APPENDIX A - PVT ISWMF OPERATIONS

OPERATIONS PLAN

PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

Prepared for

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PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

1. INTRODUCTION

1.1 Purpose

This Operations Plan has been prepared pursuant to Hawaii Administrative Rules, Title 11, Chapter 58.1 (HAR 11-58.1), Solid Waste Management Control. It responds to requirements of the following sections of HAR 11-58.1 relative to the solid waste facility types in operation at the PVT Integrated Solid Waste Management Facility:

§11-58.1-32 Recycling and Materials Recovery Facilities
§11-58.1-19 Construction and Demolition Solid Waste Landfills

This Operations Plan replaces the Operational Plan for the PVT ISWMF dated September 2009, as revised in November 2011. It is intended to fulfill two primary functions:

- To describe and define site operational parameters as a reference for regulatory personnel of the Hawaii Department of Health; and
- To serve as an operations manual for personnel of the PVT Integrated Solid Waste Management Facility.

1.2 General Facility Description

1.2.1 Location

PVT Integrated Solid Waste Management Facility (hereafter, "PVT ISWMF") is located in the community of Nanakuli near the southwestern coast of the island of Oahu, Hawaii, as shown on Figure 1, Site Location Map. The facility property begins approximately 1600 feet northeast of the intersection of Farrington Highway and Lualualei Naval Road, and extends northerly approximately one mile along of Lualualei Naval Road.

1.2.2 Site Description

The PVT ISWMF property covers a total of 200 acres. The currently developed operating area consists of 200 acres on the west side of Lualualei Naval Road. A parcel of 179 acres located east of the road is used for soil borrow, water supply and drainage control. Figure 1 shows the existing topography of the properties.

The PVT ISWMF lies along approximately 1 mile of Lualualei Naval Road, with a width ranging from 1,000 to 1,800 feet between the road and Ulehawa Stream. Elevations of the site prior to development of the existing PVT ISWMF range from 40 to 50 feet above sea level. Approximately 198 acres are designated for waste disposal (49 acres for Phase I and 104 acres for Phase II), with a maximum elevation of approximately 135 feet above sea level under existing permits.

1.2.3 Major Facility Components and Operations

PVT ISWMF is a comprehensive solid waste management facility for construction and demolition waste and other recyclable waste products. It does not accept hazardous waste or municipal solid waste as defined in state regulations. It embodies three types of waste management facilities defined in HAR 11-58.1:

- A reclamation facility, defined as "a location used for the handling, processing, or storage of recoverable material, including but not limited to composting and remediation". Recoverable material is defined as "material that can be diverted from disposal for recycling or bioconversion."
- A materials recovery facility; and
- A construction and demolition waste landfill

The primary existing and future planned operations at the site are the following:

- Segregation of incoming loads into materials for processing, recycling, on-site usage or disposal.
- Mixed waste sorting to remove and separate recyclable materials;
- Processing to produce feedstock for bioconversion of organic wastes;
- Production of aggregate materials including rock, gravel and crushed asphalt;
- Solidification of liquid wastes;
- Reclamation of previously landfilled construction and demolition waste to minimize the potential of fire, to prevent settlement, to minimize leachate potential, and to remove voids;
- Storage for recyclable materials and marketing of recyclable materials; and
- Landfill disposal of residual non-recoverable waste materials, including primarily composition/asphalt roofing shingles, tile, gypsum board, lead painted concrete and cementitious siding

Figure 2 is a site map showing the general location of the major operations. Figure 3 is a flow chart illustrating the flow of materials between operations. Details of each facility component operation are provided in Sections 3 and 4.

1.2.4 Types and Quantities of Waste

PVT ISWMF will accept the following types of material for processing or disposal:

- Construction and demolition waste;
- Waste furniture, mattresses and other organic-containing material that can be processed into feedstock for bioconversion;
- Scrap metal;
- Liquid wastes for solidification; and
- Contaminated soil for disposal or use in solidification of liquid wastes and sludge.

Detailed descriptions of these materials are contained in Section 2.

PVT ISWMF is permitted under its Solid Waste Facility Permit to accept a maximum of 2,000 tons per day of C&D waste and 500 tons per week of asbestos contaminated waste.

1.2.5 Climate

The Nanakuli area receives approximately 14 inches of rainfall per year, based on data from the on-site weather station at PVT ISWMF. Most of the annual precipitation falls between October and April. During this period, rainfall averages 1 to 2 inches per month, with less than 1 inch per month generally falling in the rest of the year.

Typical daily temperatures range from the low 60's to the upper 70's during the winter, and from the lower 70's to the upper 80's during the summer.

1.2.6 Surrounding Area

The ISWMF site is bordered by industrial, residential, agricultural and undeveloped property. The Pine Ridge Farms trucking facility is adjacent to the northern boundary of the site. Ulehawa Stream separates the ISWMF from residential areas to the west and northwest. Residences to the south along Mohini Street are separated from ISWMF operations by a minimum 100-foot wide landscaped buffer zone. The nearest of these residences is approximately 750 feet from the southernmost end of the Phase I disposal area. The land east of the site, across Lualualei Naval Road, is undeveloped property owned by Leeward Land Company, Inc.

1.3 Site Utilization Concept

Figure 2 shows the site plan showing the location of existing and future processing storage and disposal areas and ancillary facilities located on the west side of the Lualualei Naval Road, including:

- Entrance area with scalehouse and administrative offices
- Waste segregation and sorting area
- Recyclable materials storage area
- Bioconversion feedstock production area
- Liquid waste solidification area
- Contaminated soils storage areas
- C&D landfill including asbestos disposal area and landfilled waste reclamation area
- All-weather access roads
- Drainage facilities

Detailed descriptions of these facilities are contained in Sections 3 and 4.

1.4 User Population

Primary users of the PVT ISWMF are construction and demolition contractors and waste haulers on Oahu, including agents of federal military or other government agencies. PVT prequalifies all customers by requiring establishment of an approved account prior to delivering any waste to the site. Customers are notified in advance that all material brought to the ISWMF for disposal will be inspected to ensure it is acceptable waste. Special accounts and review procedures are required for customers proposing to dispose of contaminated soils, asbestos contaminated wastes or liquid wastes for solidification.

1.5 Hours of Operation

The facility scalehouse currently is open to receive customers during the following hours:

Monday – Friday	7:00 a.m. to 3:30 p.m.
Saturday	7:00 a.m. to 1:00 p.m.
Sunday	Closed

Asbestos contaminated waste is received only on Tuesdays and Thursdays, from 7:00 to 3:00 p.m.

Hours may change from time to time in response to customer needs. On-site activities including cover application, construction and maintenance generally continue after the posted hours for waste receipts.

2. WASTE ACCEPTANCE PROCEDURES

2.1 Acceptable Waste Types

PVT ISWMF accepts the following general waste types: construction and demolition (C&D) waste, asbestos contaminated waste, liquid waste for solidification; contaminated soil, and coal ash from the AES power plant, and residual waste from pyrolysis or gasification processes. The characteristics of each waste type are described below.

2.1.1 Construction and Demolition Waste

C&D waste is generated primarily by contractors and government agencies involved in the construction or demolition of houses, commercial buildings, pavements and other structures. It may include any of the following types of materials:

- Concrete and asphalt rubble
- Steel and nonferrous metal
- Wood, glass, masonry, tile, roofing, siding, and plaster
- Waste plumbing, mechanical and electrical building components
- Dirt and rock
- Brush, wood, roots, stumps, dirt and rocks from clearing and grubbing activities
- Mattresses, furniture and other furnishings resulting from whole-building demolition

Mixed C&D loads may contain incidental bulky items such as tires. If accepted (at the discretion of PVT), tires are pulled from the load and temporarily stored on site until they are hauled to a licensed tire recycler. As a community service, PVT also collects and temporarily stores tires that have been illegally dumped along the road next to the landfill. No more than 150 tires will be stored before shipment offsite. Depending on the rate at which tires are accumulated, tires are removed from the site at 3 to 6 month intervals. In the future, tires may be shredded and recycled.

A significant volume of C&D waste is diverted for on-site use or recycling. PVT uses almost all the rock, dirt, concrete and asphalt for on-site roads and construction of the wet weather pad. In addition, PVT directs source separated and select loads of C&D waste containing significant quantities of scrap metal or wood to the recycling area for sorting, stockpiling and transfer to off-site recyclers.

C&D waste is notably dry and generally inert. Based on a review of characteristics, it has been determined that C&D waste creates no significant odor issue. Its potential for creation of leachate is low and, given the waste exclusion and loadchecking programs implemented by PVT, its potential for a release of toxic or hazardous materials to air or water is minimal.

2.1.2 Wood

PVT will accept source-separated loads of wood materials for recycling. Such materials, including pallets, packing crates, or other wood products, may also be sorted out from mixed C&D loads. Most wood, including both treated and untreated wood, will be processed as a feedstock for bioconversion by a variety of waste-to-energy processes. Alternatively, wood may be processed or shipped in bulk to off-site recyclers. If recycling the material is determined to be economically infeasible, PVT may also dispose the material, with or without processing it in a shredder to reduce its size and achieve maximum compaction.

2.1.3 Miscellaneous Wastes for Recycling or Reclamation

The following categories of waste will be accepted in segregated loads or will be separated from mixed C&D loads:

- Wood furniture, mattresses and other organic-containing material that can be processed into feedstock for bioconversion;
- Scrap metal or materials containing large quantities of scrap metal;
- Glass products other than HI-5 recyclable glass containers; and
- Waste plastics other than recyclable PET bottles

2.1.4 Asbestos Contaminated Waste

Asbestos contaminated waste is accepted and managed in accordance with the requirements of DOH Permit No. LF-0152-09 and applicable regulations including Chapter 342H, Hawaii Revised Statutes and 40 CFR Part 61, National Emission Standards for Hazardous Air Pollutants. The site accepts both friable and non-friable asbestos containing products, primarily consisting of roofing, ceiling, siding and insulating materials. All friable asbestos contaminated wastes received at the site are managed as friable asbestos, requiring it to be double bagged or double wrapped with plastic before being delivered to the site. Asbestos waste is accepted only on Tuesdays and Thursdays with 24-hours prior notice and disposed in the Asbestos Pit. Non-friable asbestos for disposal is accepted in the Asbestos Pit as well.

2.1.5 Contaminated Soils

Contaminated soils, primarily petroleum contaminated soils, are received primarily from site remediation projects associated with cleanup of leaks or spills from underground or aboveground storage tanks. Other contaminated soils resulting from construction / demolition activities may be accepted, provided they are not hazardous waste or TSCA-regulated waste.

Detailed procedures for accepting and managing contaminated soils are described in Section 2.3.4.

2.1.6 Solidified Liquid Wastes

PVT operates a contaminated soils storage and liquid waste solidification process on the ISWMF property, pursuant to DOH Permit No. LF-0152-09. Under the terms of the permit, soil materials resulting from mixing soils with petroleum-contaminated liquids, with liquids originating from construction and demolition activities, or with other liquids approved by HDOH, may be disposed in the PVT ISWMF.

2.1.7 Clean Inert Waste

PVT accepts segregated clean loads of inert material, primarily concrete rubble, asphalt rubble and cold-planed asphalt material. Most of these materials are stored in stockpiles until needed for on-site construction of roads, wet-weather deck surfacing, stormwater management facilities, or other beneficial uses. At the company's option, unused inert materials may also be disposed in the ISWMF as part of fire break construction between waste cells or as common C&D waste. If specified by the design engineer, inert materials may also be used in structural fill in and outside the landfill footprint.

2.1.8 AES Coal Ash

The Hawaii Department of Health has approved the acceptance at PVT ISWMF of fly ash and bottom ash from the AES Hawaii coal-fired power plant. Ash is currently approved for beneficial use as:

- Operations Layer - Ash may be used as a substitute for soil in the protective soil layer placed above newly installed liner systems in new disposal cells.

- Fire barrier – Ash may be placed as a subsurface barrier between Phase I and Phase II, or between adjacent disposal cells in Phase II or within disposal cells. The purpose of the barrier is to limit the spread on any potential future subsurface fire to minimize potential damage to landfill liner systems. The ash is used for vertical and horizontal fire barrier layers, as described in Section 4.4 3.1.

- Void Space Filling – Ash may be used for void space filling for fire prevention.

- Solidification Ash may be used in the solidification of liquids.

- Upon approval by DOH, for daily cover and interim daily cover. PVT has conducted a demonstration project and submitted a Human Health Risk Assessment for use of AES ash for daily cover, void space fill, interim daily cover and absorption of liquids.

2.2 Excluded Wastes

Solid wastes other than those described in Section 2.1 are not accepted for disposal at PVT ISWMF. Excluded wastes for processing or landfill disposal include the following:

- Household waste, garbage, commercial solid waste or industrial solid waste as defined in HAR 11-58.1-03.
- All regulated hazardous wastes and TSCA-regulated PCB contaminated materials;
- Pesticide containers other than incidental empty small containers classified as C&D waste;

- Bulk green waste (grass, leaves, tree trimmings, etc.) or loads of land clearing debris or C&D waste containing more than 10 percent green waste.
- Whole tires (except as provided in Section 2.1.1) or car parts;
- Free liquids and liquids products, including paints, solvents, sealers or adhesives (liquids are accepted for solidification only as described in Section 2.16);
- Asbestos waste that is not properly packaged;
- White goods except incidental appliances;
- contaminated C&D loads;
- Lead-acid batteries

2.3 Acceptance Procedures

Appendix B contains copies of disposal agreements and manifest forms required by PVT for all customers delivering C&D waste, asbestos waste, contaminated soil and liquid wastes to the site for disposal. The same agreements and forms will be required for customers delivering recyclable materials to the site for processing.

PVT ensures that excluded wastes are not accepted by its notices to customers, customer prequalification procedures, and inspections of loads at the scalehouse and at the disposal active face.

This section describes the procedures implemented for acceptance of the major waste types managed at PVT ISWMF. Each section also includes procedures for excluding unacceptable wastes. Acceptable wastes include the following:

- Construction and demolition waste
- Source-separated waste accepted for recycling or bioconversion, including:
  - Wood
  - Plastic
  - Glass
  - Furniture
  - Mattresses
  - Scrap metal
  - Concrete, rock and asphalt rubble
- Asbestos-containing waste
- Contaminated soil

2.3.1 C&D Waste Acceptance

All C&D customers are subject to PVT ISWMF prequalification procedures. Customers are required to execute a disposal agreement and submit a Request for Clearance Number Form to PVT, generally 7 days in advance of the date when the customer proposes to begin transporting waste to the ISWMF. Following the inspection, PVT issues a clearance number which is referenced for each load from the job site.

Waste generators are responsible for determining and reporting to PVT that wastes proposed for management are not regulated hazardous waste. PVT requires special testing for several categories of C&D waste, including debris containing lead paint, and sand blast sand and soil. These materials must be tested using the Toxicity Characteristic Leaching Procedure (TCLP) and meet the following maximum criteria:

Lead Paint Debris	Lead	5.0 mg/L
Sand Blast Sand and Soil	Arsenic	5.0 mg/L
	Barium	100.0
	Cadmium	1.0
	Chromium	5.0
	Lead	5.0
	Mercury	0.2
	Selenium	1.0
	Silver	5.0

Fiberglass or steel waste storage tanks proposed for disposal must be certified clean by a qualified environmental contractor.

Customers are required to submit test results and certifications for these materials before PVT issues a Clearance Number authorizing acceptance of the waste for disposal.

When waste transporters arrive at the ISWMF scalehouse, if the scale attendant has any doubt or concern regarding the acceptability of the material, site supervision is summoned to the scalehouse to inspect the load and determine its acceptability. Appendix E contains the Unacceptable Waste Exclusion Program used to prevent the disposal of unacceptable wastes, including the materials listed in Section 2.2 above.

A minimum of one load of C&D waste is selected each day for a random inspection according to procedures detailed in Appendix E. If unacceptable waste is found, the material is reloaded in the customer's vehicle and removed from the site. Records are maintained of unacceptable wastes observed during inspections.

Once a waste load has been determined acceptable, it is weighed and the data entered into the scalehouse records, and the customer is directed to the appropriate processing or disposal area.

2.3.2 Source-Separated Waste Accepted for Recycling

Segregated loads of wood, plastic, glass, furniture, mattresses, scrap metal, concrete, asphalt, rock and other waste materials accepted for recycling or reclamation will be inspected at the scalehouse to verify they do not contain unacceptable materials. PVT ISWMF personnel at the designated processing area where the loads are discharged will observe the material as it is dumped to identify any unacceptable materials.

2.3.3 Asbestos Waste Acceptance

All asbestos waste customers are required to sign an agreement specifying the terms and conditions of PVT ISWMF's asbestos disposal service. All friable asbestos containing wastes are required to be contained in metal or plastic drums or barrels, or be double wrapped or double bagged in plastic with a minimum thickness of six millimeters. Each load must be accompanied by a properly executed Asbestos Waste Shipment Record manifest form. Asbestos customers are also required to provide a certificate of insurance naming PVT Land Company as an additional insured for purposes of liability.

Asbestos loads are accepted only on designated days of the week, presently Tuesday and Thursday, before 2:45 p.m. Asbestos contractors are required to notify the ISWMF at least 24 hours before delivery, and have all paperwork including a manifest and PVT authorized clearance number, with each load. No more than 500 tons of asbestos containing waste may be accepted in any week, unless arrangements are made for extended delivery times.

2.3.4 Contaminated Soil Acceptance

Generators must submit a Soil Profile Sheet describing the source of the material and containing analytical test results for specified contaminants. Unless exempted by PVT based on generator knowledge, soils will be tested for the following:

- TCLP metals including TCLP cadmium, TCLP chromium, and TCLP lead;
- Ignitability;
- Total metals including total cadmium and total lead;
- Total petroleum hydrocarbons (TPH) as gasoline (C6-C12), diesel (C12-C24) and oil (C24-C30);
- Benzene, toluene, ethylbenzene, and xylenes;
- Polynuclear aromatic hydrocarbons (not applicable to material solely contaminated with gasoline);
- PCBs (not applicable to material solely contaminated with gasoline or diesel fuel);
- Halogenated volatile organic compounds (not applicable to material solely contaminated with gasoline or diesel fuel); and
- Pesticides

Additional testing may be requested on a case-by-case basis. Soils containing TSCA-regulated polychlorinated biphenyls (PCBs) are not accepted. Soils may not be hazardous waste.

All soils proposed for disposal at PVT must be tested according to test procedures and methods set forth in the disposal agreement. PVT reserves the right to reject any load it has cause to believe contains unacceptable contaminants or levels of contaminants in excess of approved concentrations. Customers are required to provide certificates of insurance naming PVT Land Company as an additional insured for liability protection.

3. WASTE RECLAMATION AND RECYCLING OPERATIONS

This section describes the processes used by PVT ISWMF to recover resources and materials from C&D and other waste materials. Each major process category is discussed including information on waste types, equipment, labor and product handling.

3.1 Materials Processed for Reclamation

The major categories of waste materials processed to recover materials for recycling and reclamation include:

- Mixed C&D waste
- Source-separated wood waste
- Source separated rock, concrete and asphalt rubble
- Source-separated scrap metal, discarded furniture, mattresses and other products suitable for processing to incorporate into bioconversion feedstock

3.2 Reclamation Processes Overview

Figure 3 is a schematic flow diagram of the PVT ISWMF materials reclamation facility, illustrating the major process steps:

- All incoming loads are classified on arriving at the scalehouse, and directed to the appropriate area for discharge.
- Mixed loads are sorted to separate major categories of recoverable and non-recoverable materials.
- Sorted material is shredded to reduce volume.
- Material designated for bioconversion process feedstock is additionally processed to requirements of user.
- Rock, concrete and asphalt rubble is crushed to produce aggregate products.
- Existing disposed mixed C&D waste is excavated and processed as mixed C&D to reclaim materials.
- Liquid wastes are solidified by mixing with soil for disposal or use as interim landfill cover.
- Materials reclaimed or recycled for off-site uses are stored and transported to markets.

These processes are detailed in the following sections.

3.3 Material Prescreening and Segregation on Receipt

Upon receipt at the scalehouse, all incoming loads are designated as either C&D waste or non C&D material for recycling. Loads are then directed to one of the following designated areas for dumping and processing:

- Mixed materials sorting area
- Bioconversion feedstock process area
- Aggregate production facility

- Scrap metal storage area
- Liquid waste solidification area
- Contaminated soil storage area
- C&D landfill (C&D waste only)

PVT anticipates that approximately 70%-80% of the total incoming material will be directed to recycling or processing areas, and 20% to 30% will be sent directly to the C&D landfill for disposal. Signage at the site provides clear direction for customers to access the designated area for discharge of their load.

3.4 Mixed Material Sorting

Most loads of mixed C&D and other material are processed at the mixed load sorting area to separate the waste into the following categories:

- Wood;
- Metal;
- Concrete, rock, asphalt and other inert material;
- Soil;
- Plastic, paper and other organic materials suitable for use in bioconversion feedstock; and
- Non-recoverable residual waste.

PVT generally sorts and processes material as it is delivered, with minimum stockpiling or storage prior to processing. Stockpiles shall not exceed a height of 15 feet with 20-foot lanes between piles.

Receipt, stockpiling and processing of material are coordinated in order to comply with permit conditions requiring that all C&D material received at the MRD be sorted by the end of the week.

3.4.1 Equipment

Figure 4 is a schematic layout of the mixed waste sort facility, illustrating the following equipment arrangement:

- Mixed C&D material in the incoming stockpile will be initially sorted by one or more excavators. The excavators break up any large assemblies into manageable pieces, and will remove large rocks, concrete chunks, logs or stumps, and oversize metal objects to separate stockpiles.

- After large items have been removed by the excavator, the remaining mixed C&D material will be transferred by a front-end bucket loader to the primary screen, which separates it into two size fractions, nominally above and below a maximum particle size of six (6) inches. The smaller material (6"-minus) is transferred by conveyor to a separate sorting line (the "B line" for processing, while the larger material (6"-plus) proceeds to the primary sort line ("A line") for sorting.

- The A Line sorting conveyor is elevated above the surrounding concrete pad. A series of storage bays are delineated on both sides of the conveyor by steel walls. Roll-off bins may be placed in some bays to facilitate transfer of material from the storage bay to the next stage of processing. Personnel remove the following materials from the waste stream as it moves along the conveyor, and drop them into the storage bays or bins:

  - Inert material (concrete, rock, asphalt, etc.)
  - Ferrous and non-ferrous metals
  - Non-recoverable residual waste.

  Wood, plastic, paper, carpet, yard waste and other organic materials suitable for use in bioconversion feedstock are left on the sorting belt and transferred to a conveyor discharging to the primary shredder or a stockpile for transport to underground storage.

- The B Line sorting system consists of the following components to process the 6"-minus material:

  - An overhead belt magnet that collects and transfers ferrous metal from the conveyor belt to a bin;
  - A secondary screen that removes material smaller than one inch in size (1"-minus) and transfers it to a bin or stockpile;
  - An air classifier that separates the remaining material into light (wood, paper, plastic) and heavy fractions, transferring the heavy material to the A Line rock bin and the light fraction to the B Line sorting conveyor;
  - A sorting conveyor where personnel remove remaining ferrous and non-ferrous metals, and any other material not suitable for use as bioconversion feedstock; and
  - A transfer conveyor discharging to the primary shredder or stockpile.

- The final transfer conveyor of the B Line is fitted with a chute for loading pre-sorted clean wood (pallets, lumber assemblies, etc.) directly onto the conveyor for processing in the primary shredder.

- Materials are removed from storage bays and bins by the front-end loader or rolloff truck and transported to the applicable storage area or next stage of processing.

The mixed C&D waste system is designed to process approximately 80 to 100 tons per hour of material.

3.4.2 Labor Requirements

The mixed waste sort line is generally staffed by two to four equipment operators and from ten to 18 persons removing material from the sorting conveyors.

3.4.3 Residual Wastes

Non-recoverable residual waste is generally less than twenty percent (20%) of the sorted C&D waste stream. Residual wastes consist primarily of the following materials:

- Composition / asphalt roofing shingles
- Tile
- Gypsum board scrap
- Cementitious siding and tile
- Glass
- Floor tiles
- Fiberglass insulation
- Ceiling tiles
- PVC pipe and siding

Combined with the 20% to 30% of incoming material sent to the landfill directly from the scalehouse, the residual waste from recycling is expected to produce a total disposed tonnage of approximately 35% to 45% of the total material received at the facility.

3.4.4 Storage

Materials are transferred from the sorting facility to storage areas as follows:

- Wood, yard waste and miscellaneous organic materials are moved to the bioconversion feedstock production area or stockpiled underground.

- Metals are moved to ferrous and non-ferrous storage areas. These are open bays defined by concrete blocks or K-rails, with separate bays for ferrous metal, aluminum and other non-ferrous metals or bins.

- Rock, concrete and asphalt rubble are moved to the aggregate materials process area. Separate stockpiles are maintained in this area for rock, concrete without rebar, concrete with rebar, and asphalt rubble.

- Residual waste is transported either directly to the C&D landfill disposal area, or to the bioconversion feedstock area for primary shredding to reduce its volume prior to disposal.

3.5 Bioconversion Feedstock Production

PVT estimates that approximately 60% of the total incoming material streams are suitable for reclamation and conversion into feedstock for bioconversion by waste-to-energy, gasification or pyrolysis. The feedstock will be processed into the physical form required by off-site bioconversion facilities, and transported to them under supply agreements that will be developed as the anticipated bioconversion facilities are constructed and placed into service. The following information describes the feedstock production system as currently planned.

3.5.1 Feedstock Material Stream

Approximately 80 percent of the material stream converted to feedstock will be wood, consisting of lumber, pallets, panel board and other processed wood materials. The balance will be made up of yard waste, paper, plastic, carpet and other miscellaneous materials with organic content suitable for waste-to-energy, gasification or pyrolysis.

3.5.2 Equipment

The feedstock production facility includes three major pieces of stationary equipment:

- A primary shredder, which reduces the material to a nominal dimension of four inches, with a maximum of ten inches and a minimum of 3 inches. The system includes a magnet to remove small ferrous metal items from the shredded material stream. The primary shredder is usually located at the end of the A Line and B Line conveyor systems to shred material left on the conveyer belt. Under some circumstances it may be located elsewhere for loading by a front-end loader or an excavator.

- A secondary shredder to reduce the feedstock material to the maximum particle size required by the bioconversion process, which may range from 3/8 inch to two inches in its largest dimension.

- A screening system to ensure the final product meets the specified particle size, with oversize material returned to the secondary shredder for reprocessing.

Components in the system are generally sized for a production rate of approximately 100 tons per hour, depending on the type of material being processed.

Material is loaded to the primary shredder by conveyor, front-end loader or excavator. Shredded material is handled on conveyors or by front-end loaders.

3.5.3 Labor Requirements

The feedstock production system generally requires two equipment operators. The excavator operator feeding the primary shredder is responsible for blending material from material stockpiles to produce the required blend of wood and other materials established for the feedstock product.

3.5.4 Environmental Controls

Dust will be controlled, during material sorting shredding and screening by fixed and mobile water spray systems. PVT will monitor operations on a daily basis and adjust the controls as needed to prevent excessive dust emissions.

3.5.5 Products

Material that has been processed only through the primary shredder may be supplied to H-Power or other facilities utilizing mass-burn or similar technology suitable for using feedstock as auxiliary fuel.

The major users of feedstock from the secondary grinding and sorting system will be bioconversion facilities utilizing gasification or pyrolysis technology to produce synthetic gas that is combusted in a boiler to produce process steam or electricity, or converted to other forms of liquid or gaseous fuel.

3.5.6 Residual Wastes

Once materials have been sorted from the mixed stream for feedstock production, only minimal quantities of residual waste are expected from the feedstock system.

3.5.7 Storage

Under normal conditions, bioconversion feedstock will be removed from the site as it is produced in order to provide steady flow to the facilities using it. Limited stockpile quantities of less than 5,000 tons of feedstock may be accumulated. Shredded material stockpiles would be in linear form, 15 feet or less high with 20-foot access lanes between piles. As much as 700 linear feet of stockpile could be needed to store 5,000 tons of shredded feedstock.

Temporary feedstock stockpiles will be monitored and turned as necessary to ensure against spontaneous combustion, and may be covered with tarps to protect the material against rain or creation of dust during dry periods.

In the event PVT produces more feedstock than customers can use, PVT may store partially shredded material (from the primary shredder) underground in a designated area of the Phase II C&D landfill. The selected area is delineated by cones or stakes, and no C&D waste is placed within the area. Shredded feedstock material is placed in maximum 20 ft high lifts within the area, and covered with a minimum 2 feet of ash or soil to create a fire barrier before placing another lift. No C&D waste will be placed above the stockpiled material.

After a bioconversion facility is ready to receive feedstock, PVT will excavate the stored material, complete its processing using a trommel screen and the secondary grinder, and transport it to market. Material mixed with AES ash or soil used for fire barrier or cover will either be disposed, or screened to remove the ash or soil before processing it in the secondary grinder.

3.6 Aggregate Materials Production

3.6.1 Processed Materials

PVT ISWMF processes rock, concrete and asphalt rubble to produce crushed aggregate materials for use in permanent and temporary landfill construction. Primary sources of these materials are land clearing and excavation, building demolition, and road/highway construction and maintenance.

3.6.2 Equipment

Equipment required for the production of aggregate materials from C&D materials includes:

- Excavator with a concrete pulverizer attachment to reduce concrete chunks to 12 inches maximum size and remove large pieces of reinforcing steel:
- Grizzly screen to remove fine materials from rock, concrete and asphalt rubble prior to crushing;
- Impact crusher to reduce material to desired sizes;
- Screen plant to classify materials to produce specific mixes of particle size;
- Conveyors to move materials between stages of the processing system; and
- Front-end loader to load and transfer materials to and from stockpiles.

3.6.3 Labor Requirements

The aggregate production system ordinarily requires two operators, one for the concrete pulverizer and one for the front-end loader. A third operator and second loader may be required during periods when product material is being loaded from stockpiles into trucks for onsite or offsite use.

3.6.4 Products

Typical products from the aggregate production operation include:

- 6-inch minus mixed rubble for use in on-site roads or structural fill;
- 1½ inch minus crushed rock drainage media for landfill construction or off-site sale;
- 1½ inch or 2 inch minus mixed rock, concrete and asphalt rubble for surfacing on-site roads;
- ½ inch minus mixed material for use as landfill interim cover; and
- Scrap reinforcing steel, wire mesh reinforcing and other scrap ferrous metal.

Other products may be produced in response to changing or new needs of on-site operations or off-site customers.

3.6.5 Residual Wastes

Minor amounts of wood, dirt and other material unsuitable for the aggregate materials will be separated from the product at the grizzly screen. This material will be either disposed in the landfill or used as interim landfill cover, depending on the amount of paper, plastic or other materials in it that are unsuitable in interim cover soil.

3.6.6 Storage

Unprocessed aggregate materials may be stored prior to crushing, in separate stockpiles for rock, concrete and asphalt. Stockpiles would typically be less than 20 feet high, covering an area less than 200 feet in the largest dimension.

Processed aggregate material stockpiles will be maintained in a neat and orderly condition to facilitate placement and removal of material, and minimize undesirable mixing of different mixes and types of material.

3.7 Landfill Reclamation

3.7.1 Purpose

C&D waste disposal operations in the Phase I area of the PVT ISWMF prior to approximately 1995 achieved low compaction densities and produced a fill that has been determined to contain substantial amounts of void spaces. As a result, the landfill has experienced subsurface fires due to the intrusion of oxygen into the void space. PVT ISWMF plans to excavate, process and reclaim materials from a large portion of the Phase I area. This operation will provide a number of benefits, including:

- Recovery of materials for the aggregate production and bioconversion feedstock process;
- Recovery of excess soil used in the original landfill operation;
- Replacement of the removed loosely compacted fill with new well-compacted waste fill, eliminating void spaces, minimizing long-term settlement issues, minimizing the generation of landfill gases, and reducing risk of subsurface fires and associated odor issues; and
- Extension of the useful life of the C&D landfill.

3.7.2 Location and Expected Reclamation Volume

Figure 5 shows the general area where PVT ISWMF plans to reclaim materials from the Phase I C&D landfill. Approximately 1 to 1.5 million cubic yards of material will be excavated and processed.

3.7.3 Equipment

The landfill reclamation operation will be conducted using an excavator, a bulldozer and several dump trucks. The excavator will excavate the refuse and cover soil and load it directly into a tracked screener, which separates into material larger than 8", material 1" to 8", and material which is 1" or less in size (1" minus). The 1" minus material is reused as daily cover. The 1" to 8" material is loaded directly into trucks, which will deliver the material to the mixed C&D processing area. The 8"+ material is sorted with an excavator and loader to remove concrete, asphalt, carpet, large pieces of metal, and another materials that need to be recycled or reburied. The balance of the material is loaded on haul trucks to be delivered to the mixed C&D recycling area. The bulldozer will push cover soil from the area being prepared for excavation to a stockpile, and spread interim cover soil over areas that have been partially excavated.

3.7.4 Reclamation Processes

The excavation of existing landfilled waste will be done in horizontal slices across the Phase I area to be reclaimed. Once identified, the area will be staked and excavated in the following manner:

- Beginning at an outside slope, interim cover soil will be scraped and removed from an area estimated to be capable of excavation during one week's time, not to exceed one acre in size. The soil will be pushed by a bulldozer to a stockpile located outside the projected work area.
- The excavator will remove a full lift of waste, down to the level of underlying interim cover, and load it into trucks for delivery to the processing area. Each removal lift is expected to be 10 to 15 feet high.
- At the end of each work week, the previously removed and stockpiled cover soil will be used to cover any bare spots in the excavated area with a minimum six inches of soil.
- A minimum grade of approximately 3 percent will be maintained in the excavated area, to provide positive surface water drainage.
- A new area of excavation will be cleared and excavated the following week, and the process continued until a complete horizontal slice across the reclamation area has been completed. A new horizontal slice will then be initiated.
- A slope gradient of 3:1 (horizontal:vertical) will be maintained at the interior limits of the reclamation area, and a minimum of 12 inches of interim cover soil will be applied to the slope of the excavated area.
- If the entire designated reclamation area is excavated to native ground, then a liner system meeting DOH requirements for C&D landfills will be installed and new C&D residual waste will be placed in the landfill.

Excavated material from the landfill reclamation area will be delivered to the mixed C&D sort area for processing. If necessary to remove excess soil, excavated material may be screened at the active workface, or it may be processed through a preliminary screen to remove excess soil before loading it to the vibrating screen and sort line. From that point the reclaimed material will be processed along with other mixed waste.

3.7.5 Products and Residual Wastes

Products expected to be recovered and produced from reclaimed landfill material include primarily:

- Wood and other bioconversion feedstock materials;
- Rock, concrete, and asphalt paving aggregates;
- Ferrous and non-ferrous metals; and
- Soil

Non-recyclable waste materials will be disposed in the Phase II area or reburied in the Phase I area of the C&D landfill.

3.7.6 Security and Monitoring

Access to the landfill is controlled as described in Section 5.2. PVT employs a security guard during nights and weekends to prevent vandalism and theft.

Reclamation operations will be monitored and controlled to minimize dust emissions and fire potential. A water truck or portable spray/misting system will be used as needed to control dust. Any appearance of smoke or odor of burning will be immediately investigated as potential evidence of a subsurface fire in accordance with the site's fire plan. Application of cover soil to the reclamation area on a weekly basis will minimize the potential for fire.

3.8 Solidification of Liquid Wastes

3.8.1 Location

The liquid waste solidification area consists of several areas excavated slightly below surrounding grades and lined using a combination of compacted soil and geomembrane liner material. From bottom to top, these areas are lined as follows:

- Graded, moisture conditioned and compacted natural clay subgrade;
- 40-mil HDPE geomembrane liner;
- One-foot thick compacted clay liner using on-site clay materials
- One-foot thick soil cement wearing layer

The soil cement wearing layer is renewed periodically to maintain a 12-inch thickness and durable surface.

3.8.2 Process Description

Liquid wastes may be solidified using soils contaminated with acceptable levels of petroleum hydrocarbons, soil from construction and demolition operations and AES ash. Soil or ash is placed in the solidification cells as received. When a liquid waste is accepted for solidification, a bulldozer or excavator is used to create a shallow basin in the center of the stockpile. Liquid is discharged to the basin and allowed to infiltrate into the soil or ash. After free liquid has been absorbed, the bulldozer or excavator works and mixes the pile to distribute the moisture as evenly as possible. The soil or ash is allowed to dry, with additional mixing as needed, until it is either removed from the solidification cell for disposal or use as landfill interim cover, or additional liquids are added and solidified by mixing with the soil or ash.

3.8.3 Products and Residual Wastes

Solidified liquids soil mixtures are disposed in the landfill or, if soil is used, maybe used as interim cover soil in the PVT C&D landfill. There are no residual wastes from the process.

3.9 Miscellaneous Recyclables

Although most material received at PVT ISWMF are in the form of mixed C&D material, occasional loads of source-separated recyclable materials are received. Examples of such materials may include:

- Ferrous and non-ferrous metals
- Concrete, rock and asphalt rubble
- Wood, wood pallets, and wood shipping containers
- Tires
- Mattresses
- Carpet
- Other materials with organic content suitable for bioconversion by gasification or pyrolysis

These materials are handled on a case by case basis, and may be introduced into the major reclamation processes to remove undesirable materials, reduce or classify the material by particle size, or otherwise prepare them for delivery to markets or end users.

4. LANDFILL OPERATIONS

4.1 Waste Characteristics

Landfill operations of PVT ISWMF may manage by disposal any of the acceptable C&D waste materials described in Section 2.1 above, and does not dispose excluded wastes identified in Sections 2.2 and 2.3.

4.2 Landfill Siting Restrictions

As required by permit, the facility is not located in areas susceptible to flooding, in wetlands, close to potable water supplies, near fault areas, or in any other unstable location. Each of these restrictions is addressed below.

4.2.1 Floodplains

The Federal Emergency Management Agency publishes a Flood Insurance Rate Map that classifies areas of the State according to their proximity to floodplains. The applicable map for Oahu classifies the PVT ISWMF site as "Zone D", an area in which flood hazards are not determined. The FEMA map identifies the limit of the 100-year floodplain associated with the Ulehawa Stream to be within the defined stream banks. No landfill development will occur within the Ulehawa Stream.

4.2.2 Wetlands

No wetlands occur on the site, and site development will not disturb the Ulehawa Stream, which is an intermittent drainage path for runoff from upland areas.

4.2.3 Potable Water Supplies

The currently developed landfill west of Lualualei Naval road is located below the DOH underground injection control line. Groundwater below the site is tidal-influenced brackish water. There are no potable water supply wells in the landfill vicinity.

4.2.4 Fault Areas

No known fault zones have been identified on or near the landfill site.

4.2.5 Unstable Areas

The PVT site is not on or near unstable areas as defined by HAR 58.1-03 (poor foundation conditions, areas susceptible to mass movement or Karst terrains).

4.3 Landfill Design

4.3.1 Phased Development Plan

Figure 2 shows the sequence of developing new lined cells in the Phase II landfill area. To date Cells 1 through 8 in Phase II have been constructed. Additional cells will be constructed in sequence as needed. When the Phase I landfill reclamation area has been excavated, disposal operations may move into it.

4.3.2 Liner and Leachate Management Systems

4.3.2.1 Phase I C&D Landfill Liner

The Phase I C&D landfill area is constructed with a native soil liner meeting the requirements of HAR 11-58.1-19 for construction and demolition solid waste landfills. As required by the regulation, the waste is underlain by a minimum two feet thick layer of soil with a maximum permeability of 1.0×10^{-5} cm/sec. The planned Phase I landfill reclamation area will be lined to this same standard after its excavation is complete, and before new waste is placed in the area.

4.3.2.2 Phase II C&D Landfill Liner

The 55-acre Phase II disposal area is being constructed with impermeable liners and a leachate collection and removal system (LCRS). The liner and LCRS will consist of the following components, as shown on Figure 6 and listed below in order from bottom to top:

- A prepared subgrade including a minimum of 6 inches of recompacted fine-grained clayey-silty soil with less than 12 percent calcareous material (containing calcium carbonate).
- Geosynthetic clay liner (GCL), consisting of bentonite clay imbedded in a geotextile matrix, with a permeability of approximately 5×10^{-9} cm/sec.
- 60-mil high density polyethylene (HDPE) geomembrane
- 16-ounce per square yard non-woven geotextile
- A leachate collection drainage layer on the floor, consisting of 12 inches of granular drainage media (gravel), overlain by another layer of 16 ounce per square yard non-woven geotextile. Gravel used for the drainage layer will have a maximum particle size of 1.5 inches or less. Perforated pipes will be placed in trenches in the LCRS, conducting leachate to sumps from which liquids will be pumped into a truck-mounted holding tank.
- Two feet of protective cover (AES ash or soil) placed over the geotextile on the floor and side slopes

- Four to six feet of select waste containing no large rigid objects that could penetrate the liner system, to be documented during placement

All liner construction and repair is conducted by experienced geosynthetics installers under the supervision of qualified construction quality assurance (CQA) consultants. No waste is placed in a newly constructed cell until a qualified professional engineer has certified its construction and the Department of Health engineer has been afforded the opportunity to inspect the project. Record drawings and CQA documentation are maintained at the ISWMF office.

4.3.2.3 Soil Storage / Liquid Waste Solidification Area Liner

Areas used for storage of contaminated soils and solidification of liquid waste are lined using a combination of compacted soil and geomembrane liner material. From bottom to top, these areas are lined as follows:

- Graded, moisture conditioned and compacted natural clay subgrade;
- 40-mil HDPE geomembrane liner;
- One-foot thick compacted clay liner using on-site clay materials
- One-foot thick soil cement wearing layer

The soil cement wearing layer is renewed periodically to maintain a 12-inch thickness and durable surface.

4.3.3 Surface Water Management System

Stormwater is managed by controlled grading on the surface of the landfill and by maintaining an engineered system of drainage ditches, channels, pipes and basins. Drainage is managed to:

- prevent run-on of surface water to the active disposal face or uncovered refuse;
- minimize erosion in all areas of the site;
- maintain roads and other ancillary facilities in useable condition under all weather conditions; and
- prevent excessive runoff or sedimentation impacts to neighboring properties.

The landfill top deck and other areas in the vicinity of active disposal areas are graded at a slope of 2% to 5% away from the active area. Earth berms are constructed upgradient of the active area if needed to prevent run-on from contacting the leachate, and divert drainage around any exposed waste. Similarly, berms are constructed downgradient of exposed waste to prevent the runoff of any precipitation that has contacted waste. Such water is retained within the waste, for collection and management as leachate.

The site's stormwater management system is designed and constructed to manage runoff from a 25-year, 24-hour storm. Runoff is collected in a system of surface ditches, channels, pipes and ponds designed by PVT Land Company's engineering consultants. Figure 2 shows the surface water management system design at final development. As designed, the system will carry runoff from the design storm without flooding or excessive erosion from the site, and will retain a significant volume of water to minimize off-site runoff impacts and allow sediment in the runoff to be intercepted and removed before discharge from the site.

Figure 2 shows the location of the six (6) existing basins for collection of stormwater and removal of silt.

4.4 Landfill Operations

4.4.1 Landfill Operating Equipment

Equipment available for landfill operations at PVT ISWMF include the following

Compactor	1
Bulldozer	5
Front-end Loader	3
Dump Truck	2
Water Truck	3
Excavator	3

Consistent with permit conditions, PVT always operates the active disposal area with a minimum of one bulldozer of size D-8 or equal, one loader, one water truck, a recycle bin and one spotter. Disposal operations beyond 1,200 tons per day require the addition of one dozer and one spotter.

In addition to the landfill equipment listed above, PVT may use a large landfill compactor. PVT may also use the primary or secondary shredder associated with the bioconversion feedstock processing operation to reduce the size of material being disposed in the landfill, in order to improve compaction and reduce the risk of fires.

PVT will replace equipment or add additional equipment in the future as needed to improve operational efficiency, dust control, leachate management or other functions.

4.4.2 Landfill Operating Personnel

PVT Land Company, Ltd. will provide trained personnel to manage the incoming waste volume safely and efficiently. The current staff as listed below is sufficient to handle up to 2,000 tons per day of disposed waste:

Personnel:	Operations Manager	1
	Scale Attendant	2
	Equipment Operator	2
	Spotter / Laborer	2
	Total Personnel	7

Qualified personnel conduct annual training sessions for all employees to establish and maintain a high level of employee understanding of safety procedures, waste acceptance policies and emergency action plans. PVT also conducts monthly safety meetings.

4.4.3 Waste Placement and Compaction

4.4.3.1 C&D Wastes

<u>C&D Waste Unloading and Compaction</u>

Although most loads of mixed C&D material are expected in the future to be directed to the materials recovery area, during the transition period most loads of construction and demolition materials are directed to the primary disposal area. On arrival at the working face, spotters direct customers to back into specific locations for unloading. Generally, loads being unloaded by hand are directed to areas apart from those used by self-unloading trucks.

Spotters and equipment operators at the site are trained to observe waste as it is unloaded, and prevent customers from attempting to salvage waste materials. The site permit prohibits salvaging waste at the active disposal areas. Any unacceptable materials identified during unloading are required to be reloaded and removed by the customer. If the customer has already left the site, unacceptable waste is removed from the fill area and relocated to the appropriate temporary storage area before removal from the site. Materials are stored in closed containers, labeled as containing hazardous materials and located on containment pallets to prevent spills or releases to the environment.

After customer vehicles have been unloaded and left the unloading area, site equipment pushes the waste from the unloading deck to the active face for compaction. PVT uses primarily a bulldozer to push and compact waste into a lift ten to fifteen feet in height. A bulldozer or compactor passes over the waste a minimum of three times to break up and compact the waste, and level the lift to facilitate the placement of cover soil.

PVT ISWMF personnel and trucks will deliver residual waste materials from the materials recovery area to the disposal working face throughout the day for incorporation into the waste fill. PVT ISWMF personnel recover recyclable material, principally wood, metal, and concrete, from the working face for recycling. This material is loaded in bins for shipment to the materials recovery area.

<u>Fire Barrier Placement</u>

As noted in Section 2.1.3, AES coal ash may be used to create fire barriers between Phase I and Phase II, or between adjacent disposal cells in Phase II. Contaminated soil may also be placed as a fire barrier to minimize the potential for subsurface fires to begin or to spread within the landfill.

Fire barriers constructed of AES ash or soil are a minimum of two feet thick and a maximum of five feet thick. The material will be moistened and compacted as needed to control dust emissions until it is covered by waste or interim cover soil. The exposed area of fire barriers constructed of ash must not be greater than 0.5 acre at any time.

Temporary Wet Weather Deck

During wet weather conditions, access to the designated C&D disposal area may be impeded by wet and slippery road surfaces. During such conditions, C&D material may be unloaded and stored temporarily in designated areas shown on Figure 2. Both alternative wet weather tipping areas cover approximately one acre of previously filled area that has been surfaced with approximately 12 inches of crushed asphalt or similar surfacing material to provide a durable all-weather surface.

The area designated as Area 1, located on the landfill above the mechanic's maintenance area, is underlain by approximately 12 inches of low-permeability clay liner constructed above existing C&D waste and interim cover soil. The area is surrounded by an earthen berm to retain stormwater and prevent runoff that has contacted waste from leaving the area.

The material recycling area may also be used as a temporary wet weather tipping and storage area for C&D waste. This area must be maintained with a minimum 12 inches of low-permeability clay soil if used as a wet weather pad. During wet conditions, C&D loads may be directed to one of the wet weather tipping areas for unloading. At the end of the rainy period, after sufficient drying has occurred to permit safe and normal operation on access roads and the surface of the active C&D disposal cell, the waste will be loaded to PVT trucks by front-end loader, and transported to the active area for disposal. Waste will be removed from the area and transferred to the disposal cell within one week following the end of a rain event if it is safe to do so. Weather permitting, the wet weather tipping area will not be in continuous use for more than 14 consecutive days without removing material to the disposal area. The cover layer of crushed asphalt will be renewed from time to time as needed to replace material that may be lost during the process of loading C&D material into trucks for transfer.

No asbestos or contaminated soil will be discharged to the wet weather deck.

4.4.3.2 Asbestos Waste

Asbestos Waste Acceptance

All asbestos waste customers are required to sign an agreement specifying the terms and conditions of PVT ISWMF's asbestos disposal service. All friable asbestos containing wastes are required to be contained in metal or plastic drums or barrels, or be double wrapped or double bagged in plastic with a minimum thickness of six mils. Each load must be accompanied by a properly executed Asbestos Waste Shipment Record manifest form. Asbestos customers are also required to provide a certificate of insurance naming PVT Land Company as an additional insured for purposes of liability.

Asbestos loads are accepted only on designated days of the week, presently Tuesday and Thursday, before 2:45 p.m. Asbestos contractors are required to notify the ISWMF at least 24 hours before delivery, and have all paperwork including a manifest and PVT authorized clearance number, with each load. No more than 500 tons of asbestos containing waste may be accepted in any week.

Asbestos Waste Unloading and Covering

Friable asbestos loads are inspected at the scalehouse to verify they are contained or double-wrapped or double-bagged as required, then directed to the designated asbestos disposal area. Both friable and non-friable asbestos are disposed in the Asbestos Pit area, which is set apart from the C&D active area and is delineated by signs at approximately 300 ft. intervals around its perimeter in conformance with 40 CFR 61.154. Asbestos waste is not compacted or otherwise disturbed by equipment after being unloaded, in order to maintain the integrity of the double wrapping. It is covered at the end of each working day when asbestos material is received with a minimum of 6 inches of soil. Cover soil is delivered by truck and spread by a front-end loader or bulldozer. Equipment wheels or tracks are not operated in contact with the asbestos waste, but on a layer of soil placed or pushed over the waste before driving over it.

Landfill personnel are given training in asbestos handling and hazard management. Training topics include manifest requirements, unloading and covering procedures, safety measures, and emergency procedures. These and other topics are covered in annual refresher training sessions required of personnel. Training records are maintained in the site's operating record.

In addition to the general emergency procedures described in Section 4.6 of this Operational Plan, the following contingencies unique to the asbestos area are covered in training for personnel working in asbestos disposal:

Asbestos material spills are to be treated generally as a hazardous material spill, as described in Section 5.7.4, with the following refinements:

- A manager or supervisor with asbestos experience is to direct all cleanup activities.
- After isolating the spill area with cones or flags, the material is inspected to determine the extent of damage to plastic wrapping or other containment, and whether the material appears to be friable or non-friable asbestos.
- If the material is non-friable, site personnel wearing gloves and respirator masks may repackage the material in plastic or in drums, and load it for transport to the asbestos pit.
- If the material is friable and the packaging is substantially damaged, the load must be covered by a plastic tarp and secured, and a licensed asbestos contractor called in to repackage the spilled material and deliver to the asbestos pit for disposal. PVT personnel are not to participate in handling friable asbestos waste until it has been properly repackaged and placed in the disposal area.

- A full report of the incident, including a description of the cleanup activity, will be placed in the daily operating log.

Mismanaged asbestos deliveries are incidents where undocumented loads of asbestos might be accepted for disposal, or loads containing asbestos waste are mistakenly accepted as C&D waste and are directed to the C&D general disposal area. C&D area spotters and equipment operators are trained to recognize such loads and prevent their disposal outside the asbestos area. Appropriate responses to mismanaged asbestos loads include the following:

- If a load shows up at the asbestos pit without proper asbestos paperwork (a manifest approved by the scale attendant), the spotter is to deny it access to the dumping area, and direct the driver to return to the scalehouse.

- If spotters or equipment operators at the C&D disposal area identify an asbestos containing load before it is dumped, they are to check the driver's paperwork, and if it is in order and the day is one on which asbestos is being accepted, they will direct the load to the asbestos area after informing the asbestos spotter it is being sent. If the asbestos area is not in operation, a site supervisor will determine whether to reject the load entirely or open the asbestos area as a special occurrence. If the load does not have appropriate paperwork, the driver will be directed back to the scalehouse.

- If asbestos waste is identified during or after the time a load is dumped, it will be treated as an asbestos material spill. The area will be cordoned off by cones or flags and the regular C&D operation will be relocated away from the area.

4.4.3.3 Contaminated Soil

Contaminated Soil Acceptance

Generators must submit a Soil Profile Sheet describing the source of the material and containing analytical test results for specified contaminants. Unless exempted by PVT based on generator knowledge, soils will be tested for the following:

- TCLP metals including TCLP cadmium, TCLP chromium, and TCLP lead;
- Ignitability;
- Total metals including total cadmium and total lead;
- Total petroleum hydrocarbons (TPH) as gasoline (C6-C12), diesel (C12-C24) and oil (C24-C30);
- Benzene, toluene, ethylbenzene, and xylenes;
- Polynuclear aromatic hydrocarbons (not applicable to material solely contaminated with gasoline);
- PCBs (not applicable to material solely contaminated with gasoline or diesel fuel); and
- Halogenated volatile organic compounds (not applicable to material solely contaminated with gasoline or diesel fuel).

Additional testing may be requested on a case-by-case basis. Soils containing TSCA-regulated polychlorinated biphenyls (PCBs) are not accepted. Soils may not be hazardous waste.

Soils proposed for disposal at PVT must be tested according to test procedures and methods set forth in the disposal agreement. PVT reserves the right to reject any load it has cause to believe contains unacceptable contaminants or levels of contaminants in excess of approved concentrations. Customers are required to provide certificates of insurance naming PVT Land Company as an additional insured for liability protection. Each contaminated soil shipment may be accompanied by a manifest form.

Contaminated Soil Handling

Depending on the type and amount of contaminants as determined by the soil profile and test results, PVT determines the disposition of each soil material as follows:

- Soils classified as regulated hazardous waste or TSCA regulated waste are not accepted;
- Soils that may be used on-site for interim landfill cover, for intermediate landfill cover, or for solidification of liquid wastes; and
- Soils that must be disposed in the landfill.

Soils Used On-Site for Interim Landfill Cover, for Intermediate Landfill Cover, or for Solidification of Liquid Wastes

Soils meeting the criteria listed in Table 1 will be placed in the soils storage area, where they will be held for subsequent use either as interim cover in the C&D landfill, as intermediate cover in the C&D landfill, or as the solidification media in the liquid waste solidification process. Additionally, PVT may opt to use the soils for fill material in the landfill.

Table 1: Acceptance Criteria for Soils Used On-Site

TPH gasoline	2,000 mg/kg
TPH diesel (C12–C24)	5,000 mg/kg
TPH oil (C24–C30)	5,000 mg/kg
Bioaccessible arsenic	95 mg/kg
Toxicity Equivalent (TEQ) dioxins	1,800 ng/kg
Technical chlordane	65 mg/kg
All other chemicals	State of Hawaii Environmental Action Levels (EALs)

PVT operates two or more soil storage stockpiles at a time. PVT uses a bulldozer to push soil unloaded by customer vehicles into one of the stockpiles, which are located in a designated area. Soil is held in the stockpiles until used for interim cover, for intermediate cover, or in the liquid waste solidification process. Soils used in the liquid waste solidification process may be used for interim cover or intermediate cover.

Soils meeting the Hawaii residential EALs may be used as final cover material. (These soils are classified as uncontaminated).

Soils Disposed in the Landfill

Soils with concentrations in excess of those listed in Table 1 are placed in the C&D landfill and covered with appropriate cover soil the same day.

These materials must be disposed under the following special procedures:

- All truck loads should be covered.

- Wastes are discharged in a designated location at the active working face.

- If the soil is dry, a water truck must be on hand to wet it down as it is dumped, to prevent blowing dust. At the end of each working day, the water truck will spray down the top layer of soil.

- Special contaminated soil may not be dumped or handled under conditions of high winds, with speeds in excess of 30 mph as measured by the on-site weather station. Disposal operations will also be stopped immediately if any significant dust emissions occur due to high wind. Any incidents of operations stopped due to high wind will be recorded in the daily operating log, together with information on the wind speed and direction at the time.

- At the end of the working day the soil will be covered by C&D waste and/or cover soil as required for the general C&D waste fill area.

- PVT personnel will measure and record the coordinates of special contaminated soil using the site's GPS instrument. The GPS coordinates must be entered on the permanent records associated with the waste shipment.

4.4.4 Interim Cover Plan

4.4.4.1 Materials

Interim cover materials may consist of clean soil excavated from the PVT soil borrow and drainage control area located east of Lualualei Naval Road or from future landfill cell areas in the Phase II area. Additional cover materials are received from contractors and other customers delivering segregated loads of soil, rock, and concrete or asphalt rubble. The following categories of contaminated soils may also be used as daily or interim cover:

- Contaminated soils meeting the concentrations listed in Table 1; and
- Solidified liquid waste soils meeting the concentrations listed in Table 1.

Incoming inert material suitable for interim cover is segregated and stockpiled by type in order to facilitate selection and use as cover, road base or other needs of the site. At PVT's option, mixed inert loads may be screened or otherwise processed to produce cover with desired properties.

Any of the materials listed above may be used as interim cover for C&D wastes. Only clean soil or contaminated soil may be used to cover asbestos contaminated waste contained in the Asbestos Pit.

4.4.4.2 Procedures

Interim cover material is placed over the C&D waste fill at least once per week, or whenever the surface area of exposed C&D waste fill exceeds one acre, whichever occurs first. Cover material is delivered to the active area by truck or loader, and spread over the waste in a layer a minimum of six (6) inches thick, using the site's bulldozer.

An additional six inches of soil must be placed over inactive areas (outside the maximum 1 acre active area) to achieve a total thickness of 12 inches of soil. At PVT's option, part of the interim cover may be removed and stockpiled for future reuse when an additional lift of waste is placed over a previously inactive area. Areas covered with 12 inches of interim cover will be inspected and maintained at least once a year to ensure the cover is intact and not subject to erosion or standing water.

4.4.4.3 Procedures for Asbestos Wastes

Only clean soil or contaminated soil may be used to cover asbestos contaminated waste contained in the Asbestos Pit. A minimum of six inches of cover soil is placed over asbestos contaminated waste at the end of each working day when asbestos material is received. Care is taken not to damage the double-wrapped plastic film covering on asbestos wastes when placing interim cover.

4.4.5 Final Cover

Final cover will be placed above filled areas that have reached approved final grades, in accordance with the site's approved Closure and Post-Closure Plan. Different final cover designs will be applied to the Phase I and Phase II areas if the site, with both applying a minimum of two feet of earthen material. Final cover will be constructed under the supervision of a registered professional engineer. The final designs are as follows:

4.4.5.1 Phase I Area Final Cover

The final cover design for the Phase I disposal area will conform to the prescriptive requirements of HAR 11-58.1-17 for a disposal unit with no bottom liner system. It will consist of the following components, from bottom to top:

- An infiltration layer consisting of a total of 18 inches of soil (including previously placed interim cover), moisture conditioned and compacted to 90% relative density. This will be equivalent to the permeability of the underlying native soils.

- A vegetation / erosion layer of soil with a minimum thickness of six inches, planted to native grasses and shrubs for erosion control.

Phase II Area Final Cover

Disposal cells in the Phase II area will be constructed with bottom liner systems consisting of a 609 mil HDPE geomembrane above a geosynthetic clay liner. In these areas, PVT will construct an alternative final cover system:

- A foundation layer consisting of a total of 12 inches of soil (including previously placed interim cover);

- Geocomposite consisting of 30 mil LPDE bonded on both sides to 8 ounce per square yard non-wovem geotextile; and

- An erosion layer consisting of twelve inches of soil vegetated with native grasses.

The geomembrane bonded to non-woven geotextiles on both sides offers outstanding friction resistance for slope stability purposes in combination with a permeability equal to or less than that of the bottom liner system.

4.4.6 Leachate Management Procedures

The volume of leachate to be generated at PVT ISWMF is expected to be extremely low due to the dry climate and inert nature of the waste. In addition, any leachate generated is anticipated to contain relatively low levels of contaminants, due to the small volume of organic material in the waste stream. As a result, PVT ISWMF is an ideal site for a leachate management strategy based on reintroduction to the landfill as provided in 40 CFR 258.28, which allows leachate to be returned to the same landfill unit from which it is generated.

Leachate generated within the disposal cells of Phase II is collected in the gravel leachate collection system and flows by gravity to a leachate collection sump. The sump is designed to contain leachate to a depth of four (4) feet below the adjacent cell floor. By permit, the depth of leachate is not allowed to exceed 12 inches (one foot) outside the sump. Therefore, the compliance level for leachate collected in the sump is five (5) feet. A Non-Compliance Report will be filed at any time when the leachate level measured in the sump exceeds 5 feet.

The following procedures are implemented to ensure compliance with leachate management permit requirements:

- Each leachate sump is inspected weekly and after major rain events (more than one inch in 24 hours). More frequent inspections will be made whenever significant leachate volumes are being generated. The inspection will consist of lowering an electronic sounding device to the bottom of the sump to determine liquid level in the sump.

- If more than 30 inches of liquid is measured in the sump, a portable submersible pump is lowered into the sump (unless a permanently installed pump is present), and as much leachate as possible pumped into a truck-mounted tank. Care should be taken when using an electric submersible pump without float-actuated controls, in order to avoid running the pump empty after the maximum amount of liquid has been withdrawn. (For example, the Goulds 45J03 pump used by PVT requires a minimum of approximately 28 inches of liquid depth when standing vertically in the bottom of the sump.) PVT also has available a low-capacity air-actuated pump that can draw the leachate depth down to approximately 16 inches, without danger of damaging the pump when the minimum level has been reached.

- Leachate is stored in the truck-mounted tank, or transferred to a stationary holding tank if necessary. Storage tanks and connector piping will be situated within the limits of the Phase II landfill, or within secondary containment. The storage tanks will be maintained at all times.

- Leachate is spread over the C&D waste by spraying it at the active working face, to aid in dust control and compaction, in a manner that does not expose landfill customers or personnel to leachate. Leachate must be sprayed, not be dumped in a manner that would be considered bulk disposal.

- Leachate is returned only to areas within Phase II that are equipped with liners and LCRS.

- Leachate will not be returned to the landfill during periods of rain.

- Each occasion of leachate withdrawal and return is documented, including information on the volume of leachate, the sump from which it is withdrawn, and the area of the landfill to which it was returned. Records of leachate withdrawal and return will be summarized in the annual operating report.

- If the leachate collection system is inoperable, steps will be taken to rectify the problem and, if necessary, contingency measures will be implemented to comply with the permit conditions. The DOH will be notified if required by permit conditions

Samples of leachate will be collected and analyzed on an annual basis during scheduled water quality monitoring events, as described in Section 6.3 Leachate Monitoring.

5. SITEWIDE OPERATIONAL PROCEDURES

5.1 Administrative Procedures

5.1.1 Record Keeping

PVT ISWMF will maintain an operating record in a designated area of the ISWMF office, including the categories of records and documents listed below. Unless otherwise specified, the records listed below will be retained for a minimum of five years.

Daily Operating (Scalehouse) Records

Each load of refuse delivered to the site is documented in terms of the customer identity, type of waste, source of waste, and weight. Records of each load are maintained on a daily basis and are accumulated for monthly and annual reports. Scalehouse records, including waste manifest forms, are archived and retained for a minimum of five years.

Daily Log

Any unusual occurrence at the site is documented in a daily log record maintained at the site. Operations personnel are trained to report and document incidents of unacceptable waste being identified in incoming loads, accidents, severe weather conditions, fires or other unusual events.

In addition to noting unusual occurrences in the daily log, PVT personnel are responsible for maintaining two types reports of unusual events with the Department of Health, as described in Section 5.5 below.

Records Related to Hazardous Waste Exclusion

PVT maintains records of the date, content and names of employees attending annual training events related to the hazardous waste exclusion program. Any reports or other detail related to waste load inspections or incidents of unacceptable waste discovered at the landfill, in addition to information in the daily log, are placed in the Hazardous Waste Exclusion files.

Materials Recycling Data

PVT will maintain records of recyclable material recovered from C&D material. Information recorded will include the weights and destinations of outbound loads of metal, wood or other materials shipped to off-site markets, and the weights of inbound loads of clean soil, concrete or asphalt material diverted directly from the scalehouse to stockpile areas for use as cover material or construction of on-site roads or wet weather tipping pads. Incidental quantities of asphalt or concrete removed from mixed loads for on-site use will not be recorded.

Litter Control Program Records

Daily information will be maintained on litter control activities, including records of the number of personnel employed for litter control, locations where litter is collected, and the volume of litter picked up from the site and adjacent areas. Litter control program requirements are described in Section 5.5.6.

Odor Control Records

Records will be maintained of any odor complaints received, measures taken to respond to complaints, and of any unusually odorous wastes received for disposal. Records of complaints will include a description of meteorological conditions during the period of concern. Odor control program requirements are described in Section 5.5.7.

