for soil within 150m of a surface water body and situated over groundwater that is a source or potential source of drinking water).

3. Soil should be characterized in accordance with Decision Unit and Multi Increment Sample investigation methods described in the HEER *Technical Guidance Manual* (www.hawaiidoh.org) if testing is required due to insufficient generator knowledge of contamination potential.

4. "Inert Waste" includes "earth… which will not cause a leachate of environmental concern" (HAR §11-58.1, Solid Waste Management) *and* meets HDOH Tier 1 EALs for unrestricted land use.

5. Hazardous Waste Determination must include testing for Toxicity Characteristic Leaching Procedure if concentration of contaminant in soil (mg/kg) exceeds HDOH Tier 1 EALs for unrestricted land use AND is equal to or greater than 20 times the TCLP level (mg/L) for that chemical. TCLP data are not required as part of a hazardous waste determination if the concentration of the contaminant in soil is less than 20 times the TCLP level under any scenario. Soil cannot be disposed of at a municipal landfill or construction/demolition waste landfill if determined to be a hazardous waste under HAR §11-261 (Hazardous Waste Management). The soil must either be managed onsite under 128D through the HEER Office or disposed of at a permitted, hazardous waste landfill under the oversight of the SHWB.

6. Soil managed on-site under HRS §128-D (Environmental Response Law).

7. Soil managed for offsite reuse or disposal under HAR §11-261 (Environmental Response Law).

8. Offsite reuse of soil from a HEER project site that fails Tier 1 EALs for unrestricted land use but meets action levels for commercial/industrial land use *and* is not a hazardous waste must be carried out in coordination with the HEER Office and the Solid Waste Section of the SHWB. Land use restrictions and preparation of an Environmental Hazard Management for long-term management of the soil will be required under most circumstances.

Table 1. Comparison of HDOH Tier 1 EALs for chemicals with "20X" TCLP level.

USEPA Hazardous Waste Number	Contaminant	CAS No. 2	[1]Regulatory Level (mg/L)	[2]20X Equivalent in Soil (mg/kg)	[3]HDOH Tier 1 Soil EAL (mg/kg)
D004	Arsenic	7440-38 -2	5.0	100	23
D005	Barium	7440-39 -3	100.0	2,000	1000
D018	Benzene	71 -43 -2	0.5	10	0.30
D006	Cadmium	7440-43 -9	1.0	20	14
D019	Carbon tetrachloride	56 -23 -5	0.5	10	0.10
D020	Chlordane	57 -74 -9	0.03	0.6	17
D021	Chlorobenzene	108-90 -7	100.0	2,000	1.5
D022	Chloroform	67 -66 -3	6.0	120	0.026
D007	Chromium	7440-47 -3	5.0	100	1000
D023	o -Cresol	95 -48 -7	200	4,000	-
D024	m -Cresol	108-39 -4	200	4,000	-
D025	p -Cresol	106-44 -5	200	4,000	-
D026	Cresol		200	4,000	-
D016	2,4-D	94 -75 -7	10.0	200	0.34
D027	1,4-Dichlorobenzene	106-46 -7	7.5	150	0.055
D028	1,2-Dichloroethane	107-06 -2	0.5	10	0.023
D029	1,1-Dichloroethylene	75 -35 -4	0.7	14	1.1
D030	2,4-Dinitrotoluene	121-14 -2	0.13	2.6	0.024
D012	Endrin	72 -20 -8	0.02	0.4	3.8
D031	Heptachlor (and its epoxide)	76 -44 -8	0.008	0.16	0.071
D032	Hexachlorobenzene	118-74 -1	0.13	2.6	0.22
D033	Hexachlorobutadiene	87 -68 -3	0.5	10	0.041
D034	Hexachloroethane	67 -72 -1	3.0	60	0.023
D008	Lead	7439-92 -1	5.0	100	200
D013	Lindane	58 -89 -9	0.4	8.0	0.029
D009	Mercury	7439-97 -6	0.2	4.0	4.7
D014	Methoxychlor	72 -43 -5	10.0	200	16
D035	Methyl ethyl ketone	78 -93 -3	200.0	4,000	6.2
D036	Nitrobenzene	98 -95 -3	2.0	40	0.0053
D037	Pentrachlorophenol	87 -86 -5	100.0	2,000	0.098
D038	Pyridine	110-86 -1	5.0	100	-
D010	Selenium	7782-49 -2	1.0	20	78
D011	Silver	7440-22 -4	5.0	100	78
D039	Tetrachloroethylene	127-18 -4	0.7	14	0.098
D015	Toxaphene	8001-35 -2	0.5	10	0.49
D040	Trichloroethylene	79 -01 -6	0.5	10	0.089
D041	2,4,5-Trichlorophenol	95 -95 -4	400.0	8,000	0.50
D042	2,4,6-Trichlorophenol	88 -06 -2	2.0	40	0.31
D017	2,4,5-TP (Silvex)	93 -72 -1	1.0	20	0.87
D043	Vinyl chloride	75 -01 -4	0.2	4.0	0.036

Table 1 notes.

1. Promulgated TCLP level for determination of soil as a hazardous waste. If the result of a TCLP test meets or exceeds the level noted for the subject chemical, then the soil is classified as a "hazardous waste" and cannot be disposed of in a municipal landfill or construction/demolition waste landfill.

2. Minimum concentration of the subject chemical that must be present in the soil (mg/kg) in order for the TCLP level (mg/L) to be potentially reached, assuming 100% extraction of the chemical from the soil during the TCLP leaching procedure. TCLP data are required for disposal of the soil at a municipal landfill or construction/demolition waste landfill if the concentration of the chemical in soil exceeds HDOH Tier 1 EALs for unrestricted land use AND is equal to or greater than twenty-times the TCLP level noted in the Table 1. TCLP data are not required for onsite or offsite reuse of soils that meet the Tier 1 EALs provided that characterization of the soil was carried out in accordance with the HEER Office *Technical Guidance Manual*.

3. HDOH Tier 1 Soil Environmental Action Level for unrestricted land use, including residential, schools, medical facilities, parks, etc., where children and other sensitive populations might be present on a regular basis.