Vector Control Records

Records will be maintained of activities associated with control of insects, rodents or birds. Information to be recorded will include service visits by outside pest control contractors, results of inspections, bird control activities by PVT personnel, and any complaints received from the public. Vector control program requirements are described in Section 5.5.8.

Leachate Management Records

Records will be maintained of all leachate withdrawals from sumps, including dates, volumes and disposition of each load pumped. Separate records will be maintained for each sump. Results of any testing of leachate for pollutant constituents will also be maintained. Leachate management program requirements are described in Section 5.6.

Asbestos Records

In addition to daily volume and acceptance data for all asbestos loads, records will be maintained of any mismanaged asbestos deliveries and any asbestos material spills.

Groundwater Monitoring Data

In addition to the Groundwater Monitoring Program, PVT will place in the operating record and maintain all results of groundwater monitoring for the life of the site.

Closure and Post-closure Plans and Data

The operating record includes copies of the current closure plan and post-closure plan, plus records related to any actual closure or partial closure activity. Such records include engineering plans, construction inspection reports and certifications related to closure activities. Additionally, records pertaining to financial assurance for closure and post-closure will be maintained, including cost estimates and documentation of financial assurance mechanisms.

5.1.2 Signs

A large sign is posted at the facility entrance to inform all customers of the site's operating hours and waste acceptance policies. The current lettering of the sign reads as follows:

PVT Land Company Ltd.
87-2020 Farrington Hwy., Waianae, HI 96792
(808) 668-4561 ww.pvtland.com

ACCEPTING: CONSTRUCTION DEBRIS, ASBESTOS, SOIL

UNACCEPTABLE MATERIAL: HOUSEHOLD DEBRIS, TIRES, ALL CAR PARTS, PAPER WASTE, APPLIANCES, BARRELS, DRUMS, PAINTS/SOLVENTS, LIQUIDS, FLAMMABLE, EXPLOSIVE, RADIOACTIVE MATERIALS

Hours of Operation

MON – FRIDAY	7:00 AM TO 3:30 PM
SATURDAY	7:00 AM TO 1:00 PM

SUNDAYS & HOLIDAYS – CLOSED
SUBJECT TO CHANGE

In addition to the front gate sign, directional signs are provided at appropriate locations on the site to direct customers to designated areas for disposal or discharge of various waste and recyclable materials, including:

- Construction and demolition waste
- Asbestos waste
- Contaminated soil
- Cover material including dirt, rock, concrete and asphalt concrete rubble.
- Recyclable material

Other signs inform customers of exit routes and on-site speed limits. Signage is modified whenever conditions change on site, such as changes in operating hours or the location of disposal areas or access routes.

5.1.3 Safety Procedures

PVT Land Company provides training and strict enforcement of a comprehensive program to ensure the safety of customers and employees. Access routes are clearly marked, and an on-site speed limit of 15 miles per hour is enforced. Customers are directed by spotters to specific locations for unloading, with traffic managed to avoid accidents.

Employees are equipped with personal protective equipment including reflective vests and hard hats. Safety devices on equipment include seat belts, roll-over protective cabs, audible reverse warning devices and fire extinguishers. Additional detail is contained in Appendix C, the facility's Employee Safety Plan. Appendix D contains the outline of the training course given to all PVT employees regarding safety and other aspects of ISWMF operation.

5.1.4 Non-Compliance and Incident Reports

By permit, PVT must notify the Department of Health of unusual events by filing an Incident Report or Non-Compliance Report, described as follows:

An Incident Report must be submitted to notify DOH of any event which could threaten human health or the environment. Such incidents would include fire, explosion, or a release of regulated material/waste. Incidents must be reported by phone or fax within 8 hours if possible, but no longer than 24 hours after the occurrence. A written report must be filed within seven (7) calendar days to provide information on the event as prescribed in the PVT solid waste management permit (Appendix A), General Condition 9.

A Non-Compliance Report is submitted to notify DOH of any occurrence during which PVT is unable to comply with any condition or limitation specified in the Solid Waste Permit. A verbal report is required by telephone within 24 hours, and a written report must be submitted to DOH within seven (7) calendar days to document the nature of the incident, its cause, the expected period of non-compliance, and steps being taken to resolve and prevent recurrence of the non-compliance.

5.1.5 Annual Operating Report

An annual report is due to the Department of Health by July 31 of each year for the operating year ending June 30. The contents of the report must include the information requi4red by Special Conditions B.77 and C.18 of the PVT Solid Waste Management Permit (Appendix A).

5.2 Access and Traffic Control

5.2.1 Access Control

The only vehicular access to the site is the main gate at Lualualei Naval Road. Unauthorized access is prevented by the fence and drainage ditch along the road, and by the natural topographic barrier of the Ulehawa Stream on the west side of the site. The main gate is locked after hours.

5.2.2 Traffic Control

Signs direct customers from the front gate to the scalehouse, and from the scalehouse to designated areas for unloading. Signs also are posted to inform customers of on-site speed limits (15 miles per hour). Spotters are posted at key locations as needed to direct traffic to the C&D disposal area, and to direct customers to specific locations for unloading at the active disposal face.

All access roads used by customers are maintained as all-weather roads by surfacing with rock, asphalt or concrete rubble. Roads are graded and watered as needed to maintain them in a smooth condition with minimum dust generation.

5.3 Maintenance and Control

This section sets forth the policies and procedures to be followed by PVT ISWMF employees to maintain the site and control dust, fire, stormwater, erosion, litter, odor, vectors and explosive gas.

5.3.1 Access Roads

All access roads used by PVT customers must be maintained as all-weather roads by surfacing with rock, gravel, or concrete/asphalt rubble. They are graded as needed to maintain safe operating conditions, and are watered during dry periods to control dust.

Roadside drainage ditches or culverts are cleaned or otherwise maintained at least annually to prevent road washouts due to inadequate drainage control.

Two-way access roads have a minimum width of thirty (30) feet, and one-way roads are to be at least 15 feet wide. Roads are to be constructed with a maximum grade of 8 percent except for short distances where less steep grades cannot be achieved.

Temporary roads used only by PVT personnel and vehicles may be constructed as other than all-weather roads, provided they are not needed for maintenance of drainage facilities or emergency access.

5.3.2 Dust

PVT personnel are responsible for controlling the emission of excessive dust from the facility. The site's water trucks (4,000 gallons and 2,000 gallons capacity) are used during dry weather to spray water on access roads and other areas generating wind-blown dust. The volume of water and frequency of spraying is increased as needed during particularly dry and windy conditions. The water trucks are filled from two standpipes located on the site perimeter near Lualualei Naval Road. One standpipe is filled by a 4-inch pipeline from two 25,000 gallon storage tanks located on Leeward Land property east of Lualualei Naval Road, which are in turn filled by non-potable brackish water from an on-site well. The other standpipe is connected to a portable 10,000-gallon storage tank which is filled by non-potable brackish water from a second on-site well located on PVT property west of Lualualei Naval Road.

Dust will be controlled in the material recovery area primarily by use of water sprays at locations prone to dust generation. One or more portable "Dust Boss" misters will be located strategically to knock down dust before it is emitted from the work area. If necessary, fixed water sprays will be located at key transfer points or other locations. Processing operations that create substantial dust will be suspended in the event of high wind events if the water mist controls are insufficient to prevent excessive dust emissions from the operations.

5.3.3 Mud

PVT will implement a program to minimize tracking of mud onto public roads during periods of wet weather, including:

- Maintaining on-site haul roads in good condition with surface paved with asphalt, gravel, and cold-plane asphalt or other rubble;
- Periodic washing of on-site asphalt roads;
- Placement of rumble strips on exit roads;
- Operation of a truck wheel wash near the site exit; and
- Maintenance of a hard-surface wet-weather tipping pad to minimize truck exposure to muddy areas while loads are being dumped at the active disposal area.

5.3.4 Fire

PVT ISWMF has developed a detailed Emergency Fire Plan that establishes detailed procedures for preventing surface and subsurface fires at the landfill, and for responding to fire incidents if they occur. Key preventive elements of the Fire Plan are summarized below. Fire response procedures are summarized in Section 5.4.1.

Personnel at the scalehouse and unloading areas are trained and directed to notice any smoldering or burning material in incoming waste, and prevent it from contacting other combustible material or being buried in the disposal area before all combustion is extinguished. Fire extinguishers are provided in all buildings and vehicles at the site for use in extinguishing small fires, and equipment or water is used to put out larger fires in incoming waste loads.

Effective covering of the waste is an essential element of the program for preventing subsurface fires, by minimizing the intrusion of oxygen into the waste mass. In addition, fire barriers consisting of 3 feet or more of soil or ash material have been placed at the interface between the Phase I and Phase II areas, and between adjacent cells in the Phase II area. The cover and fire barrier measures help prevent the occurrence of fires, and limit the spread should a subsurface fire occur.

Inspection and monitoring of the landfill are critical for detection of subsurface fires. The site is inspected daily to detect any signs of a subsurface fire, including unusual odors, sinkholes, smoke, stressed vegetation, or fissures in the landfill surface. Gas probes placed within the landfill limits are monitored periodically for temperature and carbon monoxide, the primary precursors of a subsurface fire. If high levels of carbon monoxide are detected, the probes are used as injection points for liquid carbon dioxide as a preventive measure for subsurface fires.

Any incident of fire will be recorded in the site operating record and reported to DOH per § 5.1.4 above.

5.3.5 Stormwater

Different stormwater management strategies are employed in the C&D landfill disposal area, the petroleum contaminated soil / liquid waste solidification area, and the material recovery area, as described below.

C& D Disposal Area

Stormwater is managed by controlled grading on the surface of the landfill and by maintaining an engineered system of drainage ditches, channels, pipes and basins. Drainage is managed to:

- prevent run-on of surface water to the active disposal face or uncovered refuse;
- minimize erosion in all areas of the site;
- maintain roads and other ancillary facilities in useable condition under all weather conditions; and
- prevent excessive runoff or sedimentation impacts to neighboring properties.

The landfill top deck in the vicinity of active disposal areas is graded at a slope of 2% to 5% away from the active area. Earth berms should be constructed upgradient of the active area to prevent run-on from contacting the waste, and divert drainage around any exposed waste. Similarly, berms should be constructed downgradient of exposed waste to prevent the runoff of any precipitation that has contacted waste. Such water must be retained within the waste, for collection and management as leachate.

As described in Section 4.3, the site's stormwater management system is designed and constructed to manage runoff from a 25-year, 24-hour storm.

The stormwater control system should be inspected and maintained as needed after each significant storm event. Inspections should focus on locating and repairing any areas of excessive erosion, ensuring that skimmers installed in sedimentation basins are working properly, and that no pipe inlets are plugged or blocked with sediment or debris. Sediment should be removed from ditches and basins at least once each year.

PCS / Liquid Waste Solidification Area

The area used for storage of petroleum contaminated soils and liquid waste is located in a lined area as described in Section 3.8. Soil berms are placed around the perimeter of the area to retain stormwater and prevent its discharge to the surrounding areas of the site. All rainwater falling on the solidification cells is evaporated or incorporated into the solidified waste.

Material Recovery Area

To the extent practical, the material recovery operation will minimize contact between rainfall and runoff with unprocessed C&D material and bioconversion feedstock in the material recovery area. Receipt and processing of C&D material will be suspended during periods of significant rain, and stockpiles of unprocessed material will be minimized. Whenever possible, tarps will be used to cover processed bioconversion feedstock, to avoid increasing its moisture content and net fuel value as well as to prevent leaching into runoff.

The material recycling and recovery area is located above fine-grained native coral soils that minimize potential for percolation of surface water, and approximately 50 percent of the area is paved with concrete or asphalt. The area is graded to drain toward sedimentation Basin F.

Erosion

Erosion is controlled primarily by the stormwater management system, which incorporates diversion berms, sandbag checkdams and similar measures to control and reduce the velocity of runoff. Side slopes will be inspected periodically, and eroded areas repaired. Silt fences may be installed on bare slopes subject to erosion. Areas of the site, including slope areas that are near final grades, that are not scheduled to receive additional waste fill for a year or more may be covered with mulch or hydroseeded with grass to provide additional erosion control.

Selected slope areas along Lualualei Naval Road and the Ulehawa Stream are protected from erosion by installation of netting with embedded grass seed to promote establishment of grass cover. This erosion control method is also applied to the interior slopes of sedimentation basins.

5.3.6 Litter

C&D waste does not typically contain a large amount of paper and plastic materials subject to becoming wind-blown litter. Some litter material is present, however, and PVT therefore implements a program to maintain the site in a clean condition and prevent litter from leaving the property.

Site operational personnel are assigned on a daily basis to pick up litter, including loose paper, plastic, cardboard or other potentially wind-blown items, from the C&D disposal area. Litter anywhere on the site shall be picked up as noticed. A complete litter survey and cleanup of the site will be made at the end of each week.

PVT will also install and maintain temporary plastic litter fence along the downwind (under prevailing winds) perimeter of the landfill top deck to prevent litter from leaving the area. The fencing material will be a minimum 36 inches high, and will be relocated as necessary. Litter trapped by the fence will be collected on a weekly basis for disposal prior to placement of interim cover.

A daily record will be maintained to document litter control activities. Information to be recorded will include the number of personnel and equipment involved in litter control, total manhours, and the volume of litter picked up.

5.3.7 Odor

Odor is ordinarily not an issue at PVT ISWMF due to the inert nature of waste accepted at the site. Any noticeable odor will be investigated to determine its source, and dealt with accordingly. Potential odor sources may include waste containing decomposing organic matter or vegetative material, or some types of petroleum contaminated soil. Any unusually odorous loads are identified at the scalehouse, and operations staff prepare for special handling by preparing an area at the active working face where the material can be deposited and immediately covered with non-odorous refuse or soil.

Records will be maintained of odor complaints, investigations and complaint response activities. The daily log should also reflect the disposal of any unusually odorous waste loads. Information on odor incidents should also include data on weather conditions at the time, including wind speed and direction.

5.3.8 Vectors

Since the facility accepts primarily inert materials, PVT ISWMF does not attract significant numbers of flies, rodents, birds or other pests. Proper application of cover material will discourage use of the site by vectors. Equipment operators, spotters and other ISWMF personnel are directed to report to supervisors any sighting of rodents or other mammals, or unusual concentrations of insects or birds.

The quarterly comprehensive site inspection includes checks of the active disposal area for the presence of vectors. The inspection checklist is contained in Appendix F. Records will be maintained of vector control activities, including observations of vectors on the site, control activities by on-site personnel, and service calls by pest control contractors.

5.3.9 Explosive Gas

The rate and volume of methane gas generated by decomposition of C&D waste is extremely low compared to municipal solid waste landfills. The organic material in the waste is limited primarily to waste wood and clearing and grubbing debris, which decays slowly. To date, the site has not generated measurable quantities of methane.

5.4 5.4 Emergency Procedures

This section describes actions and procedures to be implemented by PVT Land Co. personnel in the event of unusual or emergency situations that may occur at the site, including fires, severe storms, earthquakes, hazardous material spills or injury accidents.

5.4.1 Fire

Procedures detailed in the site's Emergency Fire Plan (Appendix G), as summarized below, will be followed for potential emergencies involving fire, including waste fires on the landfill surface, brush fires in the buffer zone, and structure fires.

Landfill Surface Fire. The following actions will be taken if a fire occurs in a refuse fill area prior to application of interim cover or near the surface.

- Burning refuse will be excavated and separated from the fill area and extinguished using fire extinguishers, water or by covering with on-site soil.
- The local Fire Department will be summoned if site personnel and equipment can not extinguish the fire or if it exceeds a surface area of 5,000 square feet.

PVT ISWMF maintains two water trucks with capacities of 4000 gallons and 2000 gallons, and a bulldozer that are available 24-hours per day for use in fire fighting.

Buffer Zone Fire. The following actions will be taken if a fire occurs in the buffer zone areas surrounding the landfill. Maximum effort will be made to prevent the fire from reaching refuse fill areas by utilizing on-site assets.

- Maintain existing fire breaks between waste fill areas and surrounding vegetation.
- Excavate additional fire breaks between the landfill and the oncoming fire. Excavated soils will be bermed on the fire side of the fire break for additional protection.
- Water down areas between the fire break and the disposal area using the on-site water trucks.
- Call 911 emergency services.

Structure Fire. The following actions will be taken if a fire occurs in a site structure.

- Evacuate building.
- Call 911 emergency services.
- Prevent fire from spreading to surrounding areas by using on-site equipment to construct fire breaks, and by using the water truck to wet down adjacent areas.
- Avoid entering a burning structure for any reason.

Subsurface Fire

Subsurface fires will generally be controlled by excavating the area, removing burning material and extinguishing it by spreading and wetting it. Before excavating the area, liquid carbon dioxide or water will be injected to cool the fire, limit its spread and reduce the oxygen content of surbsurface gases prior to excavation. After the burning material is removed, the excavated area will be filled with moist soil, a tight earth cover will be installed, and the area will be monitored for a period of three months to ensure the fire does not reoccur. Large subsurface fires may be monitored longer, and additional injections of carbon dioxide may be made to further ensure the fire does not reignite.

5.4.2 Severe Storms

The following measures will be taken to protect against excessive erosion, flooding and wind damage before and during severe storms.

Prior to a forecast storm, site personnel will inspect all drainage structures on the site and verify they are in working order. Excessive silt in ditches and basins will be removed; and the condition of pipes and discharge structures from basins will be verified. Diversion berms will be constructed around the current disposal area as needed to prevent run-on from upgradient areas from entering the waste fill, and to prevent runoff from the waste fill to downgradient areas of the site. Interim cover will be placed over exposed waste at the end of the working day prior to the forecast beginning of a severe storm.

At the discretion of PVT Land Company management, the site may be closed for business during storm periods. In this event, customers will be informed of the impending closure, and only trucks already in route at the time of announcement will be allowed into the site. After the last truck en route is received and its load discharged, the working face will be closed and covered with interim cover, and graded to discharge runoff to the site surface water drainage system. Temporary diversion berms will be constructed as necessary to prevent run-on to any areas of exposed waste.

Facility personnel will periodically inspect site drainage systems during any prolonged storm involving extensive rain, and correct or repair as needed any conditions with potential to cause damage to on-site or off-site facilities.

5.4.3 Earthquake

In the unlikely event of a significant earthquake, defined here as one that produces any sign of damage in on-site structures, including but not limited to overturned furniture, wall cracks, or structural shifts, the following procedures will be implemented:

- Immediately cease or limit landfilling operations.
- Promptly conduct a visual survey of the site to identify any slope failures, fires, or other conditions that could threaten worker or public safety. Notify the Department of Health of any such condition by filing an Incident Report as provided in Section 5.1.5.
- Follow the procedures set forth in Section 5.7.1 if any fires occur.
- Follow the procedures set forth in Section 5.7.5 if any injuries occur.

In the event telephone systems are inoperable, notification of the appropriate agencies/businesses will be accomplished in the most expedient manner available (cellular phones, person to person, overnight mail, etc.). In the event power is lost, ISWMF personnel will notify the appropriate local utility companies.

Notify PVT's landfill design consulting Engineer in the event of any earthquake resulting in ground acceleration on Oahu of 0.25 g or greater. Conduct any visual observations or other investigations requested by the Engineer, who will incorporate them in a stability analysis review of the landfill liner system and waste fill. The Engineer's report will be retained in the landfill operating record for a minimum of five years and will be provided to the Department of Health upon request.

5.4.4 Hazardous Material Spills

As a C&D landfill, PVT ISWMF has a low potential for spills of hazardous materials, but incidents are possible in the event vehicle accidents or malfunctions that could cause spills of coolant, fuel or lubricants. Actions to be taken in the event of a spill are described below.

The first step in responding to an oil or substance release incident is to keep the material separated from water to minimize migration and the resulting potential increase in human and environmental exposure. Every effort should be made to prevent spills and emphasize substance containment at the source rather than resort to separation of the material from expanded portions of the environment or downstream waters.

<u>Discovery of a Release</u>

The person discovering a release of material from a container, tank, or operating equipment should initiate the following actions immediately.

- <u>Extinguish any sources of ignition</u>. Until the material is identified as nonflammable and noncombustible, all potential sources of ignition in the area should be removed. Vehicles should be turned off. If the ignition source is stationary, attempt to move spilled material away from the ignition source. Avoid sparks and movement creating static electricity.

- <u>Attempt to stop the release at its source</u>. **Assure that no danger to human health exists first**. Simple procedures (turning valves, plugging leaks, etc.) may be attempted by the discoverer if there is no health or safety hazard and there is a reasonable certainty of the origin of the leak. No site personnel shall come into contact with unknown or hazardous substances illegally brought into the facility.

- <u>Initiate spill notification and reporting procedures</u>. Report the incident immediately to a supervisor. If there is an immediate threat to human life (e.g. a fire in progress or fumes overcoming workers), an immediate alarm should be sounded to evacuate the building, and the fire department should be called. Request the assistance of the fire department's hazardous materials response team if an uncontrollable spill has occurred and/or if the spill has migrated beyond the site boundaries.

<u>Containment of a Release</u>

- <u>Attempt to stop the release at the source.</u> If the source of the release has not been found; if special protective equipment is necessary to approach the release area; or if assistance is required to stop the release, the fire department should be called to halt the discharge at its source. Facility personnel should be available to guide the fire department's efforts.

- Contain the material released into the environment. Following proper safety procedures, the spill should be contained by absorbent materials and dikes using shovels and brooms. Consult applicable material safety data sheets for material compatibility, safety, and environmental precautions.

- Obtain outside contractors to clean up the spill, if necessary.

Spill Cleanup

- Recover or cleanup the material spilled - As much material as possible should be recovered and reused where appropriate. Material that cannot be reused must be declared waste. Liquids absorbed by solid materials shall be shoveled into open top, 55-gallon drums; or if the size of the spill warrants, into a roll-off container(s). When drums are filled after a cleanup, the drum lids shall be secured and the drums shall be appropriately labeled (or re-labeled) identifying the substance(s), the date of the spill/cleanup, and the facility name and location. Combining non-compatible materials can cause potentially dangerous chemical and/or physical reactions or may severely limit disposal options. Compatibility information can be found on material safety data sheets.

- Cleanup of the spill area - Surfaces that are contaminated by the release shall be cleaned by the use of an appropriate substance or water. Cleanup water must be minimized, contained and properly disposed. Occasionally, porous materials (such as wood, soil, or oil-dry) may be contaminated; such materials will require special handling for disposal.

- Decontaminate tools and equipment used in cleanup - Even if dedicated to cleanup efforts, tools and equipment that have been used must be decontaminated before replacing them in the spill control kit.

- Arrange for proper disposal of any waste materials. - The waste material from the cleanup must be characterized, transported and disposed according to State and Federal Regulations.

5.4.5 Injury Accidents

Site management personnel are to be notified immediately if an injury accident occurs. First aid kits are maintained in site offices and vehicles for use as needed. If the nature of an injury requires additional treatment, the local emergency response provider is to be notified by dialing 911. The person making the call should inform the operator of the nature and location of the emergency, what first aid measures have been initiated, and the need for any special equipment, i.e. hazardous materials response, confined space rescue, or vehicle extrication.

Persons with major injuries should never be moved without professional assistance. Major injuries would include second or third degree burns; unconsciousness; severe bleeding; obviously broken limbs; and any head, back, or neck injury.

Additional details on procedures for preventing and responding to accidents are contained in Appendix C, the Employee Safety Plan.

Records of all site accidents and first aid treatments will be maintained at the PVT ISWMF Co. office. Accident reports will be filed with insurance companies and state agencies as required.

After the situation has stabilized, site management will arrange for investigation of the cause of the accident. A complete investigation report should be completed within seven days of the incident. The report should include a review of the actions leading up to the incident, factors that contributed to or mitigated the severity of the incident, and provide recommendations to prevent reoccurrence.

6. MONITORING PLANS

This section outlines the facilities and procedures used for monitoring groundwater, surface water, leachate and meteorological data at PVT ISWMF.

6.1 Groundwater Monitoring Plan

PVT routinely monitors groundwater quality in accordance with the site's Groundwater Monitoring Plan dated August 31, 2004 or as it may be amended in the future. A copy of the Plan is maintained at the site office for review.

6.2 Surface Water Monitoring

PVT ISWMF has received approval from the Hawaii Department of Health to discharge stormwater to the Ulehawa Stream under the General Permit of the National Pollutant Discharge Elimination System (NPDES). Under the terms of the Notice of General Permit Coverage, PVT must collect and test a sample of stormwater from each discharge point on an annual basis. The sample must be collected during a representative storm event that (1) accumulates more than 0.1 inch of rainfall and (2) occurs at least 72 hours after the previous measurable (0.1 inch) rainfall event. Ordinarily this should be the first rain event of the winter.

Procedures for monitoring stormwater are detailed in the site's Storm Water Pollution Control Plan dated June 2008 and associated amendments. A copy of this plan is maintained at the site office for review.

6.3 Leachate Monitoring

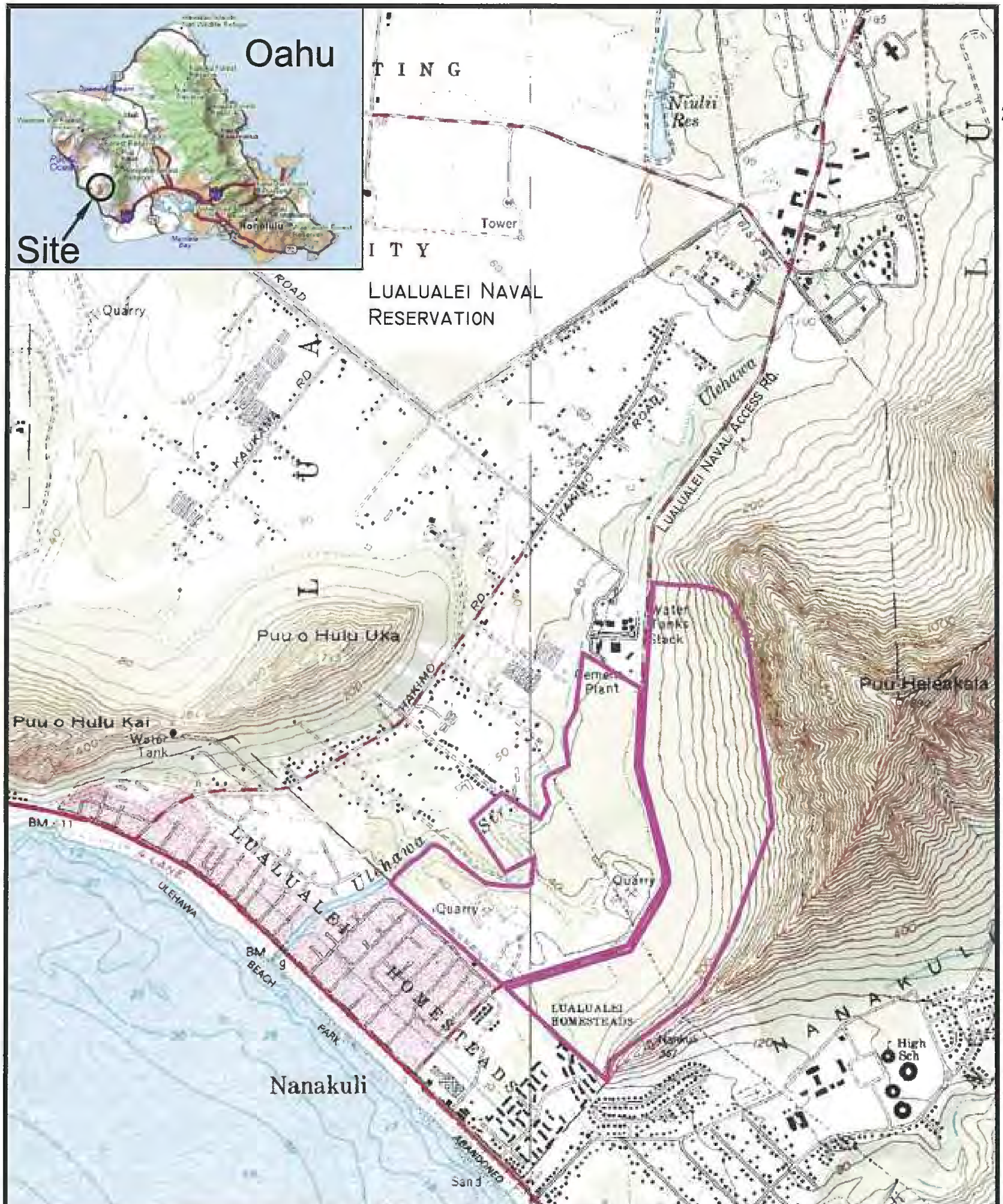
In addition to regular checking of leachate levels in leachate collection sumps in the Phase II disposal area (Leachate Management Plan, Section 4.4.6), leachate samples will be collected and tested on an annual basis concurrently with one of the groundwater monitoring events. Leachate monitoring procedures are described in the Groundwater Monitoring Plan dated August 2004 and as it may be amended.

Leachate monitoring results will be included in the applicable annual or semi-annual monitoring report.

6.4 Meterorological Data Collection

In conformance with the requirements of Solid Waste Permit No. LF-0152-09, PVT has established a system of collecting and recording meteorological information useful for annual evapotranspiration modeling using the HELP model. The following data is collected, logged and recorded from a remote continuous monitoring weather station on the site:

- Rainfall
- Wind speed and Direction
- Humidity
- Temperature
- Solar Radiation



PVT Property Boundaries

0 2000 4000

Scale In Feet

Reference: DeLorme, 2002.

N

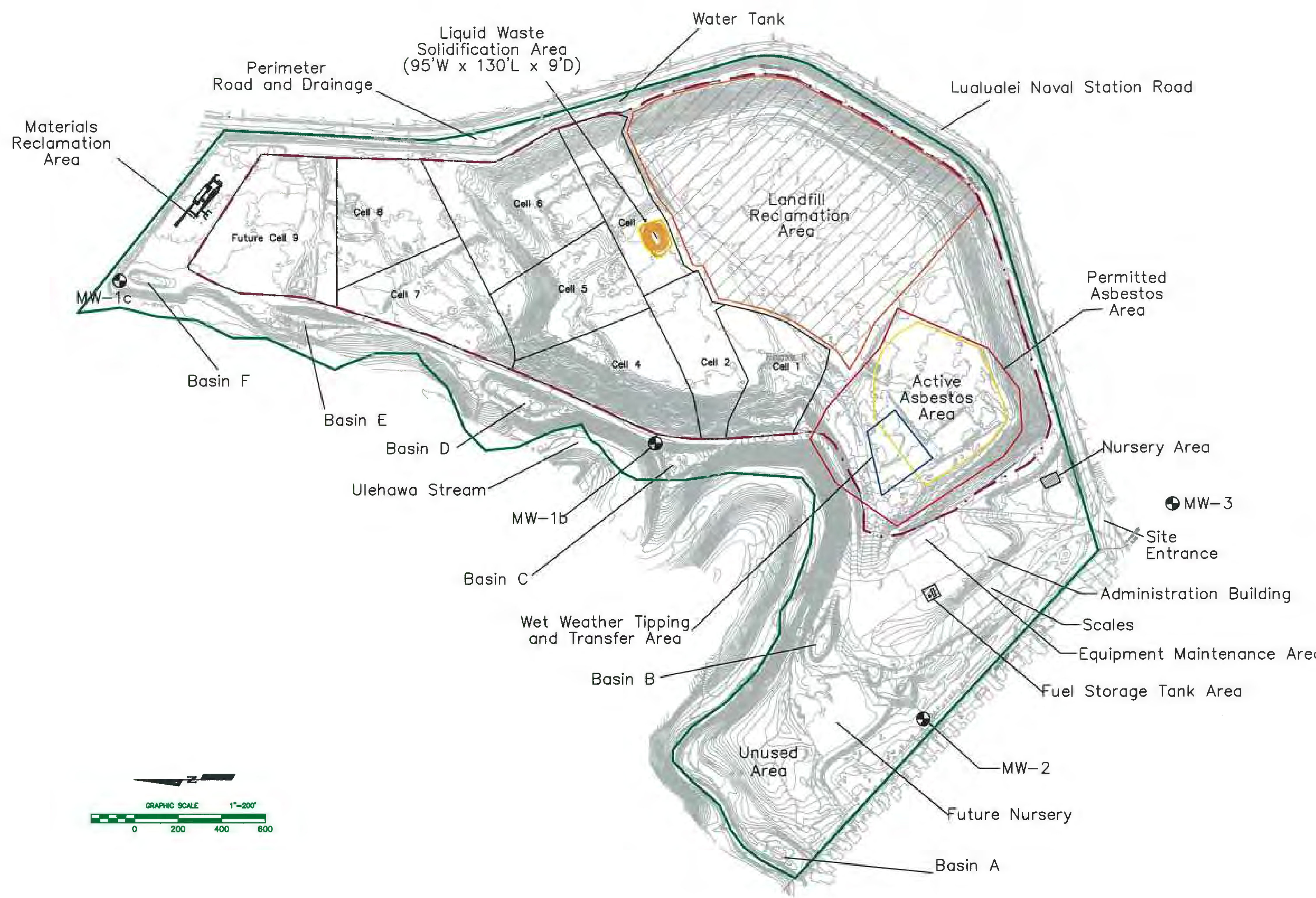
Project:	060024
Approved by:	JKH
Drawn by:	LBM
Date:	August 2009

Figure 1
Site Location Map

Operation Plan
PVT Integrated Solid Waste Management Facility
Nanakuli, Oahu, Hawaii

element environmental, llc
environmental engineering water resources

25

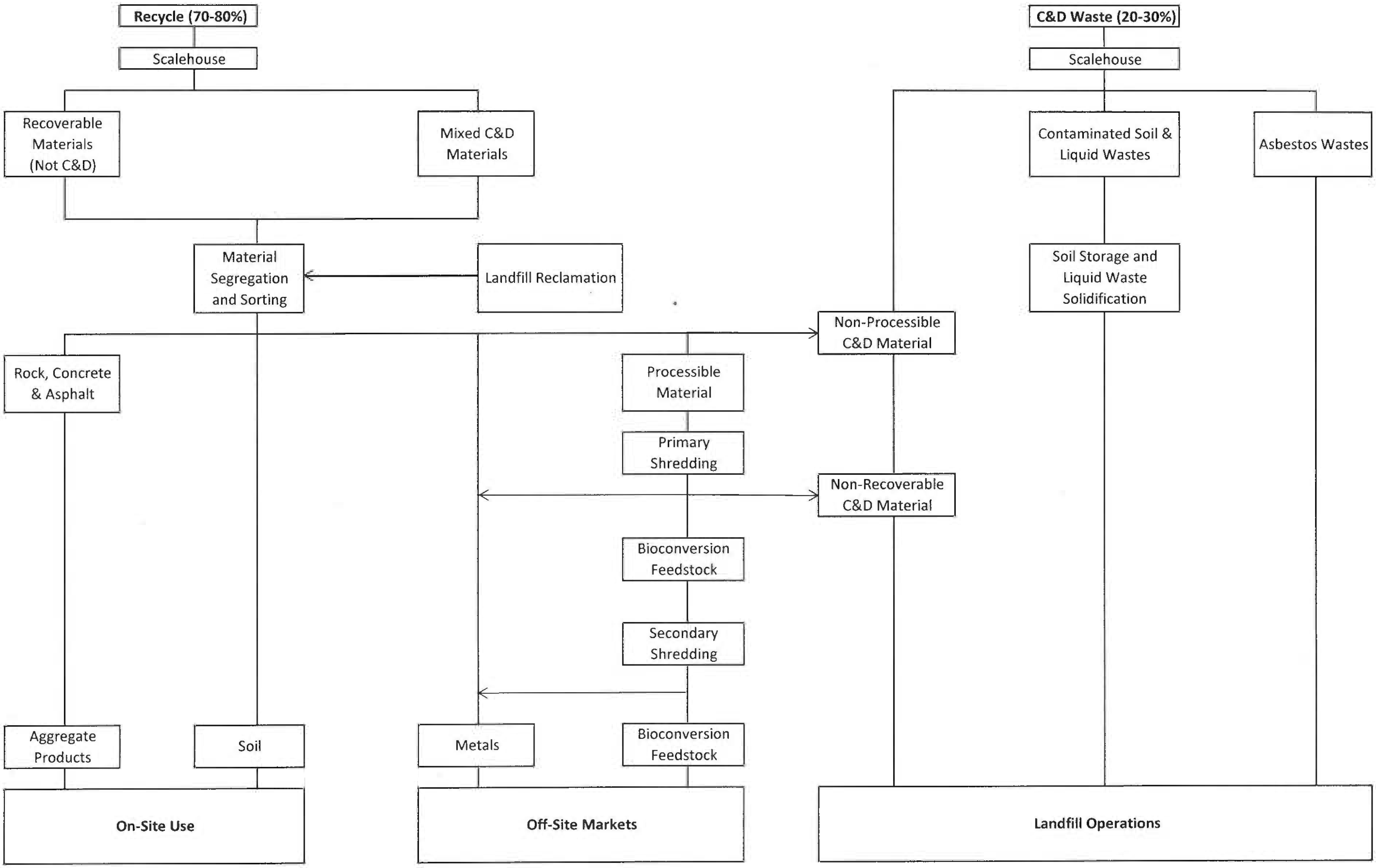


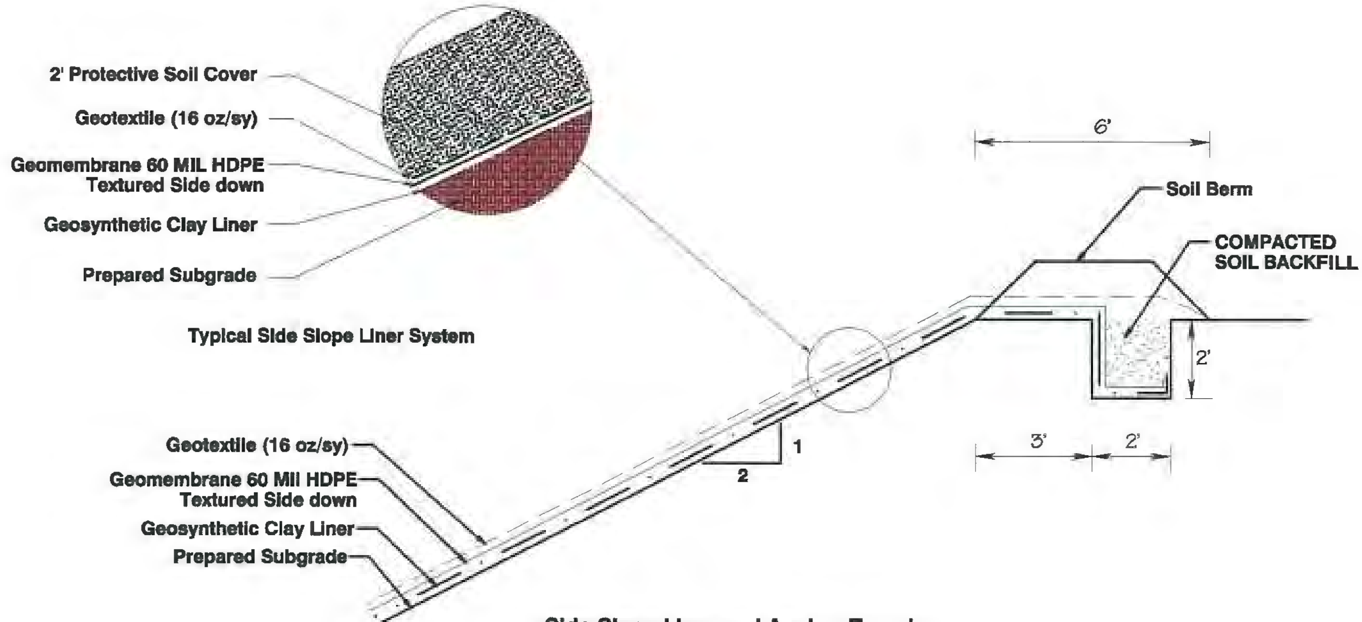
Legend
Property Boundary
Refuse Limits
July 19, 2014 Topography

Base Map Provided By: Spencer B. Gross, Inc. Topography July 2014

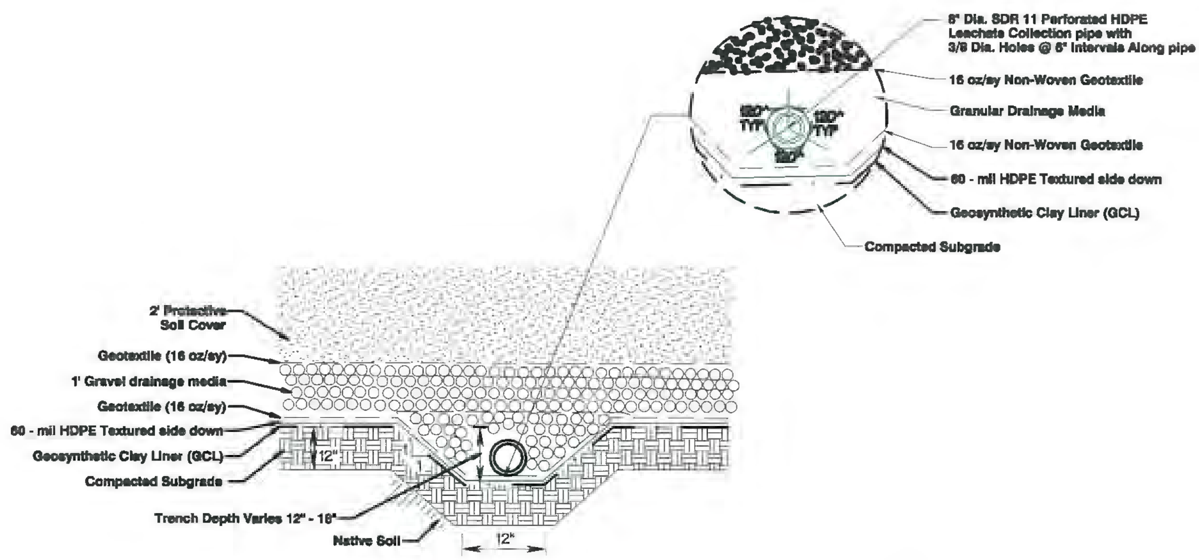
Figure 2	PVT Integrated Solid Waste Management Facilty
Approved By: SEJ	
Drawn By: WRL	Operation Plan
Date: October 2014	
Scale: As Shown	Site Plan

FIGURE 3
PVT INTEGRATED WASTE MANAGEMENT FACILITY MATERIALS FLOW





Side Slope Liner and Anchor Trench



Floor Liner and Typical LCRS Trench & Pipe

Figure 4
Phase II C&D Landfill Liner System

APPENDIX B - GEOLOGY, HYDROGEOLOGY AND WATER QUALITY ASSESSMENT

Geology, Hydrology and Water Quality Report

PVT Integrated Solid Waste Management Facility

Nānākuli, O'ahu, Hawai'i

May 2015

Prepared for:

PVT LAND COMPANY LIMITED

87-2020 Farrington Highway
Waianae, Hawaii 96792

Prepared by:

Hydrogeological Consulting
JUTURNA LLC

62-180 Emerson Road ◆ Haleiwa, Hawaii 96712
Phone: (808) 220-8620 ◆ email: jennifer.hernando@gmail.com

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List of Acronyms

°C	Degrees Celsius
BMP	Best Management Practice
C&D	Construction and Demolition
$CaCO_3$	Calcium Carbonate
cis-1,2-DCE	Cis-1,2-Dichloroethene
Cl	Chloride
cm/s	Centimeters per Second
CO_3	Carbonate
CUSUM	Cumulative Sum
DCA	1,2-Dichloroethane
DLNR	State of Hawaiʻi Department of Land and Natural Resources
DMR	Discharge Monitoring Report
DOH	State of Hawaiʻi Department of Health
DRO	Diesel Range Organics
HAR	Hawaiʻi Administrative Rules
HCO_3	Bicarbonate
mg/l	Milligrams per Liter
µg/l	Micrograms per Liter
µmhos/cm	Micromhos per Centimeter
mS/cm	Millisiemens per Centimeter
MSL	Mean Sea Level
MTBE	Methyl Tert-Butyl Ether
NA	Not Analyzed
ND	Not Detected, Non-Detect
NGPC	Notice of General Permit Coverage
NL	Not Listed
NM	Not Measured
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
PCE	Tetrachloroethene
ppm	Parts per Million
PVT ISWMF	PVT Integrated Solid Waste Management Facility
SO_4	Sulfate
SOEST	University of Hawaiʻi School of Ocean and Earth Science and Technology
TCE	Trichloroethene
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

Section 1 Introduction

This report summarizes the results of a geology, hydrology and water quality study of the PVT Integrated Solid Waste Management Facility (PVT ISWMF) located in Nānākuli, on the leeward coast of the Island of O'ahu, Hawai'i. The study involved a review of available geologic and hydrologic data from the literature and a review of site-specific data from existing groundwater wells and surface water sampling points located on the subject property. The data was compiled into this report to present an overview of surface water and groundwater conditions at the PVT ISWMF, and a discussion of the anticipated impact that proposed improvements at the PVT ISWMF will have on surface water and groundwater.

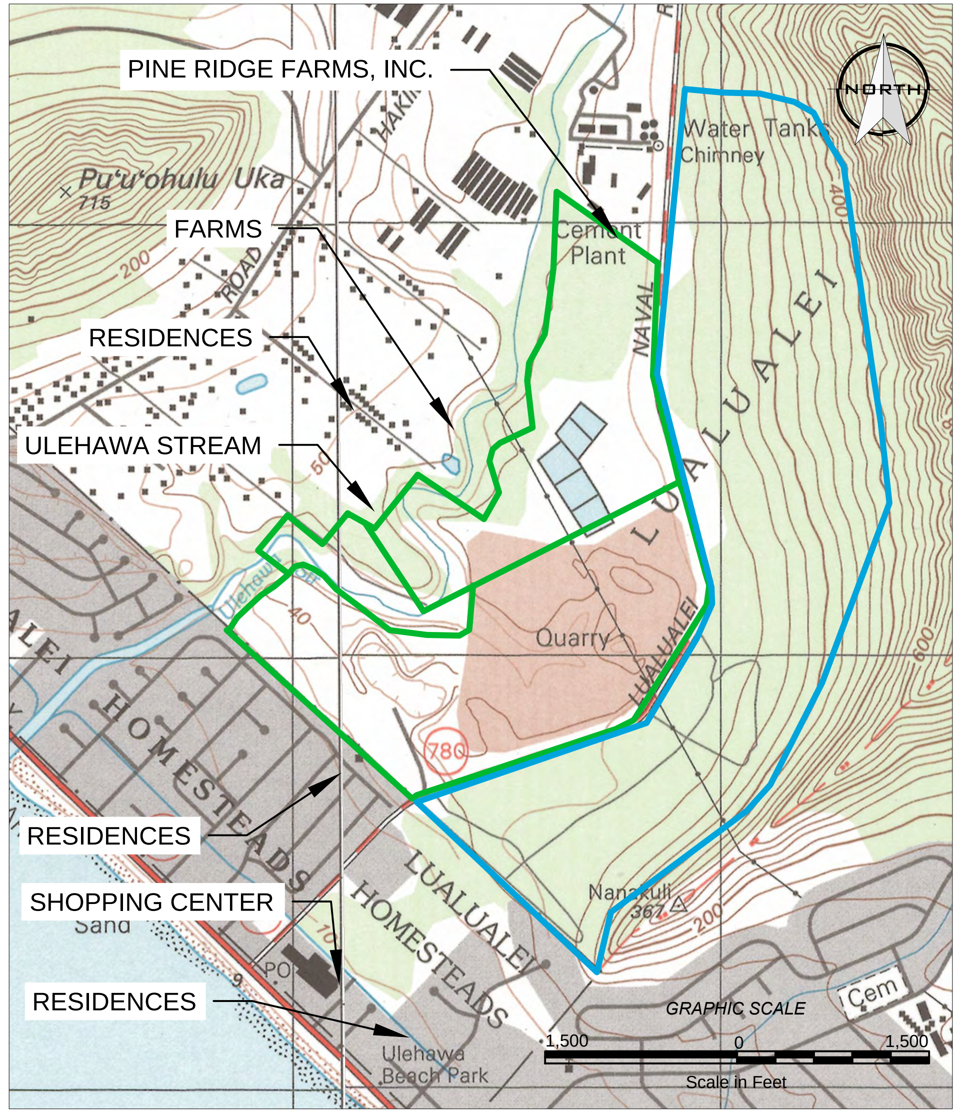
Section 2 Site Description

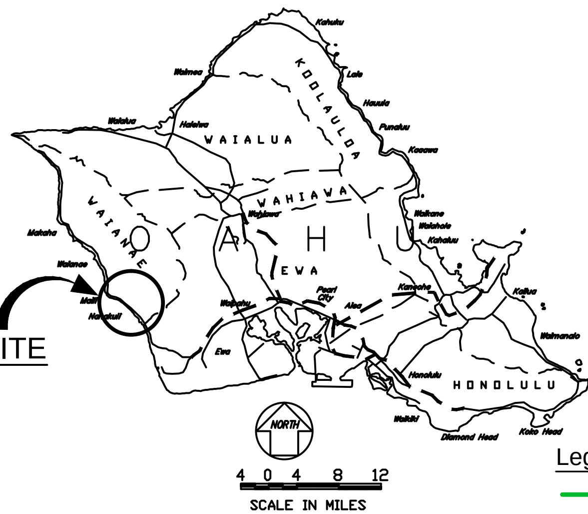
The PVT ISWMF is located in the community of Nānākuli near the western coast of the Island of O'ahu, Hawai'i. The property begins approximately 1,600 feet northeast of the intersection of Farrington Highway and Lualualei Naval Road, and extends northerly approximately one mile along Lualualei Naval Road, as shown on Figure 1, Site Vicinity Map.

The developed portion of the facility covers approximately 200 acres and is bordered to the east by Lualualei Naval Road, to the west by Ulehawa Stream, to the south by a residential neighborhood, and to the north by Pine Ridge Farms, Inc., a trucking, concrete and asphalt recycling, and concrete production facility. PVT ISWMF operations include a construction and demolition (C&D) material landfill with asbestos disposal and liquids solidification areas, and a recycling and materials recovery operation. An undeveloped parcel of 179 acres to the east of Lualualei Naval Road, owned by Leeward Land, is used for soil borrow, water supply, and drainage control. The general land use of the surrounding area includes low-density residential, commercial, and agricultural properties, in addition to industrial and undeveloped properties.

The PVT ISWMF began operations in 1985 to fill depressions from past quarry activities (Clayton Environmental Consultants, 1992). The facility has historically accepted demolition and landscaping waste, roofing and other non-degradable materials, incinerator ash, shredded automobiles, encapsulated or bagged asbestos, and oily waste (Clayton Environmental Consultants, 1992). Currently, the only wastes accepted for disposal at the landfill are C&D material, asbestos-containing material, and contaminated soil. In accordance with the facility's operations plan, facility personnel follow detailed operational procedures for the acceptance of solid waste.

The C&D landfill is comprised of two areas, Phase I and Phase II. The 49-acre Phase I area of the landfill includes the original portion of the C&D landfill, which received debris prior to October 9, 1993, and the asbestos disposal area. Phase I of the landfill is earth-lined with no leachate collection system. C&D debris disposal operations in Phase I had low compaction densities, producing a fill that contains substantial amounts of void spaces. As a result, this





SUBJECT SITE

Legend

PVT ISWMF Property Boundary

Leeward Land Property Boundary

Reference: USGS, 1998; Google Earth, 2013 (Satellite Image 1/29/2013) .

Approved by: JKH
Drawn by: LBM
Date: May 2015

Hydrogeological Consulting
JUTURNA LLC

Figure 1
Site Vicinity Map

Geology, Hydrology and Water Quality Report
PVT Integrated Solid Waste Management Facility
Nanakuli, Oahu, Hawaii

historic area of landfill has been prone to subsurface fires due to the intrusion of oxygen into the void space. In response, PVT is authorized by its Solid Waste Management Permit to: (1) remove previously buried debris; (2) process the debris to recover recyclable materials; and (3) replace any unrecyclable materials in the landfill.

The 104-acre Phase II area of the landfill consists of a series of cells numbered Cell 1 through Cell 9 as shown on Figure 2, Site Plan. To date, Cells 1 through 9A are constructed and Cell 9B, the last remaining permitted disposal area, is partly occupied by the recycling and materials recovery operation and the liquid waste solidification area. The Phase II landfill cells are constructed with an impermeable composite liner and leachate collection and removal system. In 2011, PVT ISWMF began operating the six-acre recycling and materials recovery facility to recover, reuse and recycle both previously landfilled debris and incoming debris.

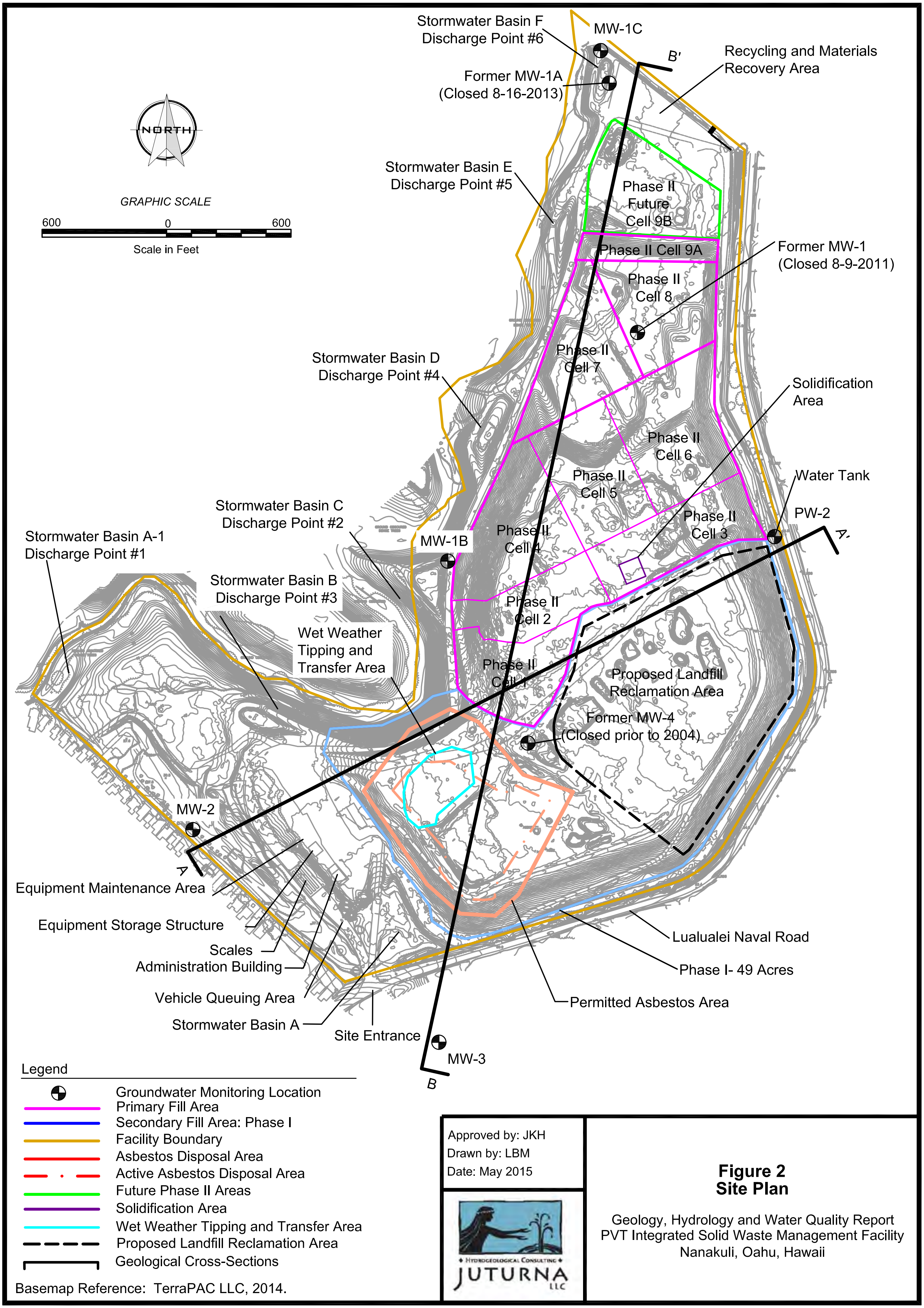
Section 3 Proposed Improvements

The proposed improvements at PVT ISWMF include: (1) expansion of the reuse, recycling and materials recovery operation; (2) allowing the site grade to reach a maximum elevation of up to 250 feet above mean sea level (MSL) at the mauka portion of the site; and (3) use of renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. The proposed improvements will allow PVT to continue to provide essential disposal services to the construction industry, to participate in the City's disaster response efforts, to provide recycled products and fuel to other businesses, and to be energy self-sufficient (Lyon, 2014).

PVT ISWMF began expanding its recycling operation in the summer of 2014 to increase the facility's processing capacity. PVT recycles and/or reuses up to 80% of the C&D debris that is brought to the landfill (Lyon, 2014). The material is reused for roads, recycled as scrap metal, and processed into feedstock to generate fuel and electricity. The expanded recycling operation will include equipment needed to process and/or store reclaimed combustible material for feedstock, including but not limited to pellitizers and silos for storage. With expanded operations, including new equipment to support renewable energy providers, PVT will be able to increase recycling processing up to 3,000 tons per day. This would yield approximately 1,500 tons of feedstock per day, enough to supply 20,000 homes with electricity (Lyon, 2014).

The proposed grading at the mauka section of the site will provide additional landfill capacity of approximately 4,500,000 cubic yards over the remaining life of the landfill (Lyon, 2014). The additional capacity will provide PVT with necessary flexibility to expand the reuse, recycling and material recovery operation and ensure that the reclamation of materials from Phase I of the landfill can be completed (Lyon, 2014).

The proposed use of renewable energy sources will be designed to make PVT ISWMF energy self-sufficient. PVT has already installed photovoltaic panels over its parking spaces, which provide power to its offices. The proposed improvements would include installation of renewable energy near the recycling and materials recovery facility to provide power for the



Approved by: JKH
Drawn by: LBM
Date: May 2015

Figure 2
Site Plan

Geology, Hydrology and Water Quality Report
PVT Integrated Solid Waste Management Facility
Nanakuli, Oahu, Hawaii

JUTURNA LLC
Hydrogeological Consulting

operations. A small gasification unit that uses the processed feedstock and/or photovoltaic panels over closed portions of the landfill is proposed (Lyon, 2014).

Section 4 Geologic Setting

4.1 Climate

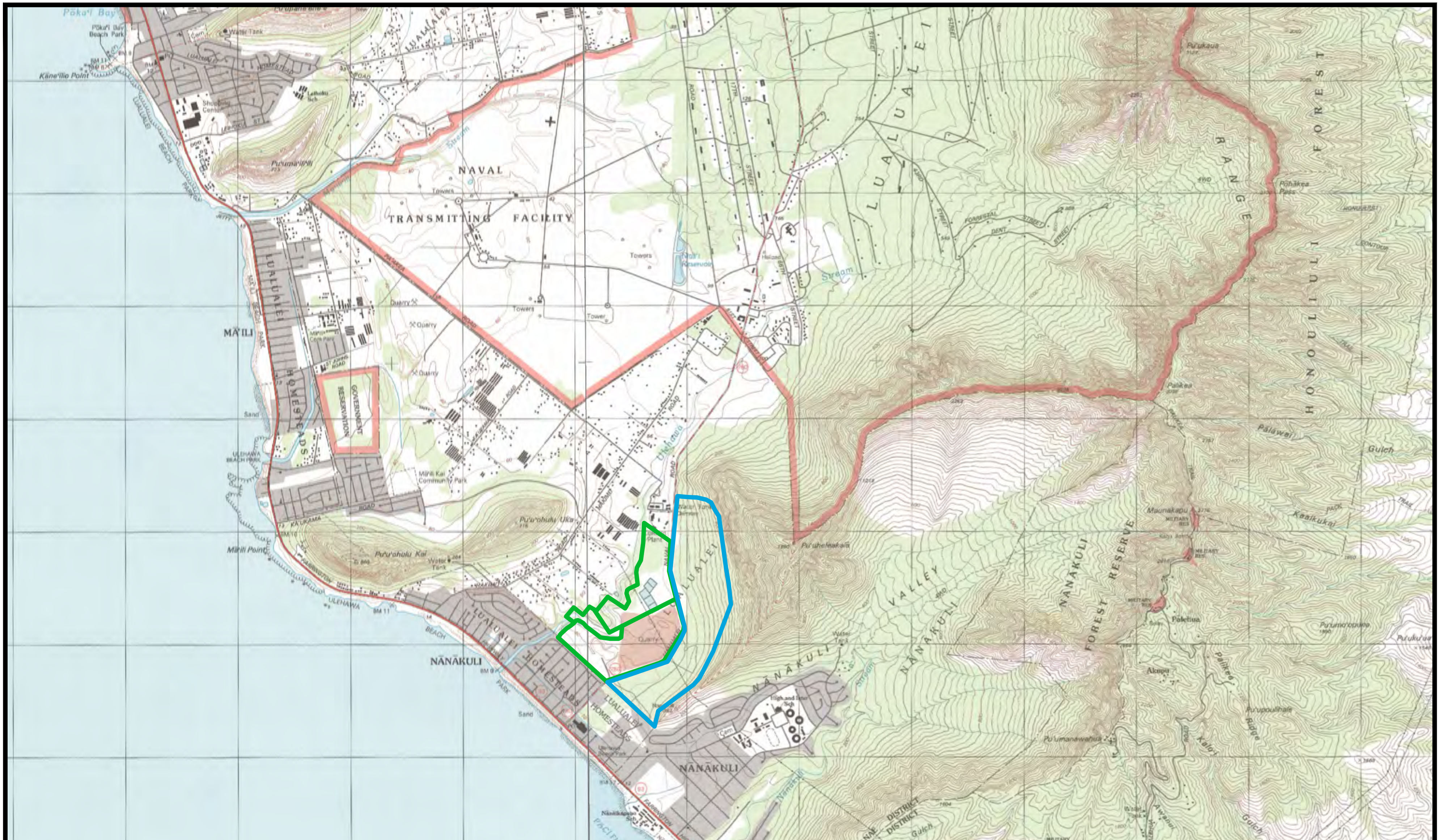
The climate of O'ahu is subtropical characterized by mild temperatures throughout the year, moderate humidity, persistence of northeasterly trade winds, significant differences in rainfall within short distances, and infrequent severe storms (National Weather Service, 2015). Another primary characteristic of O'ahu's climate is the presence of only two seasons: a dry season generally occurring between May and October, and a wet season generally occurring between October and April (National Weather Service, 2015).

The Nānākuli area receives approximately 14 inches of rainfall per year, based on data from the on-site weather station at PVT ISWMF. Most of the annual precipitation falls between October and April. During these months, rainfall averages one to two inches per month, with generally less than one inch per month falling during the rest of the year (A-Mehr, 2011). The average adjusted pan evaporation in the Nānākuli area is approximately 80 inches per year (Ekern and Chang, 1985).

Temperatures during the day range from the low 60s to the upper 70s during the winter months, and from the lower 70s to the upper 80s during the summer months (A-Mehr, 2011).

4.2 Topography

PVT ISWMF is located in Lualualei Valley, a broad amphitheater-headed valley located on the west side of the Wai'anae mountain range. The valley floor comprises approximately 14 square miles and is relatively flat, with the exception of several volcanic peaks located in the lower parts of the valley. These peaks include Pu'u o Hulu Kai, Pu'u o Hulu Uka, and Pu'u Heleakalā. PVT ISWMF is located between Pu'u Heleakalā (elevation 1,890 feet MSL) and Pu'u O Hulu Uka (elevation 715 feet MSL). In the valley the regional topography slopes gently down toward the ocean, as shown in Figure 3, Regional Topography. Elevations in the developed portion of the site prior to landfilling ranged from approximately 20 to 60 feet MSL (United States Geological Survey [USGS], 1983), while current site elevations in these areas range from approximately 20 to 130 feet MSL. In the undeveloped Leeward Land parcel, east of Lualualei Naval Road, the elevations range from approximately 40 to 350 feet MSL as shown on Figure 1. The southwestern side of the property is located approximately 2,000 feet from the shoreline, and the most inland portions of the property are within 7,500 feet of the shoreline.



Legend

PVT ISWMF Property Boundary

Leeward Land Property Boundary

GRAPHIC SCALE

5,000 0 5,000

Scale in Feet

Reference: USGS, 1998.

Approved by: JKH
Drawn by: LBM
Date: May 2015

HYDROGEOLOGICAL CONSULTING
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Figure 3
Regional Topography

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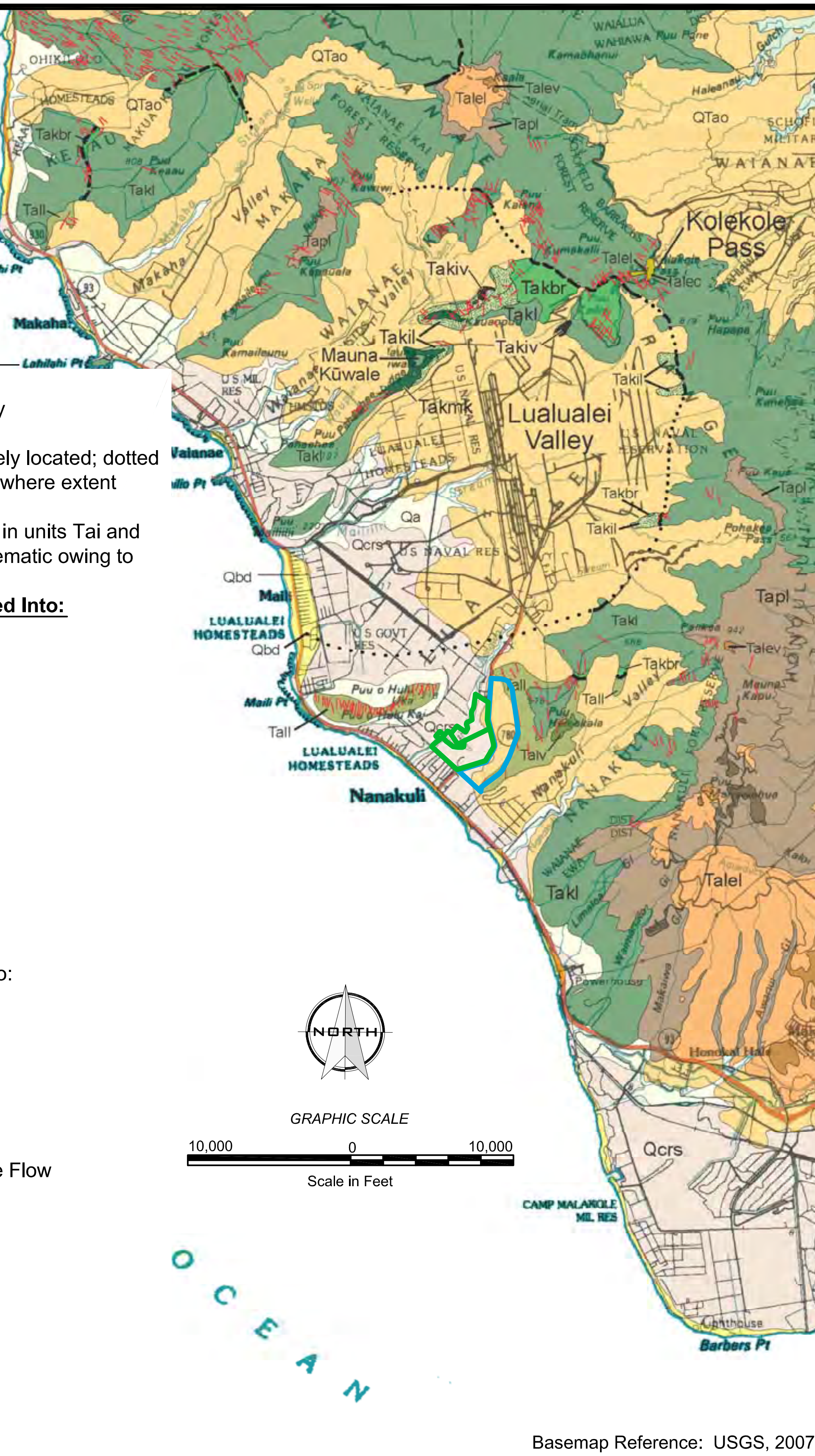
PVT Integrated Solid Waste Management Facility
Nanakuli, Oahu, Hawaii

4.3 Regional Geology

The island of Oʻahu was built by three shield volcanoes, the Kaʻena, Waiʻanae, and Koʻolau volcanoes (Macdonald et al., 1983 and Sinton et al., 2014). The now submerged Kaʻena volcano is the oldest of the three volcanoes; however, the Waiʻanae volcano rose above sea level first on the eastern flanks of Kaʻena approximately 3.9 million years ago (Sinton et al., 2014). Kaʻena emerged above sea level approximately 400,000 years later, followed by the Koʻolau volcano in another 500,000 years (Sinton et al., 2014). The present-day island of Oʻahu consists of the Waiʻanae Range (the eroded remnant of the Waiʻanae volcano) forming the western portion of the island, and the Koʻolau Range (the eroded remnant of the Koʻolau volcano) forming the eastern portion of the island. The term "range" expresses the fact that the shield form of the volcano has been eroded to form long narrow ridges. The eroded remnant of the Kaʻena volcano forms a submarine ridge located northwest of the island of Oʻahu (Sinton et al., 2014).

The rocks of the Waiʻanae volcano are known as the Waiʻanae Volcanics, and are subdivided into four members: the Lualualei (oldest), Kamaileʻunu, Pālehua, and Kolekole (youngest) Members. The Lualualei Member consists of tholeiitic basaltic lava flows that built the main mass of the Waiʻanae shield volcano, 3.9 to 3.55 million years ago (SOEST, 2015). During this shield-building stage, lava erupted along two, or possibly three, rift zones, and a well-developed caldera was present in Lualualei Valley (SOEST, 2015). In a later shield-building stage (approximately 3.55 to 3.06 million years ago) lavas from the Kamaileʻunu Member erupted within the caldera and along rift zones outside of the caldera (SOEST, 2015). The Kamaileʻunu lavas, which include plagioclase-bearing tholeiitic and alkalic basalts and basaltic hawaiites, eventually filled the caldera (SOEST, 2015). The Pālehua Member represents the post-caldera stage-eruptions, which occurred 3.06 to 2.98 million years ago, forming a relatively thin “alkalic cap” covering the top of the shield volcano (SOEST, 2015). The Pālehua Member lavas primarily contain hawaiite, with local occurrences of alkalic basalts and mugearite (Sinton, 1986). At the end of Pālehua volcanism a major erosional event occurred, possibly the great offshore, submarine Waiʻanae slump (SOEST, 2015). Following this event the plumbing system of the Waiʻanae Volcano was changed so that more mafic magmas from deep in the crust, the Kolekole Member, were erupted, carrying with them wall-rock fragments (xenoliths) of the deep crustal magma chamber (SOEST, 2015). The Kolekole Member includes the young cones and flows of Puʻu Kapuaʻi, Puʻu Kuʻua, Puʻu Makakilo, Puʻu Pālailai, and Puʻu Kapolei on the southern end of the Waiʻanae Range, a post-erosional flow at Kolekole Pass, the summit region of Mt. Kaʻala (the highest point on Oahu), and Pahole and Kuaokalā regions in the northern part of the Waiʻanae Range (Sinton, 1986 and SOEST, 2015). Figure 4 shows the regional geology.

The repeated eruptions that built the Waiʻanae shield volcano occurred along two or possibly three rift zones, now marked by innumerable exposed dikes. Dikes form from lava congealing in the fissures that bring it to the surface. In the site vicinity dikes intrude most members of the Waiʻanae Volcanics. They are sparse in the poorly permeable, massive, thick-bedded flows of



Basemap Reference: USGS, 2007.

Legend

PVT ISWMF Property Boundary

Leeward Land Property Boundary

Contact-Approximtately Located

Fault-Dashed where approximately located; dotted where concealed; queried where extent uncertain

Dike-Showing trend of intrusions in units Tai and QTki. Depiction partly schematic owing to exposure mostly to cliffs.

Wai'anae Volcanics (Pliocene)-Divided Into:

Kolekole Member:

- Talel — Lava Flows
- Talev — Vent Deposits
- Talec — Debris Flows

Pālehua Member:

- Tapl — Lava Flows
- Tapv — Vent Deposits

Kamaile'unu Member-Divided Into:

- Takl — Lava Flows
- Takv — Vent Deposits
- Takbr — Breccia
- Takmk — Mauna Kūwale Rhyodacite Flow
- Takil — Icelandite Lava Flows
- Takiv — Icelandite Vent Deposits

Lualualei Member-Divided Into:

- Tall — Lava Flows
- Talv — Vent Deposits
- Tai — Intrusive Rocks

Ko'olau Basalt (Pleistocene (?) and Pliocene):

- QTkl — Lava Flows

Surficial Deposits:

- QTao — Older Alluvium (Pleistocene and Pliocene)
- Qa — Alluvium (Holocene)
- Qcrs — Calcareous Reef Rock and Marine Sediment

Approved by: JKH
Drawn by: LBM
Date: May 2015

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Figure 4
Regional Geology

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PVT Integrated Solid Waste Management Facility
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the Pālehua member and are numerous in the highly permeable, thin-bedded flows of the Lualualei and Kamaileʻunu members (Takasaki, 1971).

The erosion of the Waiʻanae shield volcano formed large valleys on the western side of the Waiʻanae Range. These valleys (such as Lualualei) are some of the largest in Hawaiʻi, and they are believed to represent the sources for large landslides now seen on the sea floor to the west of the island (Presley et al., 1997). These valleys have extensive accumulations of alluvium and colluvium.

Also occurring along the Waiʻanae coast, and along most of Oʻahu's shorelines, are emerged coral reefs. These reefs formed during the interglacial stages when sea level was higher than it is now. Near Waiʻanae, the reef limestone extends to about 87 feet above sea level and is overlain by almost 10 feet of fossiliferous lithified beach sand (Macdonald, et al., 1983). This calcareous sedimentary material consists of coral, coral rubble, and beach sand.

PVT ISWMF is located in Lualualei Valley, which was formed by the Lualualei and Kamaileʻunu Members of the Waiʻanae Volcanics. The caldera for the Waiʻanae Volcano occupies most of Lualualei Valley; the caldera boundary is just north of the PVT ISWMF, as shown by the dotted fault line on Figure 4, Regional Geology. Lualualei Valley was formed by streams that eroded the Waiʻanae Volcano, filling the valley with alluvial and colluvial deposits. In addition, a catastrophic erosional event (mass-wasting), evident from the submarine landslide deposits located offshore, may have contributed to the formation of the valley (Presley et al., 1997). Reef deposits were laid down in Lualualei Valley approximately 500,000 years ago when sea level was 100 feet above the current sea level. The reef filled the valley to an approximate depth of 300 feet (Macdonald, et al., 1983).

4.4 Site Geology

Geologic materials at the PVT ISWMF site, as shown on Figure 4, include calcareous reef rock and marine sediment, chiefly emerged coral reefs and lagoonal deposits, on the western portion of the site, and older alluvium on the eastern portion of the site (Stearns, 1938 and USGS, 2007). The older alluvium generally consists of mottled brown to red brown, deeply weathered, poorly sorted, and nearly impermeable, friable conglomerates (Stearns, 1938). Younger alluvium is present on the far western portion of the site along Ulehawa Stream. Underlying the calcareous reef rock, marine sediments, and alluvium are lava flows of the Lualualei Member of the Waiʻanae Volcanics, which comprise the entire mountain of Puʻu Heleakalā, just east of the site.

Based on soil borings and excavation at the site, the natural surface material is a brown to dark brown clayey silt (alluvium) derived from the surrounding volcanic peaks (Mountain Edge Environmental, Inc., 2004). The underlying soil is tan silty clay with coral sand and coral fragments. This tan coralline material is approximately 6 to 18 feet thick and consists of large to small coral fragments, in which all the interstitial void space has been filled with calcic silt and clay, embedded in a calcic sand, silt and clay matrix. This material was originally deposited in a relatively quiet back-bay type of environment similar to the back bay areas of Pearl Harbor. Undisturbed samples of matrix have yielded permeabilities of 10^{-5} centimeters per second (cm/s), and this same material when used for backfill and compacted to 90% of maximum has yielded permeabilities of 10^{-7} cm/s (Joseph, 2004). In some areas of the PVT ISWMF site this soil includes more cemented coral and coralline gravel with sand and silts, which likely formed in a more active reef front or beach environment. These deposits range from 5 to 40 feet deep and are intermingled with alluvial deposits in some areas of the site (Mountain Edge Environmental, Inc., 2004). Figures 5 and 6 show geological cross sections detailing subsurface conditions encountered during installation of groundwater wells at the site.

4.5 Soils

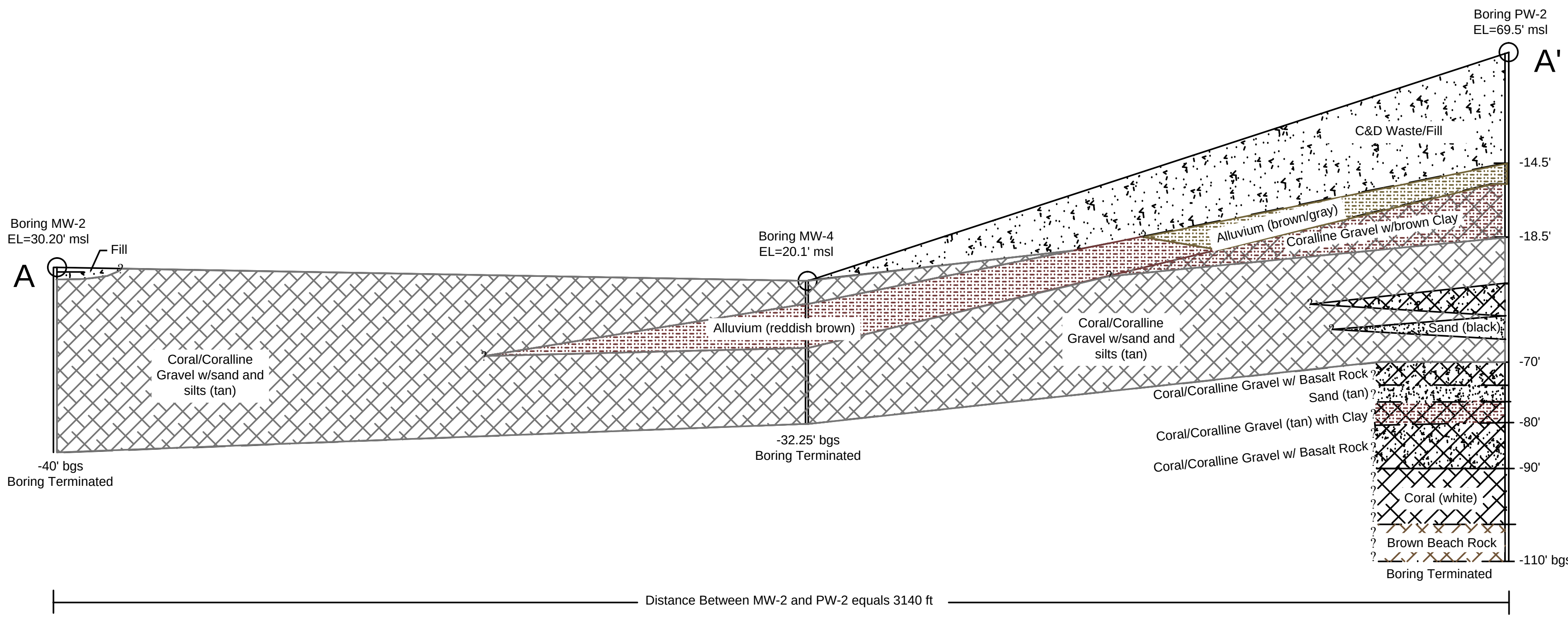
According to the United States Department of Agriculture, Soil Conservation Service (Foote et al., 1972), soils occurring on the PVT ISWMF site include Pulehu Very Stony Clay Loam (PvC), 0 to 12 percent slopes; Mamala Stony Silty Clay Loam, 0 to 12 percent slopes (MnC); and Lualualei Extremely Stony Clay (LPE), 3 to 35 percent slopes. In addition, Lualualei Clay, 2 to 6 percent slopes (LuB) and rock land (rRK) occur on portions of the undeveloped Leeward Land parcel, east of Lualualei Naval Road. Figure 7 shows the locations of these soils at the site.

As shown on Figure 7, the Pulehu Very Stony Clay Loam is located along Ulehawa Stream. This soil developed in alluvium washed from basic igneous rocks. Pulehu Very Stony Clay Loam is a dark brown clay loam underlain by dark-brown, dark grayish-brown, and brown stratified loam, loamy sand, fine sandy loam, and silt loam. As much as three percent of the surface of Pulehu Very Stony Clay Loam is covered with stones (Foote, et al., 1972).

The Mamala Stony Silty Clay Loam originally covered most of the central and southern portions of the PVT ISWMF site, but much of this soil has been removed during previous quarry activities, covered due to landfilling, or used as cover material for landfilling operations. Mamala Stony Silty Clay Loam soils formed in alluvium deposited over coral limestone and consolidated calcareous sand (Foote et al., 1972). These soils generally consist of dark reddish-brown stony silty clay loam with coral rock fragments common in the surface layer and throughout the profile (Foote et al., 1972).

The Lualualei Extremely Stony Clay, which occurs on the eastern portion of the site along Lualualei Naval Road and at the base of Pu'u Heleakalā, developed in alluvium and colluvium. Some of these soils have also been removed due to landfilling or used as cover material for landfilling operations. Lualualei Extremely Stony Clay generally consists of very dark grayish-brown, very sticky and very plastic clay that has prismatic structure and many stones on the surface and throughout the profile. According to Foote et al. (1972), this soil cracks widely upon drying and has a high shrink-swell potential and often contains gypsum crystals.

Lualualei Clay occurs in a very small area on the Leeward Land property, east of Lualualei Naval Road, as shown on Figure 7. Lualualei Clay is similar to Lualualei Extremely Stony Clay except that it does not have stones in the surface and in the profile (Foote et al., 1972).



Approved by: JKH
Drawn by: LBM
Date: May 2015

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Figure 5
Geologic Cross Section
East-West

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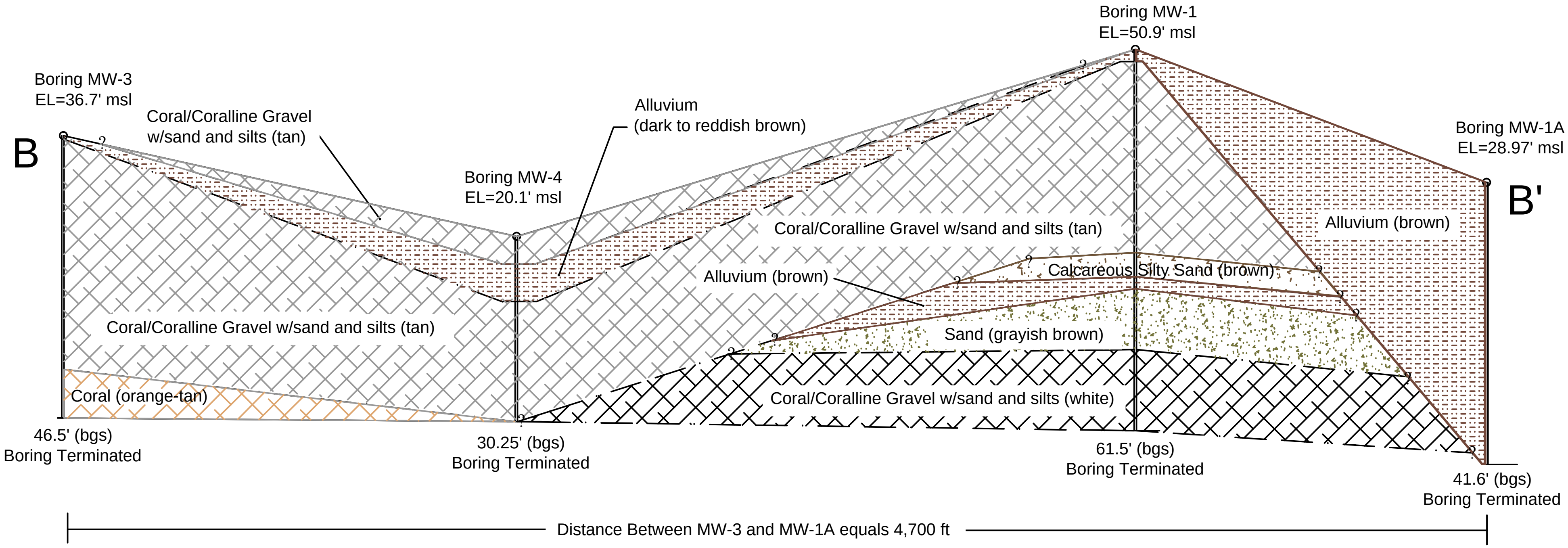
PVT Integrated Solid Waste Management Facility
Nanakuli, Oahu, Hawaii

Reference: Mountain Edge, 2004 based on boring logs by Clayton Environmental Consultants,1992
and Mountain Edge Environmental, Inc., 2003



Approved by: JKH
Drawn by: LBM
Date: May 2015

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Figure 6
Geologic Cross Section
North-South

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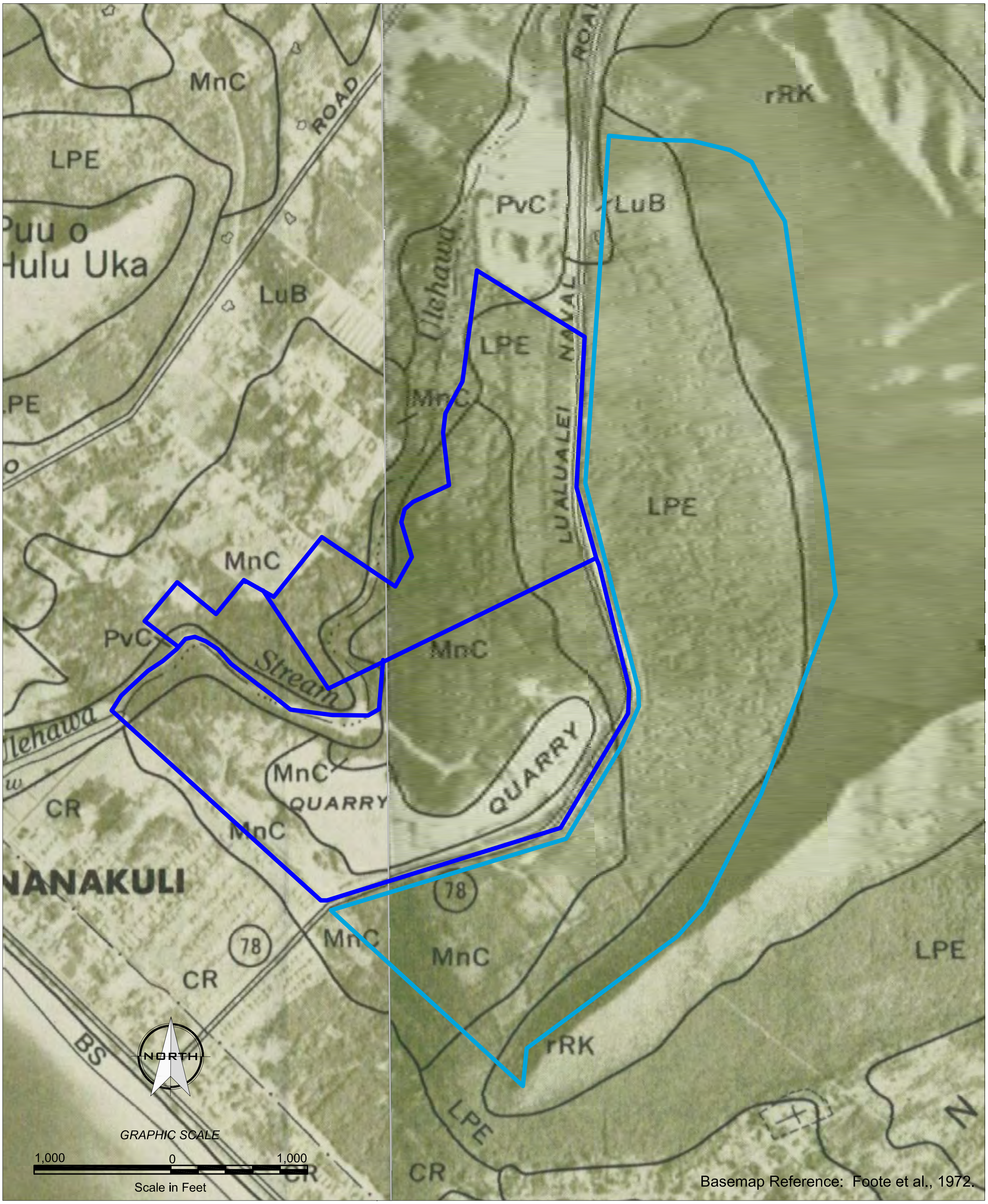
Reference: Mountain Edge, 2004 based on boring logs by Clayton Environmental Consultants,1992
and Mountain Edge Environmental, Inc., 2003



Legend

- PVT ISWMF Property Boundary
- Leeward Land Property Boundary

LPE- Lualualei extremely stoney clay, 3 to 35 percent slopes
MnC- Mamala stony silty clay loam, 0 to 12 percent slopes
PvC- Pulehu very stony clay loam, 0 to 12 percent slopes
LuB- Lualualei clay, 2 to 6 percent slopes
rRK- Rock land
CR- Coral outcrop
BS- Beaches

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Figure 7
Soil Map

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A small portion of the Leeward Land property on the upper slopes of Pu'u Heleakalā is considered rock land (rRK), which is made up of areas where exposed rock covers 25 to 90 percent of the surface. Rock outcrops and very shallow soils are the main characteristics of rock land (Foote et al., 1972).

Section 5 Hydrogeology

5.1 Regional Hydrogeology

Most of the fresh groundwater supply in the Wai'anae District occurs in flows of the Lualualei and Kamaile'unu Members of the Wai'anae Volcanics. Flows of the Pālehua and Kolekole Members are mostly above the water table, and contain only a small perennial supply. Some fresh groundwater occurs in the sedimentary material; however, development of this supply is generally limited by the low permeability of alluvium and seawater intrusion in the calcareous reef rock and marine sediments (Takasaki, 1971).

The groundwater reservoir in the volcanic rocks is very large, the top of which extends from an altitude of a few feet near the coast to over 1,800 feet near the crest of the Wai'anae Range. The bottom of the volcanic aquifer is undetermined but is probably limited by the inability of the rocks to transmit water at some great depth below sea level. The quality of water from wells tapping the volcanic aquifer is generally good, except in near-shore areas and areas abutting landward edges of the coralline aquifer where intrusion by seawater occurs. The quantity and orientation of dikes occurring within the volcanic aquifer greatly controls the permeability of the aquifer because the dikes are less permeable than the rocks they intrude. Where dikes are few and mostly parallel, they channel groundwater along their trend. Where dikes are numerous and intersect, they form compartments reducing the lateral movement of groundwater and impounding it at altitudes higher than in areas where dikes are less abundant (Takasaki, 1971).

The erosion of the Wai'anae shield volcano formed large valleys on the western side of the Wai'anae Range. These valleys have extensive accumulations of alluvium and colluvium. The older alluvium is moderately to well consolidated and weathered in its entirety. This material is generally poorly permeable and acts as a confining member where it overlies more permeable saturated rocks. The younger alluvium consists of reworked older alluvium occurring in and near stream channels and overlying the older alluvium. The younger alluvium is poorly to moderately permeable; its yield from wells is small, but the groundwater quality is generally fair to good, even near the coast. Talus, consisting mainly of poorly consolidated gravel and boulders, also occurs in the valleys of the Wai'anae Range. The talus is highly permeable; however, the storage is generally small (Takasaki, 1971).

Groundwater also occurs within the highly permeable calcareous reef rock and marine sediments near sea level. The coralline rocks extend inland approximately two miles in Lualualei Valley (Stearns, 1938). Many wells have been drilled into this aquifer, primarily for irrigation use; however, the wells are brackish and many have been abandoned due to an increase in chloride content of the water with continued pumping. Fresh water within the coralline aquifer occurs as a thin and unstable lens floating on seawater. This lens is subject to rapid contamination by seawater if wells tapping the aquifer are pumped heavily. The lack of fresh water needed to develop a thicker freshwater lens is partly due to the abundant growth of kiawe in the Wai'anae area. Transpiration by kiawe, from shallow groundwater in volcanic rock and alluvium, reduces the underflow that would flow from these aquifers to the coralline aquifer. Transpiration by kiawe that grows over the coralline aquifer also constitutes the main discharge of groundwater from this aquifer (Takasaki, 1971).

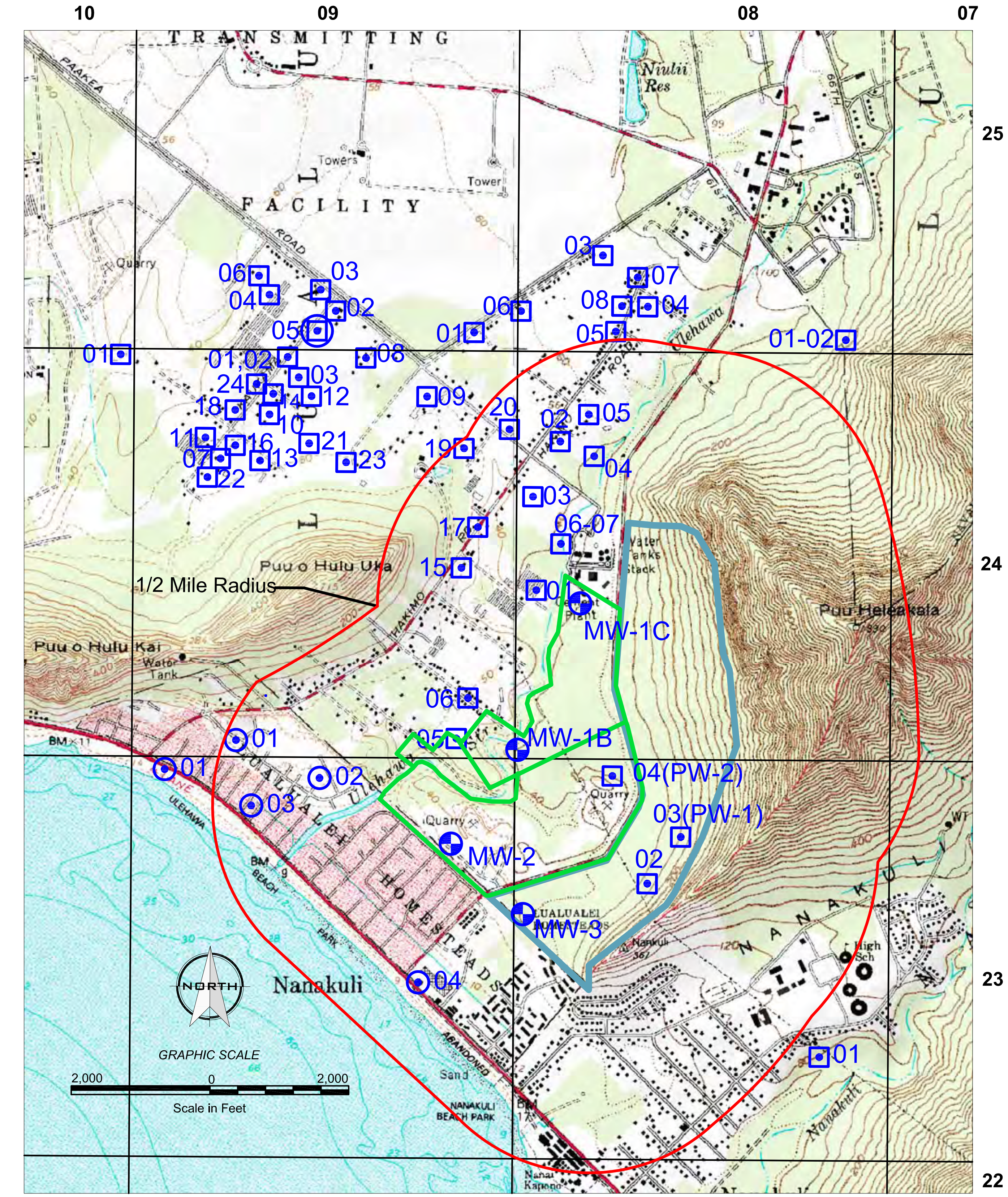
Groundwater occurring within the younger alluvium is generally fresh and water levels are higher than in the coralline aquifer; however, seawater intrusion occurs where the alluvium aquifer abuts the coralline aquifer and in near-shore areas (Takasaki, 1971).

5.2 Wells in the Site Vicinity

Figure 8 shows the locations of groundwater withdrawal wells in the vicinity of the PVT ISWMF property that are registered with the State of Hawaii, Department of Land and Natural Resources (DLNR), Commission on Water Resources Management (DLNR, 2008). DLNR does not regulate or record the locations of groundwater monitoring wells; however, Figure 8 does show the locations of PVT ISWMF's monitoring wells. Based on information provided by DLNR (2008), no drinking water wells are located on, downgradient of, or within one mile of the subject property. The closest drinking water well is located over one mile northwest and upgradient of the site. Wells in the site vicinity are used for irrigation, industrial purposes, or are currently sealed or unused (DLNR, 2008). Table 1 provides information on registered wells within one-half mile of the site.

Four wells are located on the PVT ISWMF property, and three wells, which are owned by PVT, are located on the Leeward Land property across Lualualei Naval Road from the site. The wells on the Leeward Land property include well PW-1 (State No. 2308-03) which provides water for dust control at PVT ISWMF; well 2308-02 which is unused; and monitoring well MW-3 which is one of the four active groundwater monitoring wells for PVT ISWMF. The four wells located on the PVT ISWMF property include well PW-2 (State No. 2308-04), which was installed in 2003 to provide additional water for dust control; and active groundwater monitoring wells MW-1B, MW-1C, and MW-2.

The four active groundwater monitoring wells (wells MW-1B, MW-1C, MW-2, and MW-3) are not listed on Table 1 because monitoring wells are not registered by the State. There are also three former groundwater monitoring wells at the site that have been sealed due to construction of landfill cells and the recycling and materials recovery facility. The sealed groundwater monitoring wells include MW-1, MW-1A, and MW-4. Groundwater monitoring wells MW-1B and MW-1C replaced these sealed wells. The locations of the active and sealed groundwater monitoring wells are shown on Figure 2.



Legend

- 1/2 Mile Radius from PVT ISWMF
- PVT ISWMF Property Boundary
- Leeward Land Property Boundary
- Other Well
- Injection Well
- PVT Monitoring Wells
- Potable Well

Basemap Reference: Delorme, 1985; DOH, 1984.

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Drawn by: LBM
Date: May 2015

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Figure 8
Well Location Map

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Table 1: Registered Wells within One-Half Mile of PVT ISWMF

Well Number	Well Name	Year Drilled	Owner / User	Ground Elev. (feet)	Well Depth (feet)	Initial Head (feet MSL)	Max. Chloride (ppm)*	Use
2308-02	Lualualei-PVT	1952	PVT Holdings	115	154	3.7	292	Unused
2308-03	Lualualei-PVT	1990	PVT Holdings	136	200	7.0	900	Irrigation
2308-04	Perimeter Rd	2003	PVT Land Co.	66	110	0.47	3400	Other
2408-01	Lualualei	1949	Kakazu S	33	55	2.0	1410	Unused
2408-02	Lualualei	1950	Oshiro K	59	75	2.2	1850	Irrigation
2408-03	Lualualei	1951	Shigeta H	46	66	2.1	1422	Irrigation
2408-04	Lualualei	1951	Oshiro K	42	63	2.1	1700	Unused
2408-05	Lualualei	1957	Nakata E & C	62	86	2.1	2370	Other
2408-06	Lualualei	1962	Perm Cement	40	93	NL	NL	Industrial
2408-07	Lualualei	1962	Perm Cement	40	93	NL	1980	Industrial
2408-08	Maile Irr 1	1989	Kabushiki Oban	145	220	5.0	1570	Sealed
2408-10	Lualualei GC2	1996	Kabushiki Oban	75	100	NL	NL	Unused
2409-05	Lualualei	1951	Kameya Y	49	76	1.4	1520	Irrigation
2409-06	Lualualei	1951	Kameya Y	49	64	1.4	1150	Unused
2409-15	Maili	1954	Aquillio T	47	47	1.8	1580	Unused
2409-17	Maili	1955	Tsuzuki I	45	60	1.2	1690	Unused
2409-20	Maili	1955	Tsuchitori F	51	60	1.6	1950	Other

NL = Not Listed in the DLNR database.
* = If maximum chloride concentration is NL, initial or test chloride concentration is shown, ppm = parts per million.
Reference: DLNR, 2008.

There are 14 other registered wells located within one-half mile of PVT ISWMF, including two industrial wells, three irrigation wells, six unused wells, one sealed well, and two other use wells (DLNR, 2008). As shown in Table 1, the maximum chloride concentration of groundwater from these 14 wells ranges from 1,150 to 2,370 parts per million (ppm), indicating that the wells are considered brackish water wells (freshwater typically has a chloride concentration less than 250 ppm (Mink and Lau, 1990)).

5.3 Groundwater Aquifers at the Site

Groundwater at the site occurs within coralline, alluvial, and volcanic materials. According to the aquifer identification and classification for O'ahu (Mink and Lau, 1990), two aquifers occur at the site, one overlying the other. Both aquifers are classified within the Lualualei Aquifer System of the Wai'anae Aquifer Sector.

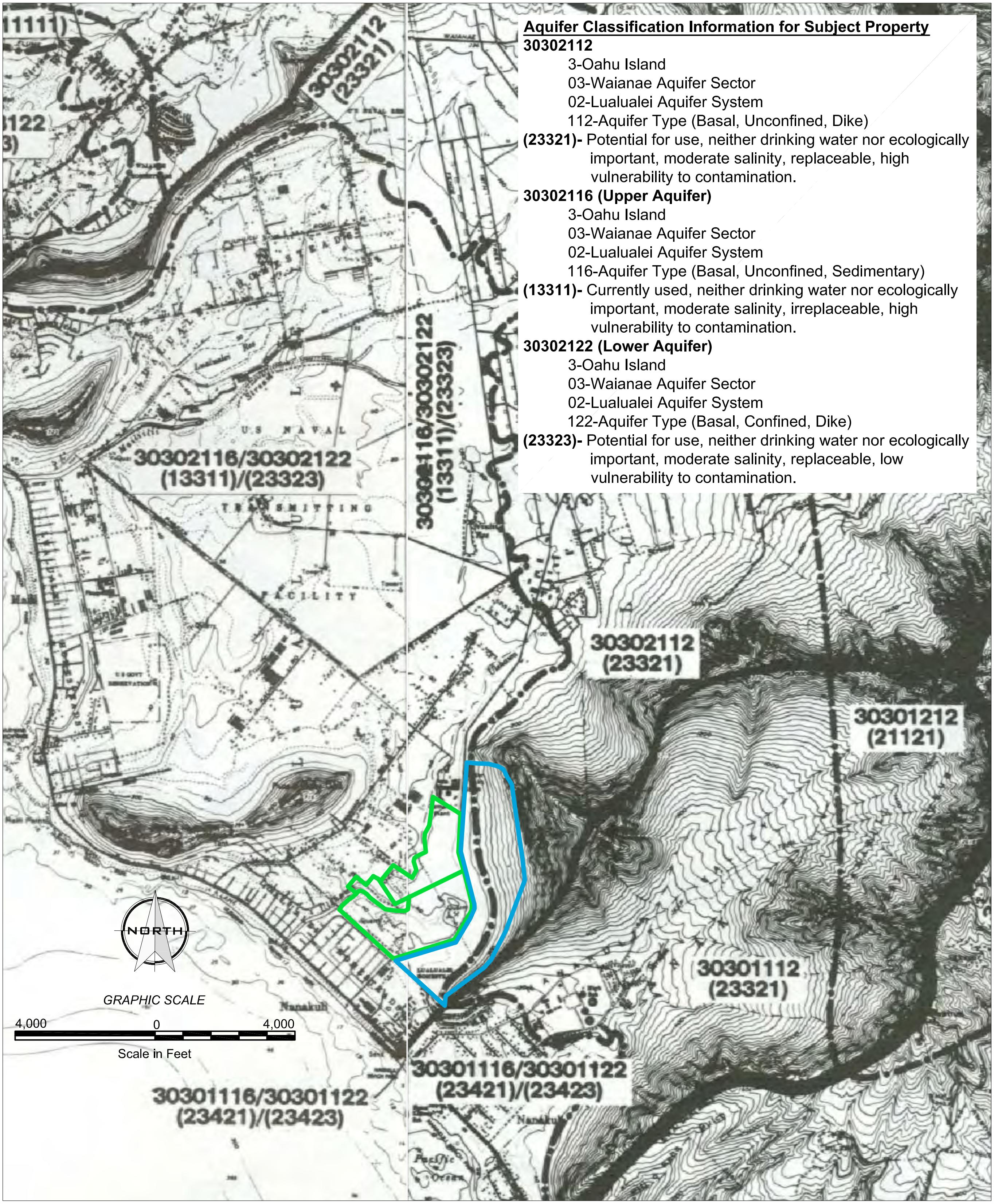
The upper aquifer is a sedimentary caprock aquifer, which overlies a deeper volcanic aquifer. The sedimentary caprock aquifer, Aquifer Code 30302116, occurs within coralline and alluvial material at the site. This aquifer is a basal aquifer, which means that fresh water is in contact with seawater. The aquifer is unconfined, where the water table is the upper surface of the saturated aquifer, and the aquifer is currently used for purposes other than drinking water, such as for irrigation or industrial purposes. In addition, the aquifer is not classified as ecologically important. Salinity in the aquifer is moderate, having 1,000 to 5,000 milligrams per liter (mg/l) or ppm of chloride. The aquifer is also classified as irreplaceable and highly vulnerable to contamination. Based on measurements taken from the groundwater monitoring wells at PVT ISWMF, the water level or head in this aquifer is approximately 1 to 3 feet above MSL (approximately 30 to 70 feet below the ground surface). Extended groundwater level monitoring using pressure transducers indicated that the groundwater in the caprock aquifer is weakly influenced by tidal fluctuations (Joseph, 2004). Inland of the tidal reach, the bottom of the channel of Ulehawa Stream has a thick layer of silt and clay. This results in minimal permeability in Ulehawa Stream and limits the amount and rate of seepage from the stream into the caprock aquifer that lies beneath the site. This also causes the water level in Ulehawa Stream to be different than the groundwater levels beneath the site (Joseph, 2004).

The lower aquifer at the site occurs within volcanic rocks directly beneath the coralline and alluvial sediments at depths on the order of 300 feet (Macdonald et al., 1983). This basal aquifer, Aquifer Code 30302122, is confined by the sedimentary materials lying above it, and occurs in volcanic rocks within compartments formed by dikes. The aquifer is not currently used; however, it does have potential for use as a source of non-drinking water. The salinity of this aquifer is moderate, 1,000 to 5,000 mg/l chloride, and the aquifer is not classified as ecologically important. This aquifer is further classified as replaceable with a low vulnerability to contamination.

These two aquifers at the site extend beneath the undeveloped property east of Lualualei Naval Road, along the lower slopes of Pu'u Heleakalā, as shown on Figure 9. However, along the upper slopes of Pu'u Heleakalā, also beneath the undeveloped Leeward Land property, lies a third aquifer within the Lualualei Aquifer System of the Wai'anae Aquifer Sector. This aquifer, Aquifer 30302112, contains unconfined, dike-impounded basal water. Aquifer 30302112 is classified as having potential use but not as a source of drinking water, nor is it considered ecologically important. The aquifer is classified as having a moderate salinity with chloride concentrations between 1,000 and 5,000 mg/l. The aquifer is also classified as replaceable with a high vulnerability to contamination since there is no overlying aquifer (Mink and Lau, 1990). PVT ISWMF's well PW-1 is located in this aquifer. Based on measurements taken at well PW-1, the groundwater surface is 132 feet below the ground surface at an elevation of approximately 4 feet above MSL.

5.4 Groundwater Flow Direction and Gradient

The groundwater monitoring wells at PVT ISWMF and production well PW-2 are located in the sedimentary caprock aquifer (Aquifer Code 30302116). The groundwater flow direction and gradient in this aquifer is monitored semiannually as part of PVT ISWMF's groundwater monitoring program. The flow direction and gradient in this aquifer has been consistent over the years and is well documented (Mountain Edge Environmental, Inc., 2004, 2005, 2006a, 2006b; Element Environmental, LLC, 2007a, 2007b, 2008a, 2008b, 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012a, 2012b; and Juturna LLC, 2013a, 2013b, 2014a, 2014b). Groundwater flows in a south to southwest direction with a very flat gradient, as shown on



Legend

- PVT ISWMF Property Boundary
- Leeward Land Property Boundary
- Aquifer Sector
- Aquifer System

Basemap Reference: Mink and Lau, 1990.

Approved by: JKH
Drawn by: LBM
Date: May 2015

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Figure 9
Aquifer Classification Map

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Figure 10. The groundwater velocity is estimated to be in the range of 1.6 to 2.4 feet per day (Joseph, 2004). The flow is low, and the maximum range of groundwater elevation change measured in the wells since 1995 is less than two feet (see Table 2). The groundwater gradient map shown on Figure 10 was generated using groundwater elevations measured on January 12, 2015 in the four monitoring wells and in well PW-2. Table 2, below, lists the groundwater elevations measured on January 15, 2015, as well as data collected over the last ten years.

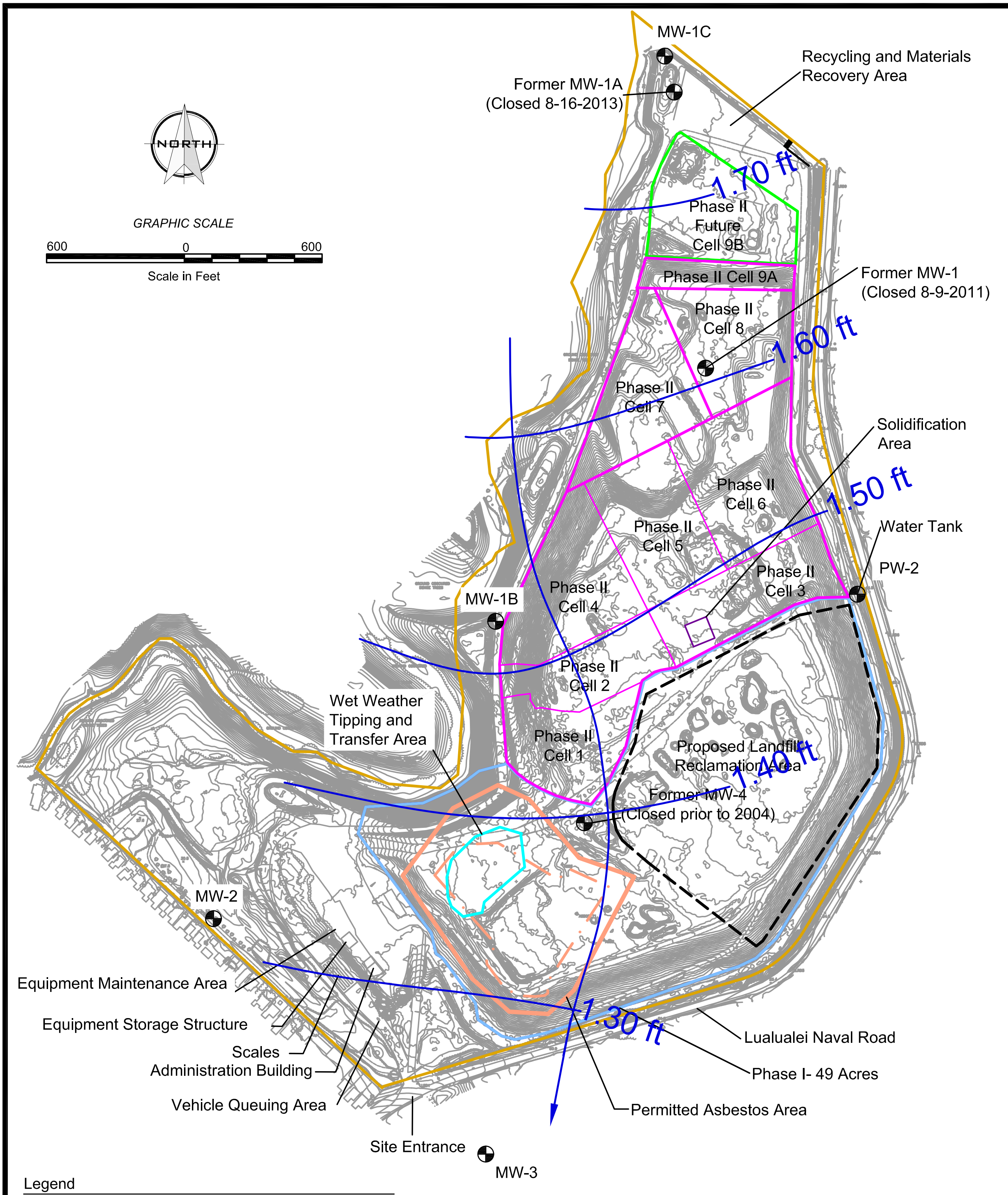
Table 2: Groundwater Elevations in PVT ISWMF Wells

Date	Well Number / Groundwater Elevation (feet MSL)						
	MW-1	MW-1A	MW-1B	MW-1C	MW-2	MW-3	PW-2
5/21/2004	1.75	1.90	----	----	1.44	1.41	1.82
6/27/2005	1.55	1.89	----	----	1.40	1.46	NM
12/27/2005	1.62	1.81	----	----	1.54	1.49	NM
10/20/2006	3.34	3.44	----	----	2.72	2.70	NM
12/19/2006	3.13	3.21	----	----	2.52	2.52	NM
6/29/2007	2.85	2.94	----	----	2.17	2.18	NM
12/12/2007	3.30	3.39	----	----	2.67	2.69	NM
6/25/2008	3.00	3.09	----	----	2.30	2.33	NM
12/9/2008	3.04	3.11	----	----	2.44	2.42	NM
6/17/2009	2.71	2.77	----	----	2.02	2.00	NM
12/9/2009	2.95	3.03	----	----	2.00	2.28	NM
6/30/2010	1.51	1.67	----	----	1.33	1.35	NM
12/30/2010	1.90	2.03	----	----	1.81	1.79	NM
6/30/2011	1.50	1.67	----	----	1.37	1.37	NM
12/28/2011	sealed	1.50	1.38	----	1.17	1.20	NM
6/14/2012	sealed	1.59	1.49	----	1.25	1.27	NM
12/26/2012	sealed	1.92	1.78	----	1.66	1.72	NM
6/26/2013	sealed	1.69	1.57	----	1.43	1.43	NM
1/23/2014	sealed	sealed	1.65	----	1.42	1.42	NM
6/6/2014	sealed	sealed	1.72	1.78	1.46	1.34	NM
1/12/2015	sealed	sealed	1.54	1.78	1.31	1.23	1.44

NM = Not Measured on indicated date. ---- = Well was not yet constructed on indicated date.
Note: An electronic water level indicator was used to measure the depth to groundwater from the known elevations at the top of the well casings. On each day, static water levels were measured within a one-hour period so that changes caused by tidal influence were minimized. Obtaining water level measurements in the pump wells is difficult because it involves turning the pumps off and allowing the water levels to equilibrate which takes several hours, and the pumps need to be running during landfill operating hours; therefore, water levels are not routinely measured in the pump wells.
Reference: Mountain Edge Environmental, Inc., 2004, 2005, 2006a, 2006b; Element Environmental, LLC, 2007a, 2007b, 2008a, 2008b, 2009a, 2009b, 2010a, 2010b, 2011a, 2011b, 2012a, 2012b; Juturna LLC, 2013a, 2013b, 2014a, 2014b.

Groundwater elevations in the wells on January 12, 2015 ranged from 1.23 feet to 1.78 feet MSL, and the groundwater gradient averaged approximately 1.39 x 10^{-4} foot/foot across the site. The gradient map (Figure 10) shows that well MW-1C is an upgradient well and that wells MW—1B, MW-2 and MW-3 are downgradient.

Two wells (well 2308-02 [PW-1] and well 2308-03) are located in the volcanic dike aquifer (Aquifer Code 30302112), which occurs along the upper slopes of Pu'u Heleakalā on the undeveloped Leeward Land property east of the site. Head levels in this aquifer are



Legend

- Groundwater Monitoring Location
- Primary Fill Area
- Secondary Fill Area: Phase I
- Facility Boundary
- Asbestos Disposal Area
- Active Asbestos Disposal Area
- Future Phase II Areas
- Solidification Area
- Wet Weather Tipping and Transfer Area
- Proposed Landfill Reclamation Area
- Groundwater Contour (ft msl)
- Groundwater Flow Direction

Basemap Reference: TerraPAC LLC, 2014.

Approved by: JKH
Drawn by: LBM
Date: May 2015

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Figure 10
Groundwater Gradient Map

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significantly higher (50 to 63 percent) than those in the sedimentary caprock aquifer (Element Environmental, LLC, 2007c). The groundwater flow direction and gradient in the volcanic dike aquifer has not been previously measured; however, based on static water level measurements in well PW-1 and on the geologic structure and aquifer boundaries documented in the literature (Mink and Lau, 1990; Macdonald, et al., 1983; Stearns, 1938), the groundwater is anticipated to flow toward the boundary with the sedimentary caprock aquifer. It is likely that groundwater from the volcanic dike aquifer discharges into the sedimentary caprock aquifer along the aquifer boundaries. However, it is possible that individual dike compartments could have a significant role in controlling the localized groundwater flow patterns at the site.

No data is available on the groundwater flow direction and gradient in the deeper volcanic dike aquifer (Aquifer Code 30302122) located below the sedimentary caprock aquifer.

5.5 Groundwater Quality

5.5.1 ***Summary of Previous Sampling Events***

The groundwater quality at PVT ISWMF in the sedimentary caprock aquifer has been monitored since 1992 initially following the guidelines set forth in the Groundwater Protection and Monitoring Plan prepared by Belt Collins (Belt Collins Hawaii, 1998), then following the Groundwater Monitoring Plan prepared by Mountain Edge Environmental, Inc. (2004). According to the 1998 plan, sampling and analysis of groundwater from wells MW-1A, MW-1, MW-2 and MW-3 was undertaken twice in 1992 and annually thereafter. In 1996, three rounds of groundwater sampling were completed to provide the minimum amount of samples needed for statistical data analysis. Samples were collected annually in 1997 and 1998 then in 1999 and 2000, three to four samples were collected per year to provide the minimum amount of samples needed for statistical analysis for new detection monitoring parameters. From 2001 to present, groundwater sampling and analysis has occurred semiannually, in June or July during the dry season and in December or January during the rainy season.

Well MW-1, which was located upgradient of the C&D landfill, was permanently closed in August 2011 to allow for construction of landfill Cell 8. Well MW-1B was installed in December 2011 to replace MW-1. Well MW-1A, which was the primary upgradient well, was permanently closed in August 2013 to allow for construction of the recycling and materials recovery facility and a new stormwater basin. Well MW-1C, which is now the only upgradient well, was installed in March 2014 to replace MW-1A. Additional groundwater samples from new well MW-1B were collected outside the standard semiannual sampling events to obtain the minimum number of samples needed for statistical analysis. Likewise, additional sampling outside the standard semiannual sampling events is currently ongoing for well MW-1C.

In accordance with PVT's Groundwater Monitoring Plan (Mountain Edge Environmental, Inc., 2004), groundwater at the site is tested for the parameters listed in Table 3. The results of the groundwater sampling events from 1992 through 2014 are presented in reports prepared by Belt Collins Hawaii (1998), Masa Fujioka & Associates (1998 to 2003), Mountain Edge

Environmental, Inc. (2004 to 2006), Element Environmental, LLC (2007 to 2012), and Juturna LLC (2012 to 2014); and a summary of these groundwater quality results is provided in the following sections.

Table 3: Groundwater Monitoring Parameters

Analyte	Fequency of Testing
Volatile Organic Compounds (VOCs)	Semiannually
Total Dissolved Solids (TDS)	Semiannually
Chloride, Sulfate	Semiannually
Alkalinity as Calcium Carbonate ($CaCO_3$), Bicarbonate	Semiannually
Calcium, Magnesium, Potassium, Sodium	Semiannually
Arsenic, Cadmium, Chromium, Iron, Lead	Every Five Years
Extractable Petroleum Hydrocarbons – Diesel Range Organics (DRO)	Every Five Years
Total Organic Carbon (TOC)	Every Five Years
Field Measured Temperature, Conductivity, pH and Water Level	Semiannually

Reference: Mountain Edge Environmental, Inc., 2004

Production well PW-1, which is located in the volcanic dike aquifer on the undeveloped Leeward Land parcel east of the site, has been sampled twice, once on February 25, 2005 and again on April 12, 2007. A summary of the groundwater quality results from these two sampling events is also provided in the following sections.

5.5.2 *Historical Organic Compound Detections*

Three volatile organic compounds (VOCs) have been historically detected in the two former upgradient groundwater monitoring wells at the site (wells MW-1A and MW-1), and now new upgradient well MW-1C has had VOC detections in its first two rounds of sampling. In addition, trace levels of one of the VOCs have been periodically detected in downgradient well MW-3. A list of historical volatile organic compound detections in the sedimentary caprock aquifer is provided in Table 4. Organic compounds have not been detected in groundwater from well PW-1 in the volcanic dike aquifer.

As shown on Table 4, groundwater samples collected in May 1993 through December 2006 and in June 2010 from upgradient well MW-1 (upgradient of PVT's C&D landfill) have contained the VOC trichloroethene (TCE), except for the first semiannual monitoring event for 2006 where TCE was not detected above the reporting limit. The detected TCE concentrations in well MW-1 have ranged from 0.0048 to 0.0459 mg/l. Low concentrations of TCE (0.0006 to 0.00813 mg/l) were also detected in groundwater collected from downgradient well MW-3 in 1999, 2002, 2010, and 2011, but have not been detected since 2011. Some of these TCE concentrations are considered estimated concentrations since they were detected below the laboratory reporting limit. Recently, low concentrations of TCE (0.0064 and 0.007 mg/l) have been detected in new upgradient well MW-1C, which is located in the northernmost corner of the site, upgradient of all site activities. Also recently detected in MW-1C were low concentrations of tetrachloroethene (PCE) (0.007 and 0.0076 mg/l) and cis-1,2-dichloroethene (cis-1,2-DCE) (0.005 and 0.0052 mg/l), which have not been previously detected in the wells at PVT ISWMF. TCE and PCE were used as dry-cleaning chemicals and as solvents to remove grease from metal parts (United States Environmental Protection Agency [US EPA], 2014). TCE is also a breakdown product of PCE, and cis-1,2-DCE is a breakdown product of TCE (US EPA, 2014). The source of these VOCs is suspected to be from an unlined wastewater pond at the Lualualei Naval Reservation, which is located upgradient of PVT ISWMF and was found to contain PCE (Belt Collins Hawaii, 2005).

Table 4: Historical Volatile Organic Compound Detections

Constituent	Units	Well	Date	Result	Laboratory Reporting Limit
Trichloroethene	mg/L	MW-1	5/28/1993	0.0048	0.00025
Trichloroethene	mg/L	MW-1	6/27/1994	0.0066	0.0005
Trichloroethene	mg/L	MW-1	6/14/1995	0.012	0.002
Trichloroethene	mg/L	MW-1	8/7/1995	0.013	0.0005
Trichloroethene	mg/L	MW-1	6/27/1996	0.015	0.0005
Trichloroethene	mg/L	MW-1	8/29/1996	0.022	0.005
Trichloroethene	mg/L	MW-1	9/23/1996	0.019	0.0005
Trichloroethene	mg/L	MW-1	7/2/1997	0.021	0.005
Trichloroethene	mg/L	MW-1	11/12/1998	0.018	0.005
Trichloroethene	mg/L	MW-1	4/23/1999	0.017	0.005
Trichloroethene	mg/L	MW-1	9/27/1999	0.018	0.005
Trichloroethene	mg/L	MW-1	12/2/1999	0.016	0.005
Trichloroethene	mg/L	MW-1	2/2/2000	0.0157	0.005
Trichloroethene	mg/L	MW-1	5/25/2000	0.0137	0.005
Trichloroethene	mg/L	MW-1	8/25/2000	0.0158	0.005
Trichloroethene	mg/L	MW-1	11/29/2000	0.0131	0.005
Trichloroethene	mg/L	MW-1	6/21/2001	0.0150	0.005
Trichloroethene	mg/L	MW-1	12/6/2001	0.0148	0.005
Trichloroethene	mg/L	MW-1	6/10/2002	0.0133	0.005
Trichloroethene	mg/L	MW-1	12/3/2002	0.0459	0.005
Trichloroethene	mg/L	MW-1	6/26/2003	0.0113	0.005
Trichloroethene	mg/L	MW-1	12/4/2003	0.0108	0.005
Trichloroethene	mg/L	MW-1	6/9/2004	0.00802	0.005
Trichloroethene	mg/L	MW-1	12/20/2004	0.00767	0.005
Trichloroethene	mg/L	MW-1	6/27/2005	0.00695	0.005
Trichloroethene	mg/L	MW-1	12/22/2005	0.0069	0.005
Trichloroethene	mg/L	MW-1	12/19/2006	0.00524	0.005
Trichloroethene	mg/L	MW-1	6/30/2010	0.0042	0.001
1,2-dichloroethane	mg/L	MW-1A	8/7/1995	0.016	0.0005
1,2-dichloroethane	mg/L	MW-1A	6/27/1996	0.013	0.0005
1,2-dichloroethane	mg/L	MW-1A	8/29/1996	0.015	0.0005
1,2-dichloroethane	mg/L	MW-1A	9/23/1996	0.026	0.0005
1,2-dichloroethane	mg/L	MW-1A	7/2/1997	0.017	0.005
1,2-dichloroethane	mg/L	MW-1A	11/12/1998	0.014	0.005

Constituent	Units	Well	Date	Result	Laboratory Reporting Limit
1,2-dichloroethane	mg/L	MW-1A	4/23/1999	0.014	0.005
1,2-dichloroethane	mg/L	MW-1A	9/27/1999	0.0078	0.005
1,2-dichloroethane	mg/L	MW-1A	12/2/1999	0.002	0.005
1,2-dichloroethane	mg/L	MW-1A	8/25/2000	0.00565	0.005
Methyl tert-butyl ether	mg/L	MW-1A	4/23/1999	0.005	0.005
Methyl tert-butyl ether	mg/L	MW-1A	9/27/1999	0.0056	0.005
Methyl tert-butyl ether	mg/L	MW-1A	2/2/2000	0.00612	0.005
Methyl tert-butyl ether	mg/L	MW-1A	5/25/2000	0.00542	0.005
Methyl tert-butyl ether	mg/L	MW-1A	8/25/2000	0.00612	0.005
Methyl tert-butyl ether	mg/L	MW-1A	6/21/2001	0.00515	0.005
Methyl tert-butyl ether	mg/L	MW-1A	12/3/2002	0.00644	0.005
Cis-1,2-dichloroethene	mg/L	MW-1C	6/6/2014	0.0052	0.005
Cis-1,2-dichloroethene	mg/L	MW-1C	7/23/2014	0.005	0.005
Tetrachloroethene	mg/L	MW-1C	6/6/2014	0.0076	0.005
Tetrachloroethene	mg/L	MW-1C	7/23/2014	0.007	0.005
Trichloroethene	mg/L	MW-1C	6/6/2014	0.0064	0.005
Trichloroethene	mg/L	MW-1C	7/23/2014	0.007	0.005
Trichloroethene	mg/L	MW-3	4/23/1999	0.0006	0.005
Trichloroethene	mg/L	MW-3	9/27/1999	0.0008	0.005
Trichloroethene	mg/L	MW-3	12/2/1999	0.001	0.005
Trichloroethene	mg/L	MW-3	12/3/2002	0.00813	0.005
Trichloroethene	mg/L	MW-3	6/30/2010	0.0020	0.001
Trichloroethene	mg/L	MW-3	12/28/2011	0.0016	0.001

Reference: Juturna LLC, 2014b.

The VOCs 1,2-dichloroethane (DCA) and methyl tert-butyl ether (MTBE) have been detected in groundwater collected from upgradient well MW-1A. Like PCE, DCA is also a metal degreaser (US EPA, 2015a), while MTBE is used as a fuel additive to motor gasoline (US EPA, 2015b). Concentrations of DCA ranged from 0.002 to 0.026 mg/l, and concentrations of MTBE ranged from 0.005 to 0.00644 mg/l. Neither VOC has been detected in groundwater collected from well MW-1A since 2002. The source of the DCA is suspected to be from the unlined wastewater pond at the Lualualei Naval Reservation (Belt Collins Hawaii, 2005). The source of the MTBE is suspected to be from abandoned buses and 55-gallon drums that were dumped in Ulehawa Stream on an adjacent property, but were removed in 2001 (Belt Collins Hawaii, 2005).

In 1994, the semivolatile organic compound benzo(a)pyrene was detected in well MW-3. However, benzo(a)pyrene was not detected in any well samples since 1994 (Belt Collins Hawaii, 1998; Masa Fujioka & Associates, 1998 to 2003; Mountain Edge Environmental, Inc., 2004 to 2006; Element Environmental, LLC, 2007 to 2012; and Juturna LLC, 2013 to 2014).

Total petroleum hydrocarbons (TPH) as diesel was detected in all wells during the June 10, 2002 sampling event and in well MW-1A in the December 3, 2002 sampling event (Masa

Fujioka & Associates, 2002). The fact that TPH-diesel had not been previously detected in these wells and that the levels encountered during the June 2002 sampling event had similar concentrations, suggests that there may have been cross-contamination during sampling. This cross-contamination perhaps resulted from inadequately decontaminated field sampling equipment. The TPH-diesel concentration encountered in well MW-1A during the December 2002 sampling event was likely remaining contamination from the previous sampling event. TPH-diesel has not been detected in groundwater above reporting limits before or after the 2002 sampling events.

Every five years total organic carbon (TOC) is monitored in the groundwater monitoring wells at the site. TOC in groundwater can originate from decaying natural organic matter and from synthetic chemicals, such as pesticides, fertilizers, and detergents, for example. In 2004 all four wells had concentrations of TOC ranging from 12.8 mg/l in MW-1A to 21.2 mg/l in MW-2. In 2009 only MW-2 had a detectable concentration of TOC, 5.9 mg/l. After installation of new wells MW-1B and MW-1C, TOC has been routinely tested to develop a background dataset. TOC has been detected in both of these new wells at concentrations between 0.88 and 1.5 mg/l in MW-1B and 2.4 and 3.0 mg/l in MW-1C.

5.5.3 *Inorganic Groundwater Geochemistry*

In addition to organic compounds, the following inorganic analytes are monitored semiannually in the groundwater at the site: total dissolved solids (TDS), chloride, sodium, potassium, magnesium, calcium, sulfate, and alkalinity. These inorganic analytes, which occur naturally in groundwater, are monitored semiannually so that small changes or trends in groundwater geochemistry can be detected. Every five years groundwater is also analyzed for the metals arsenic, cadmium, chromium, iron, and lead.

As part of PVT ISWMF's groundwater monitoring program, the groundwater monitoring data from 1992 to present is input into a statistical analysis program. The program generates Shewhart-CUSUM (cumulative sum) intra-well control charts that show the concentrations of each of the analytes detected in groundwater in each of the four monitoring wells plotted over time. The intra-well control charts include a line, called the control limit, for each of the sample points and analytes. Concentrations plotted above the control limit line are deemed "out of control" and indicate that a release may have occurred. Attachment 1 contains intra-well control charts for December 2009 (the last time the metals arsenic, cadmium, chromium, iron, and lead were monitored in all wells), and Attachment 2 contains intra-well control charts for July 2014 (the most recent available sampling results).

As shown in the December 2009 intra-well control charts, prior to 1998, the metals cadmium and chromium were periodically detected in wells MW-1A, MW-2, and MW-3 at low concentrations consistent with naturally-occurring levels of metals in groundwater; however, concentrations of these metals have been non-detectable in the groundwater samples since 1998. Cadmium and chromium have not been detected in monitoring wells MW-1, MW-1B, or MW-1C, while the metals arsenic, iron, and lead have not been detected in any of the groundwater monitoring wells at the site.

The intra-well control charts dated July 2014 (see Attachment 2) show the most recent results for the inorganic analytes that are monitored semiannually in the groundwater at the site (TDS, chloride, sodium, potassium, magnesium, calcium, sulfate, and alkalinity). Since new well MW—1C has only been sampled twice, data from closed well MW-1A is included in the intra-well control charts until well MW-1C has the recommended minimum eight sampling events for the statistical analysis to be valid (State of Hawaii Department of Health [DOH], 2002). Well MW-1C was last sampled in June 2013 prior to being closed.

The intra-well control charts for July 2014 show that over the last 16 years all CUSUM statistical analyses and all individual concentrations of all analytes have been below the control limits in all wells, except for well MW-2 in 2010 and 2011. During this time period, the CUSUM statistical analysis exceeded the control limit for calcium, chloride, magnesium, potassium, sodium, and TDS in well MW-2, and individual concentrations of magnesium, potassium, and sodium exceeded the control limits. Groundwater in well MW-2 has consistently been fresher than in the other monitoring wells; however, beginning in 2007, the groundwater in well MW-2 was becoming more brackish, as the concentrations of these constituents were increasing. This increase may have been due to a leaking old potable water line running adjacent to MW-2 that was replaced with a new line in 2007. The leaking old water line could have been causing the groundwater around well MW-2 to become fresher, then when the old water line was replaced with a new line, the groundwater became more brackish. The elevated concentrations of these constituents may have also resulted from dissolution of the coralline formation in the vicinity of well MW-2 due to the presence of freshwater from the old potable water line. Freshwater may also be influencing groundwater in the vicinity of MW-2 from the nearby residences that have cesspools and irrigate their lawns, and the amount of freshwater present may change over time due to changes in residential water use. In addition, well MW-2 is located in PVT's nursery area where the plants and trees are irrigated daily with freshwater. Since 2011, all CUSUM statistical analyses and all individual concentrations have been below the control limits. No other detected concentrations of constituents have exceeded the control limits at PVT ISWMF, which indicates that there have been no statistical exceedances, or potential releases of contaminants to groundwater from the landfill.

Table 5 shows the concentrations of the inorganic analytes detected in the groundwater monitoring wells during the latest sampling event in July 2014. Also shown on Table 5 are the results for samples collected in 2005 and 2007 from well PW-1, which is located in the volcanic dike aquifer east of the site. Additional water quality data from well PW-1 is shown on Table 6.

The inorganic analytes listed in Table 5 and the additional water quality parameters listed in Table 6 are constituents that occur naturally in groundwater, and the concentrations detected are typical of naturally occurring concentrations. As shown in Table 5, groundwater from well PW-1 generally has lower concentrations of almost all of the inorganic analytes than groundwater from monitoring wells MW-1B, MW-1C, and MW-3. Concentrations of these inorganic analytes would typically be lower in groundwater from a volcanic dike aquifer as compared to groundwater from a sedimentary caprock aquifer. However, the concentrations of magnesium, sodium, chloride and TDS in well MW-2 from the sedimentary caprock aquifer are significantly lower than in well PW-1 from the volcanic dike aquifer, which supports the conclusion that well MW-2 is being influenced by freshwater from the adjacent residences, the potable water line, and/or the irrigation system.

Table 5: Inorganic Groundwater Quality Results

Analyte	Units	Well Number / Date Sampled					
		MW-1B July 2014	MW-1C July 2014	MW-2 July 2014	MW-3 July 2014	PW-1 Feb. 2005	PW-1 Apr. 2007
Calcium	mg/l	162	194	165	151	163	83.2
Magnesium	mg/l	160	191	74.5	183	399	119
Potassium	mg/l	31.5	23.8	15.1	29.4	13.5	14.1
Sodium	mg/l	980	1000	366	941	432	530
Alkalinity as $CaCO_3$, Bicarbonate	mg/l	404	423	391	306	149	120
Chloride	mg/l	1980	2140	685	1940	924	1100
Sulfate	mg/l	389	419	204	350	109	130
Total Dissolved Solids	mg/l	3690	3960	1820	3670	2400	2300

Reference: Juturna LLC, 2014b; Element Environmental, LLC, 2007d; GE Infrastructure Water & Process Technologies, 2005.

Table 6: Additional Groundwater Monitoring Results for PW-1, February 2005

Analyte	PW-1 2/25/2005	Analyte	PW-1 2/25/2005
Ammonia, Free, as N	< 0.3	Chromium, Hexavalent	< 0.01
Ammonia, Fixed Organic, as N	< 0.4	Fluoride	< 0.4
Ammonia, Free and Fixed, as N	< 0.3	Phosphate, Filtered Total	< 0.4
pH (pH units)	7.9	Phosphate, Filtered Total Inorganic	< 0.2
Specific Conductance at 25° C (μmhos)	3380	Arsenic, Total	< 0.01
Hardness, Total, as $CaCO_3$	586	Arsenic, Filtered	< 0.1
Magnesium Hardness, Total, as $CaCO_3$	424	Boron, Filtered	0.12
Barium, Total	0.008	Beryllium	< 0.005
Strontium, Total	0.81	Boron	0.12
Hardness, Filtered, as $CaCO_3$	562	Cadmium, Filtered	< 0.01
Barium, Filtered	< 0.01	Cadmium	< 0.005
Strontium, Filtered	0.81	Chromium, Total	< 0.01
Copper, Total	0.003	Chromium, Filtered	< 0.03
Copper, Filtered	< 0.05	Cobalt, Filtered	< 0.01
Iron, Total	0.017	Cobalt, Total	< 0.005
Iron, Filtered	< 0.05	Lead, Filtered	< 0.05
Lithium	0.003	Lead, Total	< 0.005
Zinc, Total	0.01	Molybdenum, Filtered	< 0.06
Zinc, Filtered	< 0.04	Nickel, Filtered	< 0.01
Aluminum, Total	< 0.01	Nickel, Total	< 0.005
Aluminum, Filtered	< 0.1	Selenium, Total	0.01
Manganese, Total	< 0.005	Selenium, Filtered	< 0.1
Manganese, Filtered	< 0.01	Tin, Total	< 0.01
Nitrate	6.5	Titanium, Total	0.006

Analyte	PW-1 2/25/2005	Analyte	PW-1 2/25/2005
Molybdenum	<0.006	Titanium, Filtered	< 0.01
Phosphate, Total	< 0.4	Vanadium, Total	0.041
Phosphate, Total Inorganic	0.2	Vanadium, Filtered	0.04
Phosphate, Ortho	0.2	Zirconium, Total	0.012
Phosphate, Filtered Ortho	< 0.2	Thallium, Total	< 0.05
Silica, Colloidal	< 17	Tin, Filtered	< 0.05
Silica, Total	84	Total Organic Carbon	< 1
Silica, Filtered	83	Chemical Oxygen Demand as O_2	7980
Silica, Reactive	83	Turbidity (NTU)	0.8
Total Suspended Solids	< 10		

Reference: GE Infrastructure Water & Process Technologies, 2005.

Stiff diagrams, included in Attachment 3, are used to visually represent cation and anion composition trends in the data of many samples. In this case, the Stiff diagrams are used to show differences in water quality between the wells over time. Attachment 3 shows the Stiff diagrams depicting cation and anion data from each monitoring well from December 2002 through December 2009. The shapes of the Stiff diagrams for wells MW-1, MW-1A, and MW-3 have not changed much over time and are all very similar to each other. The Stiff diagrams for MW-2, however, vary over time and have a different shape than the other wells. The Stiff diagrams suggest that groundwater in well MW-2 is being influenced by freshwater because sodium and chloride concentrations in MW-2 are significantly lower than in the other wells. As with the intra-well control charts, the increase in brackishness of the groundwater in MW-2 is evident when comparing the MW-2 Stiff diagrams for 2008 and 2009 to those of the other three wells: the MW-2 Stiff diagrams for the December 2008 and 2009 monitoring events more closely resemble the shape of the Stiff diagrams of the other wells.

5.6 Results of Leachate Analyses

Leachate generated within the disposal cells of Phase II of the C&D landfill at PVT ISWMF is collected in the gravel leachate collection system and flows by gravity to a leachate collection sump. The sump is designed to contain leachate to a depth of four feet below the adjacent cell floor (A-Mehr, Inc., 2011). In accordance with the Groundwater Monitoring Plan (Mountain Edge Environmental, Inc., 2004), samples of leachate are collected from the leachate collection sump annually during the second semiannual sampling period for the constituents listed in Table 7. Table 7 also shows the leachate sample results for the last eight years.

As shown on Table 7, most of the analytes in the leachate have fluctuated over the last eight years without any apparent trend in the data. Diesel Range Organic (DRO) compounds, however, have steadily increased over the years from 0.0896 mg/l to 0.820 mg/l. Arsenic and cadmium have not been detected in the leachate, while lead was detected for the first time in December 2012 just at the reporting limit, and was non-detect again in January 2014. Chromium concentrations in the leachate have been non-detectable in some years and detectable in other years ranging from 0.009 mg/l to 0.151 mg/l. Likewise, concentrations of iron have varied from non-detect to 6.02 mg/l. The variation in analyte concentrations in the leachate is likely due to the nature of waste that has been placed in the landfill over the years and variations in the amount of rainfall. It should be noted that even though the leachate is contained within the landfill's leachate collection system and is not in contact with any groundwater, the concentrations of analytes detected in the leachate do not exceed the State of Hawaii environmental action levels for groundwater beneath the site (DOH, 2011).

Table 7: Leachate Sample Results

Analyte	Units	Leachate Sample Date							
		Jun. 2006	Dec. 2007	Dec. 2008	Dec. 2009	Dec. 2010	Dec. 2011	Dec. 2012	Jan. 2014
TDS	mg/l	10,900	3840	3850	6600	7200	6730	6120	7380
TOC	mg/l	28.0	6.6	3.5	7.6	7.3	15	9.4	14.2
Chloride	mg/l	5400	1700	1500	1500	1800	2130	1570	2420
Sulfate	mg/l	1380	730	640	2500	2000	2090	1950	2230
Arsenic	mg/l	NA	NA	ND	ND	ND	ND	ND	ND
Cadmium	mg/l	NA	NA	ND	ND	ND	ND	ND	ND
Calcium	mg/l	428	84.4	90.7	390	550	495	451	538
Chromium	mg/l	NA	NA	ND	ND	0.011	ND	0.151	0.009
Iron	mg/l	NA	NA	ND	1.9	ND	5.3	6.02	1.02
Lead	mg/l	NA	NA	ND	ND	ND	ND	0.01	ND
Magnesium	mg/l	557	105	87.4	250	370	243	187	272
Potassium	mg/l	88.9	46.1	37.7	380	160	432	530	285
Sodium	mg/l	3230	1040	972	950	1100	1150	878	1310
DRO	mg/l	NA	NA	NA	0.0896	0.0947	0.210	0.270	0.820
Bicarbonate	mg/l	582	200	208	160	96	173	359	340
Temperature	°C	NA	NA	30.7	37.3	35.5	37.1	37.7	38.9
Conductivity	mS/cm	NA	61	5.12	8.4	10.3	9.41	7.78	10.15
pH	pH unit	NA	7.77	10.1	7.26	7.3	7.15	7.13	7.06

ND = Not Detected at or above the reporting limit used by the laboratory.
NA = Not Analyzed for listed constituent.
Temperature, conductivity, and pH are measured in the field.
°C = degrees Celsius; mS/cm = millisiemens per centimeter.
Reference: Element Environmental, LLC, 2007a, 2008a, 2009a, 2011a; and Juturna LLC, 2014a.

Stiff diagrams of landfill leachate data were prepared to compare to the Stiff diagrams generated from the monitoring well data, as shown in Attachment 3. The Stiff diagrams for leachate samples from 2006 have a similar shape to the Stiff diagrams for wells MW-1, MW-1A, and MW-3, though the concentrations of cations and anions are greater in the leachate samples. The similar shape of the leachate and groundwater Stiff diagrams is likely due to the influence of rainwater on both the groundwater and the leachate. In 2006, the leachate consisted primarily of rainwater because the amount of waste in the lined area of the landfill was limited. The Stiff diagrams for leachate samples collected in 2008 and 2009 have a completely different shape than the Stiff diagrams for leachate samples collected in 2006. The different shape is likely due to the addition of more waste into the landfill. The cation and anion composition of the leachate will likely change over time due to the amount and nature of waste in the landfill.

In addition to Stiff diagrams, trilinear plots were prepared for leachate and groundwater samples collected in December 2008 and December 2009, as shown in Attachment 3. In most of the plots, the groundwater samples are clustered together while the leachate sample is positioned apart from the group, indicating differences between the cation and anion composition of the groundwater and the leachate. For example, the trilinear plot for the anions carbonate plus bicarbonate (CO_3+HCO_3), sulfate (SO_4), and chloride (Cl) in December 2009 shows that the concentration of anions in groundwater samples collected that monitoring event were fairly similar; whereas, the anion concentrations in leachate clearly differ as depicted by the leachate data point set apart from the group of groundwater data points. This is similarly shown in trilinear diagrams for cations and anions in December 2008. On trilinear diagrams, the mixture of two different waters will plot on a straight line connecting the points. If a straight line is drawn connecting the data points for the leachate, the groundwater points do not fall on this line, indicating that the leachate is not mixing with the groundwater.

Section 6 Surface Water Hydrology

6.1 Regional Surface Water Hydrology

Lualualei Valley is comprised of two watersheds: Ulehawa to the east and Māʻiliʻili to the west. The Ulehawa watershed, where PVT ISWMF is located, is 5 square miles in area and has a maximum elevation of 2,844 feet (Hawaii Division of Aquatic Resources and Bishop Museum, 2015). Ulehawa Stream, which drains the watershed, is a perennial stream with a total length of 5.1 miles (Hawaii Division of Aquatic Resources and Bishop Museum, 2015). As shown on Figures 1 and 2, Ulehawa Stream borders PVT ISWMF to the west, and discharges to the ocean approximately 2,000 feet southwest of the site.

The Māʻiliʻili watershed, which encompasses 19.2 square miles and has a maximum elevation of 3,127 feet, is much larger than the Ulehawa watershed (Hawaii Division of Aquatic Resources and Bishop Museum, 2015). Māʻiliʻili Stream, which drains the Māʻiliʻili watershed, is also a perennial stream with a total length of 20.9 miles (Hawaii Division of Aquatic Resources and Bishop Museum, 2015).

6.2 Site Surface Water Hydrology

Rainfall runoff at PVT ISWMF eventually reaches Ulehawa Stream. Hawaii Administrative Rules (HAR) Chapter 11-54 classifies Ulehawa Stream as a Class 2 Inland Water (DOH, 2014). Class 2 Inland Waters are protected for recreational purposes, support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation. HAR Chapter 11-54 states that all uses of Class 2 Inland Waters need to be compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters (DOH, 2014).

The storm water management system at PVT ISWMF is designed and constructed to manage runoff from a 25-year, 24-hour storm. Runoff is collected in a system of surface ditches, channels, pipes, and ponds designed by PVT ISWMF's engineering consultants (A-Mehr, Inc., 2011). As designed, the system will carry runoff from the design storm without flooding or excessive erosion from the site, and will retain a significant volume of water to minimize off-site runoff impacts and allow sediment in the runoff to be intercepted and removed before discharge from the site. Figure 2 shows the location of the storm water basins for collection of storm water and removal of silt. There are seven storm water basins and six discharge points which discharge storm water into Ulehawa Stream. All six discharge points are permitted under PVT ISWMF's National Pollutant Discharge Elimination System (NPDES) permit (DOH, 2008). One of the storm water basins (Basin A) does not have a discharge point because the limited amount of storm water that collects in this basin percolates into the ground resulting in no discharge off site.

Storm water in the C&D disposal area at PVT ISWMF is managed by controlled grading on the surface of the landfill and by maintaining an engineered system of drainage ditches, channels, pipes, and basins. Drainage is managed to:

- prevent run-on of surface water to the active disposal face or uncovered refuse;
- minimize erosion in all areas of the site;
- maintain roads and other ancillary facilities in useable condition under all weather conditions; and
- prevent excessive runoff or sedimentation impacts to neighboring properties (A-Mehr, Inc., 2011).

The landfill top deck and other areas in the vicinity of active disposal areas are graded at a slope of 2% to 5% away from the active area. Earth berms are constructed upgradient of the active area if needed to prevent run-on from contacting the waste, and to divert drainage around any exposed waste (A-Mehr, Inc., 2011).

Similarly, berms are constructed downgradient of exposed waste to prevent the runoff of any precipitation that has contacted waste. Such water is retained within the waste, for collection and management as leachate. No runoff of precipitation that has contacted waste is discharged into Ulehawa Stream.

The storm water control system is inspected and maintained as needed after each significant storm event. Inspections focus on locating and repairing any areas of excessive erosion, ensuring that skimmers installed in sedimentation basins are working properly, and that no pipe inlets are plugged or blocked with sediment or debris. Sediment is removed from ditches and basins at least once each year.

6.3 Storm Water Runoff Water Quality

In accordance with the requirements of their NPDES permit, PVT ISWMF collects storm water samples and flow measurements annually. The storm water samples are collected after a representative storm event. A representative storm is a rainfall event that accumulates more than 0.1 inches of rain and occurs at least 72 hours after the previous measurable (greater than 0.1 inch) rainfall event. The storm water samples are collected using an automatic Vortox sampler, which is mounted in concrete and is located at the end of the drainage pipe at the discharge points. The sampler automatically collects the sample when a there is a discharge from the sedimentation basin. After the storm water is collected, the Vortox sampler is removed from the concrete mount and the storm water sample is poured into the sample containers and delivered to an approved laboratory. A Discharge Monitoring Report (DMR) form is submitted annually to the DOH Clean Water Branch whether there is a storm event or not. If there were no discharges during the monitoring period, the DMR so states.

The Notice of General Permit Coverage (NGPC) for PVT ISWMF's NPDES Permit specifies the facility's storm water monitoring and testing requirements and storm water discharge limitations (DOH, 2008). The NGPC requires that storm water discharge from all six discharge points be tested annually for the first 16 parameters listed in Table 8, and that storm water from discharge point D-3, which is downgradient of the equipment maintenance area, be tested for five additional parameters, also listed on Table 8.

In addition to the storm water monitoring requirements and discharge limitations, Table 8 also summarizes the monitoring results for the last eight years, from 2007 to 2014. For the 2007 and 2008 annual monitoring periods, samples were only collected at discharge point D-2 because there was no discharge at discharge point D-1 and the other basins were not yet constructed (PVT Land Company, Ltd., 2008, 2009). For the 2009 annual monitoring period, there was no storm water discharge from any of the discharge points, as only about four inches of rain fell during the entire year (PVT Land Company, Ltd., 2010a). For the 2010 and 2011 annual monitoring periods, samples were collected from discharge points D-2, D-3, D-4, and D-5, as there was no discharge observed at D-1, and D-6 was not yet constructed (PVT Land Company, Ltd., 2010b and 2012). For the 2012 annual monitoring period, samples were collected from discharge points D-2 and D-5 only, because there was no discharge observed at D-1, D-3, and D-4, and D-6 was not yet constructed (PVT Land Company, Ltd., 2013). For the 2013 annual monitoring period, samples were collected from discharge points D-3 and D-5, as no discharge was observed at the other points and D-6 was not yet constructed (PVT Land Company, Ltd., 2014). For the 2014 annual monitoring period, samples were collected from discharge point D-3 and new discharge point D-6; no discharge was observed at D-1, D-2, D-4, and D-5 (PVT Land Company, Ltd., 2015).

Table 8: Storm Water Discharge Monitoring Results

Parameter	Limit	Storm Water Sample Discharge Point and Sampling Date							
		D-2 Nov. 2007	D-2 Dec. 2008	D-2 Mar. 2010	D-3 Mar. 2010	D-4 Mar. 2010	D-5 Mar. 2010	D-2 Mar. 2011	D-3 Mar. 2011
Flow (cubic feet per second)	No Limit	1.1	0.05	0.25	0.3	0.53	0.24	0.25	0.3
Biochemical Oxygen Demand (mg/l)	No Limit	< 2.00	< 2.00	< 2.00	3.44	< 2.00	11.3	< 2.00	< 2.00
Chemical Oxygen Demand (mg/l)	No Limit	82	25	141	29.7	37.4	56.1	22	22
Total Suspended Solids (mg/l)	No Limit	15.0	20.0	7.33	14.6	25.8	47.2	< 10	< 10
Total Phosphorus (mg/l)	No Limit	0.21	0.058	0.417	0.206	1.12	0.722	< 0.050	< 0.050
Total Nitrogen (mg/l)	No Limit	7.53	2.48	207	4.70	17.4	26.4	< 0.00	< 0.00
Ammonia Nitrogen (mg/l)	No Limit	0.90	< 0.50	< 0.050	0.143	< 0.050	6.26	< 0.50	< 0.50
Nitrate + Nitrite Nitrogen (mg/l)	No Limit	1.93	0.28	204	0.909	15.2	0.111	< 0.050	< 0.050
Oil and Grease (mg/l)	15	< 5.00	< 5.0	< 5.00	< 5.00	< 5.00	< 5.00	< 5.4	< 5.0
pH Range (standard units)	5.5 – 8.0	7.76	7.42	7.3	7.3	7.3	7.2	7.3	7.5
Total Recoverable Iron (µg/l)	1000	556	202	858	77.9	198	311	< 40	40
Turbidity (NTU)	No Limit	4.83	27.4	17.0	6.09	21.4	34.2	0.270	0.520
Dissolved Oxygen (mg/l)	No Limit	7.51	8.84	7.07	1.86	3.89	1.35	8.26	8.44
Oxygen Saturation (%)	No Limit	72.9	95.3	77.8	21.7	41.9	14.6	98.4	106
Temperature (°C)	No Limit	22	23.1	21.2	21.3	21.3	21.3	23.5	23.3
Specific Conductance (µmhos/cm)	No Limit	2430	994	2000	1070	1760	551	2000	2000
Polynuclear Aromatic Hydrocarbons (µg/l)*	No Limit	NA	NA	NA	< 0.216	NA	NA	NA	< 0.227
Benzene (µg/l)*	1800	NA	NA	NA	< 2.00	NA	NA	NA	< 2.00
Toluene (µg/l)*	5800	NA	NA	NA	< 2.00	NA	NA	NA	< 2.00
Ethylbenzene (µg/l)*	11,000	NA	NA	NA	< 2.00	NA	NA	NA	< 2.00
Xylenes (µg/l)*	No Limit	NA	NA	NA	< 2.00	NA	NA	NA	< 2.00

No Limit = No limitation at this time. Only monitoring and reporting is required.
< = Not Detected at or above the indicated reporting limit.
* = Only Discharge Point D-3 is required to be monitored for this parameter. NA = Not Analyzed for listed parameter.
µmhos/cm = micromhos per centimeter. µg/l = micrograms per liter. NTU = Nephelometric Turbidity Units.
Reference: PVT Land Company, Ltd., 2008, 2009, 2010a, 2010b, 2012, 2013, 2014, 2015.

Table 8: Storm Water Discharge Monitoring Results, Continued

Parameter	Limit	Storm Water Sample Discharge Point and Sampling Date							
		D-4 Mar. 2011	D-5 Mar. 2011	D-2 Mar. 2012	D-5 Mar. 2012	D-3 Oct. 2013	D-5 Oct. 2013	D-3 Oct. 2014	D-6 Oct. 2014
Flow (cubic feet per second)	No Limit	0.53	0.24	0.25	0.24	0.3	0.24	0.3	0.24
Biochemical Oxygen Demand (mg/l)	No Limit	< 2.00	< 2.00	< 2.00	2.02	6.34	4.77	< 2.00	6.00
Chemical Oxygen Demand (mg/l)	No Limit	< 20	< 20	37	< 20	27	34	14	83
Total Suspended Solids (mg/l)	No Limit	< 10	17	24	38	27	26	12	8.3
Total Phosphorus (mg/l)	No Limit	< 0.050	0.057	0.088	0.096	0.093	0.40	0.091	0.12
Total Nitrogen (mg/l)	No Limit	< 0.00	0.300	0.30	0.39	1.4	4.7	1.2	2.9
Ammonia Nitrogen (mg/l)	No Limit	< 0.50	< 0.50	< 1.0	< 1.0	0.035	0.26	0.20	0.29
Nitrate + Nitrite Nitrogen (mg/l)	No Limit	< 0.050	0.300	0.298	0.385	0.81	2.5	0.76	0.072
Oil and Grease (mg/l)	15	< 5.5	< 5.0	< 5.1	< 5.0	< 5.1	< 5.0	< 5.4	< 5.8
pH Range (standard units)	5.5 – 8.0	7.5	7.1	7.3	7.6	7.43	7.65	8.01	7.61
Total Recoverable Iron (µg/l)	1000	170	1300	820	1700	2900	2100	930	470
Turbidity (NTU)	No Limit	2.32	24.0	29.3	50.4	40.6	27.8	18.9	9.55
Dissolved Oxygen (mg/l)	No Limit	8.25	8.11	8.47	7.06	6.55	5.16	8.02	6.15
Oxygen Saturation (%)	No Limit	104	93.7	70.6	57.6	81.9	64.5	86.0	59.1
Temperature (°C)	No Limit	23.3	23.2	22.3	19.1	26.8	28	25.5	26.2
Specific Conductance (µmhos/cm)	No Limit	990	1500	3100	1100	720	1399	884	2620
Polynuclear Aromatic Hydrocarbons (µg/l)*	No Limit	NA	NA	NA	NA	< 0.21	NA	< 0.21	NA
Benzene (µg/l)*	1800	NA	NA	NA	NA	< 2.00	NA	< 2.00	NA
Toluene (µg/l)*	5800	NA	NA	NA	NA	< 2.00	NA	< 2.00	NA
Ethylbenzene (µg/l)*	11,000	NA	NA	NA	NA	< 2.00	NA	< 2.00	NA
Xylenes (µg/l)*	No Limit	NA	NA	NA	NA	< 2.00	NA	< 2.00	NA

No Limit = No limitation at this time. Only monitoring and reporting is required.
< = Not Detected at or above the indicated reporting limit.
* = Only Discharge Point D-3 is required to be monitored for this parameter. NA = Not Analyzed for listed parameter.
µmhos/cm = micromhos per centimeter. µg/l = micrograms per liter. NTU = Nephelometric Turbidity Units.
Reference: PVT Land Company, Ltd., 2008, 2009, 2010a, 2010b, 2012, 2013, 2014, 2015.

As shown on Table 8, the concentration of total recoverable iron in the March 2011, March 2012, and October 2013 storm water samples from discharge point D-5 and the October 2013 storm water sample from discharge point D-3 exceeded the effluent limitation of 1,000 micrograms per liter (μg/l). The iron in the storm water runoff is a result of naturally occurring, iron-rich surface soils (reddish brown clay and silt) running off the unpaved roadways at the site during heavy rain. To address these exceedances PVT ISWMF implemented additional best management practices (BMPs) to reduce iron concentrations in the storm water runoff. The primary BMP to reduce iron concentrations in the runoff consisted of paving the roadway in the vicinity of sedimentation Basin E where discharge point D-5 is located, and paving the entire parking area and the roadways that drain into Basin B where discharge point D-3 is located. After the roadways and parking areas were paved, iron concentrations in storm water from discharge point D-3 decreased significantly from 2,900 μg/l in October 2013 to 930 μg/l in October 2014. In October 2014 there was no discharge from discharge point D-5; however, the iron concentration in storm water from discharge point D-6 was 470 μg/l, well below the effluent limitation of 1,000 μg/l.

Besides total recoverable iron, the only other effluent limitation exceedance over the last eight years was one pH reading from discharge point D-3 in October 2014. The pH concentration in storm water from discharge point D-3 was measured at 8.01 and the effluent limitation is 8.0. The pH reading of 8.01 was taken in the field with a handheld pH meter that is not always accurate to the hundredth decimal point. This reading may be an outlier, as the next highest pH value over the last eight years was 7.76. The pH readings over the last eight years ranged from 7.1 to 8.01 with an average value of 7.46. No other storm water effluent limits have been exceeded at the PVT ISWMF.

An additional BMP that PVT ISWMF has implemented to improve the quality of storm water runoff is constructing a covered facility for vehicle and equipment maintenance and for storage of oil and grease. As shown on Table 8, concentrations of oil and grease and the petroleum-related parameters polynuclear aromatic hydrocarbons, benzene, toluene, ethylbenzene, and xylenes have never been detected in storm water discharge from the site.

Section 7 Impact of the Proposed Improvements on Water Quality

As stated in Section 3, the proposed improvements at PVT ISWMF include: (1) expansion of the reuse, recycling and materials recovery operation; (2) allowing the site grade to reach a maximum elevation of up to 250 feet MSL at the mauka portion of the site; and (3) use of renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. The impact of these proposed improvements on groundwater and surface water quality should be minimal, provided the improvement design and operation incorporates the storm water and leachate management system controls currently in place at the site.

The expanded recycling operation, which will include equipment, such as pellitizers and silos, to process and/or store reclaimed combustible material for feedstock, should have minimal impact on surface water quality and very minimal, if any, impact on groundwater quality. Storing feedstock in silos, or any other type of covered storage, would reduce potential impacts to surface water quality. Depending on the type of equipment and materials which may come in contact with rain and/or rainfall runoff, additional monitoring parameters may need to be added to the storm water sampling requirements for Basin F (discharge point D-6), where storm water runoff from the recycling and materials recovery area enters Ulehawa Stream.

The proposed grading at the mauka section of the site, which will provide additional landfill capacity and ensure that the reclamation of materials from Phase I of the landfill can be completed, should have a net positive impact on groundwater quality. While increasing the capacity of the landfill would result in more material being disposed of, the footprint of the landfill would not change; in other words, the area where groundwater could be impacted would remain the same. The positive impact to groundwater results from removing debris from the earth-lined Phase I area of the landfill, so this debris can no longer impact groundwater at the site. Much of this debris can be processed into feedstock or recycled (such as metals), leaving more inert material in the earth-lined Phase I area of the landfill, which will positively impact groundwater. In addition, removing debris from Phase I of the landfill, which has low compaction densities and a substantial amount of void spaces, and replacing it with more inert, well-compacted material will help alleviate subsurface fires, and in turn, will improve groundwater quality since gases released in subsurface fires can migrate to groundwater.

The proposed grading at the mauka section of the site should have minimal impact on surface water quality provided that grading is designed similar to PVT ISWMF's existing storm water management system, which effectively carries runoff from the design storm without flooding or excessive erosion from the site, and retains a significant volume of water to minimize off-site runoff impacts and allow sediment in the runoff to be intercepted and removed before discharge from the site (A-Mehr, 2011).

The proposed renewable energy improvements, such as a small gasification unit that uses processed feedstock and/or photovoltaic panels over closed portions of the landfill, should have minimal impact on surface water quality and very minimal, if any, impact on groundwater quality. Potential surface water quality impacts can be mitigated by incorporating the design of the renewable energy improvements into ISWMF's existing storm water management system.

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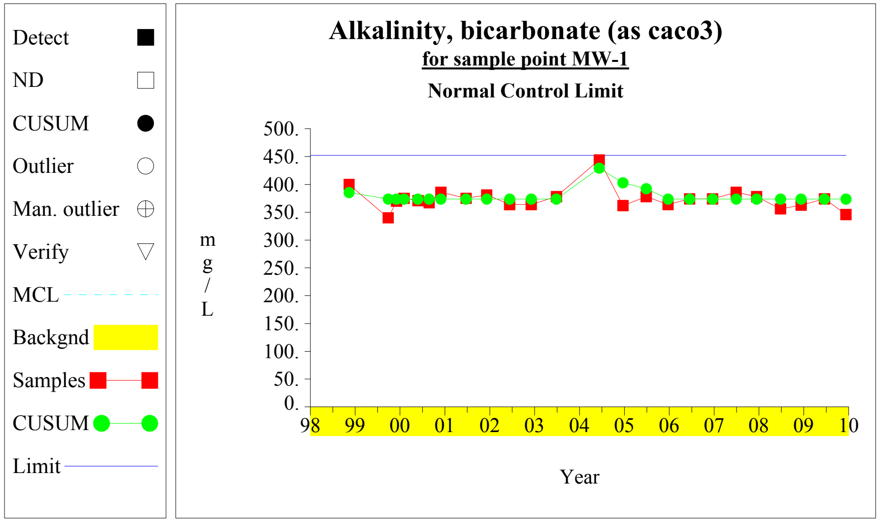
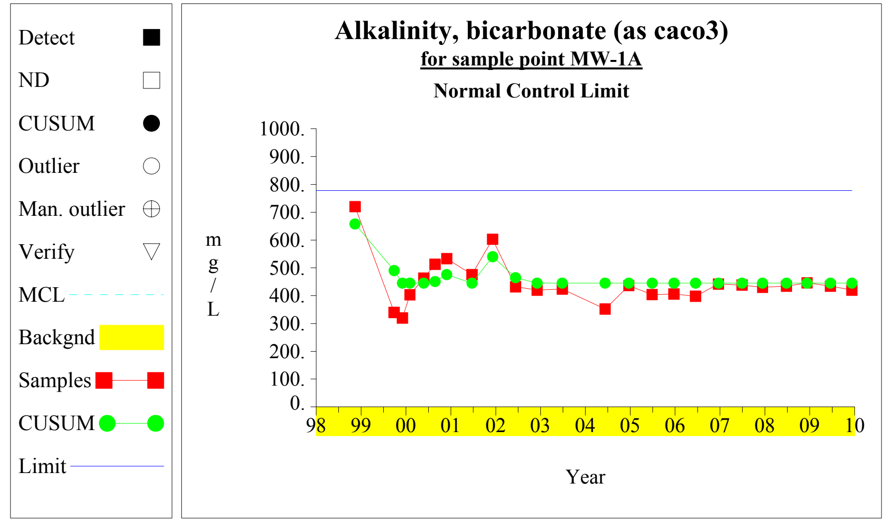
Attachment 1

Intra-Well Control Charts, December 2009

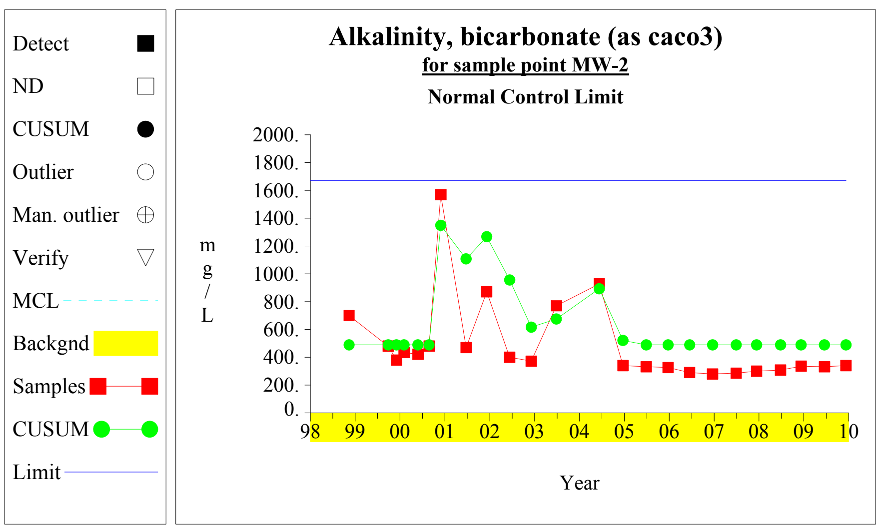
Intra-Well Control Charts



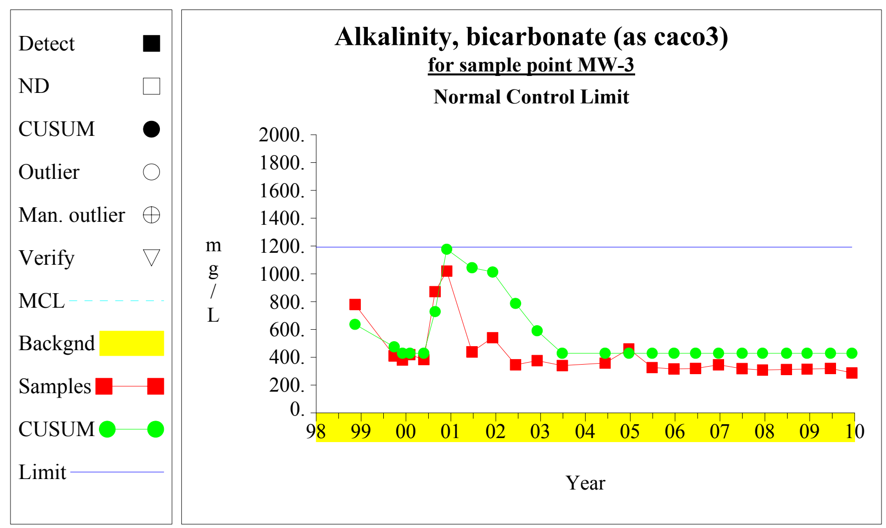
Graph 1



Graph 2

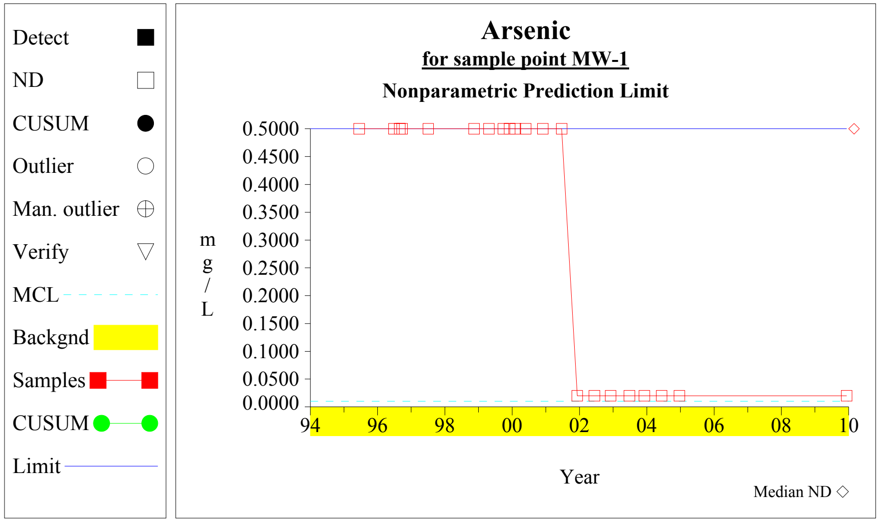


Graph 3

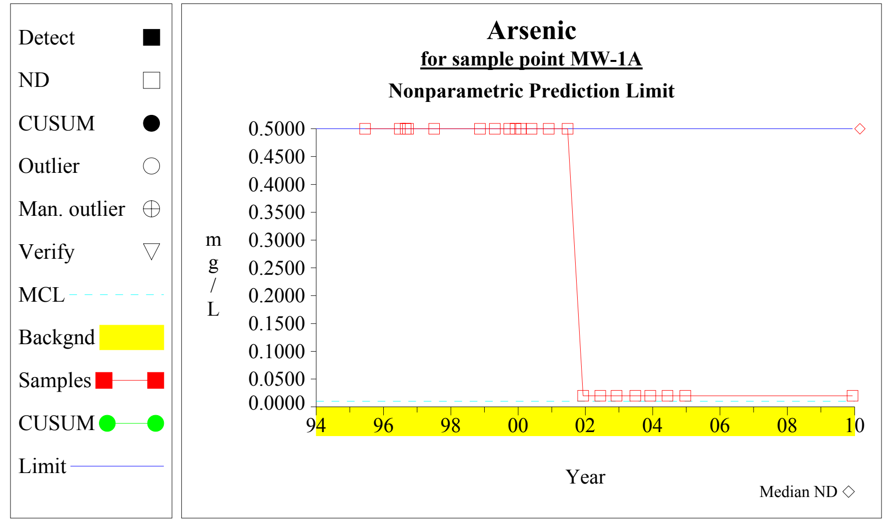


Graph 4

Intra-Well Control Charts



Graph 5



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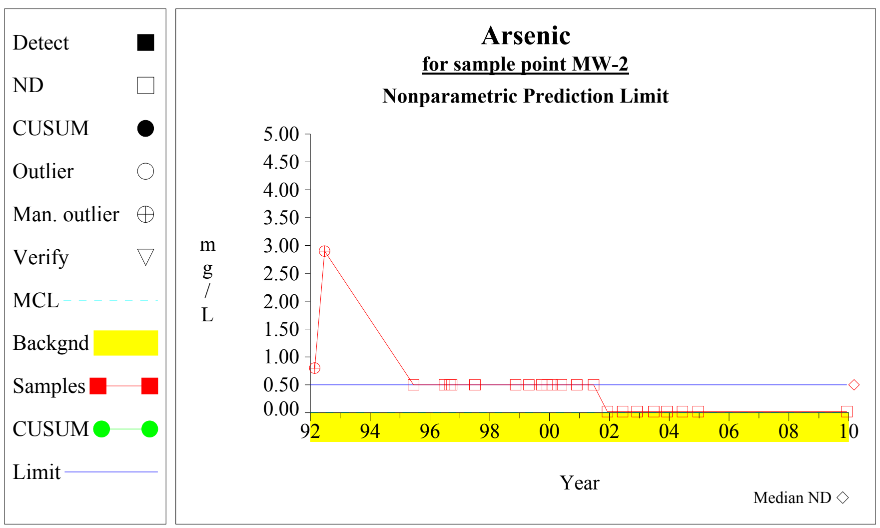
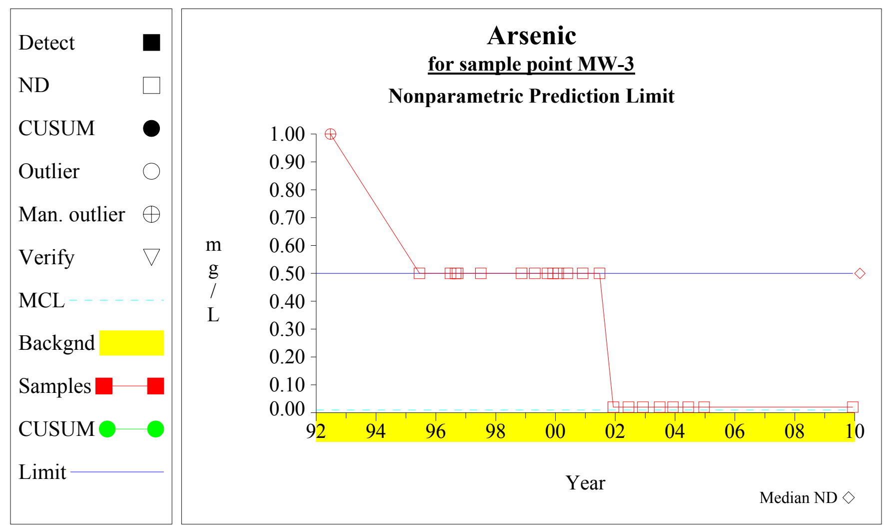
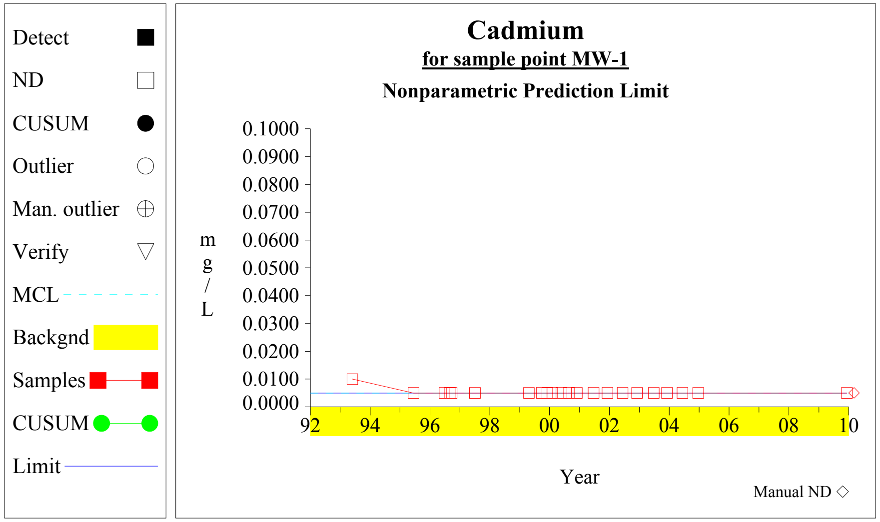


Graph 7

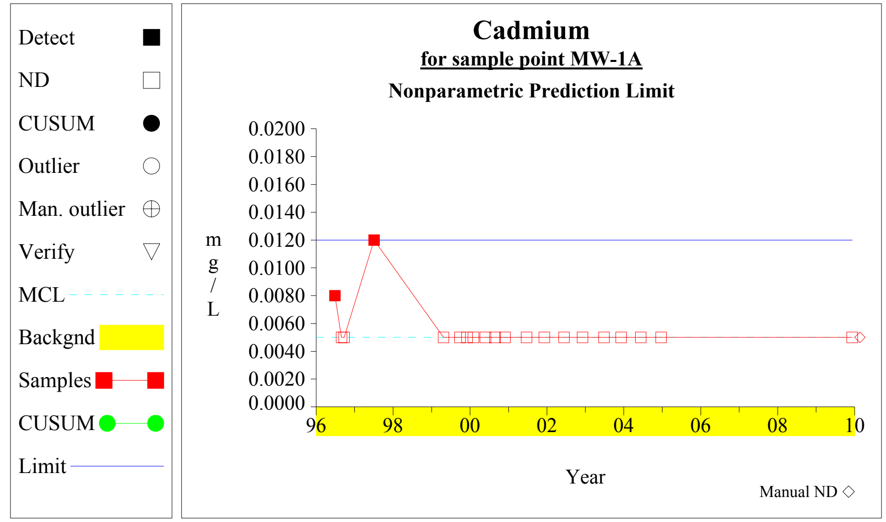


Graph 8

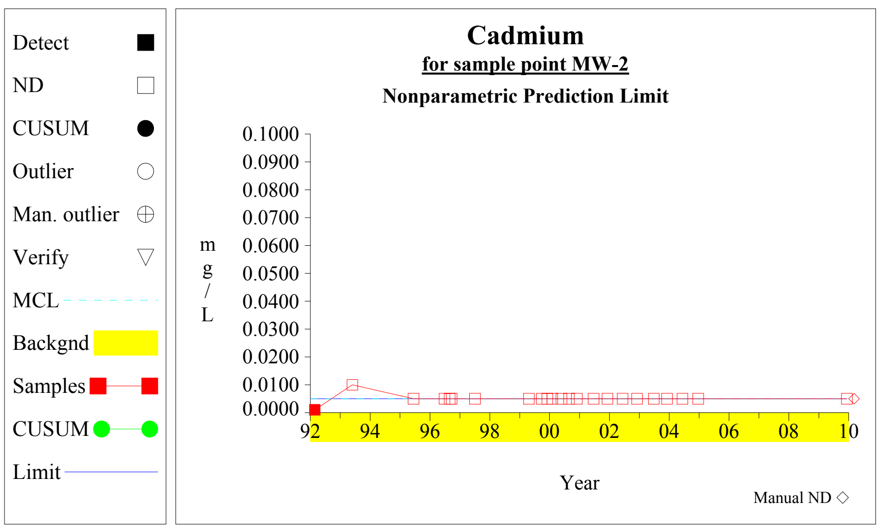
Intra-Well Control Charts



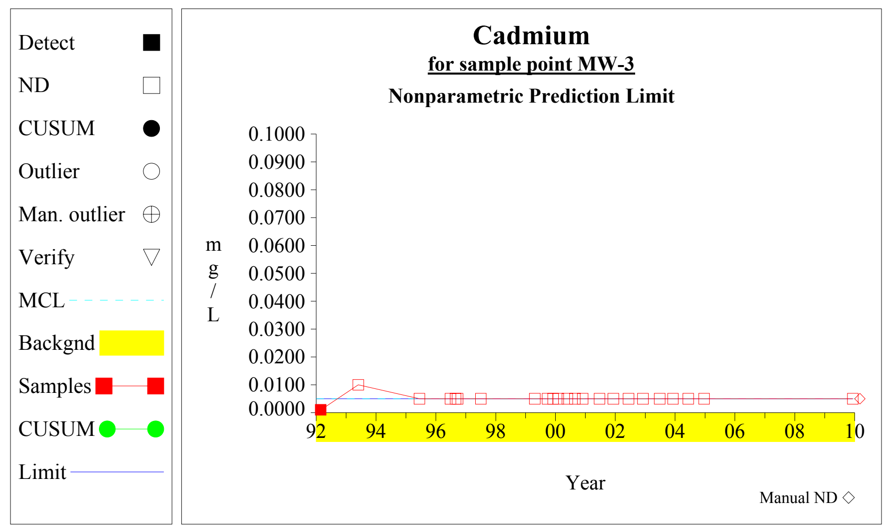
Graph 9



Graph 10

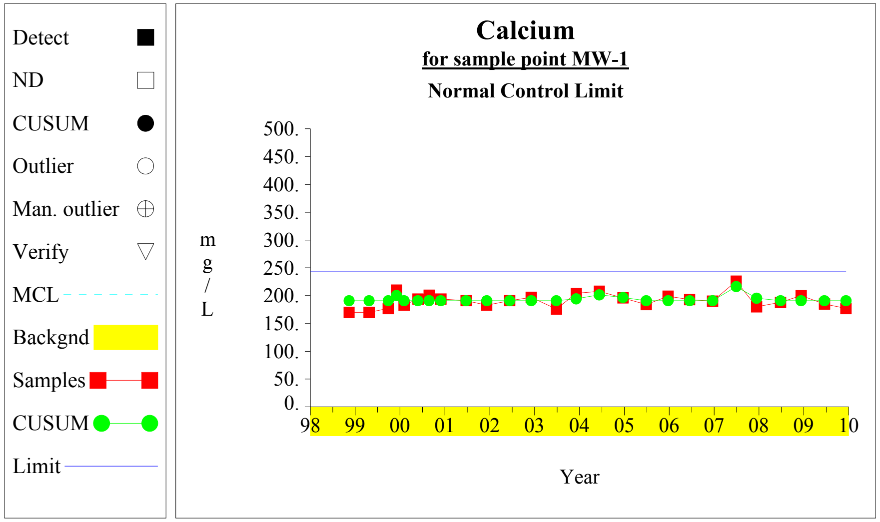


Graph 11

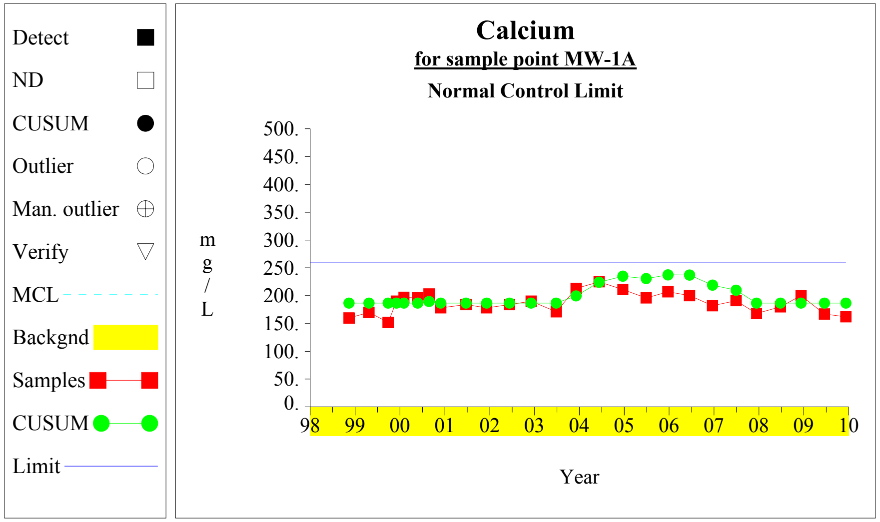


Graph 12

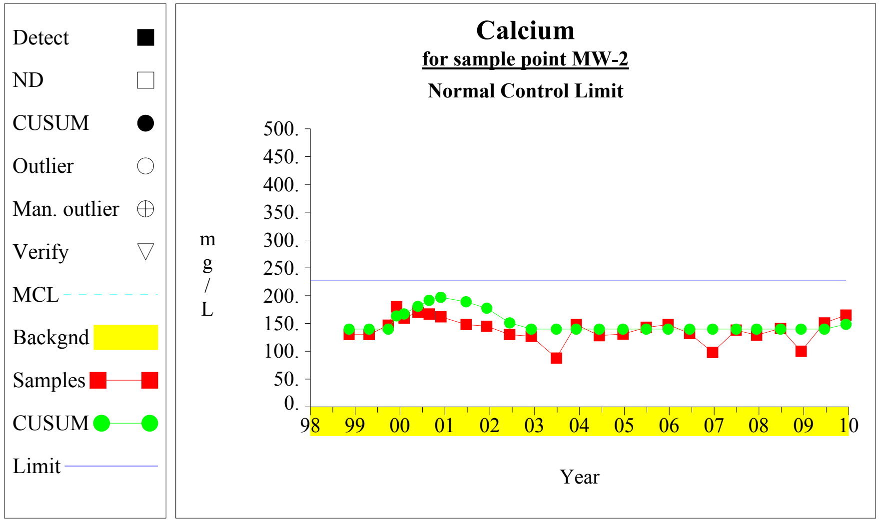
Intra-Well Control Charts



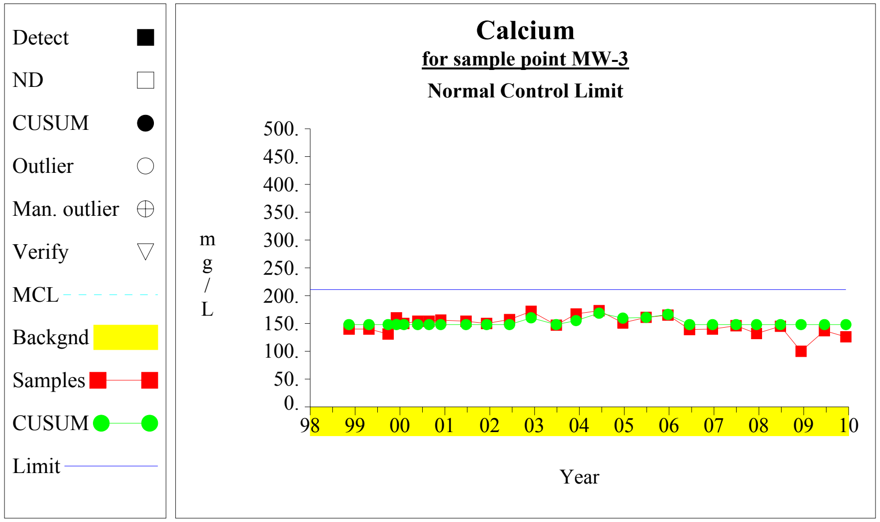
Graph 13



Graph 14

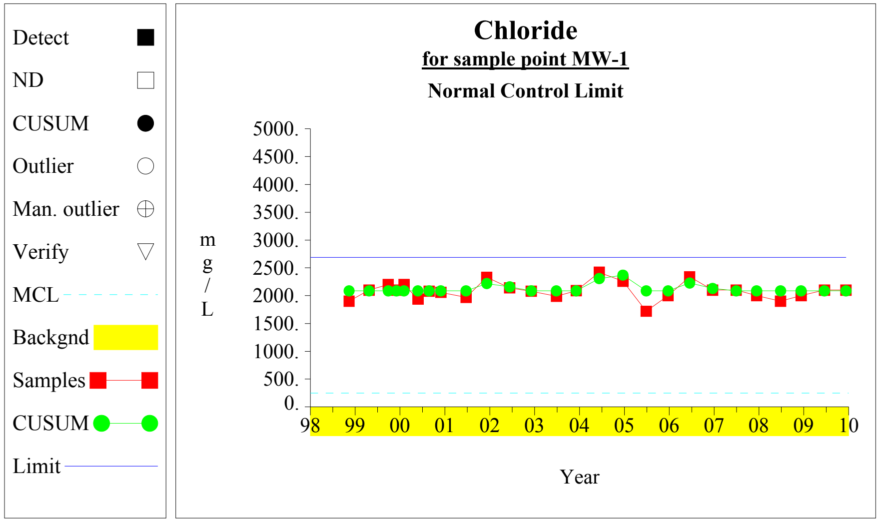


Graph 15



Graph 16

Intra-Well Control Charts



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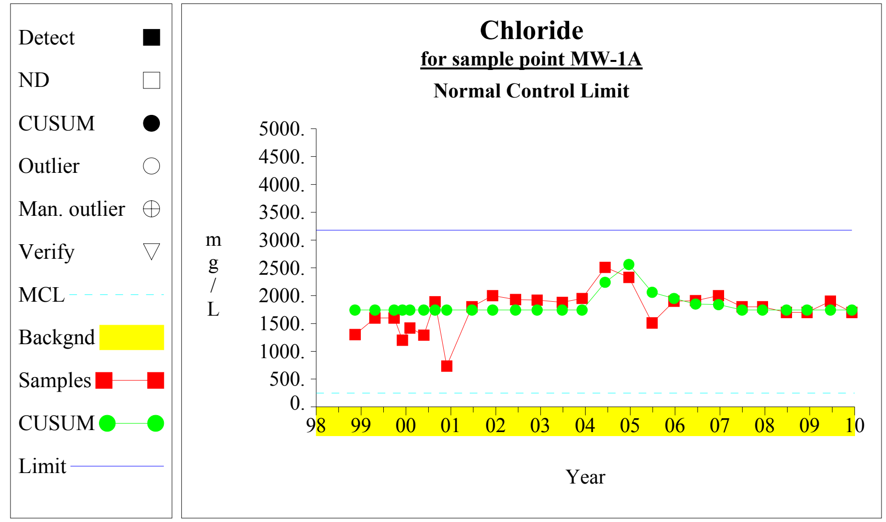
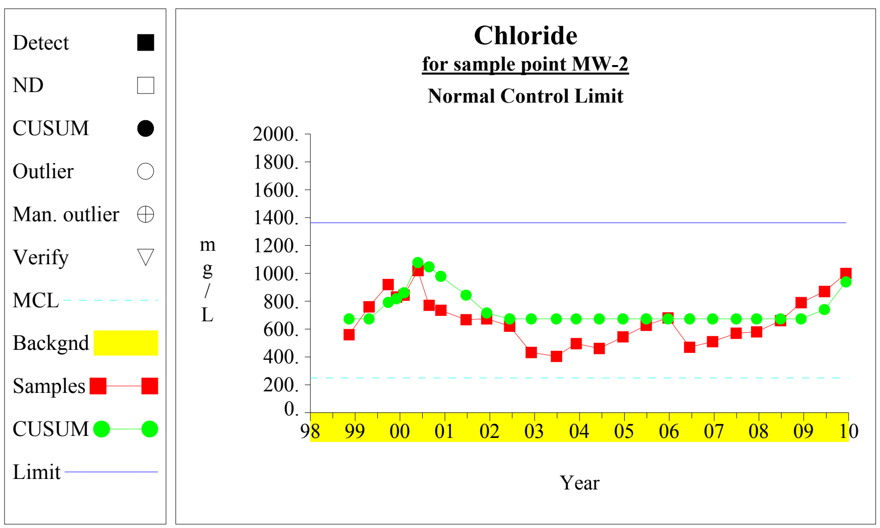
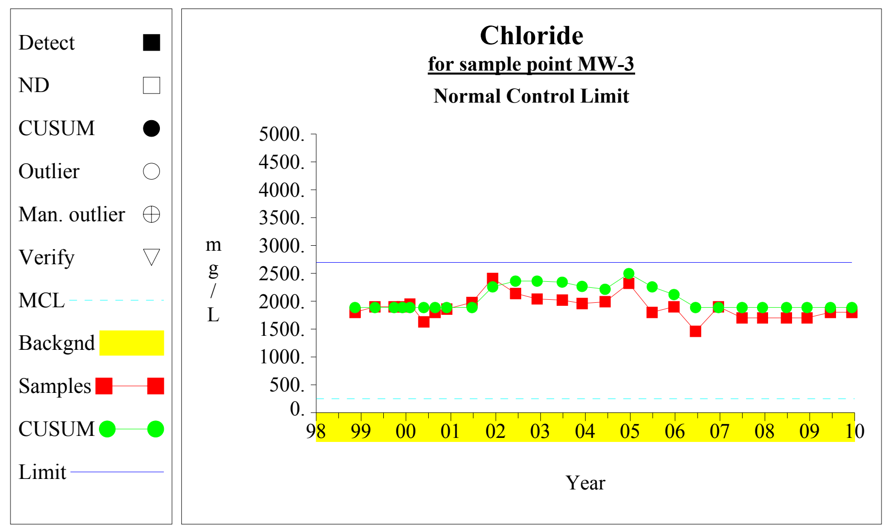


Graph 18

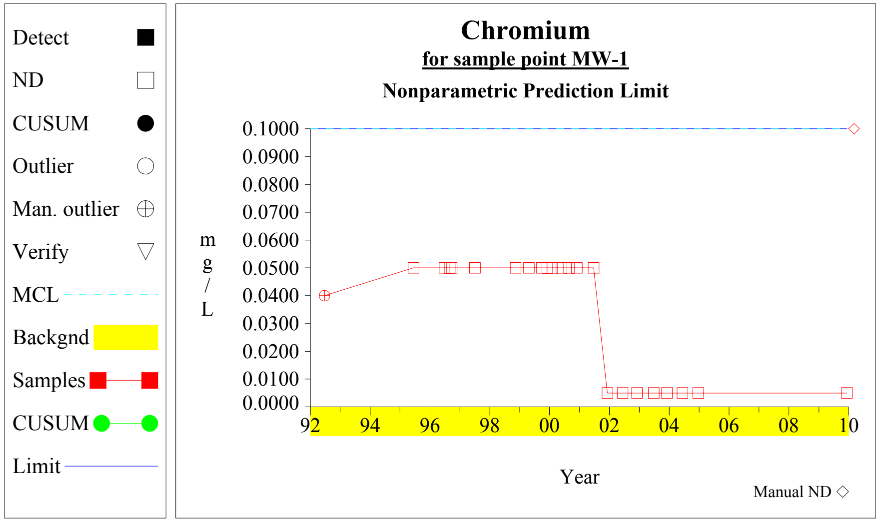


Graph 19

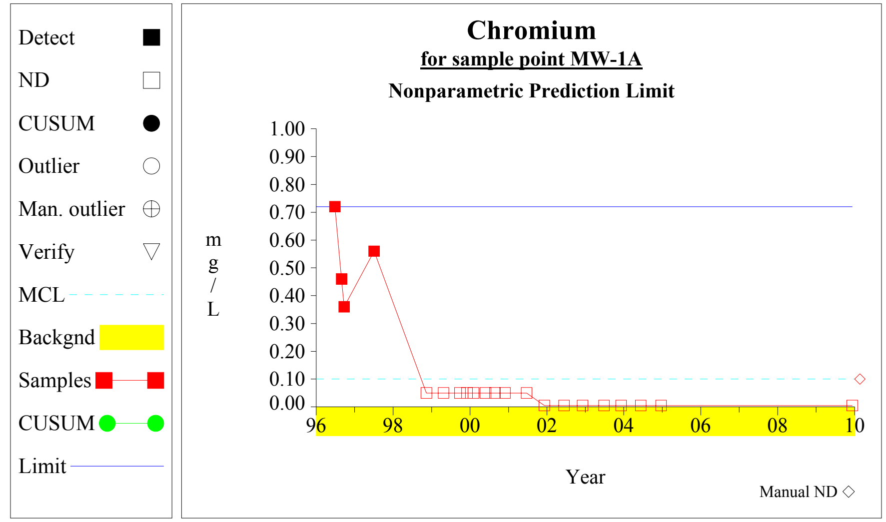


Graph 20

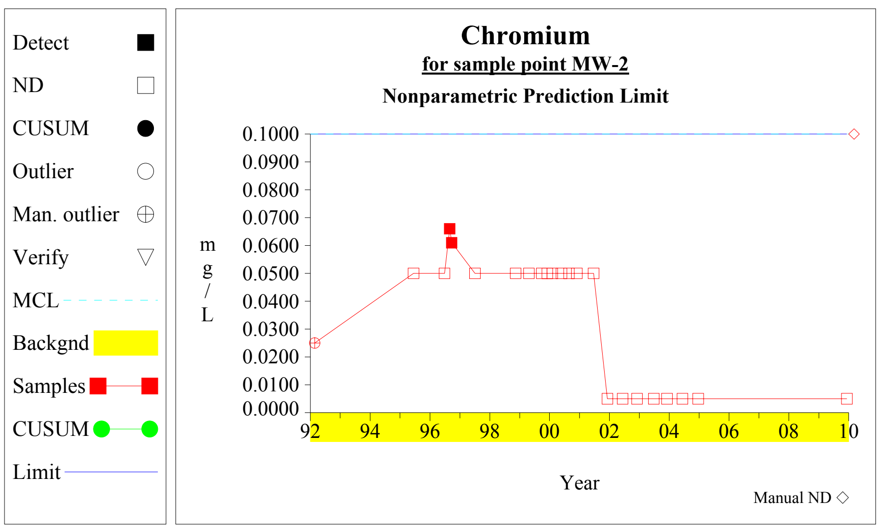
Intra-Well Control Charts



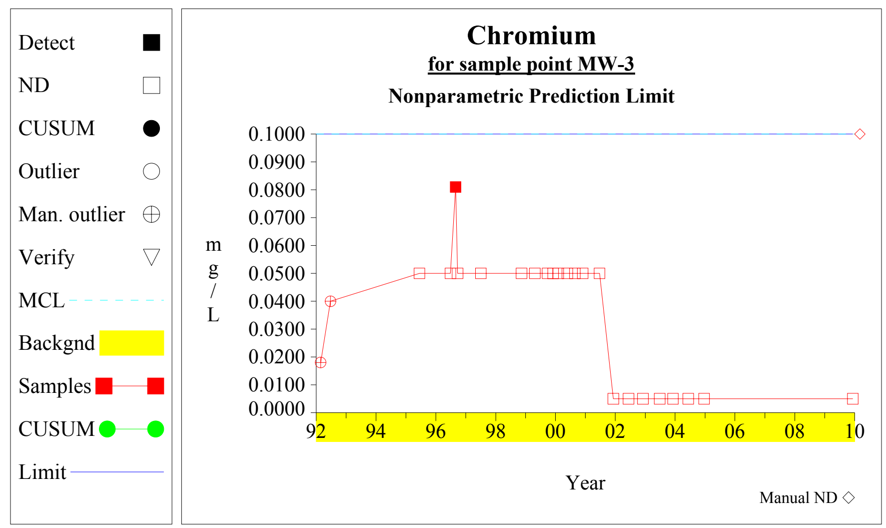
Graph 21



Graph 22

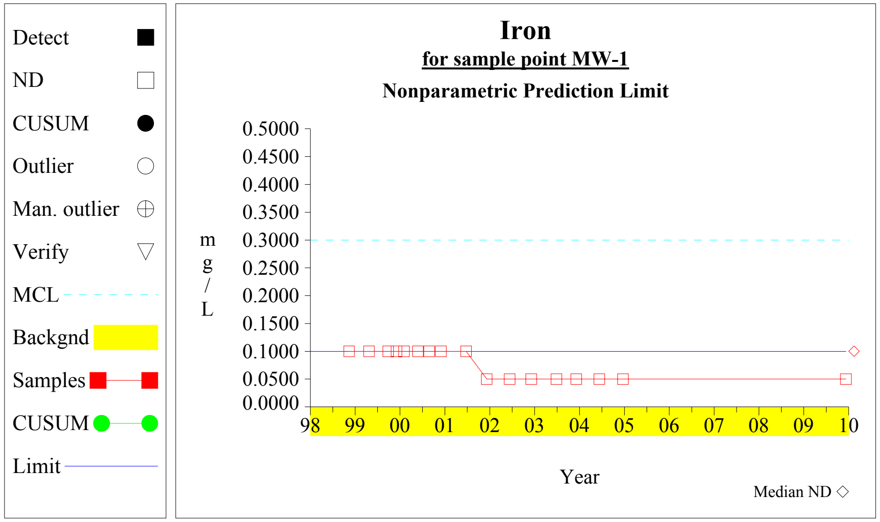


Graph 23



Graph 24

Intra-Well Control Charts



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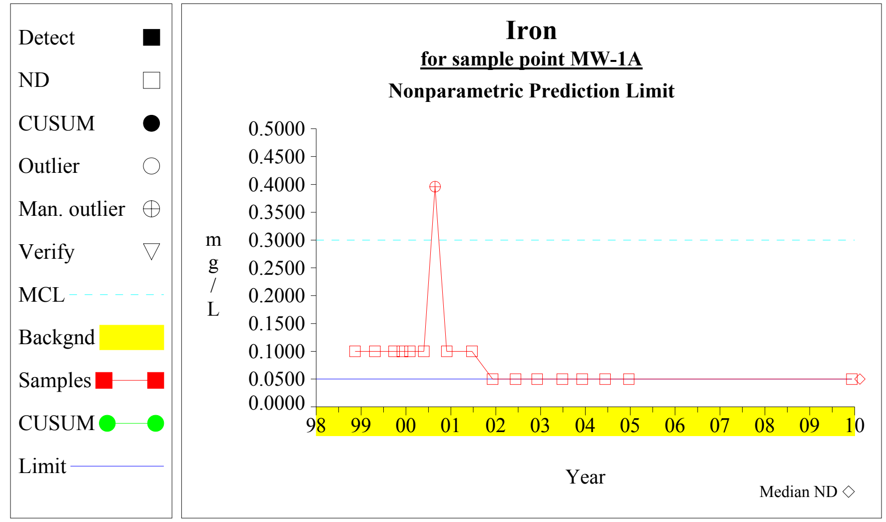

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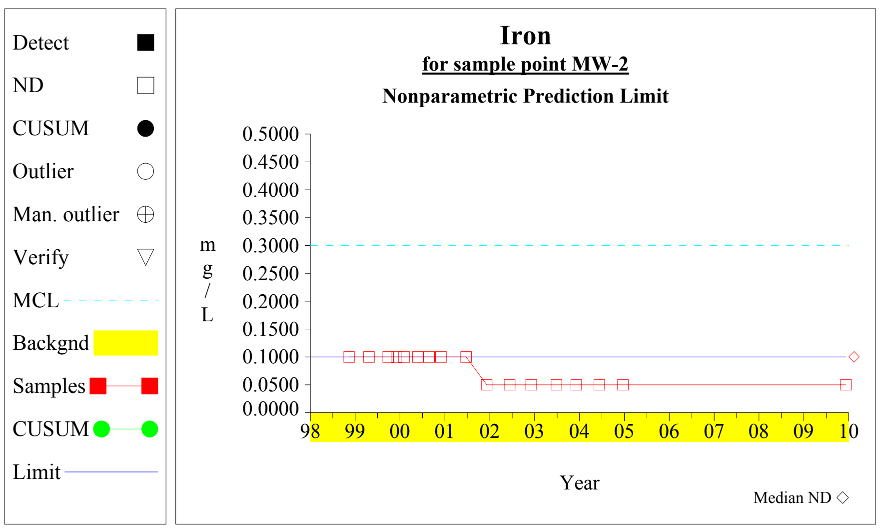

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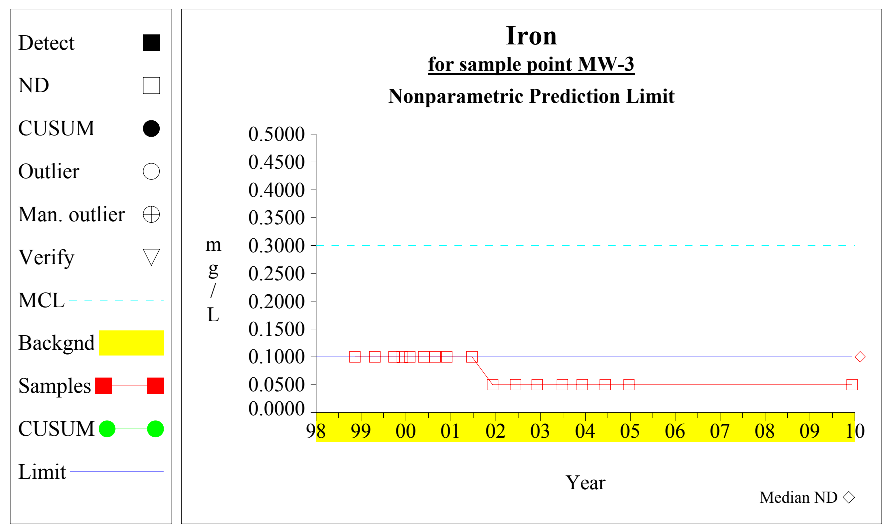
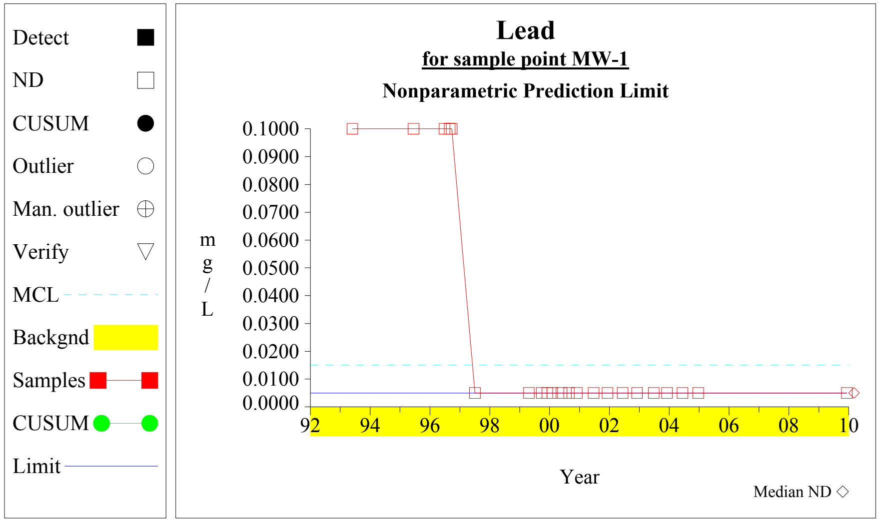
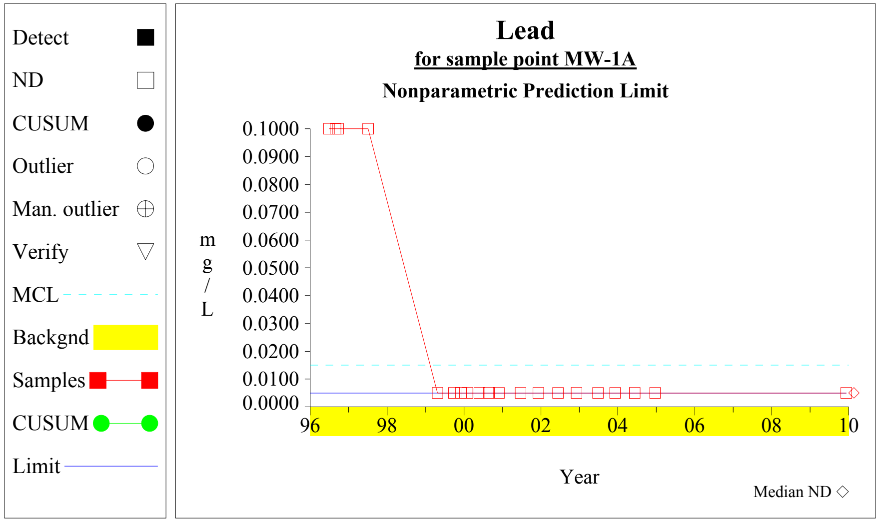


Graph 28

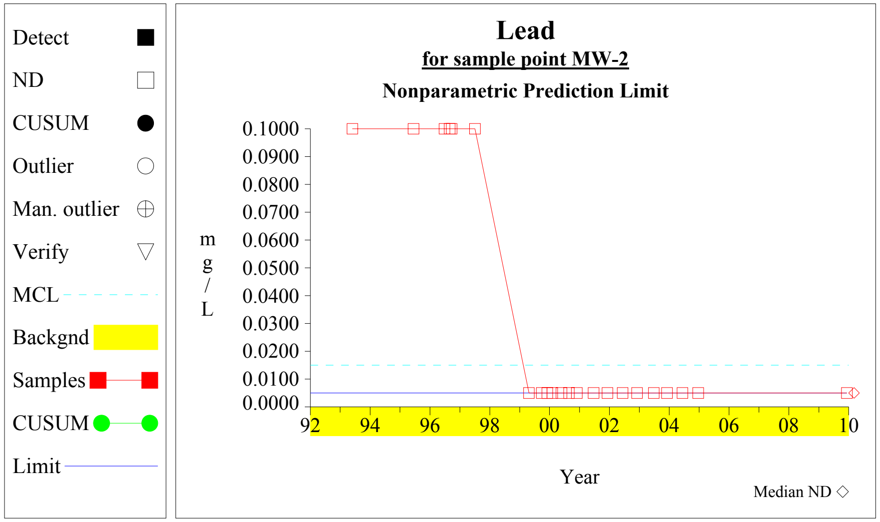
Intra-Well Control Charts



Graph 29



Graph 30



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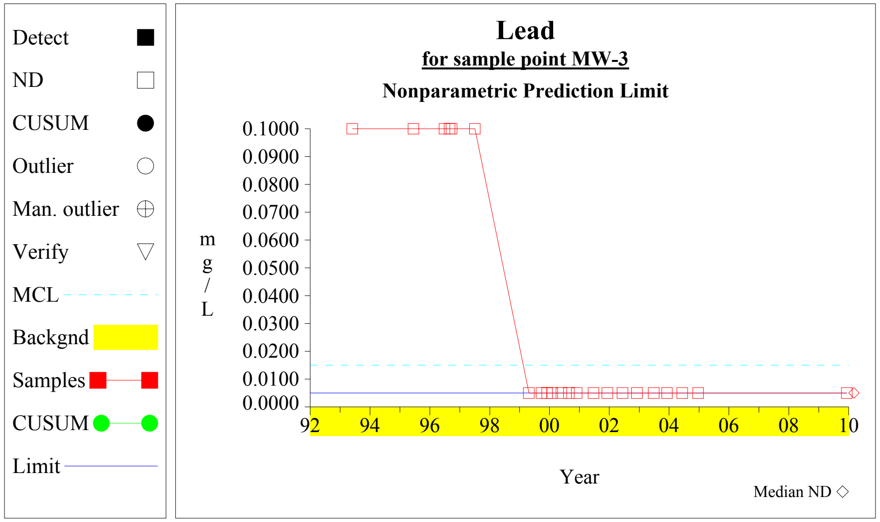
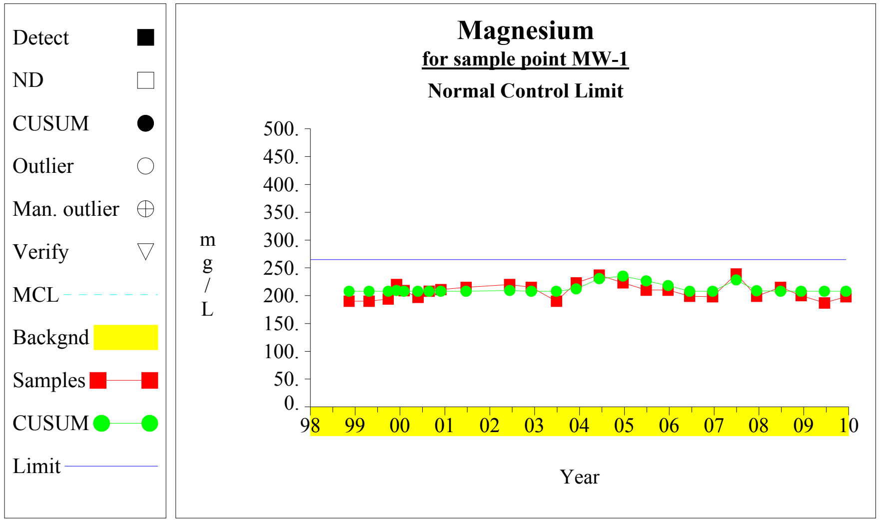
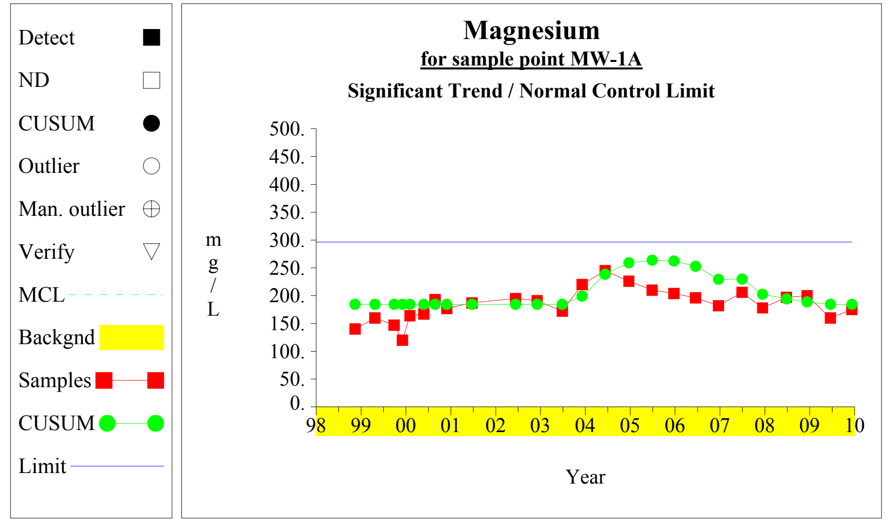


Graph 32

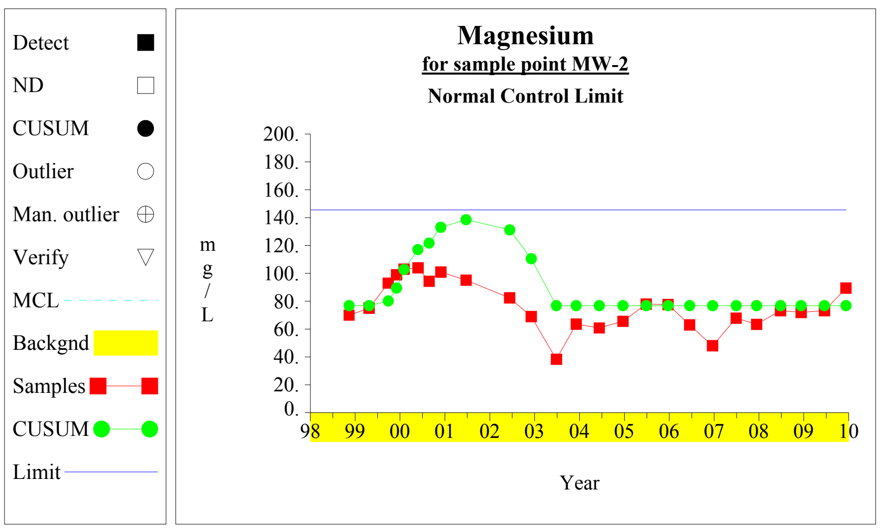
Intra-Well Control Charts



Graph 33



Graph 34



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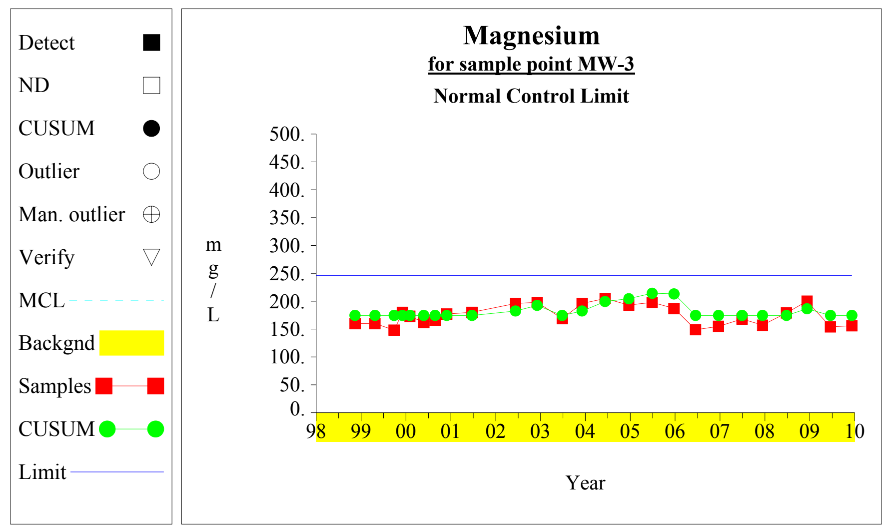
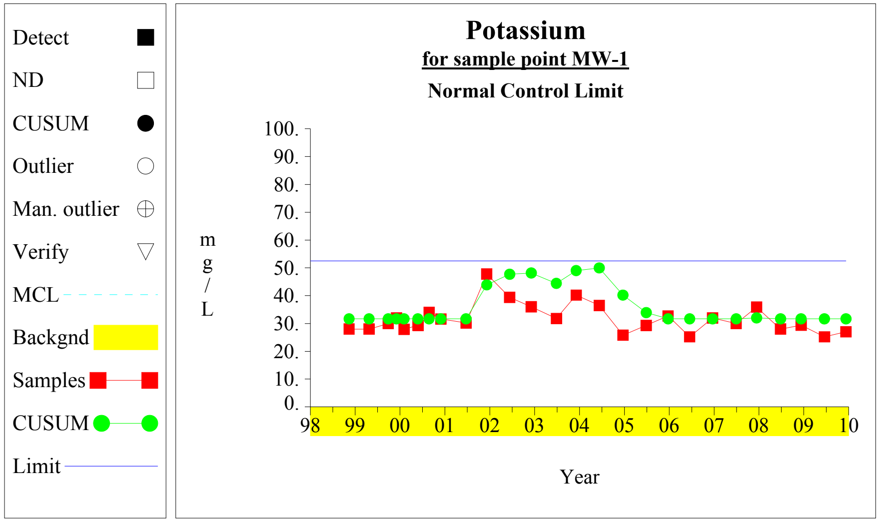


Graph 36

Intra-Well Control Charts



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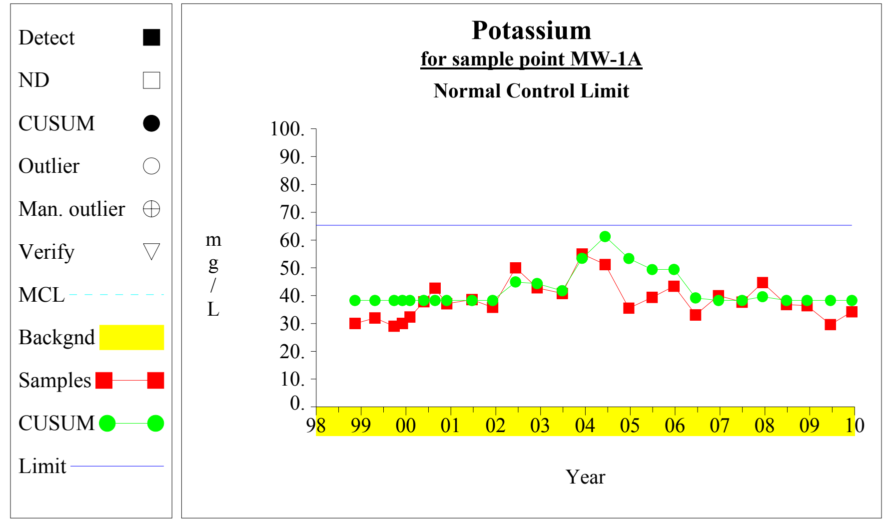

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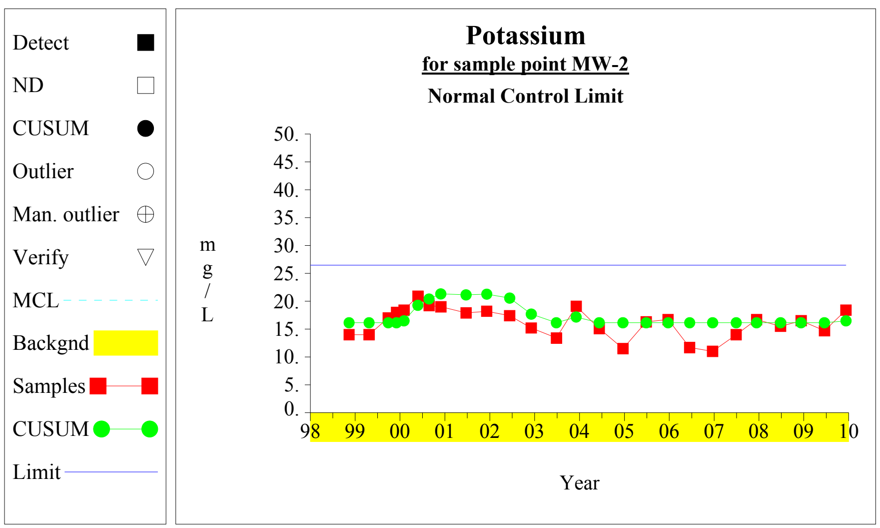

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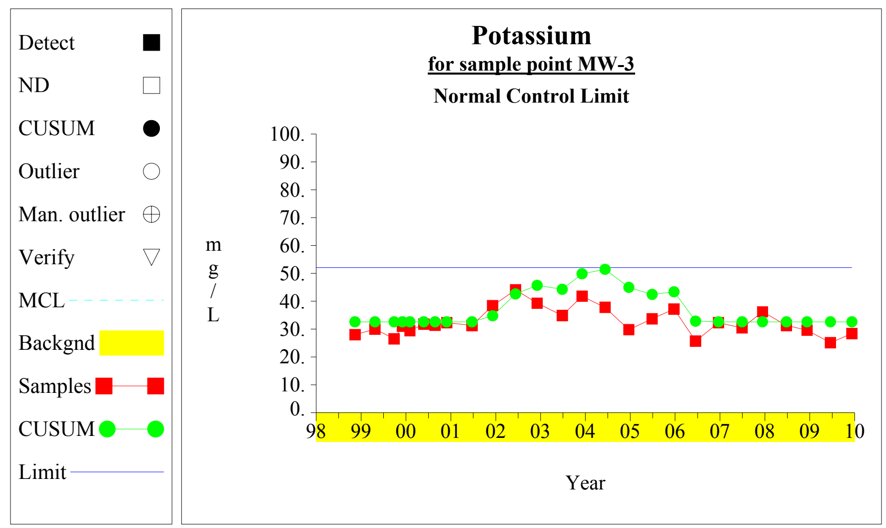

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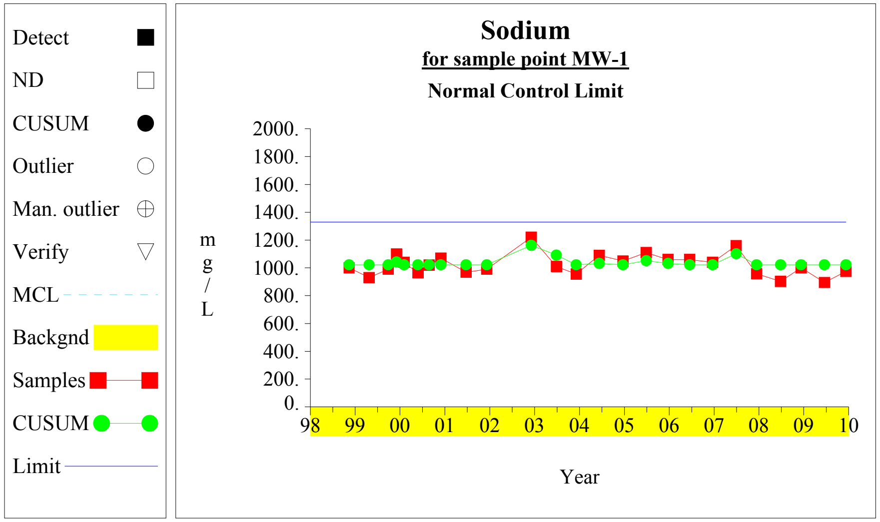
Intra-Well Control Charts



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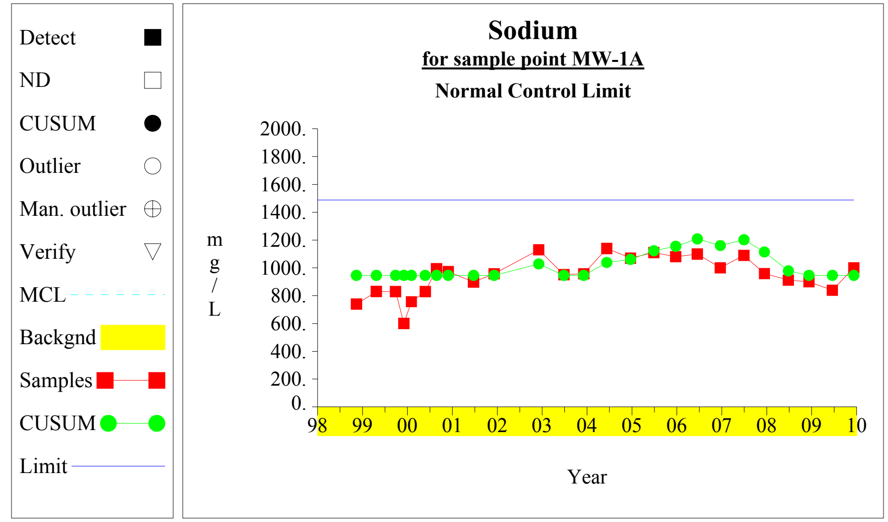

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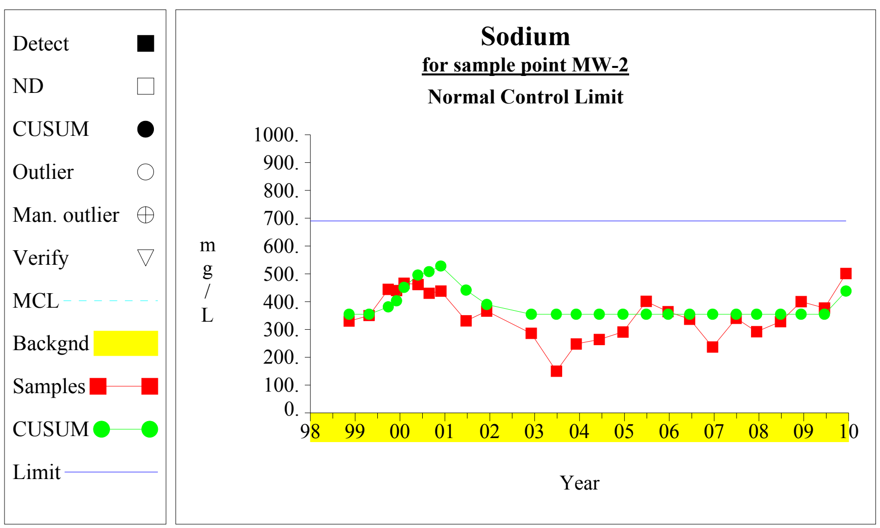

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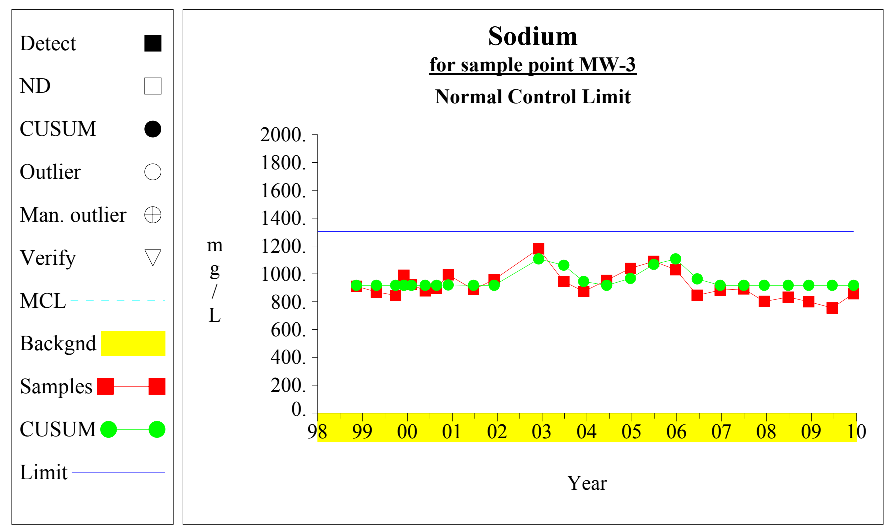
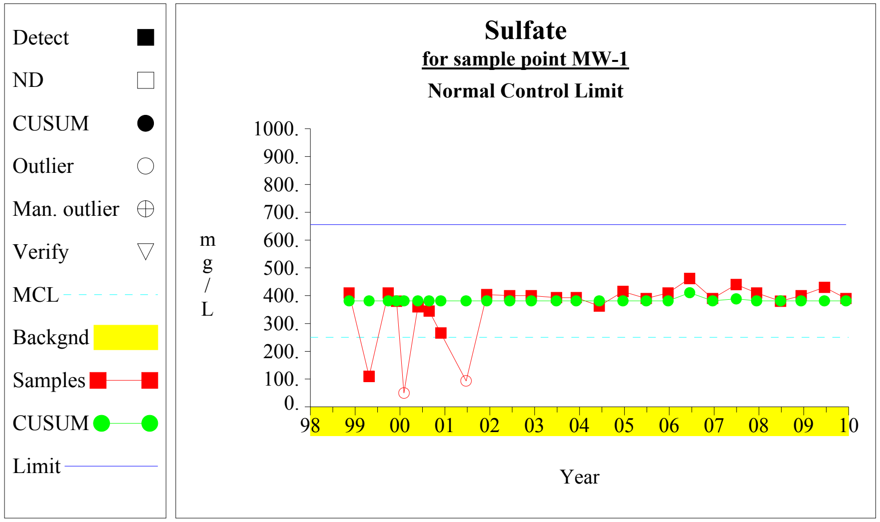


Graph 44

Intra-Well Control Charts



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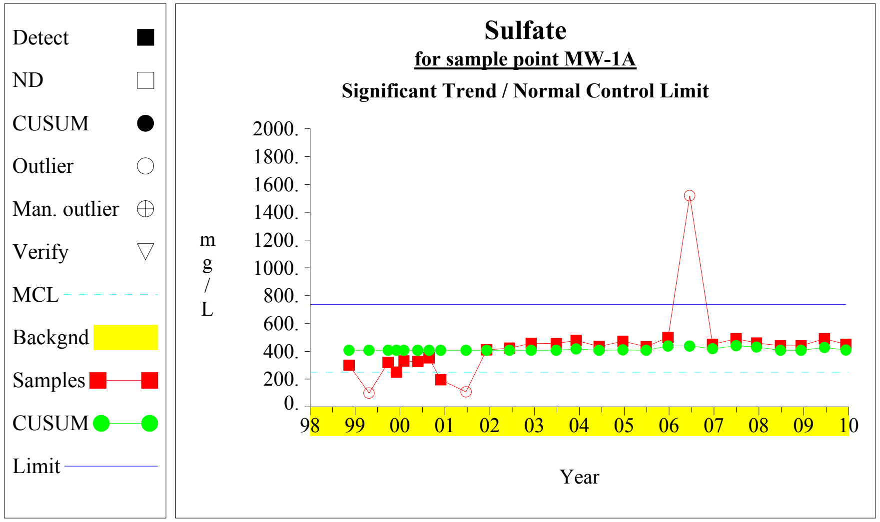

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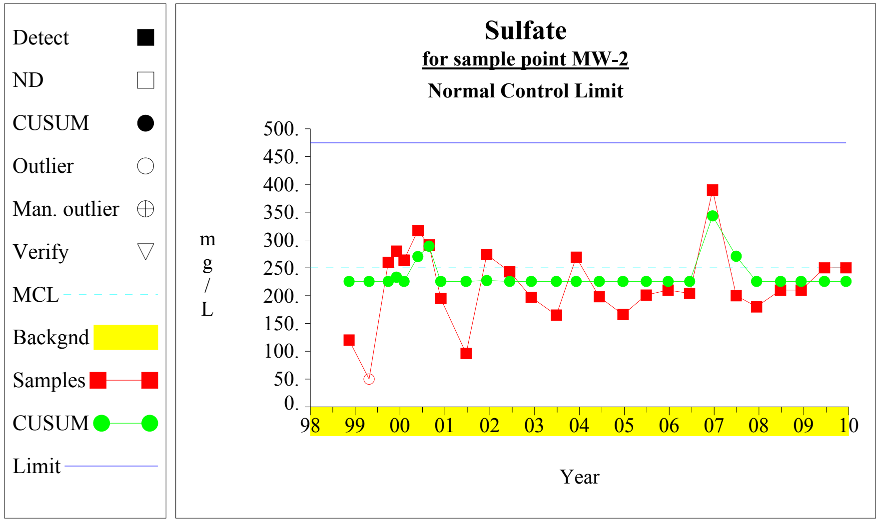

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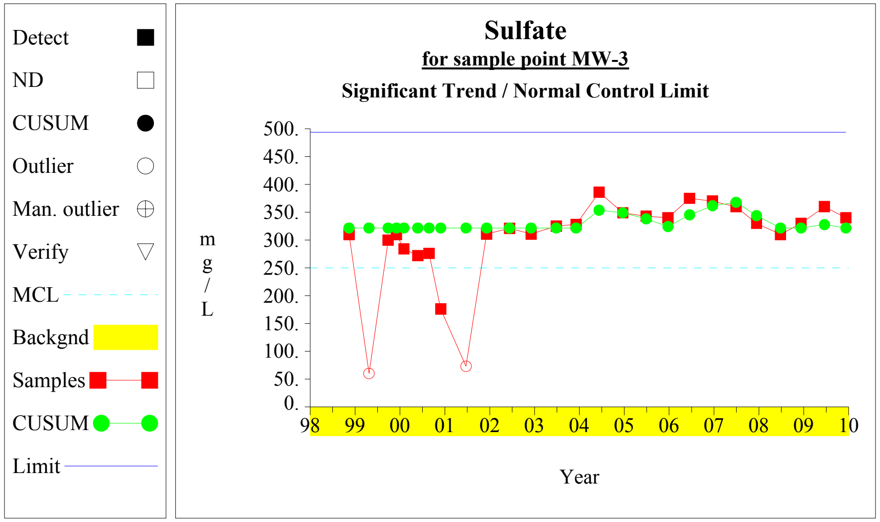
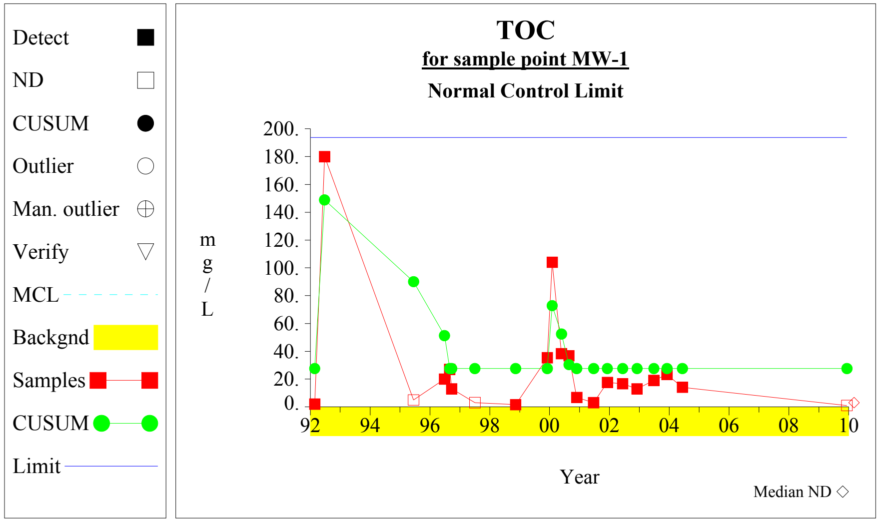


Graph 48

Intra-Well Control Charts



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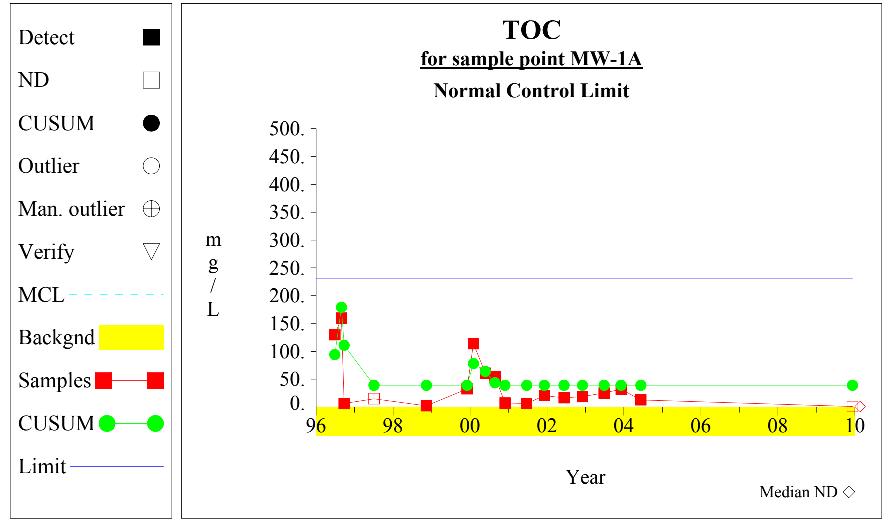
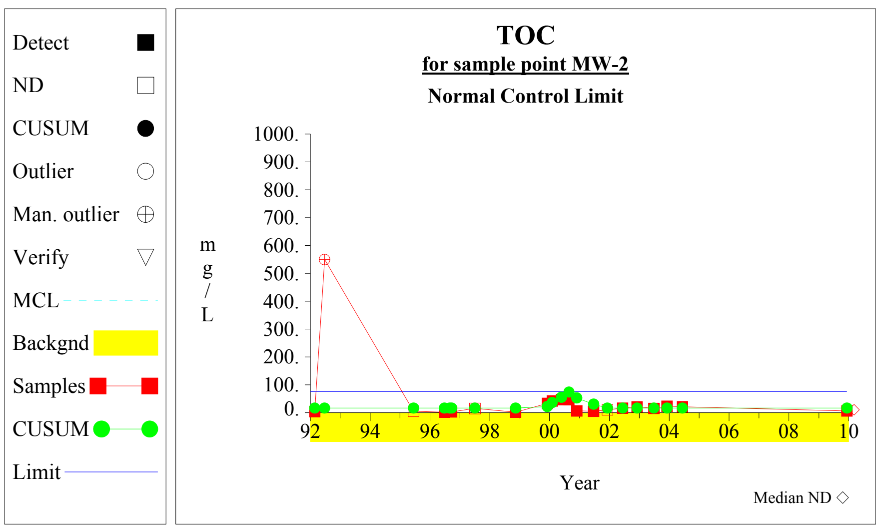


Graph 50



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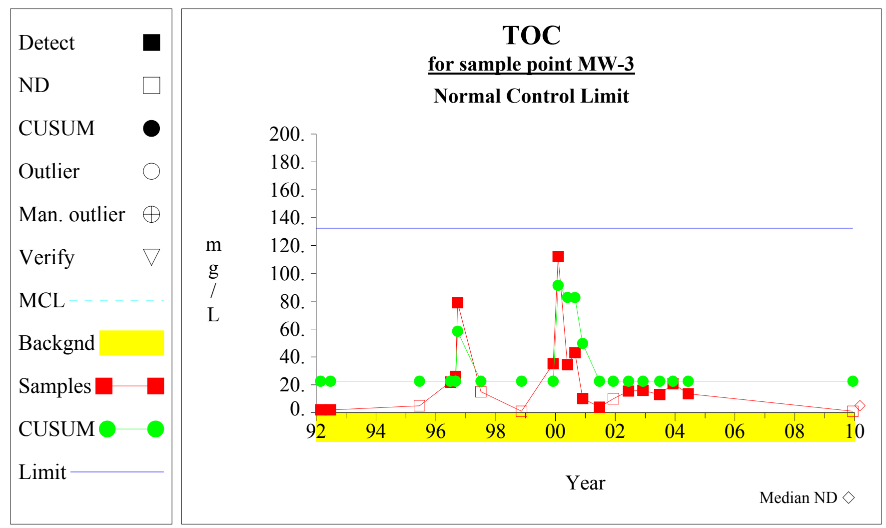
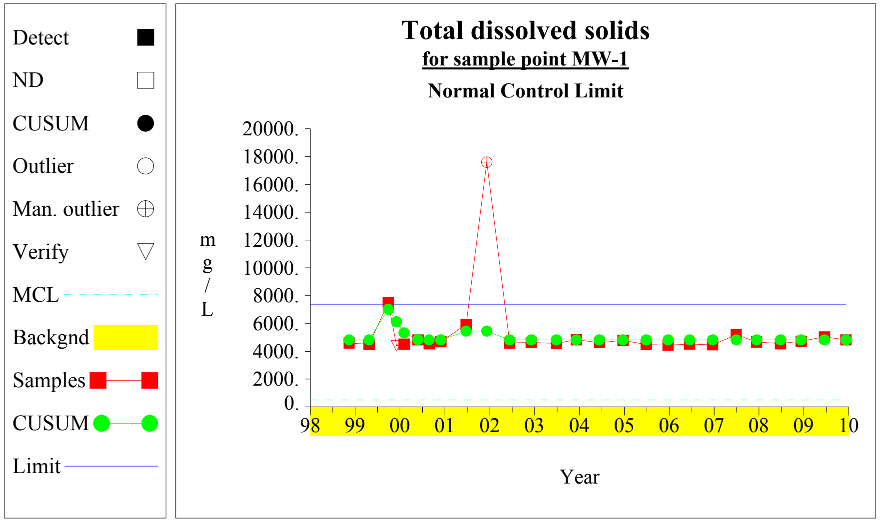


Graph 52

Intra-Well Control Charts



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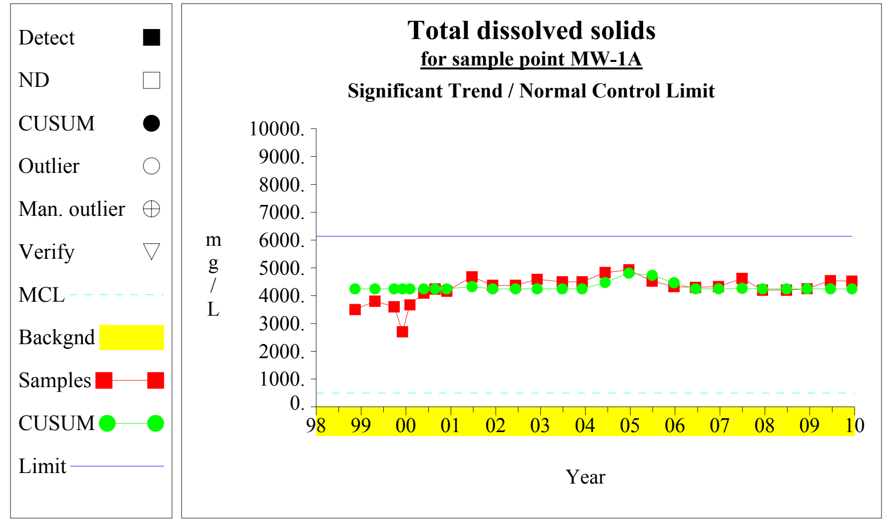

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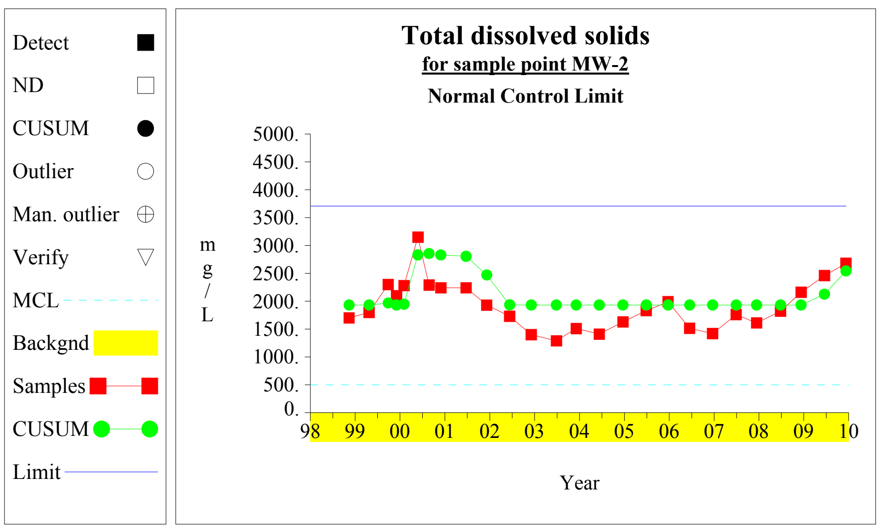

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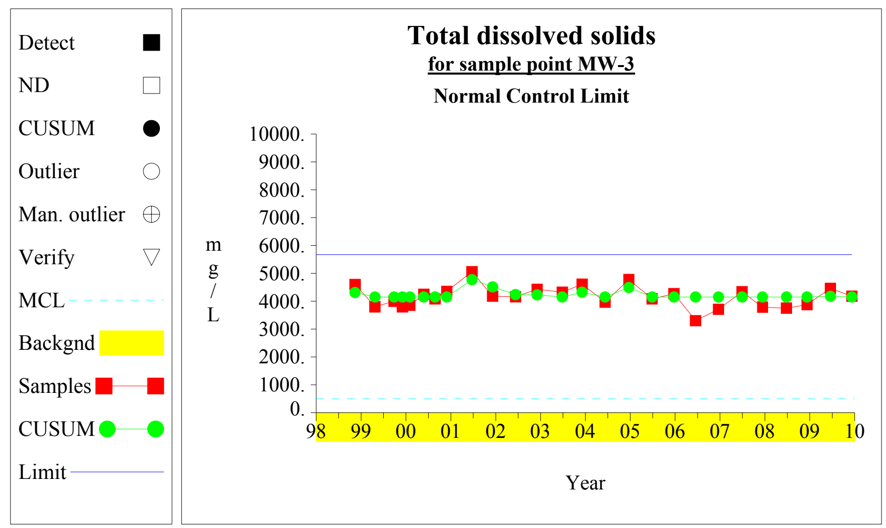
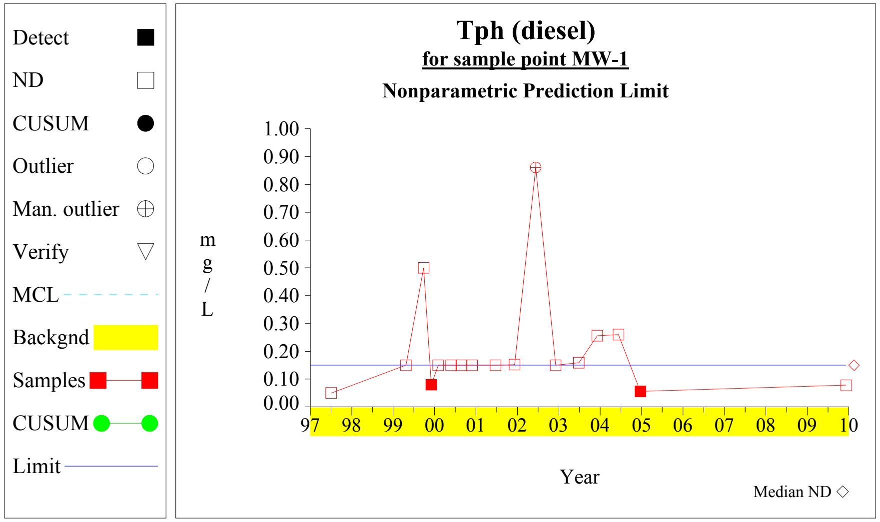


Graph 56

Intra-Well Control Charts



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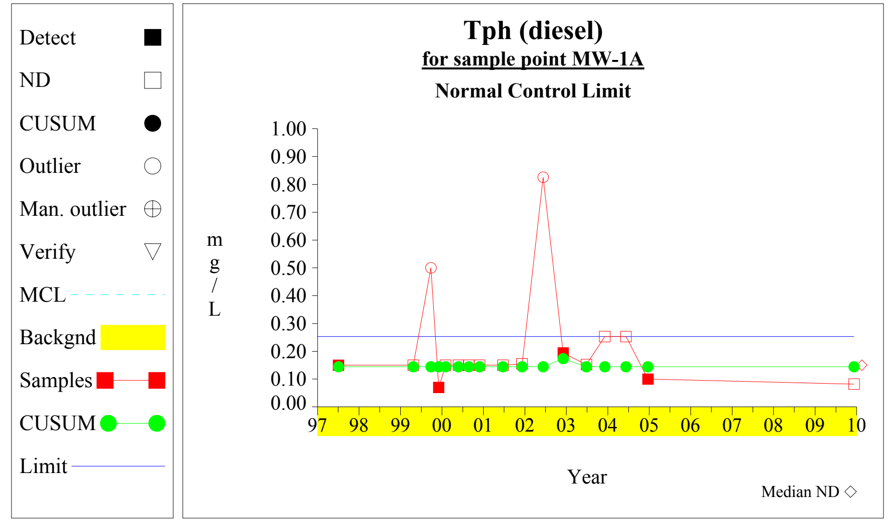

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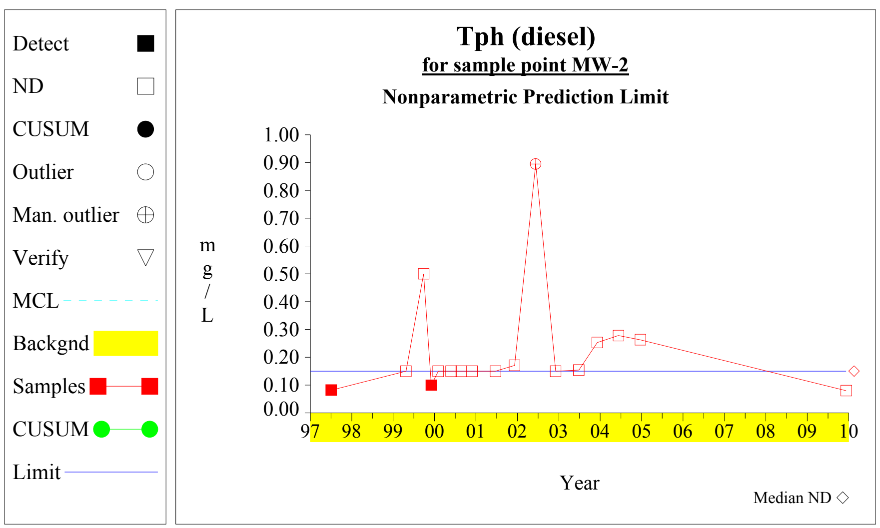

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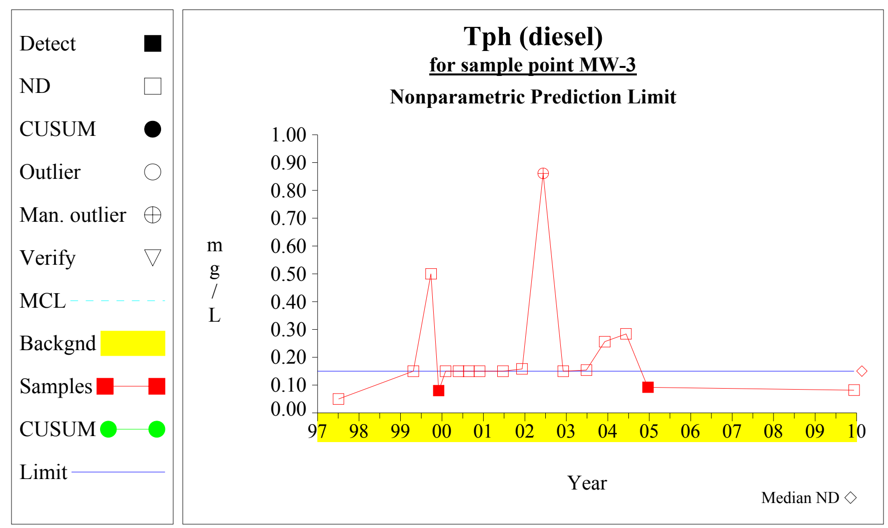
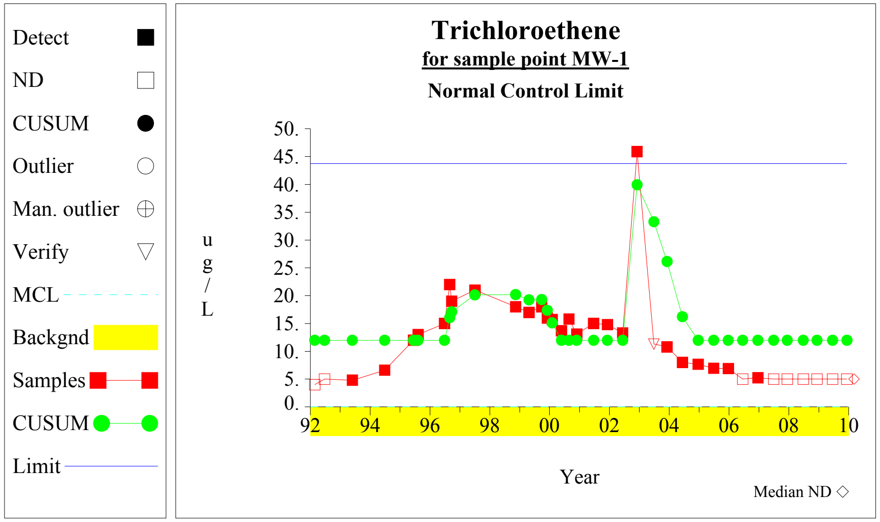


Graph 60

Intra-Well Control Charts



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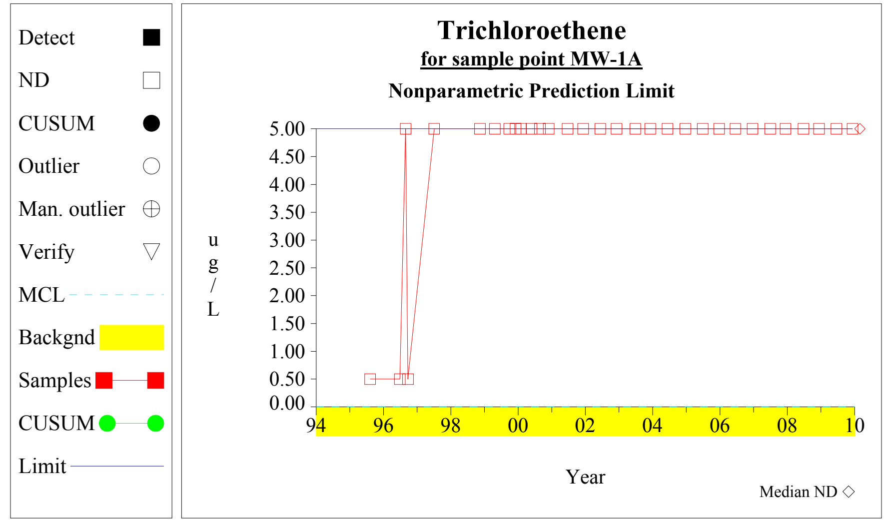

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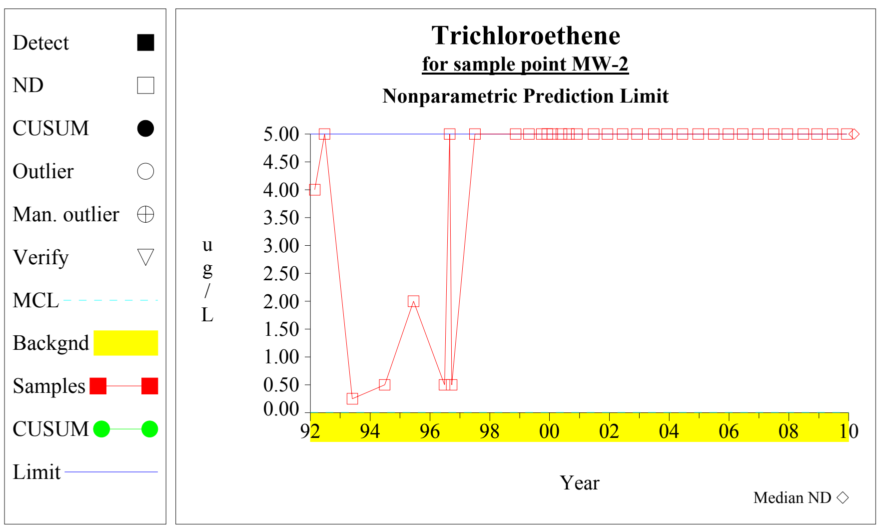

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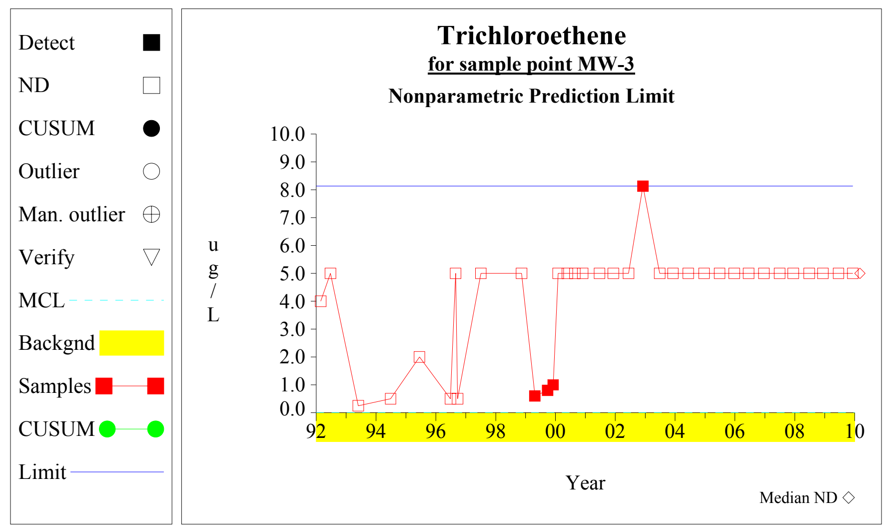
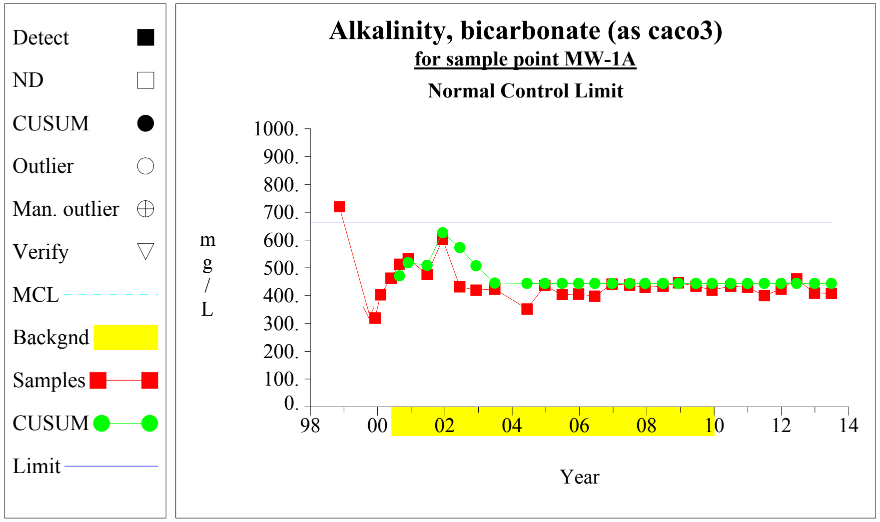


Graph 64

Attachment 2

Intra-Well Control Charts, July 2014

Intra-Well Control Charts



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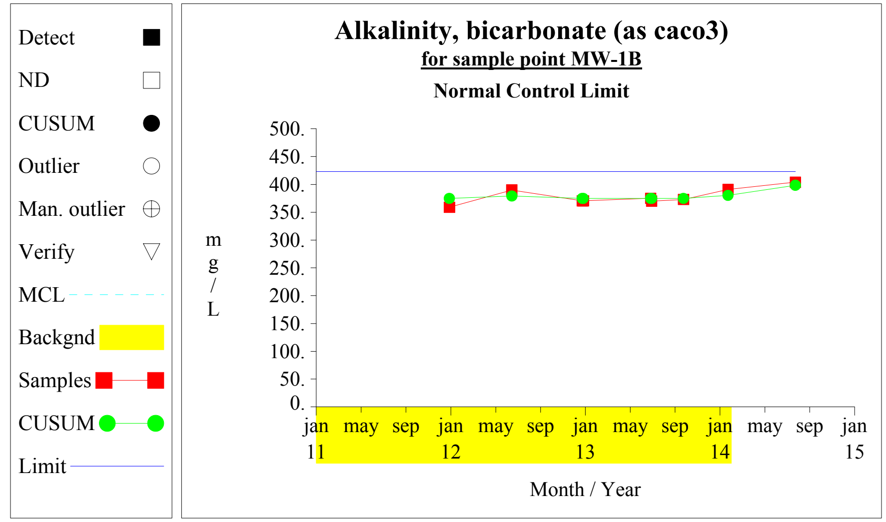
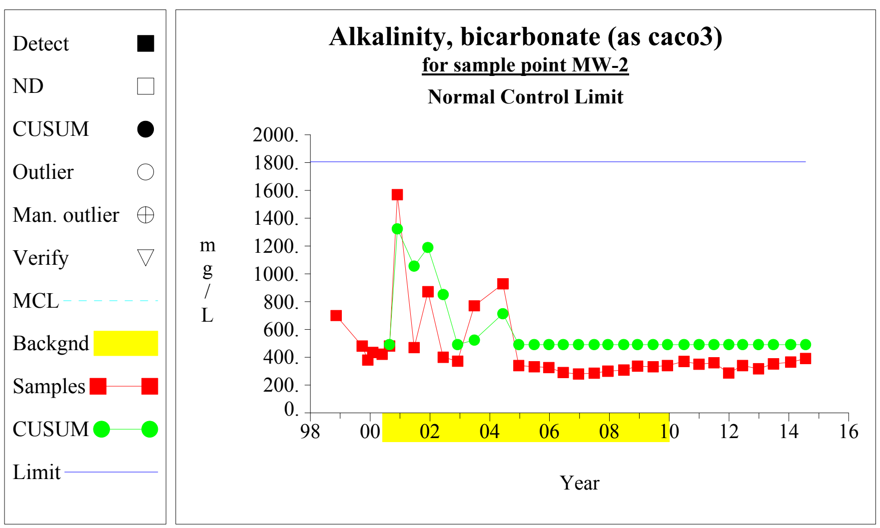
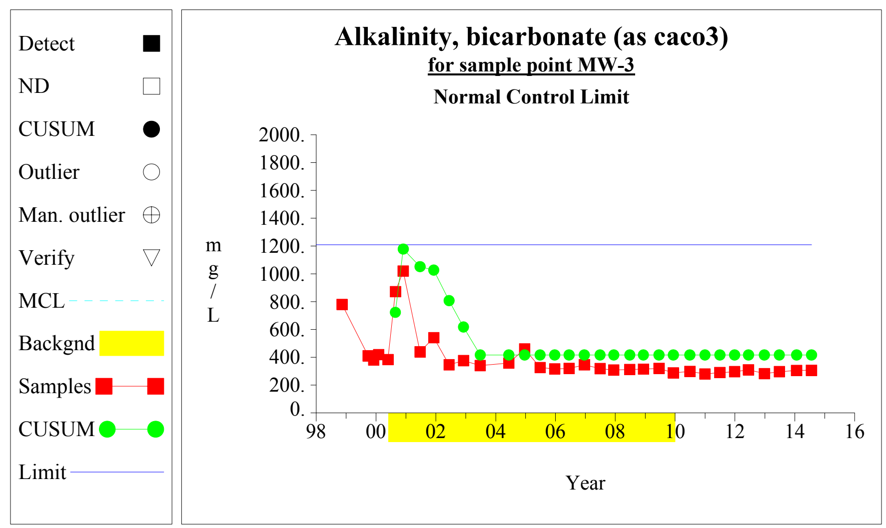


Graph 2

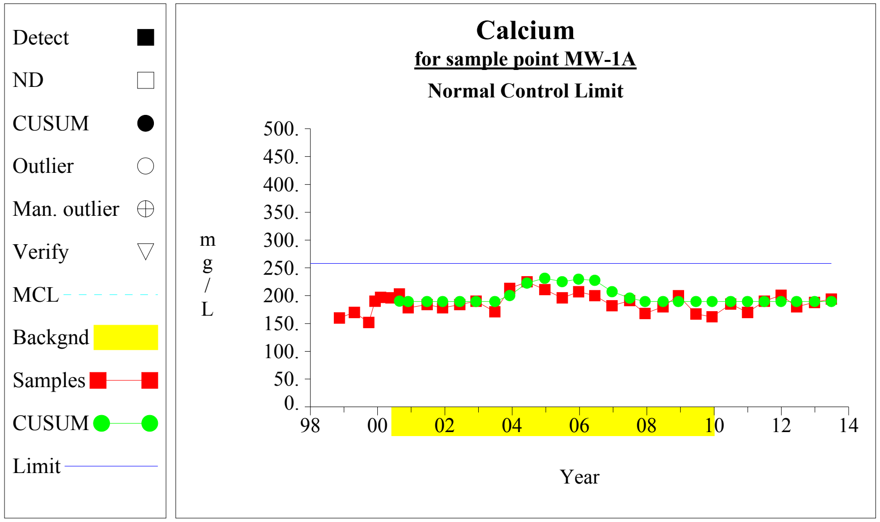


Graph 3



Graph 4

Intra-Well Control Charts



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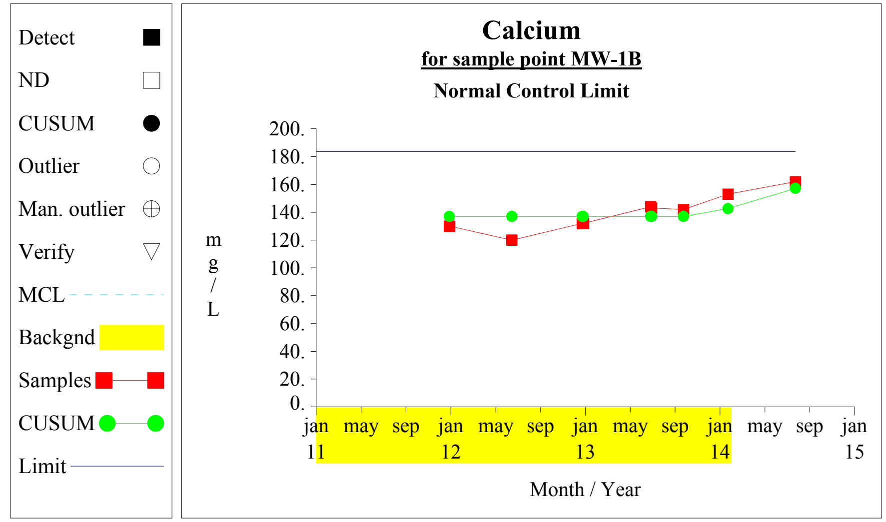

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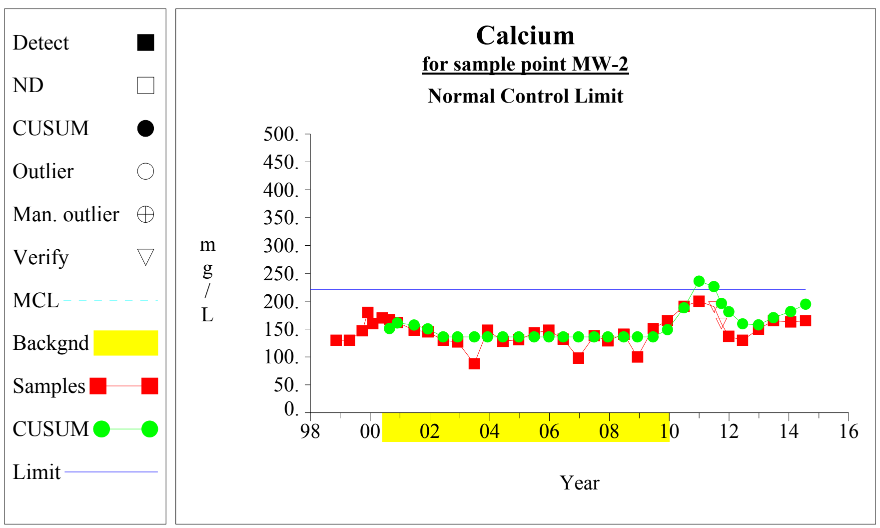

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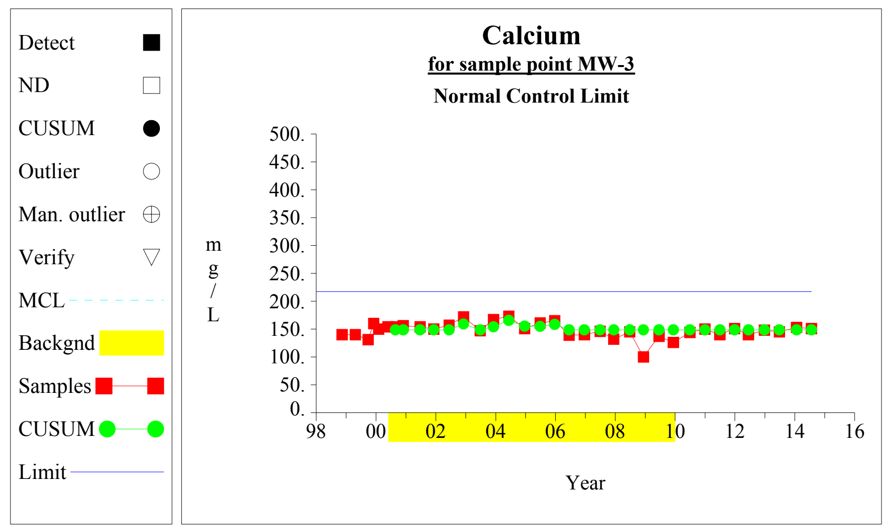
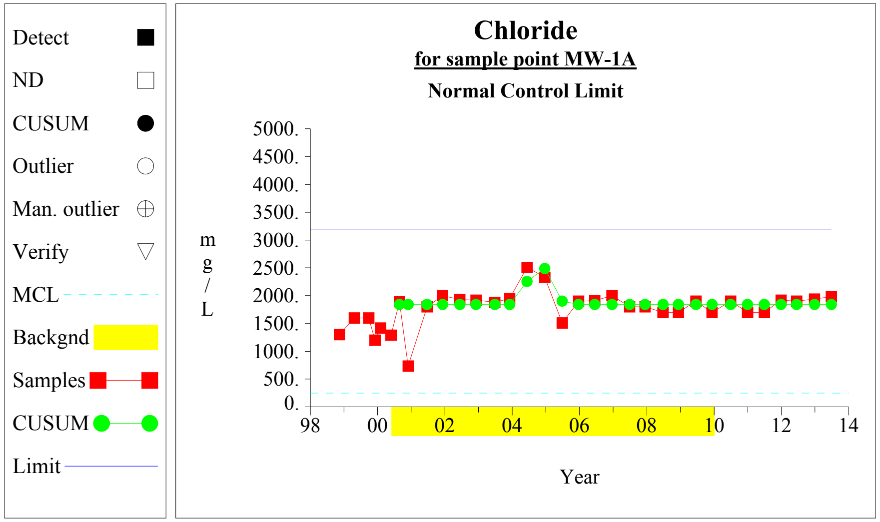


Graph 8

Intra-Well Control Charts



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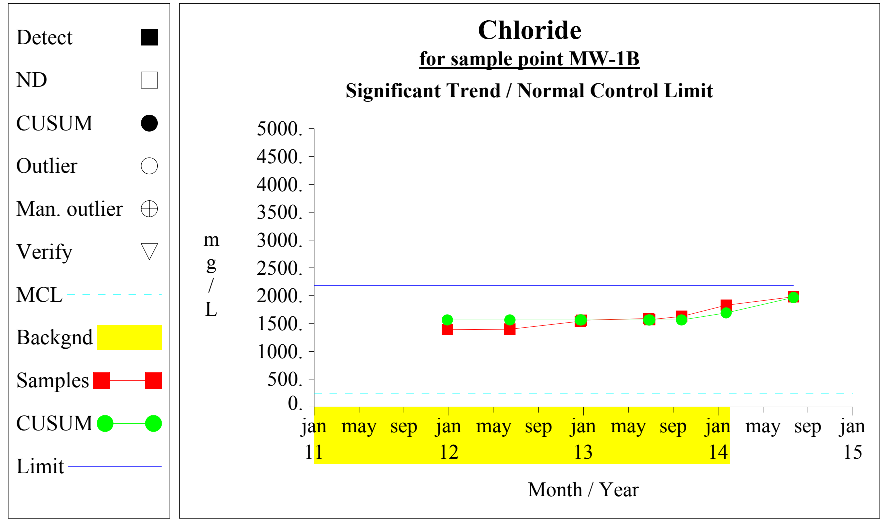

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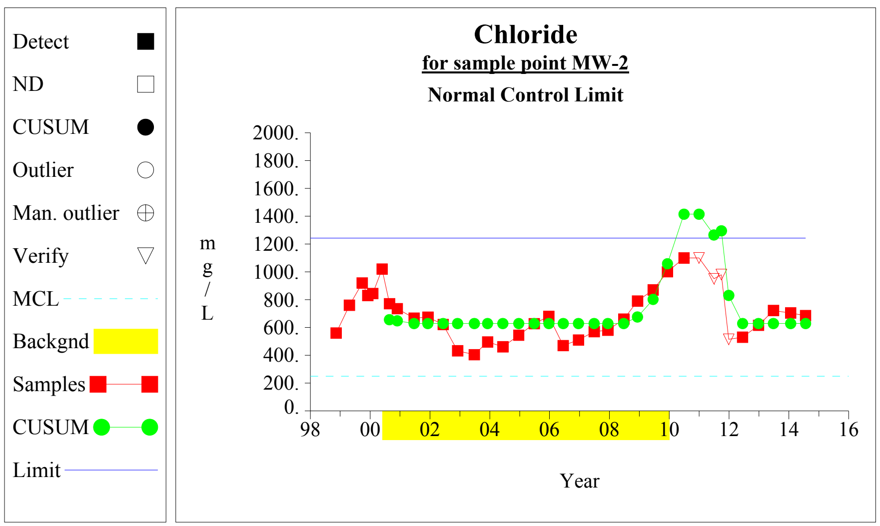
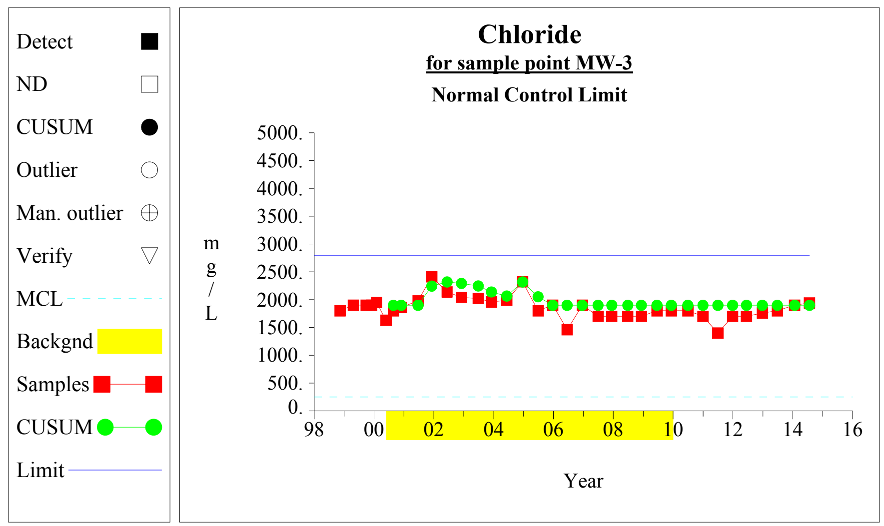
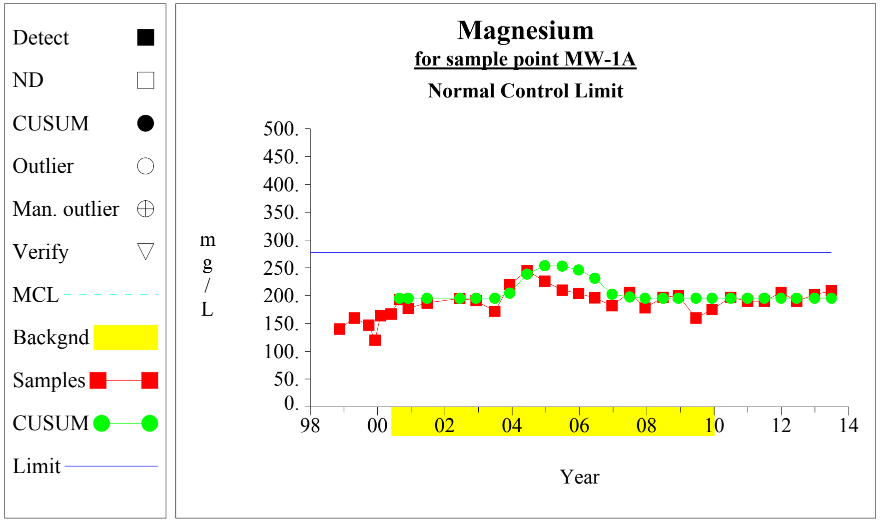


Graph 11



Graph 12

Intra-Well Control Charts



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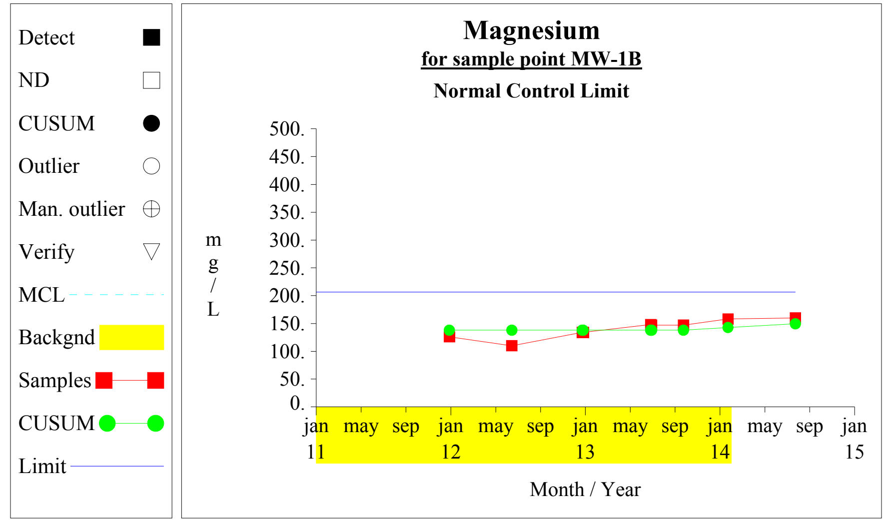
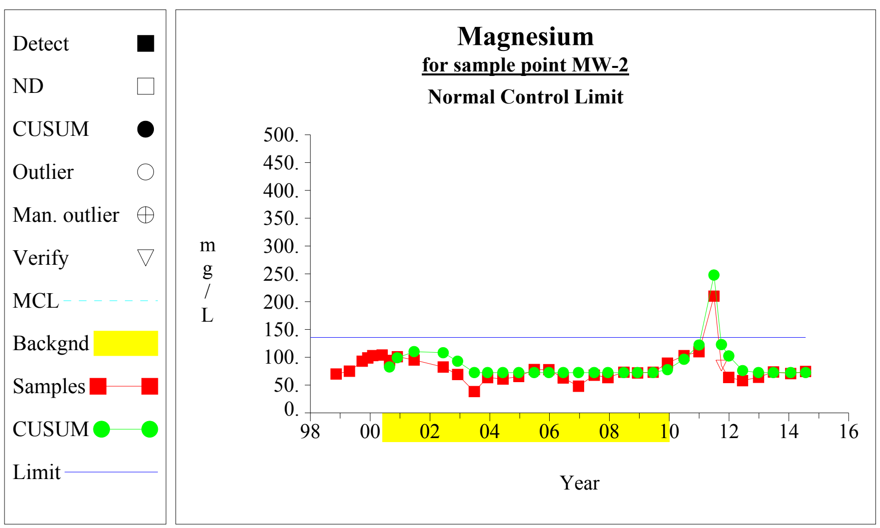
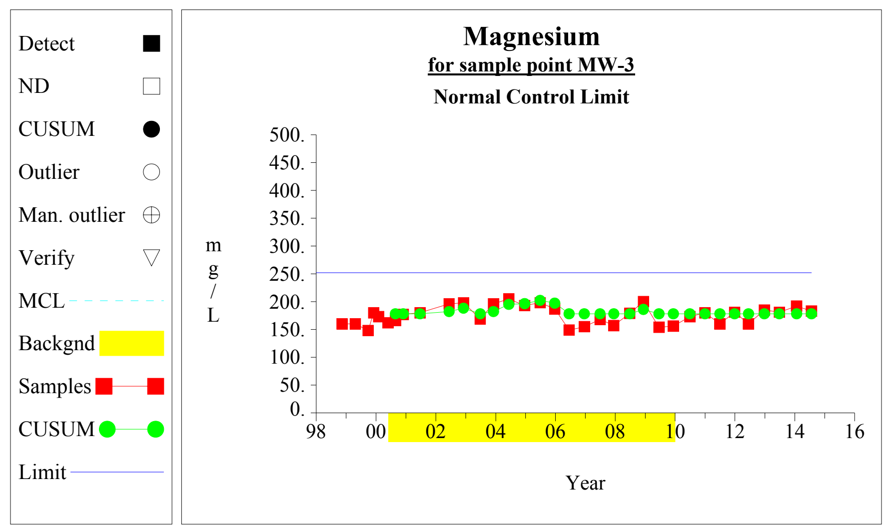


Graph 14

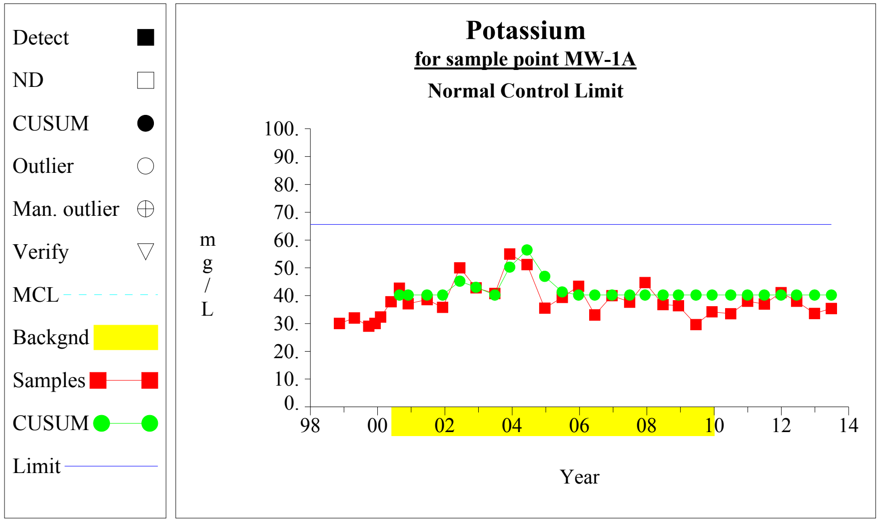


Graph 15

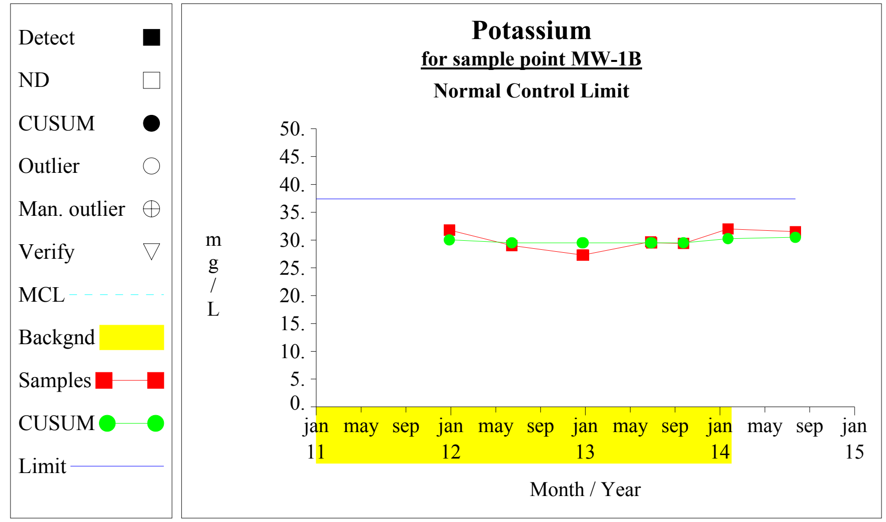


Graph 16

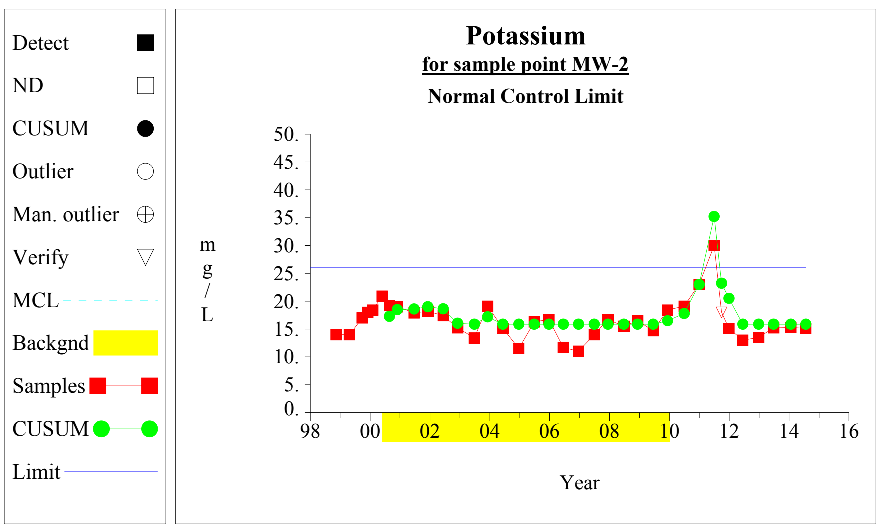
Intra-Well Control Charts



Graph 17



Graph 18



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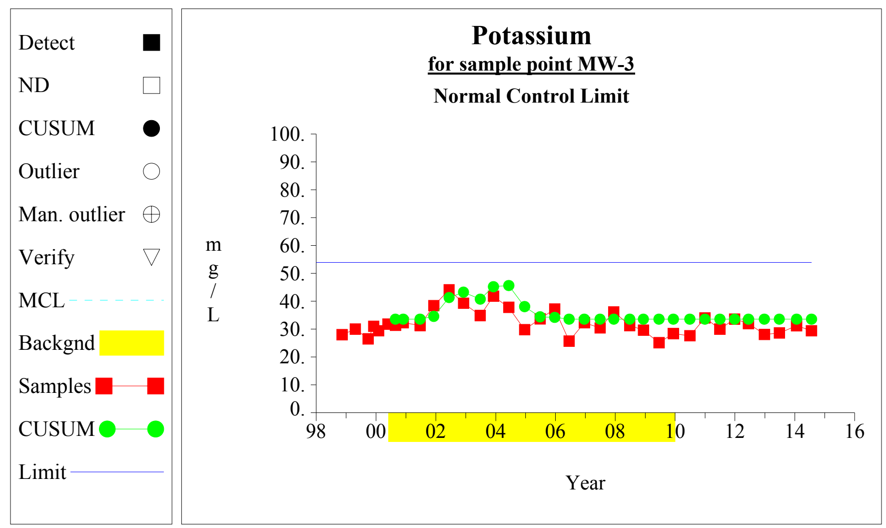
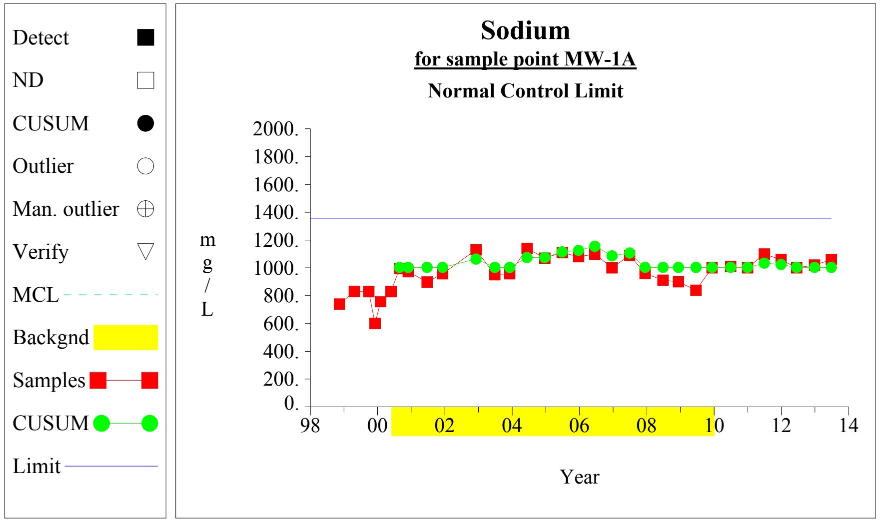


Graph 20

Intra-Well Control Charts



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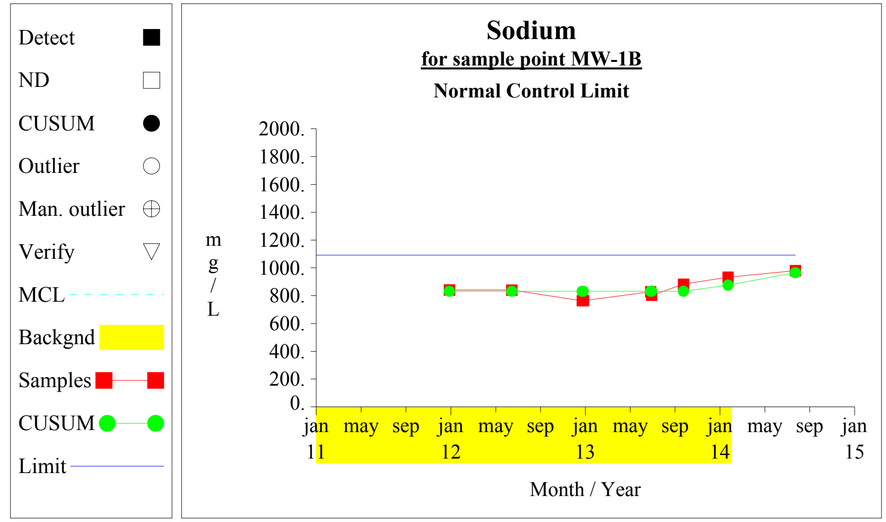

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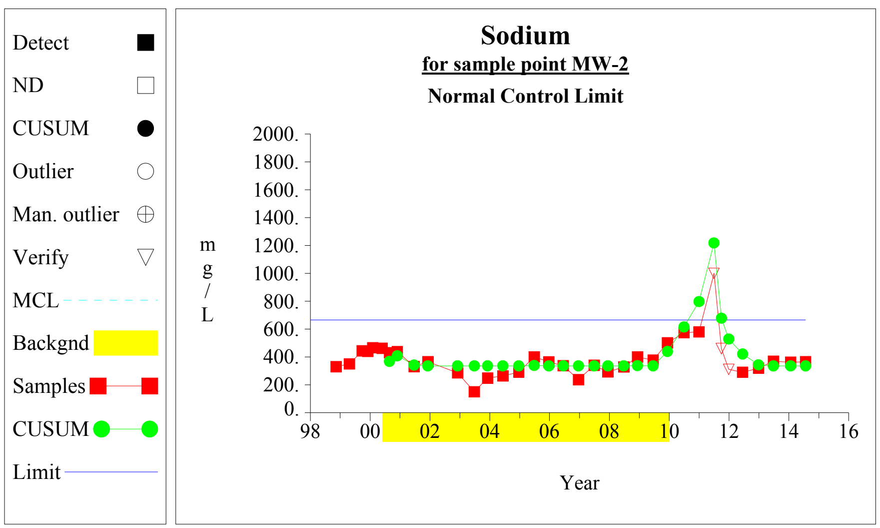

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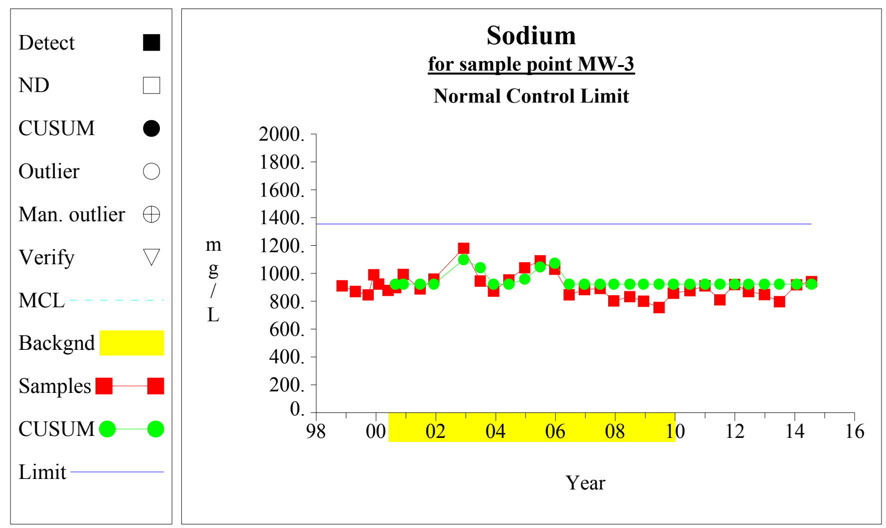

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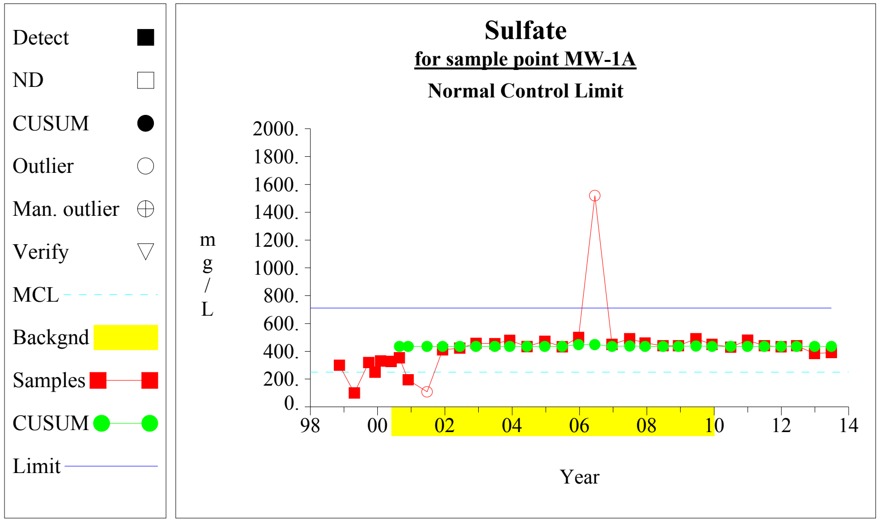

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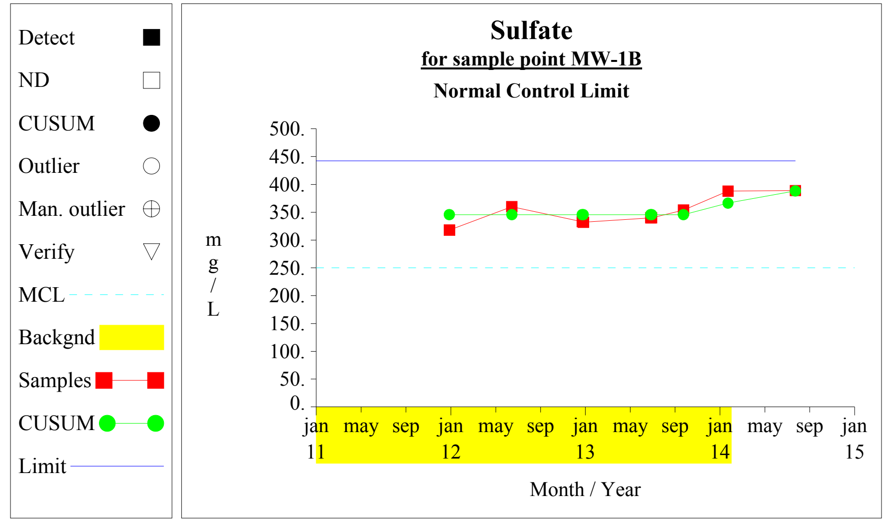

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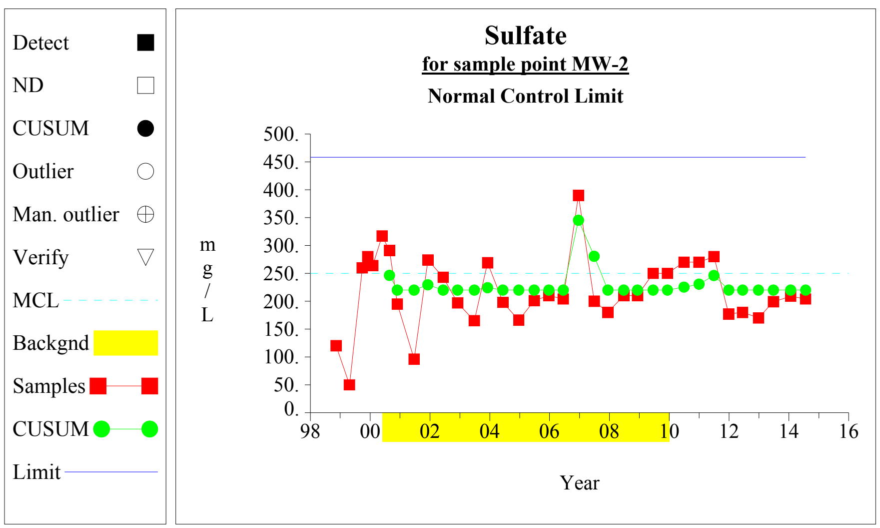

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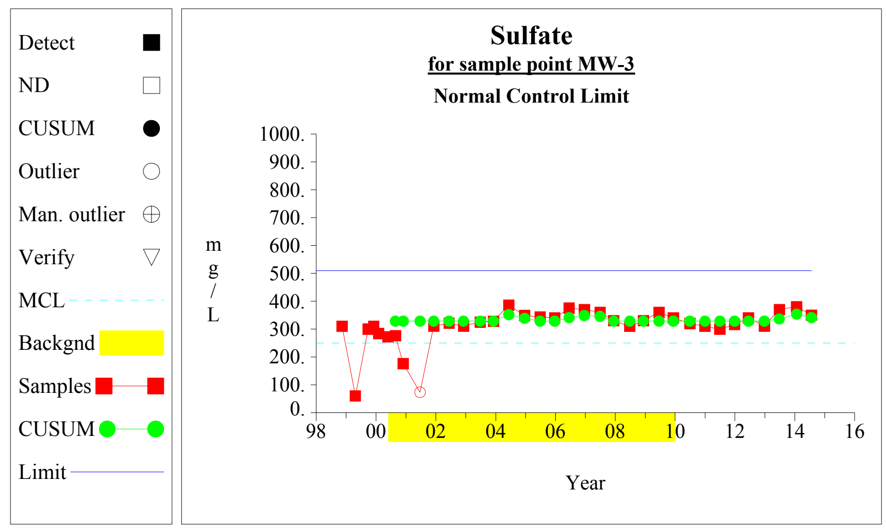

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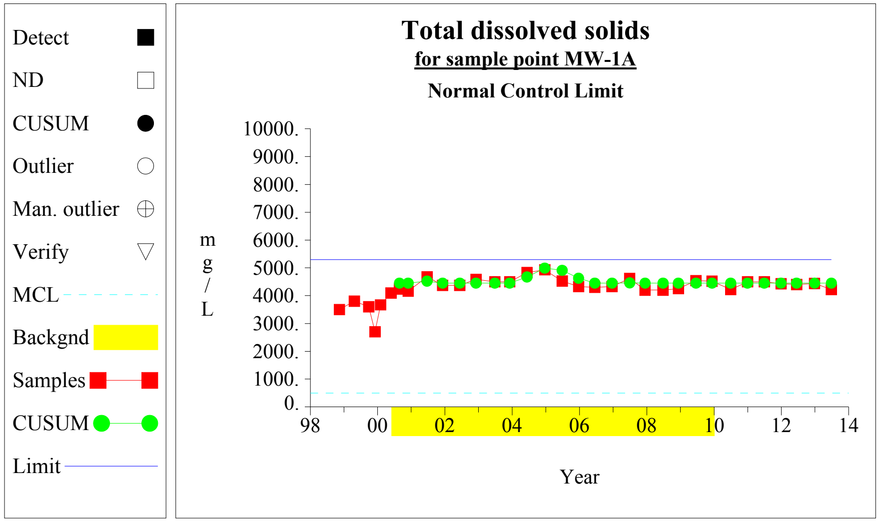

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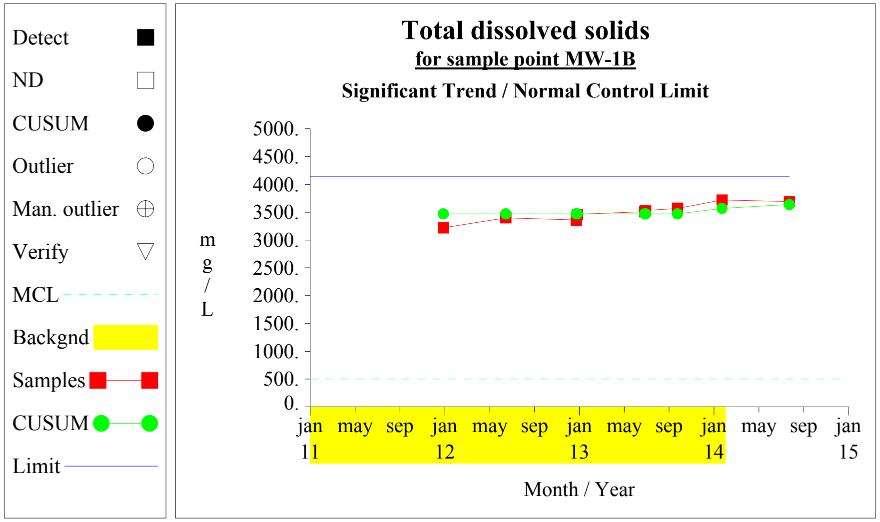

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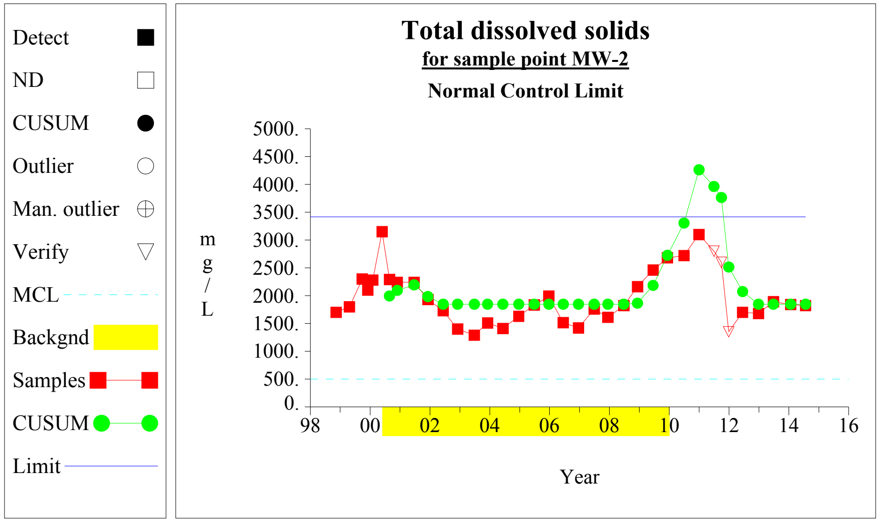

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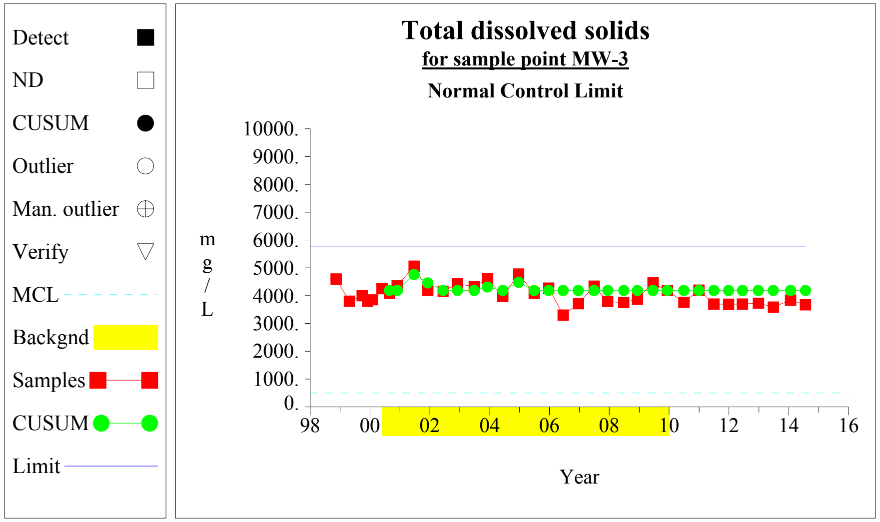

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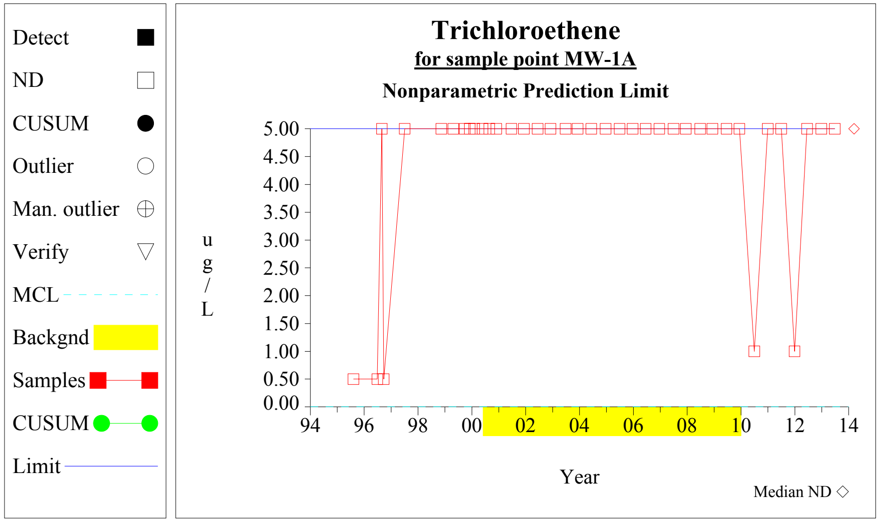

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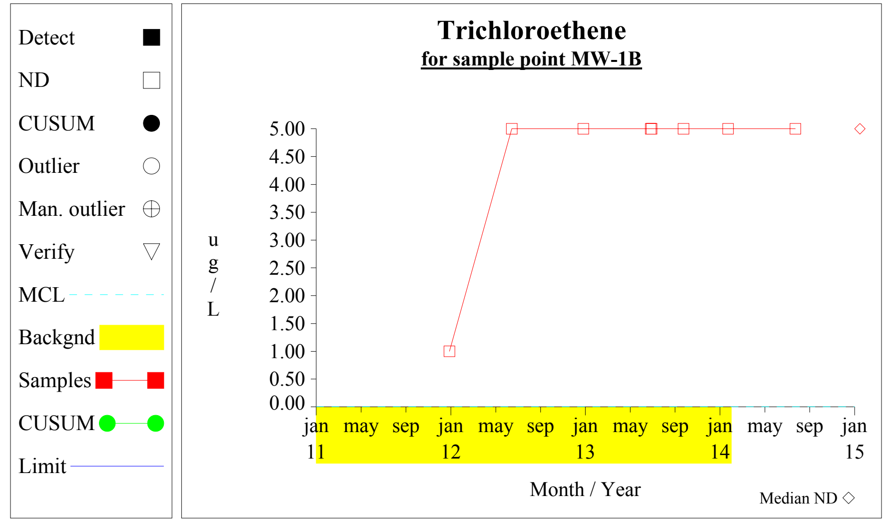

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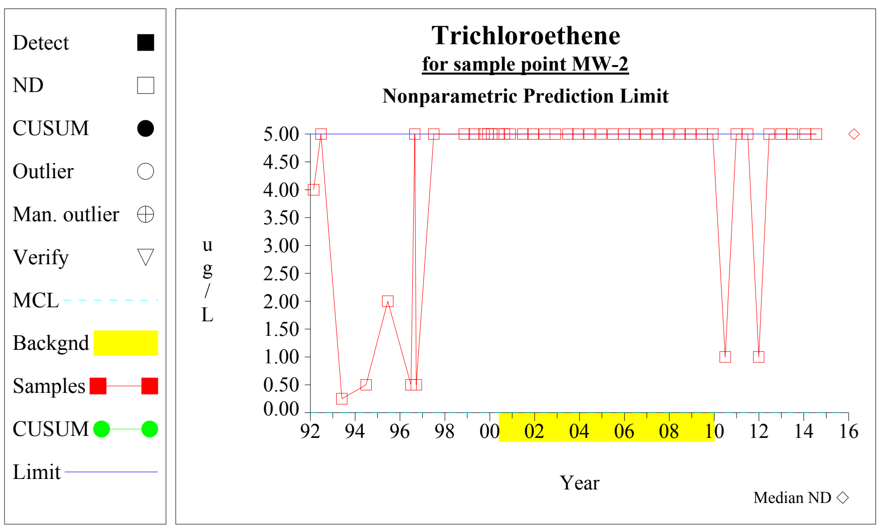

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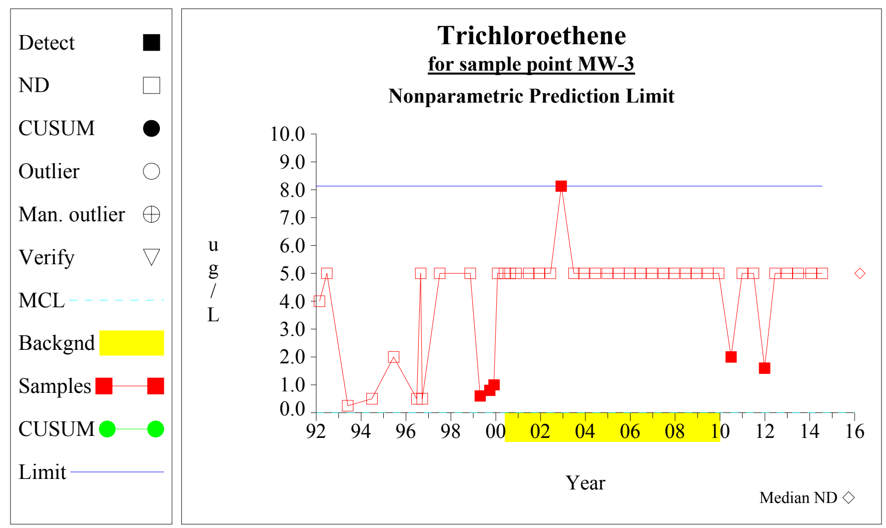
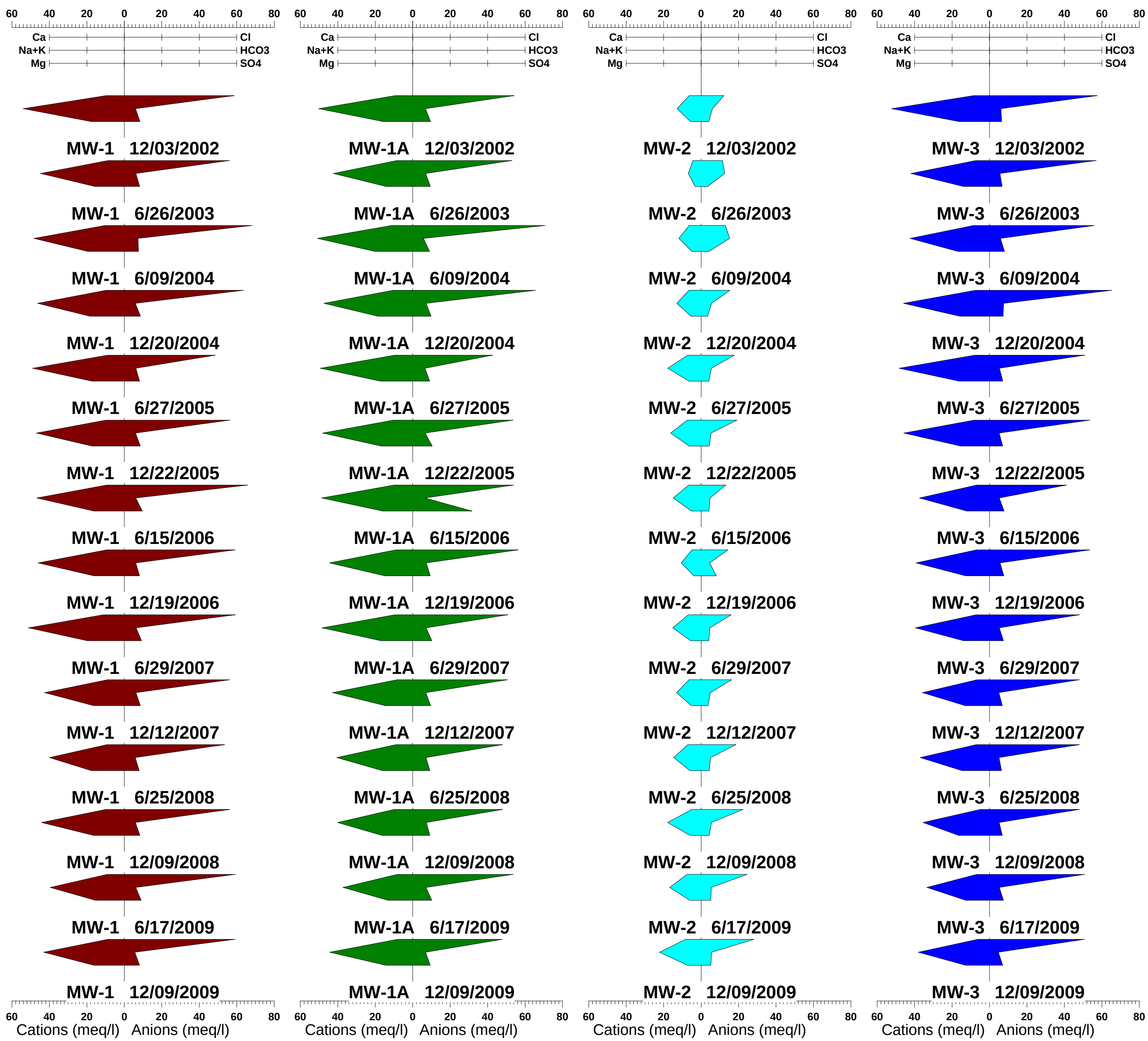


Graph 36

Attachment 3

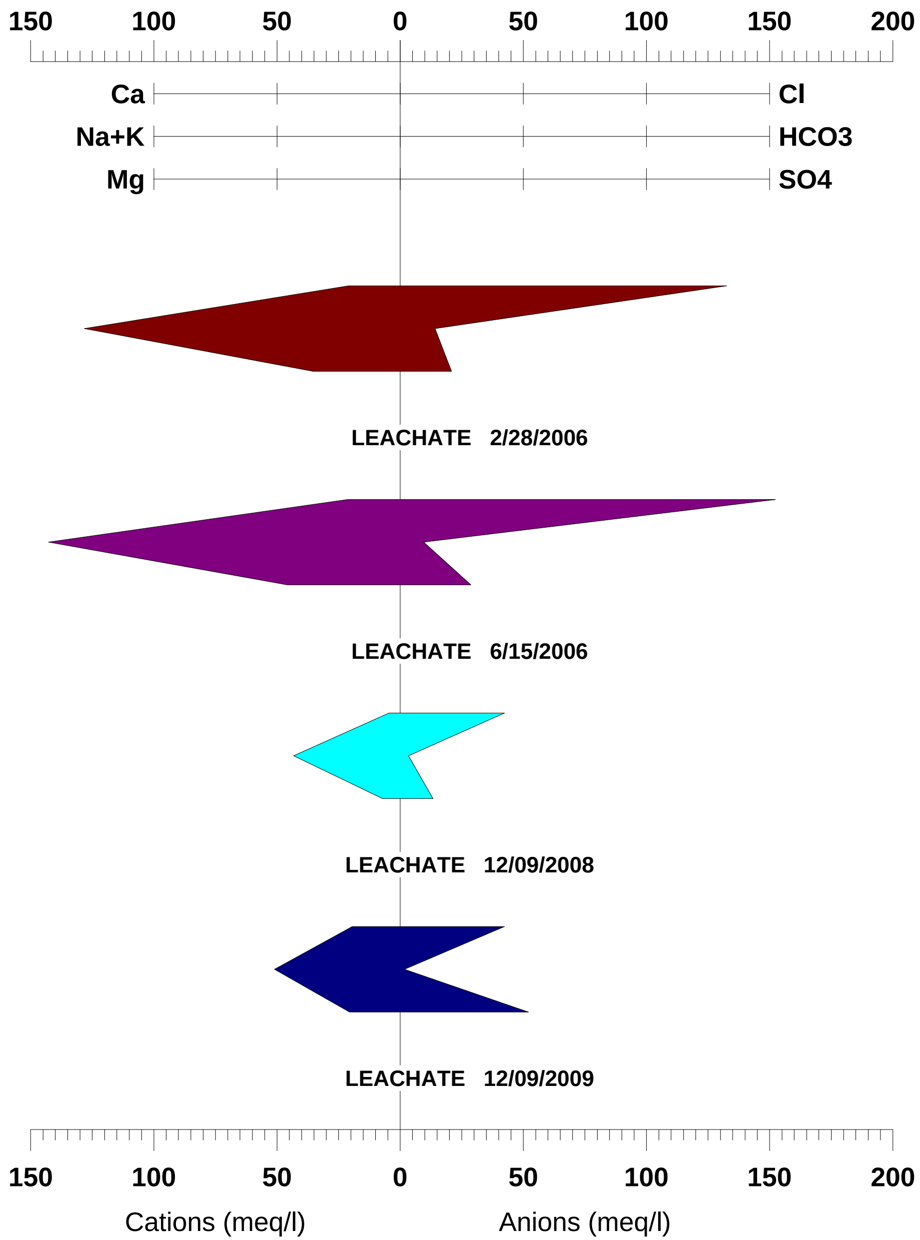
Stiff Diagrams and Trilinear Plots

PVT Landfill: Stiff Diagrams



Prepared by: Element Environmental, LLC

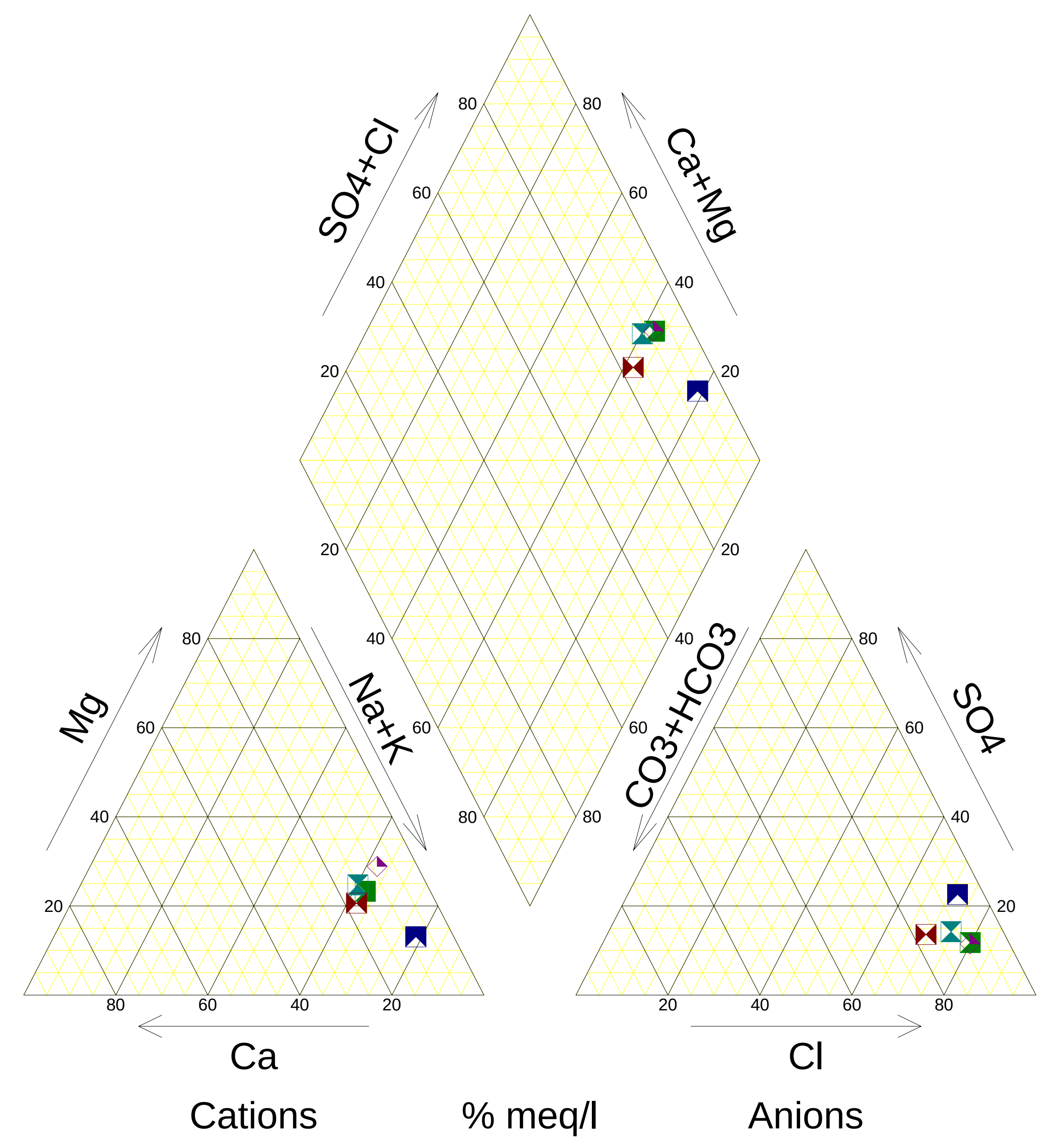
PVT Landfill



Prepared by: Element Environmental, LLC

PVT Landfill

LEACHAT	12/09/2008
MW-1	12/09/2008
MW-1A	12/09/2008
MW-2	12/09/2008
MW-3	12/09/2008



Prepared by: Element Environmental, LLC

PVT Landfill

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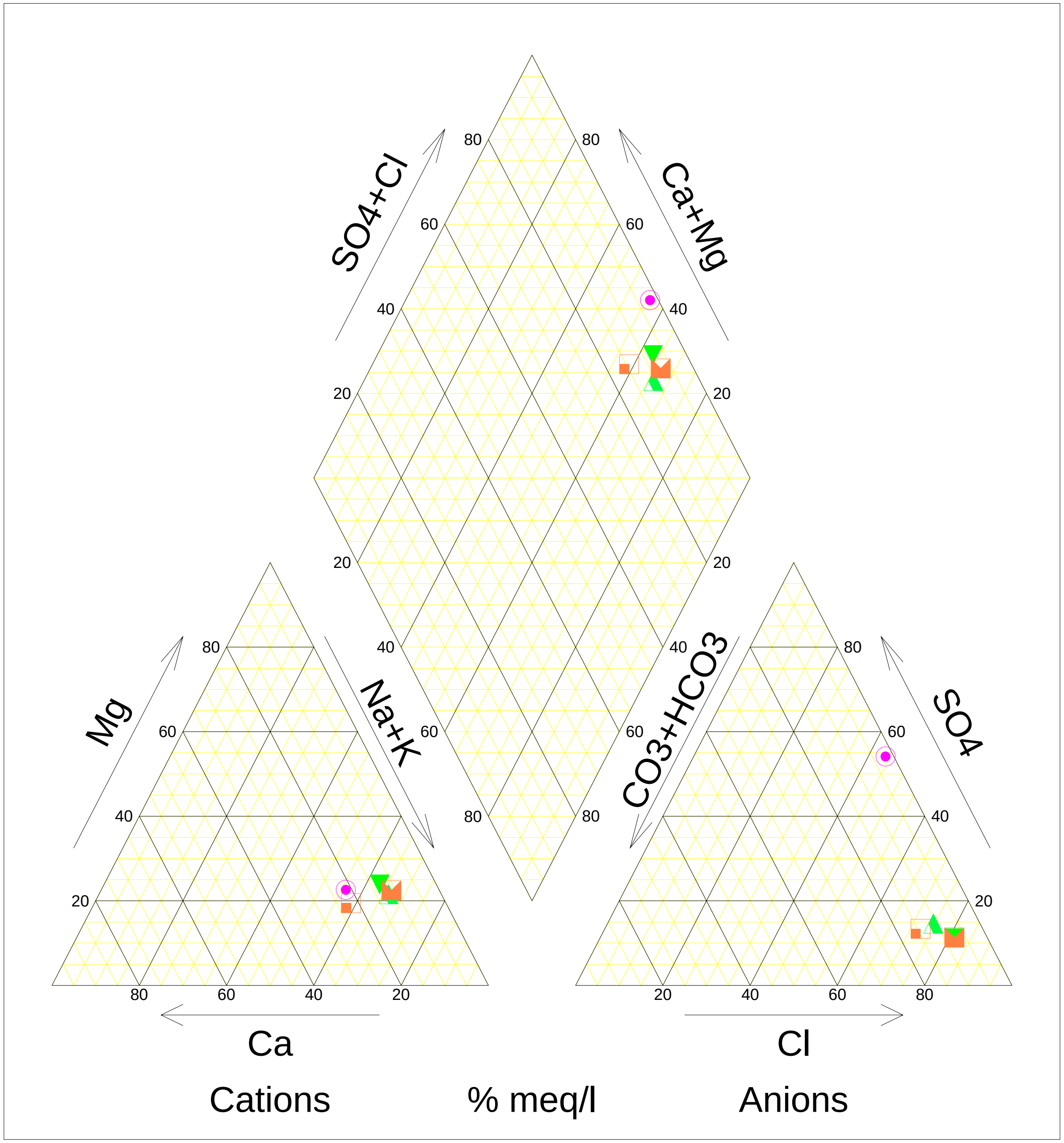
MW-1A	12/09/2009
MW-2	12/09/2009
MW-3	12/09/2009



Prepared by: Element Environmental, LLC

APPENDIX C - HUMAN HEALTH RISK ASSESSMENT - CONSTRUCTION DEBRIS RECYCLING AND MATERIAL RECYCLING FACILITY

PVT LANDFILL
HUMAN HEALTH RISK ASSESSMENT
CONSTRUCTION DEBRIS RECYCLING
MATERIALS RECOVERY FACILITY

Submitted To:

PVT Land Company
87-2020 Farrington Hwy
Waianae, Hawaii 96792

Submitted By:

Environmental Risk Analysis LLC
820 W. Hind Drive #240606
Honolulu, Hawaii 96824

April 2015

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EXECUTIVE SUMMARY

Environmental Risk Analysis (ERA) has evaluated the potential for human health impacts associated with the new Materials Recovery Facility (MRF) for recycling at PVT Integrated Solid Waste Management Facility (ISWMF) Reclamation and Recycling System program. The PVT MRF replaced a smaller system to increase the quantity of debris that may be recycled at PVT. Up to 900 tons per day of construction and demolition (C&D) debris can be processed for use as feedstock for renewable energy, including gasification. The human health risk assessment (HHRA) described herein was designed to conservatively address concerns regarding potential dust generation and migration to surrounding residential communities. The following operations occur as part of the MRF operations which generate dust:

- Airborne dust impacts during delivery and stockpiling of debris/material
- Airborne dust impacts during the separation of metal recyclables
- Airborne dust impacts during the sorting of debris by size
- Airborne dust impacts during processing, crushing and shredding of feedstocks

Potential human health risk was assessed from the collection of dust samples in the immediate vicinity of the new MRF during full-scale operation. Air samples were collected upwind of the MRF operations, directly within the worker area of the MRF, and at two (2) locations downwind of the MRF operations.

Potential health risks via the inhalation pathway were estimated for adults and children who are assumed to live approximately ¼ mile downwind from dust generating activities. Barium and lead were detected in one dust sample collected in the immediate vicinity of the MRF. Chemical concentrations were modeled to residential locations using the SCREEN3 air dispersion model. Potential estimated lifetime cancer risks and noncancer hazards were compared to the U.S. Environmental Protection Agency (EPA) and State of Hawaii, Department of Health (HDOH) regulatory levels of concern for residential areas of one excess cancer in 1,000,000 people and total Hazard Index of 1. In addition, this study also evaluated whether it is safe for PVT ISWMF workers to work in and around the MRF. Dust concentrations and metals concentrations in dust during recycling operations were compared to Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) (OSHA, 2006) and EPA Regional Screening Levels (RSLs) for industrial site use (EPA, 2015a). OSHA PELs are time-weighted concentrations of dust or chemicals that should not be exceeded over an 8 hour period (OSHA, 2006).

WORKER RESULTS

To ensure worker safety, active air sampling for total metals and total dust was performed and compared to OSHA PELs and EPA RSLs for industrial air. Detected air concentrations of barium and lead were below both the OSHA PELs and the RSLs for industrial air. Respirable dust was detected in one downwind sample in the immediate vicinity of the MRF at 0.09 milligrams per cubic meter (mg/m^3). The OSHA PEL for respirable dust is 5 mg/m^3 (OSHA, 2006). Respirable dust concentrations from the MRF operations were below the OSHA PEL for worker safety. As no chemical constituents were detected above the OSHA PEL or the RSLs for industrial air, hazards were identified as low and the worker scenario was eliminated from further evaluation in the HHRA.

RESIDENT RESULTS

The residential scenario assumed fugitive dust is generated during delivery and stockpiling of debris/material; during separation of recyclables from the waste stream; during sorting waste by size; and during processing, crushing and shredding of feedstock. The residential scenario assumed migration of fugitive dust (24 hours per day, 7 days a week) to residential areas located approximately ¼ mile away from dust generating activities. In reality, the majority of recycling activities (e.g., processing of material) will only occur during working hours. The nearest residences are located approximately ¼ mile from the MRF, however the majority of residential receptors would be located at a greater distance from the MRF.

Noncancer hazard quotient from barium inhalation was 0.002 which is well below the regulatory level of concern of 1. Barium is not considered carcinogenic, therefore excess lifetime cancer risk was not evaluated. Lead hazards are presented in this HHRA as blood-lead (PbB) concentrations. The HHRA compared calculated PbB concentrations to both the EPA regulatory risk value of 10 micrograms per deciliter (µg/dL) and the regulatory risk value promulgated by HDOH of 5 µg/dL. The maximum calculated PbB was 1.8 µg/dL for children aged 1-2, substantially lower than the EPA and HDOH regulatory levels of concern.

Arsenic and chromium may be present at low levels in the waste stream from Chromated Copper Arsenate (CCA) treated wood. Arsenic and chromium were evaluated separately from chemicals of potential concern (COPCs) detected in the air monitoring samples. Arsenic and chromium were not detected in a single air sample collected, however their analytical limits of detection were not low enough to adequately be protective of human health in a residential scenario. In order to estimate the concentration of arsenic and chromium transported by fugitive dust to resident locations, the chemical concentrations in bulk materials from a demonstration study performed by ERA in 2010 was utilized to estimate the concentration of COPCs in the fugitive dust. In this study, arsenic and chromium were "spiked" into the bulk material samples. Arsenic and chromium concentrations in air were estimated by modeling bulk material (source) concentrations to receptor locations as a percentage of the respirable dust concentration.

Human Health Risks from modeled source concentrations were well below all applicable regulatory levels of concern. Residential scenarios resulted in a noncancer hazard index of 0.003, well below the regulatory level of concern of 1. The total residential excess lifetime cancer risk (including 6 years as a child, and 20 years as an adult) was determined to be 1E-07 or a 1 in 10,000,000 probability that a resident will develop cancer in his or her lifetime, over and above the background cancer rate. This is well below the point-of-departure regulatory level of concern for residential receptors of 1E-06 or 1 in 1,000,000.

The recycling program does not pose a significant threat to human health. The chemical driver responsible for the majority of cancer risk and noncancer hazard was arsenic assumed present in the bulk material (i.e., the HHRA assumed that arsenic was present in bulk material by "spiking" it with a conservative quantity of CCA treated lumber). Concentrations of CCA treated wood are anticipated to be much lower based on waste acceptance records provided by PVT. Real-life data corroborates this, as arsenic was not detected in any of the air samples collected in this study.

ERA has estimated health impacts to nearby residents from potential air sources originating from the recycling program and determined it is safe. PVT Landfill workers who are involved in the program and work on or around the MRF were also evaluated by comparison of detected air concentrations to applicable industrial worker thresholds (OSHA PELs, EPA RSLs). Air concentrations did not exceeded any industrial worker thresholds, therefore risk and hazards to PVT Landfill workers is also low. The MRF operation does not pose a potentially significant threat to human health or the environment.

1.0 INTRODUCTION

PVT Land Company has retained Environmental Risk Analysis LLC (ERA) to evaluate potential human health risks associated with new Materials Recovery Facility (MRF) operations for the recycling of construction and demolition (C&D) materials. The human health risk assessment (HHRA) was prepared to address potential concerns about the safety of the proposed recycling operations, including the use of the new MRF at the PVT Integrated Solid Waste Management Facility (ISWMF) (Figure 1). The MRF will generate dust which could impact surrounding residential neighborhoods. The plant is part of a larger recycling initiative that significantly reduces the volume of material going to landfill, provides the State with an additional renewable source of fuel gas and aligns PVT operations with the State's Clean Energy Initiative and Integrated Solid Waste Management Plan. The PVT recycling system replaced a smaller system to increase the quantity of debris that may be recycled at PVT. Up to 900 tons per day of C&D debris can be processed for use as feedstock for renewable energy, including gasification. Gasification is a process in which the feedstock from C&D debris may be burned to produce clean synthetic natural gas or liquid natural gas for use a fuel to produce electricity. The following operations occur as part of the MRF operations which generate dust:

- Airborne dust impacts during delivery and stockpiling of debris/material
- Airborne dust impacts during the separation of metal recyclables
- Airborne dust impacts during the sorting debris by size
- Airborne dust impacts during processing, crushing and shredding of feedstocks

The study described herein was designed to conservatively address these concerns.

1.1 Site and Sampling Area Location

The PVT ISWMF Site is located at on Lualualei Naval Road on the western side of the island of O'ahu, in Nanakuli, Hawai'i (Figure 1). The PVT ISWMF Site consists of an irregularly shaped 15.44-acre parcel of land (Latitude/Longitude: 21º 23' 50'' N/158º 09' 00''W). The Site is bounded by residential areas at its southern and western borders.

PROJECT NAME:	FIGURE TITLE: Site Location Map
PVT Landfill Human Health Risk Assessment Construction Debris Recycling Material Recycling Facility	FIGURE NUMBER: 1

Environmental Risk Analysis

1.2 General Study Approach

The PVT ISWMF Reclamation and Recycling System program is an expansion to the current recycling program at PVT. PVT has implemented a new MRF operation that processes approximately 900 tons per day of debris. The material is processed by separating combustibles from metal recyclables and course shreds. The PVT Reclamation and Recycling System is the latest addition to the PVT ISWMF. Each day, trucks offload about 1,775 tons of construction debris at PVT. PVT is able to recycle up to 80 percent of the debris that enters the facility, with roughly 40 percent of that being available for use as feedstock. Of the approximately 1,775 tons of C&D debris which enters PVT, approximately 42 tons are metals for recycling. Concrete, rock and dirt account for 840 tons which can be recycled for use on roads at the facility. An additional 900 tons of C&D debris may be processed for use as feedstock for renewable energy, including gasification. The process of sorting C&D materials for recycling is as follows:

- Excavators load debris into the feed conveyor, pulling out pieces of metal, concrete and wood that are too large to pass through the system.
- A vibrating screen allows debris less than six inches in size to fall through onto an “unders” conveyor belt. Debris over six inches in size continues to the “overs” conveyor. Roughly 60 percent of debris is in the “overs” category.
- At the top of the “unders” conveyor, a magnetic separator pulls anything magnetic (hinges, nails, bolts, and other metal pieces) from the conveyor and drops it into a metals bin.
- A secondary taper slot separates dirt, rocks, broken glass and other pieces of debris that are less than one inch in size. These will be stockpiled and taken to the landfill.
- Strong blasts of air lift lighter pieces of debris and allow heavy pieces to fall through to a conveyor that carries them to a waiting bin. Debris continues on to the “unders” sorting line.
- On the “unders” sorting line, workers clean and separate, pulling pieces of rock, metal, and other materials from the debris stream.
- Ferrous metal, aluminum, copper, and wire are all pulled and dropped into assigned bins. The goal is to allow only debris suitable as feedstock to continue on to the grinder.
- Feedstock debris drops onto the grinder feed conveyor. Before it reaches the grinder, it will pass beneath yet another magnetic separator that will pull any remaining magnetic items.
- On the “overs” sorting line, a team of ten workers sorts debris six inches in size and over, pulling metals and other materials from the debris stream. These are dropped into bins below the sorting line for further recycling.
- Debris suitable for feedstock is ground and shredded into pieces of uniform size and stockpiled for pickup.

In this risk assessment, health risks from chemicals in fugitive dust from the new MRF operations were evaluated to determine if unacceptable levels are generated that migrate and impact human health of surrounding residents. Evaluation of potential health risks due to MRF operations requires 1) an estimation of dust generation from these activities, 2) modeling of dust to receptor locations, 3) estimation of metals concentrations at receptor locations, and 4) estimation of cancer risks and noncancer hazards. Each of these steps is discussed in the sections below.

The technical approach of this study and the HHRA was performed in accordance with standards, principles and guidance documents including but not limited to:

- Sampling and Analysis Plan Guidance and Template (EPA, 2000).
- ASTM Standard D6051-96 (revised in 2001), Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities (ASTM 2001).
- Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples EPA/600/R-03/027, November, 2003.
- Risk Assessment Guidance for Superfund (RAGS): Human Health Evaluation Manual, Part A (U.S. Environmental Protection Agency [EPA] 1989)
- EPA guidance documents (EPA 1991a, 1991b, 1992, 1994a, 1995b, 1996, 1997, 2002, and 2011)
- EPA Regional Screening Level (RSL) Tables. Revised January 2015 (EPA 2015a)

2.0 ESTIMATION OF DUST GENERATION

Estimation of dust from the expanded MRF was accomplished by field measuring dust from currently ongoing operations *in total* (i.e., measuring dust generated from all current activities: stockpiling of bulk material, separation of recyclables, sorting the materials by size, and shredding).

2.1 Dust Associated with Current Operations

PVT currently stockpiles feedstock material, separates combustible material from metal recyclables, sorts materials by size, and coarse shreds materials for recycling. ERA collected air samples from the immediate vicinity of the MRM during current processing activities and analyzed samples for total Resource Conservation and Recovery Act (RCRA) 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), total dust and respirable dust (PM10). Sampling methodology and results for each analysis is described below.

Air Monitoring for Total RCRA 8 Metals, Respirable Dust, and Total Dust

Air sampling was conducted over the course of three (3) days. Each day, active air sampling for RCRA 8 metals, total dust, and respirable dust employed four (4) air pumps for each sampling location. A set of pumps were situated at four (4) locations in and around the immediate vicinity of the MRF. Locations included:

- upwind of processing activities,
- within the worker area of the MRF, and
- two (2) locations approximately 50 yards downwind of processing activities.

Low-flow pumps were set at an air collection rate appropriate for the chemicals of concern:

- Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Total Dust – 2.0L/min
- Mercury – 0.25L/min
- Silver – 2.0L/min
- Respirable Dust – 2.5L/min

Low-flow pumps were set up and collected air samples during all dust generating activities. Photographs of the air sampling even are presented in Appendix A. Analytical laboratory results are provided in Appendix B and are summarized in Table 2-1. Only barium and lead were detected above laboratory reporting limits in a single downwind sample of the twelve (12) samples collected. Barium and lead air concentrations were compared to the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) (OSHA, 2006), the National Ambient Air Quality Standards (NAAQS), and to establish a baseline risk estimate, were also compared to the

EPA Regional Screening Levels (RSLs) for air in residential and industrial scenarios (EPA, 2015a). Detected air concentrations of barium and lead were below both the OSHA PELs and the RSLs for industrial air. Lead dust concentrations detected exceeded the RSL for residential air and the NAAQS. As this dust sample was collected in the immediate vicinity of the MRF, the residential RSL and the NAAQS are not applicable.

Respirable dust was detected in the downwind samples at 0.09 mg/m^3. The OSHA PEL for respirable dust is 5 mg/m^3 (OSHA, 2006). Respirable dust concentrations from the MRF operations were below the OSHA PEL for worker safety and the NAAQS.

As no chemical constituents were detected above the OSHA PEL or the RSLs for industrial air, no hazards were identified for workers at PVT ISWMF and the worker scenario was not further evaluated in the HHRA.

TABLE 2-1

OCCURRENCE, RISK-BASED SCREENING AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

DUST SAMPLES, RECYCLING OPERATIONS

PVT LANDFILL, NANAKULI, HAWAII

Exposure Point	Chemical	Maximum Concentration Detected (Qualifier)	Units	Location of Max Detect	Detection Frequency			(%)	Maximum Limit of Quantitation	OSHA PEL	Exceeds OSHA PEL (Y/N)	National Ambient Air Quality Standards	Exceeds National Ambient Air Quality Standards (Y/N)	EPA RSL Residental Air	Exceeds EPA Residential RSL (Y/N)	EPA RSL Industrial Air	Exceeds EPA Industrial RSL (Y/N)
Dust from Recycling Operations	Arsenic	-	mg/m^3	-	0	/	12	0.0%	0.00029	0.01	N	-	N	0.00000065	N	0.0000029	N
	Barium	0.00049	mg/m^3	212-DW1	1	/	12	8.3%	0.00014	0.5	N	-	N	0.00052	N	0.0022	N
	Cadmium	-	mg/m^3	-	0	/	12	0.0%	0.000029	0.005	N	-	N	0.0000016	N	0.0000068	N
	Chromium	-	mg/m^3	-	0	/	12	0.0%	0.014	0.005	N	-	N	0.000000012	N	0.00000015	N
	Lead	0.00027	mg/m^3	212-DW1	1	/	12	8.3%	0.00014	0.05	N	0.00015	**Y**	0.00015	**Y**	-	N
	Selenium	-	mg/m^3	-	0	/	12	0.0%	0.0043	0.2	N	-	N	0.021	N	0.088	N
	Mercury	-	mg/m^3	-	0	/	12	0.0%	0.00062	0.1	N	-	N	0.00031	N	0.0013	N
	Silver	-	mg/m^3	-	0	/	12	0.0%	0.00058	0.01	N	-	N	-	N	-	N
	Respirable Dust (PM10)	0.09	mg/m^3	212-DW1	1	/	12	8.3%	0.077	5	N	0.15	N	-	N	-	N
	Total Dust	-	mg/m^3	-	0	/	12	0.0%	0.38	15	N	-	N	-	N	-	N

Notes:

Screening of dust concentrations at the emission source was conducted to provide provide a baseline potential risk range. All detected chemicals were carried forward for dust migration modeling to the nearest residential receptor

OSHA PEL - General Industry based on an 8-hour time weighted average

Arsenic PEL and RSL based on inorganic arsenic.

Chromium PEL and RSL based on chromium VI

Mercury PEL based on particulate mercury

PM10 PEL based on the respirable fraction of dust

The NAAQS for lead is based on a 3 month average. The NAAQS for lead are not directly applicable to the detected concentrations of lead as samples were collected only during dust generating activities at the emission source

EPA = Environmental Protection Agency

mg/m^3 = milligrams per cubic meter

NAAQS = National Ambient Air Quality Standards

OSHA = Occupational Safety and Health Administration

PEL = Permissible Exposure Limit

RSL = Regional Screening Levels

$\mu g/m^3$ = micrograms per cubic meter

3.0 AIR DISPERSION MODELING OF DUST TO RESIDENT LOCATIONS

Air emission data were evaluated using SCREEN3. Barium, lead and respirable dust were modeled to the nearest residential community which was assumed to be located approximately 1/4 mile from the MRF operations. No evaluation for deposited particulates was performed but is anticipated to not be significant based on the low level of contaminants at the MRF source.

The maximum chemical concentration from the one sample with detections above laboratory reporting limits was used as the Reasonable Maximum Exposure (RME) point concentration in the air dispersion model, SCREEN3. SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources, as well as concentrations in the cavity zone, and concentrations due to inversion break-up and shoreline fumigation. SCREEN3 is a screening version of the ISC3 model. The SCREEN3 air dispersion model (Version 13043) (EPA, 2005a, 2013) was used to predict off-site ambient concentrations based on the calculated emission rates for the MRF operations.

3.1 Dust Emission Rate Calculations

Emission rates were calculated for MRF operations to estimate the amount of dust generated at the point of production. These emission rates were then be used in the SCREEN3 air dispersion model to estimate the amount of dust at a residential community assumed to be ¼ mile downwind. Emission rates were calculated as described in the following sections.

Emission Rate from MRF Operations

Estimation of emission rates of barium, lead, and respirable dust from the MRF operations was accomplished by field measuring concentrations from currently ongoing operations *in total* (i.e., measuring dust generated from all current activities: stockpiling of bulk material, separation of recyclables, sorting and coarse shredding). The emission rate (Q) during these activities was determined using the Box Model described by Stern (Stern, 1984). The maximum detected concentration from a single sample with detections above laboratory reporting limits was conservatively chosen as the concentration to estimate emission rates from the MRF operations.

The Box Model is presented as below:

$$E_{10} = (L \times Q / (h \times u_{mean})) \times 10^6$$

or

$$Q = (E_{10} \times h \times u_{mean}) / (L \times 10^6)$$

where:

Q: emission rate (g/s-m^2)

E_{10}: air concentration (µg/m^3)
h: mixing height
u_{mean}: mean wind speed (m/s), and
L: landfill length.

The air concentration (E_{10}) was derived from the maximum detected site-specific data obtained from a single sample during the air monitoring sampling. This assumption is a conservative estimate of the dust generated by MRF operations as the maximum detected concentrations were detected entirely downwind of the activities and within the immediate vicinity of the MRF.

Two emission rates were calculated based on the mean wind speeds during the wet (November through March), and dry (April through October) seasons. Wind speed data was site-specific based on the past year of meteorological data provided by the PVT weather station. Wind speed data collected every 15 minutes from the past year (January 1, 2014 through April 1, 2015) was averaged across each season. The average wind speed from November through March was 2.68 meters per second (m/s). The average wind speed from April through October was 2.26 m/s.

The emission rate for barium, lead and respirable dust are presented in Table 3-1. Calculations are presented in Appendix C. Calculations were based on the following equation and variables:

$$Q = (E_{10} \times h \times u_{mean}) / (L \times 10^6)$$

Parameters	Value	Reference
Q: emission rate (g/s-m^2)		calculated
E10: air concentrations (µg/m^3)		maximum detected concentration from air sampling
h: mixing height	10	site-specific based on the approximate size of the MRF
u_{mean}: mean wind speed (m/s)	2.68 2.26	wet season (November – March) average dry season (April – October) average
L: landfill length	50	site-specific based on the approximate size of the MRF

3.2 Fugitive Dust Concentration

The SCREEN3 air dispersion model (Version 13043) (EPA, 2005a, 2013) was used to predict off-site ambient dust concentrations for various scenarios based on the calculated emission rates for the MRF operations as described in the previous section. SCREEN3 determines 1-hour maximum chemical concentrations under worst-case wind conditions. It assumes that fugitive dust blows in the direction of the receptor continuously, 100% of the time. The model does not allow for an adjustment to be made to the percentage of time wind blows in the direction of the residents over a longer averaging time. To account for this, EPA states that annual average PM10 concentrations should be calculated by multiplying the 1-hour maximum concentration by a factor of 0.08 (EPA, 1992). However, this assessment utilized a Hawaii-specific value of 0.2 (Personal Communication with HDOH HEER Office). 0.2 is a factor which considers Hawaii-specific wind and meteorological conditions and is 2.5 times more health protective than the EPA factor.

The source area for MRF operations (stockpiling of bulk material, separation of recyclables, sorting material by size and coarse shredding of bulk material) were modeled as ground-level sources of 50 x 20 square meters. The area is the approximate area of the MRF operation activities.

SCREEN3 Areas Source calculations were based on the following assumptions:

Parameter	Value
Source type	area
Source release height	0.1 m
Length of larger side for area	50 m
Length of smaller side of area	20 m
Receptor height above ground	1.8 m
Urban or Rural Area	Rural
Meteorology	
Stability class	1 – Unstable/Turbulent
Anemometer height wind speed	Wet - 2.68 m/s Dry – 2.26 m/s

As noted above, air dispersion modeling was conducted for both dust generated during the wet and dry seasons. Source area dimensions were based on the approximate size of the MRF processing area.

The SCREEN3 air dispersion model calculations are presented in Appendix C. Table 3-1 lists the measured air concentration measured at the site, the calculated emission rate, and SCREEN3 results at 1/4 mile after the 0.2 adjustment factor is applied.

The respirable dust concentration at the location 1/4 mile from the MRF estimated by the SCREEN3 model was 0.1711 $\mu g/m^3$. Although not directly comparable, this estimated annual average is significantly lower than the NAAQS PM10 24 hr average limit of 150 $\mu g/m^3$. The estimated lead and barium air concentrations at the location 1/4 mile from the MRF were also less than the EPA RSLs for residential air. The SCREEN3 model predicted the same air concentrations for respirable dust, barium, and lead during both the wet and dry seasons. As no distinguishable seasonable variability was predicted, no further evaluation of the wet and dry seasons was conducted. The estimated chemical concentrations were evaluated as an annual average for receptor exposure.

TABLE 3-1

EXPOSURE POINT CONCENTRATIONS (EPCs)

DUST SAMPLES, RECYCLING OPERATIONS

PVT LANDFILL, NANAKULI, HAWAII

Exposure Point	Chemical of Potential Concern	Maximum Concentration (mg/m^3)	Limit of Quantitation (mg/m^3)	Dust at Emission Source Exposure Point Concentration		Calculated Emission Rate		Modeled 1-hour Maximum Dust Exposure Point Concentration at Receptor Location		Hawaii-Specific 1-hour maximum Adjustment Factor	Modeled Average Dust Exposure Point Concentration at Receptor Location	
				Value (mg/m^3)	Statistic	Wet Season ($g/s\text{-}m^2$)	Dry Season ($g/s\text{-}m^2$)	Wet Season ($\mu g/m^3$)	Dry Season ($\mu g/m^3$)		Wet Season ($\mu g/m^3$)	Dry Season ($\mu g/m^3$)
Dust from Recycling Operations	Barium	0.00049	0.00014	0.00049	Max	0.00000026	0.00000022	0.0047	0.0047	0.2	0.00093	0.00093
	Lead	0.00027	0.00014	0.00027	Max	0.00000014	0.00000012	0.0026	0.0026	0.2	0.00051	0.00051
	Respirable Dust (PM10)	0.09	0.077	0.090	Max	0.000048	0.000041	0.86	0.86	0.2	0.1711	0.1711

Notes:

The dust concentration at emission source is based on the maximum detected concentration.

The emission rate (Q) was determined using the Box Model described by Stern (Stern, 1984) based on detected concentrations, landfill length, mixing height and average wind speed.

Modeled dust concentration at receptor location was modeling using EPA SCREEN3 (EPA, 1995, 2013b) to model dust concentrations at a distance from the emission source. The nearest residential receptor is located 1/4-mile from the recycling operations.

SCREEN 3 is a single source Gaussian plume model which provides 1-hour maximum concentrations. It assumes that fugitive dust blows in the direction of the receptor continuously, 100% of the time. The model does not allow for an adjustment to be made to the percentage of time wind blows in the direction of the residents over a longer averaging time. That annual average PM10 concentrationswere calculated by multiplying the 1-hour maximum concentration by a factor of Hawaii-specific value of 0.2.

mg/m^3 = milligrams per cubic meter

$\mu g/m^3$ = micrograms per cubic meter

4.0 ESTIMATION OF CANCER RISKS AND NON-CANCER HAZARDS

A human health risk assessment was conducted to quantify potential risks to adult and children residents who might breathe site-related chemicals associated with current and future recycling activities. Chemicals of Potential Concern (COPCs) included barium and lead detected in dust samples collected. Residential receptors were evaluated assuming they would be exposed to recycling derived dust via the inhalation pathway only.

As described in Section 3 above, barium, lead, and respirable dust concentrations were modeled to specific receptor locations assumed 1/4 mile away from recycling operations using emission rates estimated from air sampling. The air dispersion model, SCREEN3 conservatively estimates maximum ground-level concentrations of respirable dust at specific set residential receptor points. Potential health risks via the inhalation pathway are then estimated for adult and child residents who reside approximately 1/4 mile from dust generating activities.

The purpose of a HHRA is to determine if a site poses acceptable risk and hazards based on current or future land use and current (i.e., baseline) site conditions if no response actions or institutional controls are applied at the site (EPA 1989). HHRAs also provide a basis for identifying concentrations of chemicals that can remain on site and still be adequately protective of public health. HHRAs are site-specific, thus they may vary both in detail and the extent to which qualitative and quantitative analyses are used, depending on the complexity and particular circumstances of the site (EPA 1989).

This HHRA was divided into the following four steps:

- Hazard Identification
- Exposure assessment
- Toxicity assessment
- Risk characterization

The following subsections discuss each of the four steps.

4.1 Hazard Identification

The Hazard Identification is the process of identifying COPCs for evaluation in the HHRA and to ensure that data are appropriate for use. This process includes various analytical steps that are followed to select a usable data set for evaluating exposures at a site. The level of effort and need for each step depends on the quantity of the data, the complexity of the site, and the analytical results. The following subsections discuss the steps required in this process.

In this step, compounds assumed to be of concern are selected for inclusion in the quantitative risk assessment. These compounds are designated as COPCs. COPCs for this investigation include only those detected in the active dust sampling: barium and lead. Arsenic, cadmium, chromium, mercury, selenium and silver were not detected in any sample collected and eliminated from consideration in the risk assessment process.

4.2 Toxicity Assessment

The toxicity assessment identifies toxicity values and effects to evaluate cancer risks and noncancer hazards. EPA states that the purpose of the toxicity assessment is to "weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects" (EPA, 1989). In essence, the toxicity assessment can also be described as a dose-response assessment. A dose-response assessment is used to identify the types of adverse health effects a COPC may potentially cause, as well as the relationship between the amount of COPCs to which receptors may be exposed (i.e., dose) and the likelihood of an adverse health effect (i.e., response). EPA characterizes adverse health effects as either cancer or noncancer and defines dose-response relationships for inhalation routes of exposure. The results of the toxicity assessment, when combined with the results of the exposure assessment, provide an estimate of potential risk.

The most current EPA-verified dose-response criteria were used in this assessment. Dose-response information was obtained from the following sources, in order of priority:

- U.S. EPA's RSL Tables (EPA, 2015a)
- U.S. EPA's Integrated Risk Information System (IRIS) (EPA, 2015b);
- Hawaii Department of Health; Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater; EHE Guidance (HDOH, 2011)

Noncancer dose-response information for both oral and dermal routes of exposure were not used as this assessment only characterizes inhalation risks to offsite receptors. To evaluate inhalation exposure, U.S. EPA has derived reference concentrations (RfCs) for certain compounds. For use in estimating noncancer hazards, these RfCs (in units of mg/m^3) are compared to an Exposure Concentration (EC) calculated based on the estimated Exposure Point Concentration. This conversion allows the risk assessment to consider receptor-specific exposure duration described in the exposure assessment.

To evaluate cancer risks from inhalation exposures, cancer dose-response values are generally provided as inhalation unit risk (IUR) values expressed in terms of (µg/m^3)-1. Cancer risk is estimated by multiplying this IUR value by the EC. Dose-Response information used in this assessment is listed in Table 4-1.

TABLE 4-1: DOSE-RESPONSE INFORMATION

Constituent	Inhalation Unit Risk Factor (µg/m^3)$^{-1}$		Inhalation RfC (µg/m^3)	
METALS				
Barium	NA		5.00E-01	a, b
Lead	NA		NA	

NA - Not Applicable
(a) RSL Table (2015a)
(b) Hawaii Department of Health EALs (2011)

The traditional risk assessment approach for evaluating effects from exposure to chemicals is based on a comparison of chemical intakes to an RfC or an IUR. This approach is inappropriate for lead because EPA has not identified a no-observable-adverse-effects level for lead (i.e., there is no RfC for lead). Similarly, EPA has not established an IUR for lead to evaluate cancer risks. Blood-lead (PbB) concentrations are accepted as the preferred measure of cumulative lead exposures. The Centers for Disease Control and Prevention (CDC) has stated that children with PbB concentrations greater than 10 micrograms per deciliter (µg/dL) may have adverse health impacts (CDC, 2005). EPA recommends that exposure to lead in soil should not result in a PbB concentration greater than 10 µg/dL for more than 5 percent of the population (EPA, 1994b, 1994c, and 1998). In other words, a typical child (or group of similarly exposed children) would have less than a 5 percent chance of exceeding the PbB concentration of 10 µg/dL based on exposure to lead in soil. However, results of recent studies indicated adverse health effects to children at PbB concentrations lower than 10 µg/dL. EPA is now targeting reductions in the number of children with PbB concentrations of 5 µg/dL or higher (EPA, 2015c). HDOH has followed suit and also recommends an action level for direct exposure to lead in residential soil of 200 mg/kg to reflect the more stringent PbB concentration of 5 µg/dL (HDOH, 2011). This HHRA compares calculated PbB concentrations to both the more stringent PbB concentration of 5 µg/dL as well as the less conservative, 10 µg/dL for child exposures to lead.

This HHRA used EPA’s Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (EPA, 2007, 2010) to assess residential lead risks. The EPA recommends the use of central tendency or average exposure values as inputs to the IEUBK Model to estimate PbB concentrations for receptors which have average or typical intake of environmental media, for comparison to the regulatory levels of concern. The IEUBK Model for Lead in Children estimates the PbB concentration for a hypothetical child or population of children via a plausible distribution of PbB concentrations centered on the geometric mean PbB concentration predicted by the available information about children's exposure to lead. From this distribution, the model calculates the probability that children's PbB concentrations will exceed the level of concern (5 µg/dL or 10 µg/dL). This assessment conservatively uses default model parameters for a residential scenario with the following notations: (a) This assessment uses the HDOH defined soil background lead concentration of 73 µg/g (HDOH, 2011) as the default soil concentration, (b) lead concentrations in air was based on the detected lead in air concentration, and (c) indoor air lead concentration was assumed to be equivalent (100 percent) to the outdoor air concentration.

The HHRA compares calculated PbB concentrations to both the EPA regulatory risk value of 10 µg/dL and the new regulatory risk value promulgated by HDOH of 5 µg/dL.

4.3 Exposure Assessment

In the Exposure Assessment, the magnitude and frequency of a receptors' potential exposure to COPCs is quantified. Exposure factors including length and duration of exposure and potential absorption adjustment factors are designated during this phase of work. Other receptor specific factors such as ingestion, inhalation, and body weight are usually quantified in this section but not required for this assessment. Based on the results of above-described tasks, the final phase of the exposure assessment is the derivation of exposure point concentrations and the calculation of the Inhalation Exposure Concentration. The results of the exposure assessment are described in the following subsections.

4.3.1 Identification of Receptors

Potential human receptors for this investigation are adult and children residents who may breathe fugitive dust containing COPCs. Adult and child residents were identified based on characteristics of the site and surrounding area and the specific concerns of the neighboring community.

4.3.2 Identification of Potential Exposure Pathways

Potential exposure pathways are the mechanisms by which the receptors in the study area may be exposed to compounds found in fugitive dust from MRF operations. According to U.S. EPA (1989), four elements must be present in order for a potential human exposure pathway to be complete:

- a source and mechanism of compound release to the environment;
- an environmental transport medium;
- an exposure point, or point of potential contact with the potentially impacted medium; and

- a receptor with a route of exposure at the point of contact.

The exposure pathways examined in this risk assessment include the inhalation of fugitive dust generated from MRF operations.

4.3.3 Identification of Exposure Scenarios

Exposure scenarios describe the frequency and magnitude of exposure to chemicals as they relate to specific receptors and exposure pathways. The exposure scenarios evaluated in this risk assessment include the following:

- Resident Adults presumed to be exposed to contaminants via fugitive dust generation. Residential adults are assumed to be exposed to fugitive dust from recycling operations 24 hours per day, 350 days per year, over a 20 year period (EPA, 2014);
- Resident Children presumed to be exposed to contaminants via fugitive dust generation. Residential children are assumed to be exposed to fugitive dust from recycling operations 24 hours per day, 350 days per year, over a 6 year period (EPA, 2014);

The two residential scenarios are summed to create a total 26 year residential scenario including 6 years as a child and 20 years as an adult (EPA, 2014).

4.3.4 Exposure Concentration Calculations

This section describes the equations and assumptions used to evaluate the concentration of contaminants to which a receptor may be exposed. The equation used to calculate the EC adjusts the EPC by receptor specific exposure time factors and averaging over the period of time for which the receptor is assumed to be exposed. The EC for each compound is compared to the noncancer reference concentration for that compound in order to estimate the potential noncancer hazard index (HI) due to exposure to that compound via inhalation.

For compounds with potential carcinogenic effects, the EC is calculated by averaging the assumed chemical concentration over the receptor's entire lifetime (assumed to be 70 years). The EC for each compound is combined with the cancer IUR for that compound in order to estimate the potential cancer risk due to exposure to that compound via inhalation.

The equations for estimating the EC (both lifetime and chronic) are presented in the following subsections. The exposure parameters used in each potential exposure pathway are also discussed in the following subsections. Exposure parameters were sourced from the EPA Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (EPA, 2014) and the Exposure Factors Handbook (EPA, 2011).

Estimation of Potential Exposure via Inhalation

Calculations of potential risk resulting from the inhalation of the COPCs in air are presented in Appendix D. The equation used to calculate the EC due to inhalation exposure is as follows:

$$A = \frac{B \times C \times D \times E \times F}{G}$$

where:

A = Exposure Concentration (mg/m^3)
B = Concentration of COPC Particulates in Air (mg/m^3)
C = Exposure Time (hr/day)
D = Exposure Frequency (days/year)
E = Exposure duration (years)
F = Inhalation Absorption Adjustment Factor (unitless)
G = Averaging Time (hours).

Concentration of COPCs in Air

Concentrations of COPCs in air at offsite locations for the residential scenarios were calculated in the SCREEN3 analysis as detailed in Section 3. It was assumed that 100% of the COPC concentrations were derived from onsite operations.

Exposure Time and Frequency

Assuming that dust is generated only during onsite operations, offsite residents would be exposed to contaminants only for the duration of these operations. However, for this assessment it was assumed that MRF operations are occurring 24 hrs/day for the entire exposure duration period. Accordingly, offsite adult and children residents were also assumed to be continuously exposed to fugitive dust generated from the site 24 hours/day, 350 days/year (EPA, 2014).

Exposure Duration

As previously described, the risk assessment assumes that potential offsite residential receptors are exposed for a 26 year period. This 26 year duration is split between 6 years as a child and 20 years as an adult (EPA, 2014).

Absorption Adjustment Factors

Absorption Adjustment Factors were assumed to be 100% via the inhalation route of exposure for all COPCs.

Averaging Time

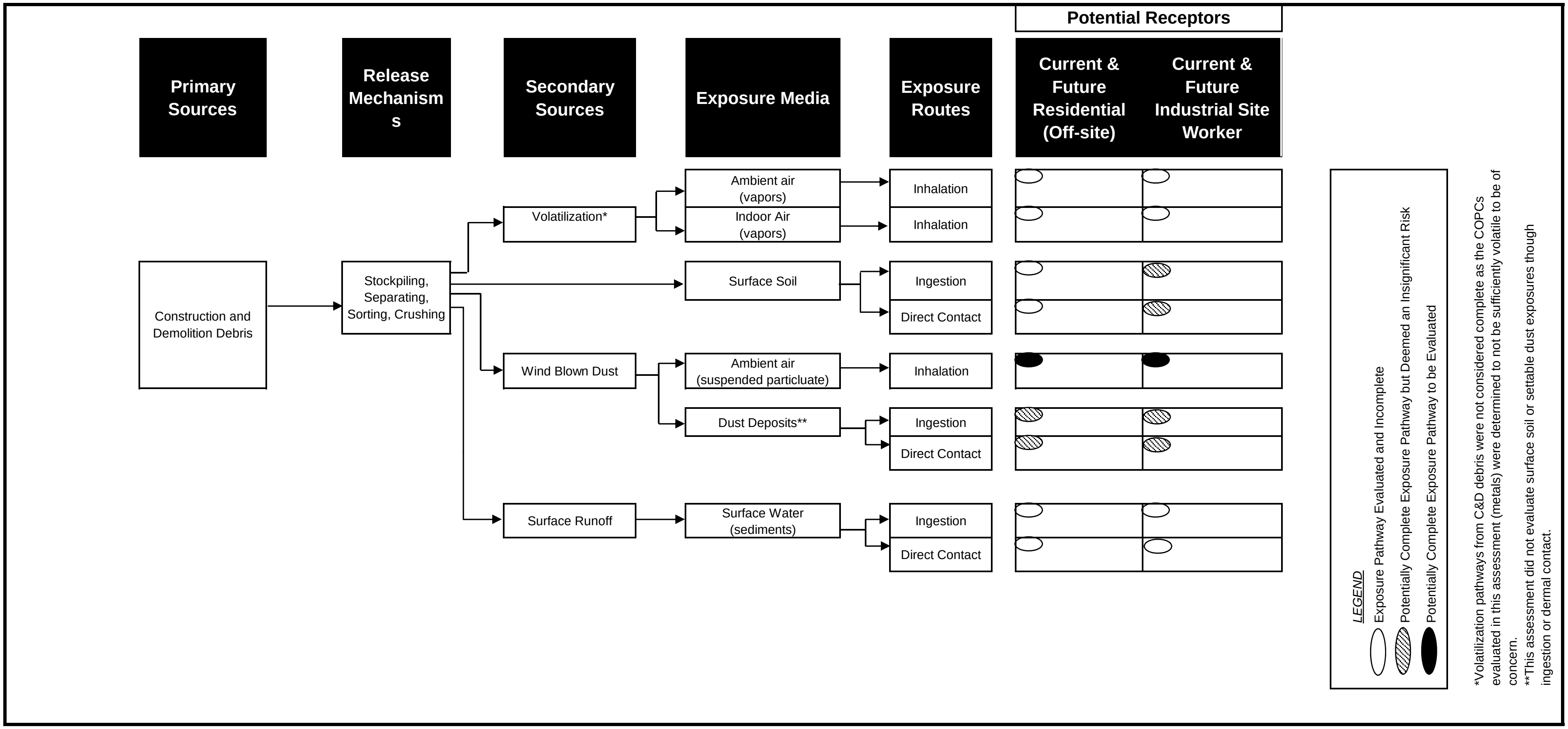
The EC of COPCs used to calculate noncancer hazards must be averaged over the duration which the receptor is assumed to be exposed (EPA, 1989). Therefore, the averaging time for noncancer EC is equal to the exposure duration × 365 days/year × 24 hours/day.

The EC used to determine potential carcinogenic effects, however, must be averaged over the entire lifetime (70 years), regardless of the length of time which the receptor is assumed to be exposed (EPA, 1989). Therefore, the averaging time for carcinogenic EC is equal to the 70 years × 365 days/year × 24 hours/day.

TABLE 4-2: EXPOSURE ASSUMPTIONS

Receptor	**Parameter (units)**	**Value**
Adult Resident	Exposure Duration (hr/d)	24
	Exposure Frequency (d/y)	350
	Exposure Period (y)	20
	Averaging Period - Lifetime (hr)	613,200
	Averaging Period - Chronic Noncancer (hr)	175,200
	Fraction from Site (unitless)	1
Child Resident	Exposure Duration (hr/d)	24
	Exposure Frequency (d/y)	350
	Exposure Period (y)	6
	Averaging Period - Lifetime (hr)	613,200
	Averaging Period - Noncancer (hr)	52,560
	Fraction from Site (unitless)	1

Figure 2
Human Health Conceptual Site Model



4.4 Risk Characterization

The Risk Characterization combines the results of the Exposure Assessment with the results of the Toxicity Assessment to derive quantitative estimates of the potential for adverse health effects to occur as a result of potential exposure to fugitive dust from MRF operations. The potential for both noncancer and cancer effects are estimated for each receptor for each potential exposure pathway identified in the Exposure Assessment.

The risk characterization is the step in the risk assessment process that combines the results of the exposure assessment and the toxicity assessment for each compound of concern in order to estimate the potential for cancer and noncancer human health effects from chronic exposure to that compound. This section summarizes the results of the risk characterization for each receptor evaluated in the risk assessment.

4.4.1 Noncancer Hazard Characterization

The potential for exposures to COPCs to result in adverse noncancer health effects is estimated for each receptor by comparing the Exposure Concentration for each compound with the Reference Concentration for that compound. The resulting ratio, which is unitless, is known as the Hazard Quotient (HQ) for that compound. The HQ is calculated using the following formula:

$$A = \frac{B}{C}$$

where:

A = Hazard Quotient (unitless);
B = Exposure Concentration ($\mu g/m^3$); and
C = Reference Concentration ($\mu g/m^3$).

When the HQ for a given compound does not exceed 1, the RfC has not been exceeded, and no adverse noncancer health effects are expected to occur as a result of exposure to that compound via that route. The HQs for each compound are summed to yield the HI for that pathway. An HI is calculated for each receptor for each pathway by which the receptor is assumed to be exposed. A total HI for a chemical is then calculated for each receptor by summing the pathway-specific HIs. A total HI for a chemical that does not exceed 1 for a given receptor indicates that no adverse noncancer health effects are expected to occur as a result of that receptor's potential exposure to a chemical in the environmental media. The HIs calculated for this assessment are presented in Table 4-3. All HIs were lower than the U.S. EPA and HDOH criterion goal of 1, and therefore all were below the regulatory level of concern.

TABLE 4-3: NONCANCER HAZARDS

RECEPTOR	HAZARD QUOTIENTS
	MRF Operations
Adult Resident, inhalation exposure	2.E-03
Child Resident, inhalation exposure	2.E-03

4.4.2 Cancer Risk Characterization

The purpose of cancer risk characterization is to estimate the likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of facility-related exposures to COPCs in various environmental media. This likelihood is a function of the Exposure Concentration and the Inhalation Unit Risk (IUR) Factor for that compound. The relationship between the Excess Lifetime Cancer Risk (ELCR) and the Exposure Concentration of a compound may be expressed by the equation:

$$A = B \times C$$

where:

A = Excess Lifetime Cancer Risk (unitless);
B = Inhalation Unit Risk ($(\mu g/m^3)^{-1}$); and
C = Exposure Concentration ($\mu g/m^3$).

The product of the IUR and the EC is unitless, and provides an estimate of the potential cancer risk associated with a receptor's exposure to that compound via that pathway. ELCRs are calculated for each potentially carcinogenic compound. Barium is not considered carcinogenic, no current IUR is available and hence the total ELCR was not evaluated.

4.4.3 Lead Hazards

The lead hazards are presented in this HHRA as PbB concentrations. The HHRA compares calculated PbB concentrations to both the EPA regulatory risk value of 10 µg/dL and the new regulatory risk value promulgated by HDOH of 5 µg/dL. The PbB calculated for this assessment are presented in Table 5-5. The maximum calculated PbB was 1.8 µg/dL for children aged 1-2. The lead hazard to the offsite residential children receptors was substantially lower than the EPA regulatory risk value of 10 µg/dL and HDOH regulatory value of 5 µg/dL.

TABLE 4-4: LEAD HAZARDS

RECEPTOR	Age Group	PbB Concentrations (µg/dL) MRF Operations
Child Resident, inhalation exposure	.5-1	1.6
	1-2	1.8
	2-3	1.7
	3-4	1.6
	4-5	1.3
	5-6	1.2
	6-7	1.1

5.0 ASSESSMENT OF ARSENIC AND CHROMIUM BY ESTIMATION OF CHEMICAL CONCENTRATIONS IN BULK MATERIAL

Due to specific regulatory concerns regarding potential for arsenic and chromium to be present in the waste stream from Chromated Copper Arsenate (CCA) treated wood, arsenic and chromium were evaluated separately from those COPCs detected in the air monitoring samples. Arsenic and chromium were not detected in a single air sample collected, however the limits of detection were not low enough to adequately be protective of human health in a residential scenario. In order to estimate the concentration of arsenic and chromium transported by fugitive dust to resident locations, the chemical concentrations in bulk materials from a demonstration study performed by ERA in 2010 was utilized to estimate the concentration of COPCs in the fugitive dust. Arsenic and chromium concentrations in air were estimated by modeling bulk material (source) concentrations to receptor locations as a percentage of the respirable dust concentration.

5.1 Estimation of chemical concentration in bulk material

In 2010, ERA collected three (3), five (5) – gallon buckets of bulk C&D material representative of material accepted by the landfill. Representative material included but was not limited to, painted and unpainted wood, untreated wood, CCA treated wood, drywall, insulation, and small amounts of metal (e.g. nails), concrete, glass, plastics, etc. In an effort to ensure that the sample submitted to the laboratory included representative quantities of CCA treated wood, known samples of CCA treated wood were included in the samples and submitted to the laboratory. Multiple waste stream analyses have been performed by third parties at PVT Landfill. Based on multiple waste stream alaysis performed by third parties at PVT, this risk assessment assumes that CCA treated wood comprises 2.5% of the PVT ISWMF waste stream. In an effort to ensure that the representative fraction of CCA treated wood was included in the bulk sample analyzed by the laboratory, PVT required the laboratory to spike the bulk sample with known quantities of CCA treated wood. Samples were sent to a certified laboratory for total RCRA 8 metals analyses as well as RCRA 8 and pentachlorophenol toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP) analyses (ERA, 2010). The arsenic and chromium results are provided in Table 5-1.

TABLE 5-1: ANALYTICAL RESULTS FROM BULK SAMPLING

Sample ID	Results (mg/kg)	
	Arsenic	**Chromium**
HTB0121-01	233	299
HTB0121-02	111	148
HTB0121-03	122	161
Max	233	299

.

The maximum value detected was conservatively used to represent concentrations in bulk material. Laboratory data reports are presented in Appendix B.

5.2 Estimation of Chemical Concentrations at Receptor Locations

Estimation of COPC Concentrations in Dust at Offsite Locations

This assessment utilized a similar approach used in a previous studies conducted by ERA (ERA, 2010) and by HDOH (AMEC, 2005) to assess human health risks from soil derived fugitive dust from PVT ISWMF. Respirable particulate data was used in conjunction with bulk material analytical data to estimate COPC concentrations at specific receptor locations assumed to be 1/4 mile from the MRF. Estimated dust concentrations as determined by the SCREEN3 were multiplied by the COPC concentrations assumed present in the bulk material to estimate the concentration of COPCs in fugitive dust. The site-specific respirable dust concentration from the current air sampling for the MRF operations was used to estimate the EPC for arsenic and chromium. All dust generated was assumed to be operation-derived. Table 4-2 summarizes the calculated EPCs for arsenic and chromium at potentially affected residential communities approximately 1/4 mile away from dust generating activities.

TABLE 5-2: FUGITIVE DUST COPC EXPOSURE POINT CONCENTRATIONS

Exposure Point	Chemical of Potential Concern	Maximum Concentration in Bulk Material (mg/kg)	Respirable Dust Concentration at Receptor Location (mg/m^3)	Chemical Exposure Point Concentration at Receptor Location (µg/m^3)
Dust from Recycling Operations	Arsenic	233	0.0001711	3.99E-08
	Chromium*	11.96	0.0001711	2.05E-09

* This assessment assumed that hexavalent chromium exists at 4% of the total chromium detected, which is the upper end value of speciation studies which detected hexavalent chromium from disposed CCA treated wood samples in concentrations of approximately 0.7 to 4% of the total chromium.

Respirable particulate data was used in conjunction with analytical data (of bulk material) to estimate COPC concentrations at specific receptor locations (in this case 1/4 mile away from MRF operations). Potential health risks via the inhalation pathway are then estimated for adult and child residents who are assumed to reside approximately 1/4 mile from dust generating activities.

In the case of chromium, site-specific valence state of chromium in CCA treated wood was not available. Based on historic speciation studies, the majority of hexavalent chromium present in CCA treatment products is reduced to trivalent chromium during the fixation process (Dahlgren and Hartford, 1972). The chemicals within CCA treatment products react with the wood fibers which affixes the products to the wood. During this process hexavalent chromium is reduced to low toxicity trivalent chromium (Ung, 2004). Speciation studies indicate that both new and weathered CCA treated wood contain hexavalent chromium in concentrations of approximately 0.7 to 4% of the total chromium. Shredding of CCA treated wood is not anticipated to alter the valence state of chromium. To be conservative, this assessment assumed that hexavalent chromium exists at 4% of the total chromium detected, which is the upper end value of detected hexavalent chromium from CCA treated wood samples (Song, 2005).

The calculated arsenic and chromium concentrations in air available for exposure to residential receptors were evaluated in the HHRA process as described in Section 4. The receptors, exposure pathways, and evaluation of risk followed the same four step process as described in Section 4. To evaluate inhalation exposure of arsenic and chromium, EPA has derived RfCs and IUR values to estimate noncancer hazards and cancer risk respectively. Dose-Response information used in this assessment is listed in Table 5-3.

TABLE 5-3: DOSE-RESPONSE INFORMATION – ARSENIC AND CHROMIUM

Constituent	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$		Inhalation RfC $(\mu g/m^3)$	
METALS				
Arsenic	4.30E-03	a, b, c	1.50E-02	a, c
Chromium VI	8.40E-02	a, c	1.00E-01	a,b, c

NA - Not Applicable
(a) RSL Table (2015a)
(b) U.S. EPA (2015b). IRIS
(c) Hawaii Department of Health EALs (2011)

Cancer risk and noncancer hazards were calculated and presented in Appendix E. The HIs calculated for this assessment are presented in Table 5-4. All HIs were lower than the U.S. EPA and HDOH criterion goal of 1, and therefore all were below the regulatory level of concern.

TABLE 5-4: NONCANCER HAZARDS – ARSENIC AND CHROMIUM

RECEPTOR	**HAZARD QUOTIENTS**		
	Arsenic	**Chromium**	**Total**
Adult Resident, inhalation exposure	3.E-03	2.E-05	3.E-03
Child Resident, inhalation exposure	3.E-03	2.E-05	3.E-03

The ELCRs calculated for this assessment are presented in Table 5-5. All risks to the offsite residential receptors assumed to be 1/4 mile from the MRF were substantially lower than the EPA and HDOH regulatory point of departure level of concern of 1 E-06.

TABLE 5-5: CANCER RISK – ARSENIC AND CHROMIUM

RECEPTOR	**Excess Lifetime Cancer Risk**		
	Arsenic	**Chromium**	**Total**
Adult Resident, inhalation exposure	6.E-08	6.E-08	1.E-07
Child Resident, inhalation exposure	1.E-08	1.E-08	3.E-08
Total Residential Scenario	7.E-08	7.E-08	**1.E-07**

6.0 CONCLUSIONS

This risk assessment was performed to assess the human health impacts associated with the new MRF for the PVT ISWMF Reclamation and Recycling System program. The following operations occur as part of the MRF operations which generate dust:

- Airborne dust impacts during delivery and stockpiling of debris/material
- Airborne dust impacts during the separation of metal recyclables
- Airborne dust impacts during the sorting debris by size
- Airborne dust impacts during processing, crushing and shredding of feedstocks

Potential human health risk was assessed from the collection of dust samples in the immediate vicinity of the new MRF during full-scale operations. Air samples were collected immediately upwind of the MRF operations, directly within the worker area of the MRF, and at two (2) locations immediately downwind of the MRF operations. To evaluate worker risks, dust and metal concentrations were compared to OSHA PELs (OSHA, 2006) and EPA Industrial Air RSLs (EPA, 2015a). No detected metal or dust concentrations in air exceeded the OSHA PELs or EPA Industrial RSLs, therefore landfill workers were determined to not be subject to risk or hazards above regulatory levels of concern.

The HHRA also evaluated potential risks and hazards to offsite residential receptors. Barium and lead were detected in a single dust sample collected in the immediate vicinity of the MRF. Chemical concentrations were modeled to residential properties assumed to be located approximately 1/4 mile away using the SCREEN3 air dispersion model. Potential estimated lifetime cancer risks and noncancer hazards were compared to the EPA and HDOH regulatory levels of concern for residential areas of one excess cancer in 1,000,000 people and total HI of 1. Noncancer hazard quotient from barium inhalation was 0.002 and well below the regulatory level of concern of 1. Barium is not considered carcinogenic, therefore excess lifetime cancer risk was not evaluated. Lead hazards are presented in this HHRA as PbB concentrations. The HHRA compared calculated PbB concentrations to both the EPA regulatory risk value of 10 µg/dL and the regulatory risk value promulgated by HDOH of 5 µg/dL. The maximum calculated PbB was 1.8 µg/dL for children aged 1-2, substantially lower than the EPA and HDOH regulatory levels of concern.

Arsenic and chromium may be present at low levels in the waste stream from CCA treated wood. Arsenic and chromium were evaluated separately from chemicals of potential concern (COPCs) detected in the air monitoring samples. Arsenic and chromium were not detected in a single air sample collected, however their analytical limits of detection were not low enough to adequately be protective of human health in a residential scenario. In order to estimate the concentration of arsenic and chromium transported by fugitive dust to resident locations, the chemical concentrations in bulk materials from a demonstration study performed by ERA in 2010 was utilized to estimate the concentration of COPCs in the fugitive dust. Arsenic and chromium concentrations in air were then estimated by modeling bulk material (source) concentrations to receptor locations as a percentage of the respirable dust concentration.

Human Health Risks from modeled source concentrations were well below all applicable regulatory levels of concern. Residential scenarios resulted in a noncancer hazard index of 0.003, well below the regulatory level of concern of 1. The total residential excess lifetime cancer risk (including 6 years as a child, and 20 years as an adult) was determined to be 1E-07 or a 1 in 10,000,000 probability that a resident will develop cancer in his or her lifetime, over and above the background cancer rate. This is well below the point-of-departure regulatory level of concern for residential receptors of 1E-06 or 1 in 1,000,000.

The recycling program does not pose a significant threat to human health. The chemical driver responsible for the majority of cancer risk and noncancer hazard was arsenic assumed present in the bulk material (i.e., the HHRA assumed that arsenic was present in bulk material by “spiking” it with a conservative quantity of CCA treated lumber). Concentrations of CCA treated wood are anticipated to be much lower based on waste acceptance records provided by PVT. Real-life data corroborates this, as arsenic was not detected in any of the air samples collected in this study.

ERA has estimated health impacts to nearby residents from potential air sources originating from the recycling program and determined it is safe. Risk and hazards to PVT ISWMF workers who are involved in the program and work on or around the MRF are also low. The MRF operation does not pose a potentially significant threat to human health or the environment.

7.0 UNCERTAINTY ANALYSIS

Within any of the four steps of the risk assessment process, assumptions must be made due to a lack of absolute scientific knowledge. Some of the assumptions are supported by considerable scientific evidence, while others have less support. Every assumption introduces some degree of uncertainty into the risk assessment process. Conservative assumptions are made throughout the risk assessment to ensure that the health of workers and local residents are protected. Therefore, when all of the assumptions are combined, it is much more likely that actual risks, if any, are overestimated rather than underestimated.

7.1 Hazard Identification

During the Hazard Identification step, compounds are selected for inclusion in the quantitative risk assessment. Eight metals that may be present in C&D debris were selected as COPCs. This assessment was not exhaustive and did not include all chemicals and compounds (e.g., pentachlorophenol, dioxins, etc.) that may be disposed of at the landfill and subsequently processed for recycling.

Although arsenic and chromium were not detected in a single air sampling collected, this assessment evaluated arsenic and chromium by using concentration data of presumed waste stream materials where known samples of CCA treated wood was added (spiked) to waste stream samples analyzed by the laboratory. Actual concentrations of CCA treated wood are anticipated to be significantly less based on PVT waste acceptance records. This approach is health protective and increases the conservativeness of the risk assessment.

7.2 Toxicity Assessment

Dose-response values are usually based on limited toxicological data. For this reason, a margin of safety is built into estimates of both cancer risk and noncancer hazards, and actual risks are lower than those estimated. The two major areas of uncertainty introduced in the dose-response assessment are: (1) animal to human extrapolation; and (2) high to low dose extrapolation.

Human dose-response values are often extrapolated, or estimated, using the results of animal studies. Extrapolation from animals to humans introduces a great deal of uncertainty in the risk assessment because in most instances, it is not known how differently a human may react to the chemical compared to the animal species used to test the compound. The procedures used to extrapolate from animals to humans involve conservative assumptions and incorporate several uncertainty factors that overestimate the adverse effects associated with a specific dose. As a result, overestimation of the potential for adverse effects to humans is more likely than underestimation.

Predicting potential health effects from the facility emissions requires the use of models to extrapolate the observed health effects from the high doses used in laboratory studies to the anticipated human health effects from low doses experienced in the environment. The models contain conservative assumptions to account for the large degree of uncertainty associated with this extrapolation (especially for potential carcinogens) and therefore, tend to be more likely to overestimate than underestimate the risks.

Additional uncertainty could be introduced with regards to the toxicity of chromium in the bulk material sampled. Valence state of chromium was not available and based upon historical information regarding the valence proportion present in discarded CCA treated wood. Speciation studies indicate that both new and weathered CCA treated wood contain hexavalent chromium in concentrations of approximately 0.7 to 4% of the total chromium. To be conservative, this assessment assumed that hexavalent chromium exists at 4% of the total chromium detected, which is the upper end value of detected hexavalent chromium from CCA treated wood samples (Song 2005).

This risk assessment also took a very conservative approach regarding the bioaccessible fraction of COPCs available to be absorbed by the body. Absorption factors estimate the amount a chemical that is absorbed by the body through different routes of exposure. The HDOH and EPA have recommended dermal and gastro-intestinal absorption fractions for different compounds. This assessment uses a conservative value of 1, meaning that the entire concentration is assumed available for absorption by the body. More realistic bioaccessible fractions for this pathway could be derived and would most likely reduce the portrayed risk in this assessment.

7.3 Exposure Assessment

During the exposure assessment, exposure point concentrations are estimated, and exposure doses are calculated. Exposure point concentrations are the estimated concentrations of compounds to which humans may be exposed. Because ambient air chemical concentrations do not exist at the remote receptor locations at levels which would most likely exceed analytical detection limits, and direct measurement would be confounded by non-relevant sources, exposure point concentrations were estimated using models containing numerous assumptions, such as the amount of compound released from the site, the dispersion of the compound in air and its fate and transport in the environment, and the location of people potentially exposed to released compounds. Once the concentrations in air have been predicted, the calculation of human exposure and dose involves making additional assumptions. The major sources of uncertainty associated with these assumptions are discussed below.

7.3.1 Estimation of Particulate Emission Factors

Offsite concentrations of COPCs for this risk assessment were derived from ambient air-monitoring. While only a single sample at a single location of ambient air monitoring resulted in detectable barium, lead, and respirable dust concentrations, the maximum detected values from the single sample were used in this assessment. This assumption is health-protective because in the majority of cases it overestimates the amount of dust that could result from MRF operations occurring on site. During this sampling event, dust concentrations were monitored downwind as close as reasonably possible to dust generating activities. In efforts to be conservative, sampling was performed in worst case scenario locations so as to not underestimate the amount of dust generated during processing activities. This assessment also assumed that the sampling performed was representative of conditions that exist onsite 24 hours a day, 7 days a week.

7.3.2 Estimation of Airborne Dust Concentrations Offsite

There is some uncertainty in the estimation of airborne dust concentrations, because the risk assessment does not separately consider dust concentrations on days when winds are high. This uncertainty is minimal, however, as described below. The current risk assessment utilizes an EPA screening air dispersion model that assumes winds are blowing towards residential receptors 24 hours a day, 365 days a year at an average wind speed of 2.68 m/s for either a 1-year or 30-year period. The EPA states that a 0.08 times multiplication factor should be used to convert the 1-hr maximum average to an annual average. This was not done in this evaluation. Instead, an adjustment factor of 0.2 was applied to estimate the annual average (personal communication with HDOH HEER Office). Had a more realistic air dispersion model been used, the ambient dust concentrations at remote receptor locations would have been lower.

This HHRA modeled airborne dust concentrations ¼ mile distance from dust generating activities. If dust generating activities were moved closer to neighboring residences or in the future new residences are built closer to dust generating activities, the concentration of airborne dust would likely be higher. Likewise, ¼ mile was chosen as a conservative assumption for the nearest residential receptors. Residents which live further than ¼ mile from dust generating activities would likely be exposed to lower ambient dust concentrations.

7.3.3 Estimation of Exposure Dose

Exposure point concentrations are estimated values of what is a Reasonable Maximum Exposure across the entire site. Given that these are estimates, a significant amount of uncertainty can be introduced into the assessment. In this assessment, the maximum detected concentration of contaminants was used as the exposure point concentration in dust that would potentially be released off site. For the use of bulk sampling to estimate arsenic and chromium concentrations in dust, uncertainty was introduced in analytical results from the bulk samples as known quantities of arsenic was added to the bulk material samples evaluated by the laboratory. Actual concentrations of arsenic are anticipated to be much lower based on waste acceptance records noted by PVT. The concentration in bulk material was multiplied by the modeled concentration of fugitive dust to determine an exposure point concentration of respirable contaminants offsite. This assumption therefore introduces significant uncertainty as it relates to the true risk and almost certainly overestimates both offsite concentrations and risk.

Once the concentrations of the potentially released compounds in air have been predicted through modeling, the extent of human exposure must be estimated. This requires making assumptions about the frequency and duration of human exposure. Uncertainty may be associated with some of the assumptions used to estimate how often exposure occurs. Such assumptions include location, accessibility, and use of an area. With this in mind, the receptor, or person who may potentially be exposed, and the location of exposure were defined for this risk assessment. The locations where certain activities were assumed to take place have been purposely selected because chemical concentrations and frequency of exposure are expected to be high (i.e., use of the maximally affected areas). In this assessment, residential receptors were assumed to live in the neighboring communities for 26 years and be present 24 hours per day, 350 days per year. However, actual frequencies and durations of exposure are likely to be much lower than assumed, because residents are not likely to stay in one place and may, for instance, work far away or move to another location. Additionally, the majority of recycling activities (e.g., processing of material) will only occur during working hours, not continuously 24 hours per day. In these cases, the person's potential exposure would be reduced, and the health risks discussed in this assessment would be overestimated.

7.4 Risk Characterization

The risk of adverse human health effects depends on estimated levels of exposure and dose-response relationships. Once exposure to and risk from each of the selected compounds is calculated, the total risk posed by recycling operations is determined by combining the health risk contributed by each compound. For virtually all combinations of compounds present in chemicals evaluated in this assessment, there is little or no evidence of interaction. However, in order not to understate the risk, it is assumed that the effects of different compounds may be added together.

The current assessment evaluates risk from dust generated from the MRF recycling operations. The risk estimates derived herein do so in a deterministic manner. Doing so ensures that risks determined are from facility operations. It does not derive screening levels for PM10 or COPCs at the fence line. Evaluation of fence line data may be problematic as sources of dust and COPCs may not be 100% PVT operation derived.

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Appendix A. Photographs

Photograph #1

<u>Description of Photograph</u>:

The Material Recycling Facility (MRF) at the PVT Landfill

<u>Photograph Date</u>:
February 12, 2015

Photograph #2

<u>Description of Photograph</u>:

Operations associated with the MRF

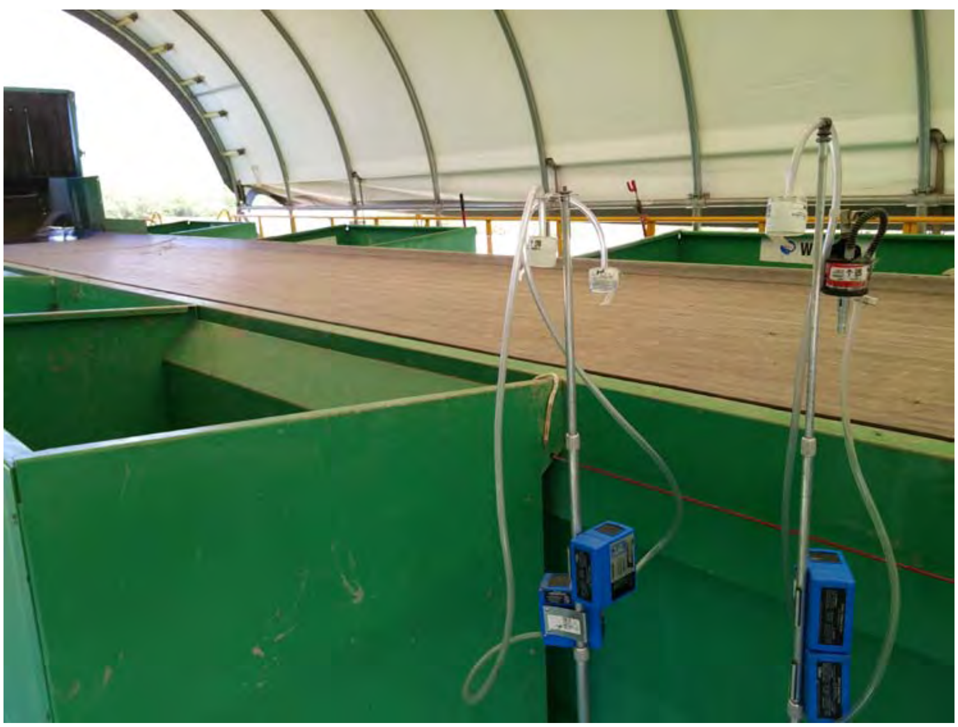
<u>Photograph Date</u>:
February 11, 2015

Photograph #3

<u>Description of Photograph</u>:

Operations associated with the MRF

<u>Photograph Date</u>:
February 11, 2015



Photograph #4

<u>Description of Photograph</u>:

Air sampling pumps set up in the 2nd floor area where the workers manually sort the recyclables

<u>Photograph Date</u>:
February 11, 2015

Photograph #5

Description of Photograph:

Air sampling pumps set up in the area upwind from the MRF on February 11

Photograph Date:
February 11, 2015

Photograph #6

Description of Photograph:

Air sampling pumps set up in the area downwind from the MRF on February 11

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Photograph Date:
February 11, 2015

Photograph #7

Description of Photograph:

Air sampling pumps set up in a second area downwind from the MRF on February 11

Photograph Date:
February 11, 2015

Photograph #8

Description of Photograph:

MRF from a distance downwind

Photograph Date:
February 11, 2015

Appendix B. Laboratory Analytical Results

2015 Air Sampling

Sample Location	Sample ID	Arsenic			Barium			Cadmium			Chromium		
		LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3
211-UW	211-RCRA-UW	0.15	<0.15	<0.00029	0.075	<0.075	<0.00014	0.015	<0.015	<0.000029	7.5	<7.5	< 0.014
211-WA	211-RCRA-WA	0.15	<0.16	<0.00029	0.075	<0.075	<0.00014	0.015	<0.015	<0.000029	7.5	<7.5	< 0.014
211-DW1	211-RCRA-DW1	0.15	<0.17	<0.00028	0.075	<0.075	<0.00014	0.015	<0.015	<0.000028	7.5	<7.5	< 0.014
211-DW2	211-RCRA-DW2	0.15	<0.18	<0.00028	0.075	<0.075	<0.00014	0.015	<0.015	<0.000028	7.5	<7.5	< 0.014
212-UW	212-RCRA-UW	0.15	<0.19	<0.00025	0.075	<0.075	<0.00012	0.015	<0.015	<0.000025	7.5	<7.5	<0.012
212-WA	212-RCRA-WA	0.15	<0.20	<0.00024	0.075	<0.075	<0.00012	0.015	<0.015	<0.000024	7.5	<7.5	<0.012
212-DW1	212-RCRA-DW1	0.15	<0.21	<0.00024	0.075	**0.31**	**0.00049**	0.015	<0.015	<0.000024	7.5	<7.5	<0.012
212-DW2	212-RCRA-DW2	0.15	<0.22	<0.00024	0.075	<0.075	<0.00012	0.015	<0.015	<0.000024	7.5	<7.5	<0.012
304-UW	304-RCRA-UW	0.15	<0.23	<0.00026	0.075	<0.075	<0.00013	0.015	<0.015	<0.000026	7.5	<7.5	<0.013
304-WA	304-RCRA-WA	0.15	<0.24	<0.00022	0.075	<0.075	<0.00011	0.015	<0.015	<0.000022	7.5	<7.5	<0.011
304-DW1	304-RCRA-DW1	0.15	<0.25	<0.00022	0.075	<0.075	<0.00011	0.015	<0.015	<0.000022	7.5	<7.5	<0.011
304-DW2	304-RCRA-DW2	0.15	<0.26	<0.00022	0.075	<0.075	<0.00011	0.015	<0.015	<0.000022	7.5	<7.5	<0.011

number of samples analyzed	12	12	12	12
number of non-detect	12	11	12	12
number of detections	0	1	0	0
Frequency of Detection	0.0%	8.3%	0.0%	0.0%
Maximum Detected	-	0.00049	-	-
Mean of Detects	-	0.00049	-	-
Sample of Max Detection	-	212-DW1	-	-
Max Dectection Limit	<0.00029	<0.00014	<0.000029	< 0.014

Sample Location	Sample ID	Lead			Selenium			Mercury			Silver		
		LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3
211-UW	211-RCRA-UW	0.075	<0.075	<0.00014	2.3	<2.3	<0.0043	0.04	<0.040	<0.00062	0.3	<0.30	<0.00058
211-WA	211-RCRA-WA	0.075	<0.075	<0.00014	2.3	<2.3	<0.0043	0.04	<0.040	<0.00062	0.3	<0.30	<0.00058
211-DW1	211-RCRA-DW1	0.075	<0.075	<0.00014	2.3	<2.3	<0.0042	0.04	<0.040	<0.00060	0.3	<0.30	<0.00057
211-DW2	211-RCRA-DW2	0.075	<0.075	<0.00014	2.3	<2.3	<0.0042	0.04	<0.040	<0.00060	0.3	<0.30	<0.00057
212-UW	212-RCRA-UW	0.075	<0.075	<0.00012	2.3	<2.3	<0.0037	0.04	<0.040	<0.00051	0.3	<0.30	<0.00049
212-WA	212-RCRA-WA	0.075	<0.075	<0.00012	2.3	<2.3	<0.0036	0.04	<0.040	<0.00051	0.3	<0.30	<0.00048
212-DW1	212-RCRA-DW1	0.075	**0.17**	**0.00027**	2.3	<2.3	<0.0036	0.04	<0.040	<0.00052	0.3	<0.30	<0.00048
212-DW2	212-RCRA-DW2	0.075	<0.075	<0.00012	2.3	<2.3	<0.0036	0.04	<0.040	<0.00052	0.3	<0.30	<0.00048
304-UW	304-RCRA-UW	0.075	<0.075	<0.00013	2.3	<2.3	<0.0038	0.04	<0.040	<0.00055	0.3	<0.30	<0.00051
304-WA	304-RCRA-WA	0.075	<0.075	<0.00011	2.3	<2.3	<0.0033	0.04	<0.040	<0.00046	0.3	<0.30	<0.00043
304-DW1	304-RCRA-DW1	0.075	<0.075	<0.00011	2.3	<2.3	<0.0033	0.04	<0.040	<0.00047	0.3	<0.30	<0.00044
304-DW2	304-RCRA-DW2	0.075	<0.075	<0.00011	2.3	<2.3	<0.0033	0.04	<0.040	<0.00047	0.3	<0.30	<0.00044

number of samples analyzed	12	12	12	12
number of non-detect	11	12	12	12
number of detections	1	0	0	0
Frequency of Detection	8.3%	0.0%	0.0%	0.0%
Maximum Detected	0.00027	-	-	-
Mean of Detects	0.00027	-	-	-
Sample of Max Detection	212-DW1	-	-	-
Max Dectection Limit	<0.00014	<0.0043	<0.00062	<0.00058

Sample Location	Sample ID	Respirable Dust (PM10)			Total Dust		
		LOQ µg	Weight µg	Conc. mg/m3	LOQ µg	Weight µg	Conc. mg/m3
211-UW	211-RCRA-UW	0.05	<0.050	<0.075	0.2	<0.20	<0.38
211-WA	211-RCRA-WA	0.05	<0.050	<0.075	0.2	<0.20	<0.38
211-DW1	211-RCRA-DW1	0.05	<0.050	<0.077	0.2	<0.20	<0.38
211-DW2	211-RCRA-DW2	0.05	<0.050	<0.077	0.2	<0.20	<0.38
212-UW	212-RCRA-UW	0.05	<0.050	<0.066	0.2	<0.20	<0.33
212-WA	212-RCRA-WA	0.05	<0.050	<0.065	0.2	<0.20	<0.32
212-DW1	212-RCRA-DW1	0.05	**0.071**	**0.09**	0.2	<0.20	<0.32
212-DW2	212-RCRA-DW2	0.05	<0.050	<0.063	0.2	<0.20	<0.32
304-UW	304-RCRA-UW	0.05	<0.050	<0.068	0.2	<0.20	<0.34
304-WA	304-RCRA-WA	0.05	<0.050	<0.058	0.2	<0.20	<0.29
304-DW1	304-RCRA-DW1	0.05	<0.050	<0.059	0.2	<0.20	<0.30
304-DW2	304-RCRA-DW2	0.05	<0.050	<0.059	0.2	<0.20	<0.29

number of samples analyzed	12	12
number of non-detect	11	12
number of detections	1	0
Frequency of Detection	8.3%	0.0%
Maximum Detected	0.09	-
Mean of Detects	0.09	-
Sample of Max Detection	212-DW1	-
Max Dectection Limit	<0.077	<0.38

Ms. Rachel Okoji
Environmental Risk Analysis, LLC
820 W. Hind Drive #240606
Honolulu, HI 96824

March 17, 2015

DOH ELAP #11626
AIHA-LAP #100324

Account# 27217

Login# L340979

Dear Ms. Okoji:

Enclosed are the analytical results for the samples received by our laboratory on March 11, 2015. All test results meet the quality control requirements of AIHA-LAP and NELAC unless otherwise stated in this report. All samples on the chain of custody were received in good condition unless otherwise noted.

Results in this report are based on the sampling data provided by the client and refer only to the samples as they were received at the laboratory. Unless otherwise requested, all samples will be discarded 14 days from the date of this report, with the exception of IOMs, which will be cleaned and disposed of after seven calendar days.

Current Scopes of Accreditation can be viewed at www.galsonlabs.com in the accreditations section under the "about Galson" tab.

Please contact Nicole Tormey at (888) 432-5227, if you would like any additional information regarding this report.

Thank you for using Galson Laboratories.

Sincerely,

Galson Laboratories

Mary G Unangst

Mary G. Unangst
Laboratory Director

Enclosure(s)

LABORATORY ANALYSIS REPORT

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15 Account No.: 27217
Date Received : 11-MAR-15 Login No. : L340979
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Client ID : 211-RCRA-UW **Lab ID : L340979-13** **Air Volume : 520 Liter**
Date Sampled : 02/11/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00029	mg/m3
Barium	0.075	<0.075	<0.00014	mg/m3
Cadmium	0.015	<0.015	<0.000029	mg/m3
Chromium	7.5	<7.5	<0.014	mg/m3
Lead	0.075	<0.075	<0.00014	mg/m3
Selenium	2.3	<2.3	<0.0043	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

LABORATORY ANALYSIS REPORT

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 211-RCRA-WA **Lab ID : L340979-14** **Air Volume : 520 Liter**
Date Sampled : 02/11/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00029	mg/m3
Barium	0.075	<0.075	<0.00014	mg/m3
Cadmium	0.015	<0.015	<0.000029	mg/m3
Chromium	7.5	<7.5	<0.014	mg/m3
Lead	0.075	<0.075	<0.00014	mg/m3
Selenium	2.3	<2.3	<0.0043	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 211-RCRA-DW1 **Lab ID : L340979-15** **Air Volume : 530 Liter**
Date Sampled : 02/11/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00028	mg/m3
Barium	0.075	<0.075	<0.00014	mg/m3
Cadmium	0.015	<0.015	<0.000028	mg/m3
Chromium	7.5	<7.5	<0.014	mg/m3
Lead	0.075	<0.075	<0.00014	mg/m3
Selenium	2.3	<2.3	<0.0042	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 211-RCRA-DW2 **Lab ID : L340979-16** **Air Volume : 530 Liter**
Date Sampled : 02/11/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00028	mg/m3
Barium	0.075	<0.075	<0.00014	mg/m3
Cadmium	0.015	<0.015	<0.000028	mg/m3
Chromium	7.5	<7.5	<0.014	mg/m3
Lead	0.075	<0.075	<0.00014	mg/m3
Selenium	2.3	<2.3	<0.0042	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

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Client	: Environmental Risk Analysis, LLC		
Site	: PVT Landfill MRD		
Date Sampled	: 11-FEB-15 - 04-MAR-15	Account No.:	27217
Date Received	: 11-MAR-15	Login No.	: L340979
Date Analyzed	: 12-MAR-15 - 13-MAR-15		
Report ID	: 873655		

Client ID : 212-RCRA-UW **Lab ID : L340979-17** **Air Volume : 610 Liter**
Date Sampled : 02/12/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00025	mg/m3
Barium	0.075	<0.075	<0.00012	mg/m3
Cadmium	0.015	<0.015	<0.000025	mg/m3
Chromium	7.5	<7.5	<0.012	mg/m3
Lead	0.075	<0.075	<0.00012	mg/m3
Selenium	2.3	<2.3	<0.0037	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 212-RCRA-WA **Lab ID : L340979-18** **Air Volume : 620 Liter**
Date Sampled : 02/12/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00024	mg/m3
Barium	0.075	<0.075	<0.00012	mg/m3
Cadmium	0.015	<0.015	<0.000024	mg/m3
Chromium	7.5	<7.5	<0.012	mg/m3
Lead	0.075	<0.075	<0.00012	mg/m3
Selenium	2.3	<2.3	<0.0036	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 212-RCRA-DW1 **Lab ID : L340979-19** **Air Volume : 630 Liter**
Date Sampled : 02/12/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00024	mg/m3
Barium	0.075	0.31	0.00049	mg/m3
Cadmium	0.015	<0.015	<0.000024	mg/m3
Chromium	7.5	<7.5	<0.012	mg/m3
Lead	0.075	0.17	0.00027	mg/m3
Selenium	2.3	<2.3	<0.0036	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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LABORATORY ANALYSIS REPORT

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 212-RCRA-DW2 **Lab ID : L340979-20** **Air Volume : 630 Liter**
Date Sampled : 02/12/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00024	mg/m3
Barium	0.075	<0.075	<0.00012	mg/m3
Cadmium	0.015	<0.015	<0.000024	mg/m3
Chromium	7.5	<7.5	<0.012	mg/m3
Lead	0.075	<0.075	<0.00012	mg/m3
Selenium	2.3	<2.3	<0.0036	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

LABORATORY ANALYSIS REPORT

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 304-RCRA-UW **Lab ID : L340979-21** **Air Volume : 586 Liter**
Date Sampled : 03/04/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00026	mg/m3
Barium	0.075	<0.075	<0.00013	mg/m3
Cadmium	0.015	<0.015	<0.000026	mg/m3
Chromium	7.5	<7.5	<0.013	mg/m3
Lead	0.075	<0.075	<0.00013	mg/m3
Selenium	2.3	<2.3	<0.0038	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

LABORATORY ANALYSIS REPORT

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 304-RCRA-WA **Lab ID : L340979-22** **Air Volume : 690 Liter**
Date Sampled : 03/04/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00022	mg/m3
Barium	0.075	<0.075	<0.00011	mg/m3
Cadmium	0.015	<0.015	<0.000022	mg/m3
Chromium	7.5	<7.5	<0.011	mg/m3
Lead	0.075	<0.075	<0.00011	mg/m3
Selenium	2.3	<2.3	<0.0033	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 304-RCRA-DW1 **Lab ID : L340979-23** **Air Volume : 676 Liter**
Date Sampled : 03/04/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00022	mg/m3
Barium	0.075	<0.075	<0.00011	mg/m3
Cadmium	0.015	<0.015	<0.000022	mg/m3
Chromium	7.5	<7.5	<0.011	mg/m3
Lead	0.075	<0.075	<0.00011	mg/m3
Selenium	2.3	<2.3	<0.0033	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 12-MAR-15 - 13-MAR-15
Report ID : 873655

Account No.: 27217
Login No. : L340979

Client ID : 304-RCRA-DW2 **Lab ID : L340979-24** **Air Volume : 682 Liter**
Date Sampled : 03/04/15 **Date Analyzed : 03/13/15**

Parameter	LOQ ug	Total ug	Conc	Units
Arsenic	0.15	<0.15	<0.00022	mg/m3
Barium	0.075	<0.075	<0.00011	mg/m3
Cadmium	0.015	<0.015	<0.000022	mg/m3
Chromium	7.5	<7.5	<0.011	mg/m3
Lead	0.075	<0.075	<0.00011	mg/m3
Selenium	2.3	<2.3	<0.0033	mg/m3

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Collection Media : MCE MW 37mm

Submitted by: JJL
Approved by : mlh
Date : 13-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	LOQ-Limit of Quantitation

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

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LABORATORY ANALYSIS REPORT

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 13-MAR-15
Report ID : 873498

Account No.: 27217
Login No. : L340979

Mercury

Sample ID	Lab ID	Air Vol liter	Total ug	Conc mg/m3
211-HG-UW	L340979-25	65	<0.040	<0.00062
211-HG-WA	L340979-26	65	<0.040	<0.00062
211-HG-DW1	L340979-27	66.25	<0.040	<0.00060
211-HG-DW2	L340979-28	66.25	<0.040	<0.00060
212-HG-UW	L340979-29	78.75	<0.040	<0.00051
212-HG-WA	L340979-30	78.75	<0.040	<0.00051
212-HG-DW1	L340979-31	76.25	<0.040	<0.00052
212-HG-DW2	L340979-32	77.5	<0.040	<0.00052
304-HG-UW	L340979-33	73.25	<0.040	<0.00055
304-HG-WA	L340979-34	86.25	<0.040	<0.00046
304-HG-DW1	L340979-35	84.5	<0.040	<0.00047
304-HG-DW2	L340979-36	85.25	<0.040	<0.00047

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 0.040 ug
Analytical Method : mod. NIOSH 6009; CVAA FILTER
OSHA PEL : 0.1 mg/m3
Collection Media : MCE UW 37mm

Submitted by: JMY
Approved by : mlh
Date : 17-MAR-15 NYS DOH # : 11626
Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15 Account No.: 27217
Date Received : 11-MAR-15 Login No. : L340979
Date Analyzed : 12-MAR-15
Report ID : 873382

Silver

Sample ID	Lab ID	Air Vol liter	Total ug	Conc mg/m3
211-AG-UW	L340979-37	520	<0.30	<0.00058
211-AG-WA	L340979-38	520	<0.30	<0.00058
211-AG-DW1	L340979-39	530	<0.30	<0.00057
211-AG-DW2	L340979-40	530	<0.30	<0.00057
212-AG-UW	L340979-41	610	<0.30	<0.00049
212-AG-WA	L340979-42	620	<0.30	<0.00048
212-AG-DW1	L340979-43	630	<0.30	<0.00048
212-AG-DW2	L340979-44	630	<0.30	<0.00048
304-AG-UW	L340979-45	586	<0.30	<0.00051
304-AG-WA	L340979-46	690	<0.30	<0.00043
304-AG-DW1	L340979-47	676	<0.30	<0.00044
304-AG-DW2	L340979-48	682	<0.30	<0.00044

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 0.30 ug Submitted by: gjm
Analytical Method : mod. OSHA ID-121 AP 1; ICP Approved by : mlh
OSHA PEL : 0.01 mg/m3 (TWA) Date : 12-MAR-15 NYS DOH # : 11626
Collection Media : MCE UW 37mm Supervisor: KEG QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

LABORATORY ANALYSIS REPORT

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15 Account No.: 27217
Date Received : 11-MAR-15 Login No. : L340979
Date Analyzed : 12-MAR-15
Report ID : 873290

Respirable Dust

Sample ID	Lab ID	Air Vol liter	Total mg	Conc mg/m3
211-RD-UW	L340979-1	662.5	<0.050	<0.075
211-RD-WA	L340979-2	662.5	<0.050	<0.075
211-RD-DW1	L340979-3	650	<0.050	<0.077
211-RD-DW2	L340979-4	650	<0.050	<0.077
212-RD-UW	L340979-5	762.5	<0.050	<0.066
212-RD-WA	L340979-6	775	<0.050	<0.065
212-RD-DW1	L340979-7	787.5	0.071	0.090
212-RD-DW2	L340979-8	787.5	<0.050	<0.063
304-RD-UW	L340979-9	732.5	<0.050	<0.068
304-RD-WA	L340979-10	862.5	<0.050	<0.058
304-RD-DW1	L340979-11	845	<0.050	<0.059
304-RD-DW2	L340979-12	852.5	<0.050	<0.059

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 0.050 mg
Analytical Method : mod. NIOSH 0600; Gravimetric
OSHA PEL : PNOR 5 mg/m3 (TWA)
Collection Media : PVC PW 37mm

Submitted by: PAH
Approved by : CRI
Date : 12-MAR-15 NYS DOH # : 11626
Supervisor: CRI QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

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LABORATORY ANALYSIS REPORT

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East Syracuse, NY 13057
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Client : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received : 11-MAR-15
Date Analyzed : 11-MAR-15
Report ID : 873244

Account No.: 27217
Login No. : L340979

Total Dust

Sample ID	Lab ID	Air Vol liter	Total mg	Conc mg/m3
211-RCRA-UW	L340979-13	520	<0.20	<0.38
211-RCRA-WA	L340979-14	520	<0.20	<0.38
211-RCRA-DW1	L340979-15	530	<0.20	<0.38
211-RCRA-DW2	L340979-16	530	<0.20	<0.38
212-RCRA-UW	L340979-17	610	<0.20	<0.33
212-RCRA-WA	L340979-18	620	<0.20	<0.32
212-RCRA-DW1	L340979-19	630	<0.20	<0.32
212-RCRA-DW2	L340979-20	630	<0.20	<0.32
304-RCRA-UW	L340979-21	586	<0.20	<0.34
304-RCRA-WA	L340979-22	690	<0.20	<0.29
304-RCRA-DW1	L340979-23	676	<0.20	<0.30
304-RCRA-DW2	L340979-24	682	<0.20	<0.29

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of quantitation: 0.20 mg
Analytical Method : mod. NIOSH 0500; Gravimetric
OSHA PEL : PNOR 15 mg/m3 (TWA)
Collection Media : MCE MW 37mm

Submitted by: PAH
Approved by : CRI
Date : 11-MAR-15 NYS DOH # : 11626
Supervisor: CRI QC by: TJB

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

LABORATORY FOOTNOTE REPORT

Client Name : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received: 11-MAR-15
Date Analyzed: 11-MAR-15 - 13-MAR-15

Account No.: 27217
Login No. : L340979

Unless otherwise noted below, all quality control results associated with the samples were within established control limits or did not impact reported results.

Unrounded results are carried through the calculations that yield the final result and the final result is rounded to the number of significant figures appropriate to the accuracy of the analytical method. Please note that results appearing in the columns preceeding the final result column may have been rounded in order to fit the report format and therefore, if carried through the calculations, may not yield an identical final result to the one reported.

The stated LOQs for each analyte represent the demonstrated LOQ concentrations prior to correction for desorption efficiency (if applicable).

Unless otherwise noted below, reported results have not been blank corrected for any field blank or method blank.

L340979 (Report ID: 873498):
Reported results reflect elemental analysis of the requested metals. Certain compounds may not be solubilized during digestion, resulting in data that is biased low.
SOPs: MT-SOP-20(4), im-hgair(16)

L340979 (Report ID: 873498):
Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated uncertainty applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process.

Parameter	Accuracy	Mean Recovery
Mercury	+/-13.3%	100%

L340979 (Report ID: 873382):
Reported results reflect elemental analysis of the requested metals. Certain compounds may not be solubilized during digestion, resulting in data that is biased low.
SOPs: MT-SOP-3(14), MT-SOP-9(26)

L340979 (Report ID: 873382):
Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated uncertainty applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process.

Parameter	Accuracy	Mean Recovery
Silver	+/-19.8%	106%

L340979 (Report ID: 873655):
Reported results reflect elemental analysis of the requested metals. Certain compounds may not be solubilized during digestion, resulting in data that is biased low.
SOPs: MT-SOP-21(5), im-mwvfilt(21)
OSHA PEL: Chromium II and III = 0.5 mg/m3; Chromium metal (as Cr) = 1 mg/m3

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

LABORATORY FOOTNOTE REPORT

Client Name : Environmental Risk Analysis, LLC
Site : PVT Landfill MRD

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.galsonlabs.com

Date Sampled : 11-FEB-15 - 04-MAR-15
Date Received: 11-MAR-15
Date Analyzed: 11-MAR-15 - 13-MAR-15

Account No.: 27217
Login No. : L340979

L340979 (Report ID: 873655):

Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated uncertainty applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process.

Parameter	Accuracy	Mean Recovery
Arsenic	+/-9%	103%
Barium	+/-9.8%	100%
Cadmium	+/-9%	102%
Chromium	+/-9%	99.3%
Lead	+/-8.8%	99.9%
Selenium	+/-13.3%	100%

Parameter	Method	PEL
Arsenic	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/M	0.01 mg/m3 (TWA)
Barium	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/M	0.5 mg/m3 (Soluble) (TWA)
Cadmium	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/M	0.005 mg/m3 (TWA)
Chromium	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/I	Varies, see footnote
Lead	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/M	0.05 mg/m3 (TWA)
Selenium	mod. NIOSH 7300/mod. OSHA ID-125G; ICP/I	0.2 mg/m3 (TWA)

L340979 (Report ID: 873244):

SOPs: GRAV-SOP-7(8)
LOQ determined using Zefon matched weight media. Reported LOQ may not apply to non-Zefon media.
PNOR = Particulates Not Otherwise Regulated.

L340979 (Report ID: 873290):

SOPs: GRAV-SOP-5(9), GRAV-SOP-6(9)
Dust analytical accuracy is within +/- 0.008 mg (95% confidence interval or k=2). The estimated uncertainty applies to the media, technology, and SOP(s) referenced in this report and does not account for any uncertainty associated with the sampling process.
PNOR = Particulates Not Otherwise Regulated.

< -Less Than	mg -Milligrams	m3 -Cubic Meters	kg -Kilograms
> -Greater Than	ug -Micrograms	l -Liters	NS -Not Specified
NA -Not Applicable	ND -Not Detected	ppm -Parts per Million	

773072189045
Date:03/11/15
Shipper:FEDEX
Initials:SK
Prep:PSY331035

B10

East Syracuse, NY 13057
Tel: 1-315-432-5227
1-888-432-LABS (5227)
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Client Acct No.: 27217
Original Prep No.: PSY331035
CS Rep: NTORMEY
Online COC No.: 10810

Report To:	Ms. Rachel Okoji	Invoice To:	Ms. Rachel Okoji
Company Name:	Environmental Risk Analysis, LLC	Company Name:	Environmental Risk Analysis, LLC
Address 1:	820 W. Hind Drive #240606	Address 1:	820 W. Hind Drive #240606
Address 2:		Address 2:	
City, State Zip:	Honolulu, HI 96824	City, State Zip:	Honolulu, HI 96824
Phone No.:	808 - 783 - 6840	Phone No.:	808 - 783 - 6840
Cell No.:		Email Address:	rachelokoji@envirorsikhawaii.com
Email reports to:	rachelokoji@envirorsikhawaii.com	Payment:	☐ P.O. No. ☐ Card on File ☐ Call for Credit Card Info.
Comments:		Comments:	

Turn Around Time (TAT):	(surcharge)
☐ Standard	0%
☑ 4 Business Days	35%
☐ 3 Business Days	50%
☐ 2 Business Days	75%
☐ Next Day by 6pm	100%
☐ Next Day by Noon	150%
☐ Same Day	200%

☐ Samples submitted using the FreePumpLoan™ Program
☐ Samples submitted using the FreeSamplingBadges™ Program

Site Name: PVT Landfill MRD
Project:
Sampled By:

List description of industry or Process/interferences present in sampling area:

State samples were collected in (e.g., NY): HI

Please indicate which OEL(s) this data will be used for:
☐ OSHA PEL ☐ ACGIH TLV ☐ MSHA ☐ Cal OSHA ☐ Other (specify below):
* lowest detection limit

Comments:

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume / Sample Time / Sample Area	Liters / Minutes / in², cm², ft²	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
211-RD-UW	2/11/15	3pc 37mm PW PVC	662.5	Liters	Dust, respirable	mod. NIOSH 0600; Gravimetric	
211-RD-WA		3pc 37mm PW PVC	662.5		Dust, respirable	mod. NIOSH 0600; Gravimetric	
211-RD-DW1		3pc 37mm PW PVC	650		Dust, respirable	mod. NIOSH 0600; Gravimetric	
211-RD-DW2		3pc 37mm PW PVC	650		Dust, respirable	mod. NIOSH 0600; Gravimetric	
212-RD-UW	2/12/15	3pc 37mm PW PVC	762.5		Dust, respirable	mod. NIOSH 0600; Gravimetric	
212-RD-WA		3pc 37mm PW PVC	775		Dust, respirable	mod. NIOSH 0600; Gravimetric	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature	Date	Time		Print Name / Signature	Date	Time
Relinquished By:	Brandis Ueyama [signature]	3/6/15	1300	Received By:			
Relinquished By:				Received By:	m. Ysauso [signature]	3/11/15	1012

Samples received after 3pm will be considered as next day's business.

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Online COC No.: 10810
Draft: 1/30/2015 4:15:06 pm

RFL

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1 - 888 - 432 - LABS (5227)
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Comments :

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
212-RD-DW1	2/12/15	3pc 37mm PW PVC	787.5	Liters	Dust, respirable	mod. NIOSH 0600; Gravimetric	
212-RD-DW2	↓	3pc 37mm PW PVC	787.5	↓	Dust, respirable	mod. NIOSH 0600; Gravimetric	
304-RD-UW	3/4/15	3pc 37mm PW PVC	732.5		Dust, respirable	mod. NIOSH 0600; Gravimetric	
304-RD-WA	↓	3pc 37mm PW PVC	862.5		Dust, respirable	mod. NIOSH 0600; Gravimetric	
304-RD-DW1		3pc 37mm PW PVC	845		Dust, respirable	mod. NIOSH 0600; Gravimetric	
304-RD-DW2	↓	3pc 37mm PW PVC	852.5	↓	Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	
		3pc 37mm PW PVC			Dust, respirable	mod. NIOSH 0600; Gravimetric	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :	Brandis Ueyama	[signature]	3/6/15	1300	Received By :				
Relinquished By :					Received By :	M-Crause	M-Crause	3/11/15	1012

Samples received after 3pm will be considered as next day's business.

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Online COC No. : 10810
Draft : 1/30/2015 4:15:06 pm

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R11

Comments :

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
211-RCRA-UW	2/11/15	37mm MW MCE, 2pc	520	Liters	Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
211-RCRA-WA		37mm MW MCE, 2pc	520		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
211-RCRA-DW1		37mm MW MCE, 2pc	530		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
211-RCRA-DW2		37mm MW MCE, 2pc	530		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
212-RCRA-UW	2/12/15	37mm MW MCE, 2pc	610		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
212-RCRA-WA		37mm MW MCE, 2pc	620		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
212-RCRA-DW1		37mm MW MCE, 2pc	630		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :	Brandis Ueyama	[signature]	3/6/15	1300	Received By :				
Relinquished By :					Received By :	M-Kraus	M Kraus	3/11/15	1012

Samples received after 3pm will be considered as next day's business.

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Online COC No. : 10810
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RII

Comments :

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
212-RCRA-DW2	2/12/15	37mm MW MCE, 2pc	630	Liters	Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
304-RCRA-UW	3/4/15	37mm MW MCE, 2pc	586		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
304-RCRA-WA		37mm MW MCE, 2pc	690		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
304-RCRA-DW1		37mm MW MCE, 2pc	676		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
304-RCRA-DW2		37mm MW MCE, 2pc	682		Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
		37mm MW MCE, 2pc			Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	
		37mm MW MCE, 2pc			Ar, Ba, Cd, Cr, Pb, Se, TD; Barium; Cadmium; Chromium; Lead; Selenium; Total Dust	mod. NIOSH 7300/mod. OSHA ID-125G; ICP	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :	Brandis Veyama	[signature]	3/6/15	1300	Received By :				
Relinquished By :					Received By :	M. Craus	M. Craus	3/11/15	1012

Samples received after 3pm will be considered as next day's business.

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Online COC No. : 10810
Draft : 1/30/2015 4:15:06 pm

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Comments :

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in^2, cm^2, ft^2	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g., welding, plating, painting, etc.)
211-Hg-UW	2/11/15	37mm UW MCE, 3pc	65	Liters	Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
211-Hg-WA		37mm UW MCE, 3pc	65		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
211-Hg-DW1		37mm UW MCE, 3pc	66.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
211-Hg-DW2		37mm UW MCE, 3pc	66.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
212-Hg-UW	2/12/15	37mm UW MCE, 3pc	78.75		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
212-Hg-WA		37mm UW MCE, 3pc	78.75		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
212-Hg-DW1		37mm UW MCE, 3pc	76.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
212-Hg-DW2		37mm UW MCE, 3pc	77.5		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
304-Hg-UW	3/4/15	37mm UW MCE, 3pc	73.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
304-Hg-WA		37mm UW MCE, 3pc	86.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
304-Hg-DW1		37mm UW MCE, 3pc	84.5		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
304-Hg-DW2		37mm UW MCE, 3pc	85.25		Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
		37mm UW MCE, 3pc			Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	
		37mm UW MCE, 3pc			Mercury, particulate	mod. NIOSH 6009; CVAA FILTER	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :	Brandis Ueyama	B-S	3/6/15	1310	Received By :				
Relinquished By :					Received By :	M. Kraus	M. Kraus	3/11/15	1002

Samples received after 3pm will be considered as next day's business.

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Online COC No. : 10810
Draft : 1/30/2015 4:15:06 pm

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Comments :

Client ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference ^	Hexavalent Chromium Process (e.g.: welding, plating, painting, etc.)
211 - Ag - UW	2/11/15	37mm UW MCE, 3pc	520	Liters	Silver	mod. OSHA ID-121 AP 1; ICP	
211 - Ag - WA		37mm UW MCE, 3pc	520		Silver	mod. OSHA ID-121 AP 1; ICP	
211 - Ag - DW1		37mm UW MCE, 3pc	530		Silver	mod. OSHA ID-121 AP 1; ICP	
211 - Ag - DW2		37mm UW MCE, 3pc	530		Silver	mod. OSHA ID-121 AP 1; ICP	
212 - Ag - UW	2/12/15	37mm UW MCE, 3pc	610		Silver	mod. OSHA ID-121 AP 1; ICP	
212 - Ag - WA		37mm UW MCE, 3pc	620		Silver	mod. OSHA ID-121 AP 1; ICP	
212 - Ag - DW1		37mm UW MCE, 3pc	630		Silver	mod. OSHA ID-121 AP 1; ICP	
212 - Ag - DW2		37mm UW MCE, 3pc	630		Silver	mod. OSHA ID-121 AP 1; ICP	
304 - Ag - UW	3/4/15	37mm UW MCE, 3pc	586		Silver	mod. OSHA ID-121 AP 1; ICP	
304 - Ag - WA		37mm UW MCE, 3pc	690		Silver	mod. OSHA ID-121 AP 1; ICP	
304 - Ag - DW1		37mm UW MCE, 3pc	676		Silver	mod. OSHA ID-121 AP 1; ICP	
304 - Ag - DW2		37mm UW MCE, 3pc	682		Silver	mod. OSHA ID-121 AP 1; ICP	
		37mm UW MCE, 3pc			Silver	mod. OSHA ID-121 AP 1; ICP	
		37mm UW MCE, 3pc			Silver	mod. OSHA ID-121 AP 1; ICP	

☐ ^ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By :	Brandis Ueyama	[signature]	3/6/15	1300	Received By :				
Relinquished By :					Received By :	M. Evans	[signature]	3/11/15	1012

Samples received after 3pm will be considered as next day's business.

Page : 11 / 13
Online COC No. : 10810
Draft : 1/30/2015 4:15:06 pm

2010 Bulk Material Sampling

THE LEADER IN ENVIRONMENTAL TESTING

99-193 Aiea Heights Drive, Suite 121 Aiea, HI 96701 * 808-486-5227 * Fax 808-486-2456

March 05, 2010

LABORATORY REPORT

Client:
PVT Land Company
87-2020 Farrington Hwy.
Waianae, HI 96792
Attn: Steve Joseph

Work Order:	HTB0121
Project Name:	PVT Landfill
Project Number:	[none]
Date Received:	02/22/10

The results listed within this Laboratory Report pertain only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a wet weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the sole use of TestAmerica and its client. This report shall not be reproduced, except in full, without written permission from TestAmerica.

TestAmerica Analytical Testing Corporation certifies that the analytical results contained herein apply only to the specific sample(s) analyzed.

The Chain(s) of Custody, 2 pages, are included and are an integral part of this report. This entire report was reviewed and approved for release.

If you have any questions relating to this analytical report, please contact your Laboratory Project Manager at 1-(808)486-5227

Case Narrative: Two buckets of wood, plastic, waste and other material were provided by client. Three samples were collected by TestAmerica Honolulu from the material for the analyses following the composition details provided by client, to the best possible and with the best representative material.
SPLP Pentachlorophenol and SPLP RCRA8 were added for all samples by phone after the COC was submitted.
Mercury was detected in the SPLP method blank and the SPLP client sample at a similar level. It is possible that the mercury hit found in the client sample was contributed from contamination similar to the associated method blank.
syl 3/5/10

Samples were received into laboratory at a temperature of 25 °C.

NELAC states that samples which require thermal preservation shall be considered acceptable if the arrival temperature is within 2 degrees C of the required temperature or the method specified range. For samples with a temperature requirement of 4 degrees C, an arrival temperature from 0 degrees C to 6 degrees C meets specifications. Samples that are delivered to the laboratory on the same day that they are collected may not meet these criteria. In these cases, the samples are considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

The reported results were obtained in compliance with the 2003 NELAC standards unless otherwise noted.

Approved By:

Samuel A. Lui
Project Manager

NELAC Certification # E87907

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PVT Land Company	Work Order: HTB0121	Received:	02/22/10
87-2020 Farrington Hwy.		Reported:	03/05/10 13:53
Waianae, HI 96792	Project: PVT Landfill		
Steve Joseph	Project Number: [none]		

SAMPLE IDENTIFICATION	LAB NUMBER	COLLECTION DATE AND TIME
222-01	HTB0121-01	02/22/10 12:00
222-02	HTB0121-02	02/22/10 12:00
222-03	HTB0121-03	02/22/10 12:00

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PVT Land Company 87-2020 Farrington Hwy. Waianae, HI 96792 Steve Joseph	Work Order:	HTB0121	Received: Reported:	02/22/10 03/05/10 13:53
	Project: Project Number:	PVT Landfill [none]		

ANALYTICAL REPORT

Analyte	Sample Result	Data Qualifiers	Units	Rpt Limit	Dil	Date Analyzed	Prep Date	Seq/ Batch	Method
Sample ID: HTB0121-01 (222-01 - Solid/Soil)				**Sampled: 02/22/10 12:00**			**Recvd: 02/22/10 14:50**		
SPLP Metals									
Arsenic	ND		mg/L	0.200	1	02/24/10 16:19	02/24/10	10B0182	SW1312/6010B
Barium	ND		"	0.200	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	ND		"	0.0500	"	"	"	"	"
Lead	ND		"	0.0500	"	"	"	"	"
Mercury	**0.000500**	B	"	0.000125	"	02/25/10 15:27	02/25/10	10B0197	SW1312/7470
Selenium	ND		"	0.200	"	02/24/10 16:19	02/24/10	10B0182	SW1312/6010B
Silver	ND		"	0.100	"	"	"	"	"
TCLP Mercury per EPA 7000 Series Methods									
Mercury	ND		mg/L	0.00250	1	02/23/10 17:31	02/23/10	10B0174	SW1311/7470
TCLP Metals									
Arsenic	ND		mg/L	0.500	1	02/23/10 18:21	02/23/10	10B0169	SW1311/6010B
Barium	ND		"	5.00	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	ND		"	0.100	"	"	"	"	"
Lead	ND		"	0.200	"	"	"	"	"
Selenium	ND		"	0.500	"	"	"	"	"
Silver	ND		"	0.300	"	"	"	"	"
Total Metals by SW 846 Series Methods									
Arsenic	**233**		mg/kg	11.0	10	02/24/10 19:13	02/24/10	10B0183	SW6010B
Barium	ND		"	22.0	"	"	"	"	"
Cadmium	ND		"	11.0	"	"	"	"	"
Chromium	**299**		"	11.0	"	"	"	"	"
Lead	**31.6**		"	22.0	"	"	"	"	"
Mercury	**0.0477**		"	0.00500	1	02/24/10 15:53	"	10B0179	SW7471
Selenium	ND		"	22.0	10	02/24/10 19:13	"	10B0183	SW6010B
Silver	ND		"	11.0	"	"	"	"	"
Sample ID: HTB0121-02 (222-02 - Solid/Soil)				**Sampled: 02/22/10 12:00**			**Recvd: 02/22/10 14:50**		
SPLP Metals									
Arsenic	ND		mg/L	0.200	1	02/24/10 16:29	02/24/10	10B0182	SW1312/6010B
Barium	ND		"	0.200	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	**0.0630**		"	0.0500	"	"	"	"	"
Lead	ND		"	0.0500	"	"	"	"	"
Mercury	**0.000550**	B	"	0.000125	"	02/25/10 15:33	02/25/10	10B0197	SW1312/7470
Selenium	ND		"	0.200	"	02/24/10 16:29	02/24/10	10B0182	SW1312/6010B
Silver	ND		"	0.100	"	"	"	"	"
TCLP Mercury per EPA 7000 Series Methods									
Mercury	ND		mg/L	0.00250	1	02/23/10 17:32	02/23/10	10B0174	SW1311/7470
TCLP Metals									
Arsenic	ND		mg/L	0.500	1	02/23/10 18:26	02/23/10	10B0169	SW1311/6010B
Barium	ND		"	5.00	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	ND		"	0.100	"	"	"	"	"

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PVT Land Company 87-2020 Farrington Hwy. Waianae, HI 96792 Steve Joseph	Work Order:	HTB0121	Received: Reported:	02/22/10 03/05/10 13:53
	Project: Project Number:	PVT Landfill [none]		

ANALYTICAL REPORT

Analyte	Sample Result	Data Qualifiers	Units	Rpt Limit	Dil	Date Analyzed	Prep Date	Seq/ Batch	Method
Sample ID: HTB0121-02 (222-02 - Solid/Soil) - cont.				**Sampled: 02/22/10 12:00**			**Recvd: 02/22/10 14:50**		
TCLP Metals - cont.									
Lead	ND		"	0.200	"	"	"	"	"
Selenium	ND		"	0.500	"	"	"	"	"
Silver	ND		"	0.300	"	"	"	"	"
Total Metals by SW 846 Series Methods									
Arsenic	**111**		mg/kg	9.91	10	02/24/10 19:17	02/24/10	10B0183	SW6010B
Barium	**20.4**		"	19.8	"	"	"	"	"
Cadmium	ND		"	9.91	"	"	"	"	"
Chromium	**148**		"	9.91	"	"	"	"	"
Lead	ND		"	19.8	"	"	"	"	"
Mercury	**0.0385**		"	0.00500	1	02/24/10 15:54	"	10B0179	SW7471
Selenium	ND		"	19.8	10	02/24/10 19:17	"	10B0183	SW6010B
Silver	ND		"	9.91	"	"	"	"	"
Sample ID: HTB0121-03 (222-03 - Solid/Soil)				**Sampled: 02/22/10 12:00**			**Recvd: 02/22/10 14:50**		
SPLP Metals									
Arsenic	ND		mg/L	0.200	1	02/24/10 16:34	02/24/10	10B0182	SW1312/6010B
Barium	ND		"	0.200	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	ND		"	0.0500	"	"	"	"	"
Lead	ND		"	0.0500	"	"	"	"	"
Mercury	**0.000650**	B	"	0.000125	"	02/25/10 15:34	02/25/10	10B0197	SW1312/7470
Selenium	ND		"	0.200	"	02/24/10 16:34	02/24/10	10B0182	SW1312/6010B
Silver	ND		"	0.100	"	"	"	"	"
TCLP Mercury per EPA 7000 Series Methods									
Mercury	ND		mg/L	0.00250	1	02/23/10 17:36	02/23/10	10B0174	SW1311/7470
TCLP Metals									
Arsenic	ND		mg/L	0.500	1	02/23/10 18:31	02/23/10	10B0169	SW1311/6010B
Barium	ND		"	5.00	"	"	"	"	"
Cadmium	ND		"	0.0500	"	"	"	"	"
Chromium	ND		"	0.100	"	"	"	"	"
Lead	ND		"	0.200	"	"	"	"	"
Selenium	ND		"	0.500	"	"	"	"	"
Silver	ND		"	0.300	"	"	"	"	"
Total Metals by SW 846 Series Methods									
Arsenic	**122**		mg/kg	10.1	10	02/24/10 19:22	02/24/10	10B0183	SW6010B
Barium	ND		"	20.3	"	"	"	"	"
Cadmium	ND		"	10.1	"	"	"	"	"
Chromium	**161**		"	10.1	"	"	"	"	"
Lead	ND		"	20.3	"	"	"	"	"
Mercury	**0.0613**		"	0.00500	1	02/24/10 15:55	"	10B0179	SW7471
Selenium	ND		"	20.3	10	02/24/10 19:22	"	10B0183	SW6010B
Silver	ND		"	10.1	"	"	"	"	"

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PVT Land Company	Work Order:	HTB0121	Received:	02/22/10
87-2020 Farrington Hwy.			Reported:	03/05/10 13:53
Waianae, HI 96792	Project:	PVT Landfill		
Steve Joseph	Project Number:	[none]		

LABORATORY BLANK QC DATA

Analyte	Source Result	Spike Level	Units	MDL	MRL	Result	Dup Result	% REC	Dup %REC	% REC Limits	RPD	RPD Limit	Q
SPLP Metals													
Batch\Seq: 10B0182 Extracted: 02/24/10													
Blank Analyzed: 02/24/2010 (10B0182-BLK1)													
Arsenic			mg/L	N/A	0.200	ND							
Barium			mg/L	N/A	0.200	ND							
Cadmium			mg/L	N/A	0.0500	ND							
Chromium			mg/L	N/A	0.0500	ND							
Lead			mg/L	N/A	0.0500	0.0697							A-01,B
Selenium			mg/L	N/A	0.200	ND							
Silver			mg/L	N/A	0.100	ND							
Batch\Seq: 10B0197 Extracted: 02/25/10													
Blank Analyzed: 02/25/2010 (10B0197-BLK1)													
Mercury			mg/L	N/A	0.000125	0.000250							B
TCLP Mercury per EPA 7000 Series Methods													
Batch\Seq: 10B0174 Extracted: 02/23/10													
Blank Analyzed: 02/23/2010 (10B0174-BLK1)													
Mercury			mg/L	N/A	0.00250	ND							
Blank Analyzed: 02/23/2010 (10B0174-BLK2)													
Mercury			mg/L	N/A	0.00250	ND							
TCLP Metals													
Batch\Seq: 10B0169 Extracted: 02/23/10													
Blank Analyzed: 02/23/2010 (10B0169-BLK1)													
Arsenic			mg/L	N/A	0.500	ND							
Barium			mg/L	N/A	5.00	ND							
Cadmium			mg/L	N/A	0.0500	ND							
Chromium			mg/L	N/A	0.100	ND							
Lead			mg/L	N/A	0.200	ND							
Selenium			mg/L	N/A	0.500	ND							
Silver			mg/L	N/A	0.300	ND							
Blank Analyzed: 02/23/2010 (10B0169-BLK2)													
Arsenic			mg/L	N/A	0.500	ND							
Barium			mg/L	N/A	5.00	ND							
Cadmium			mg/L	N/A	0.0500	ND							
Chromium			mg/L	N/A	0.100	ND							
Lead			mg/L	N/A	0.200	ND							
Selenium			mg/L	N/A	0.500	ND							
Silver			mg/L	N/A	0.300	ND							
Total Metals by SW 846 Series Methods													
Batch\Seq: 10B0179 Extracted: 02/24/10													
Blank Analyzed: 02/24/2010 (10B0179-BLK1)													
Mercury			mg/kg	N/A	0.00500	ND							
Batch\Seq: 10B0183 Extracted: 02/24/10													
Blank Analyzed: 02/24/2010 (10B0183-BLK1)													
Arsenic			mg/kg	N/A	1.00	ND							
Barium			mg/kg	N/A	2.00	ND							

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PVT Land Company
87-2020 Farrington Hwy.
Waianae, HI 96792
Steve Joseph

Work Order: HTB0121
Project: PVT Landfill
Project Number: [none]

Received: 02/22/10
Reported: 03/05/10 13:53

LABORATORY BLANK QC DATA

Analyte	Source Result	Spike Level	Units	MDL	MRL	Result	Dup Result	% REC	Dup %REC	% REC Limits	RPD	RPD Limit	Q
Total Metals by SW 846 Series Methods													
Batch\Seq: 10B0183 Extracted: 02/24/10													
Blank Analyzed: 02/24/2010 (10B0183-BLK1)													
Cadmium			mg/kg	N/A	1.00	ND							
Chromium			mg/kg	N/A	1.00	ND							
Lead			mg/kg	N/A	2.00	ND							
Selenium			mg/kg	N/A	2.00	ND							
Silver			mg/kg	N/A	1.00	ND							

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PVT Land Company 87-2020 Farrington Hwy. Waianae, HI 96792 Steve Joseph	Work Order: HTB0121 Project: PVT Landfill Project Number: [none]	Received: 02/22/10 Reported: 03/05/10 13:53

LCS/LCS DUPLICATE QC DATA

Analyte	Source Result	Spike Level	Units	MDL	MRL	Result	Dup Result	% REC	Dup %REC	% REC Limits	RPD	RPD Limit	Q
SPLP Metals													
Batch\Seq: 10B0182 Extracted: 02/24/10													
LCS Analyzed: 02/24/2010 (10B0182-BS1)													
Arsenic		20.0	mg/L	N/A	0.200	20.0		100		80-120			
Barium		20.0	mg/L	N/A	0.200	19.5		98		80-120			
Cadmium		20.0	mg/L	N/A	0.0500	19.5		97		80-120			
Chromium		20.0	mg/L	N/A	0.0500	19.5		97		80-120			
Lead		20.0	mg/L	N/A	0.0500	18.3		92		80-120			
Selenium		20.0	mg/L	N/A	0.200	20.3		101		80-120			
Silver		2.00	mg/L	N/A	0.100	2.01		100		80-120			
Batch\Seq: 10B0197 Extracted: 02/25/10													
LCS Analyzed: 02/25/2010 (10B0197-BS1)													
Mercury		0.0100	mg/L	N/A	0.000125	0.0101		101		80-120			
TCLP Mercury per EPA 7000 Series Methods													
Batch\Seq: 10B0174 Extracted: 02/23/10													
LCS Analyzed: 02/23/2010 (10B0174-BS1)													
Mercury		0.0100	mg/L	N/A	0.00250	0.00990		99		80-120			
TCLP Metals													
Batch\Seq: 10B0169 Extracted: 02/23/10													
LCS Analyzed: 02/23/2010 (10B0169-BS1)													
Arsenic		20.0	mg/L	N/A	0.500	21.0		105		80-120			
Barium		20.0	mg/L	N/A	5.00	19.9		100		80-120			
Cadmium		20.0	mg/L	N/A	0.0500	17.9		89		80-120			
Chromium		20.0	mg/L	N/A	0.100	19.0		95		80-120			
Lead		20.0	mg/L	N/A	0.200	21.3		106		80-120			
Selenium		20.0	mg/L	N/A	0.500	21.4		107		80-120			
Silver		2.00	mg/L	N/A	0.300	1.80		90		80-120			
Total Metals by SW 846 Series Methods													
Batch\Seq: 10B0179 Extracted: 02/24/10													
LCS Analyzed: 02/24/2010 (10B0179-BS1)													
Mercury		0.524	mg/kg	N/A	0.0500	0.537		102		80-120			
Batch\Seq: 10B0183 Extracted: 02/24/10													
LCS Analyzed: 02/24/2010 (10B0183-BS1)													
Arsenic		100	mg/kg	N/A	10.0	101		101		80-120			
Barium		100	mg/kg	N/A	20.0	101		101		80-120			
Cadmium		100	mg/kg	N/A	10.0	102		102		80-120			
Chromium		100	mg/kg	N/A	10.0	98.3		98		80-120			
Lead		100	mg/kg	N/A	20.0	94.6		95		80-120			
Selenium		100	mg/kg	N/A	20.0	100		100		80-120			
Silver		10.0	mg/kg	N/A	10.0	9.65		97		80-120			

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PVT Land Company 87-2020 Farrington Hwy. Waianae, HI 96792 Steve Joseph	Work Order: HTB0121 Project: PVT Landfill Project Number: [none]	Received: Reported:	02/22/10 03/05/10 13:53

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC DATA

Analyte	Source Result	Spike Level	Units	MDL	MRL	Result	Dup Result	% REC	Dup %REC	% REC Limits	RPD	RPD Limit	Q
SPLP Metals													
Batch\Seq: 10B0182 Extracted: 02/24/10													
Matrix Spike Analyzed: 02/24/2010 (10B0182-MS1)				**QC Source Sample: HTB0121-01**									
Arsenic	ND	20.0	mg/L	N/A	0.200	20.2	19.0	101	95	80-120	6	20	
Barium	0.104	20.0	mg/L	N/A	0.200	19.7	18.6	98	92	80-120	6	20	
Cadmium	ND	20.0	mg/L	N/A	0.0500	19.7	18.9	99	95	80-120	4	20	
Chromium	ND	20.0	mg/L	N/A	0.0500	19.6	18.6	98	93	80-120	5	20	
Lead	ND	20.0	mg/L	N/A	0.0500	18.4	17.5	92	88	80-120	5	20	
Selenium	ND	20.0	mg/L	N/A	0.200	20.6	19.5	103	98	80-120	5	20	
Silver	ND	2.00	mg/L	N/A	0.100	1.95	1.89	97	94	80-120	3	20	
Batch\Seq: 10B0197 Extracted: 02/25/10													
Matrix Spike Analyzed: 02/25/2010 (10B0197-MS1)				**QC Source Sample: HTB0121-01**									
Mercury	0.000500	0.0100	mg/L	N/A	0.000125	0.0102	0.0103	98	98	75-125	1	20	
TCLP Mercury per EPA 7000 Series Methods													
Batch\Seq: 10B0174 Extracted: 02/23/10													
Matrix Spike Analyzed: 02/23/2010 (10B0174-MS1)				**QC Source Sample: HTB0103-01**									
Mercury	ND	0.0100	mg/L	N/A	0.00250	0.0102	0.0101	102	101	75-125	1	20	
TCLP Metals													
Batch\Seq: 10B0169 Extracted: 02/23/10													
Matrix Spike Analyzed: 02/23/2010 (10B0169-MS1)				**QC Source Sample: HTB0101-02**									
Arsenic	0.0593	20.0	mg/L	N/A	0.500	21.7	21.5	108	107	80-120	1	20	
Barium	1.26	20.0	mg/L	N/A	5.00	21.8	21.6	103	102	80-120	1	20	
Cadmium	0.00660	20.0	mg/L	N/A	0.0500	18.6	18.7	93	94	80-120	1	20	
Chromium	ND	20.0	mg/L	N/A	0.100	20.0	20.0	100	100	80-120	0	20	
Lead	0.0192	20.0	mg/L	N/A	0.200	20.9	20.9	104	104	80-120	0	20	
Selenium	ND	20.0	mg/L	N/A	0.500	21.5	21.5	107	108	80-120	0	20	
Silver	ND	2.00	mg/L	N/A	0.300	1.83	1.82	92	91	80-120	0	20	
Total Metals by SW 846 Series Methods													
Batch\Seq: 10B0179 Extracted: 02/24/10													
Matrix Spike Analyzed: 02/24/2010 (10B0179-MS1)				**QC Source Sample: HTB0109-01**									
Mercury	0.0270	0.524	mg/kg	N/A	0.0500	0.555	0.553	101	100	75-125	1	20	
Batch\Seq: 10B0183 Extracted: 02/24/10													
Matrix Spike Analyzed: 02/24/2010 (10B0183-MS1)				**QC Source Sample: HTB0075-03**									
Arsenic	6.90	98.2	mg/kg	N/A	9.82	50.0	61.2	44	55	80-120	20	20	M1
Barium	125	98.2	mg/kg	N/A	19.6	168	211	43	86	80-120	23	20	M1,R
Cadmium	ND	98.2	mg/kg	N/A	9.82	67.5	85.8	69	87	80-120	24	20	M1,R
Chromium	165	98.2	mg/kg	N/A	9.82	207	242	43	78	80-120	15	20	M1
Lead	2.43	98.2	mg/kg	N/A	19.6	76.2	98.6	75	97	80-120	26	20	M1,R
Selenium	1.88	98.2	mg/kg	N/A	19.6	41.1	48.3	40	47	80-120	16	20	M1
Silver	2.71	9.82	mg/kg	N/A	9.82	9.58	11.0	70	84	80-120	14	20	M1

PVT Land Company 87-2020 Farrington Hwy. Waianae, HI 96792 Steve Joseph	Work Order: HTB0121 Project: PVT Landfill Project Number: [none]	Received: 02/22/10 Reported: 03/05/10 13:53

CERTIFICATION SUMMARY

TestAmerica Honolulu

Method	Matrix	Nelac	Hawaii
SW1311/6010B	Solid/Soil	X	
SW1311/7470	Solid/Soil	X	
SW1312/6010B	Solid/Soil		
SW1312/7470	Solid/Soil		
SW6010B	Solid/Soil	X	
SW7471	Solid/Soil	X	

Subcontracted Laboratories

STL - Seattle, WA

5755 8th Street East - Tacoma,, WA 98424

Analysis Performed: 8270D SPLP
Samples: HTB0121-01, HTB0121-02, HTB0121-03

Analysis Performed: 8270D TCLP Semivols
Samples: HTB0121-01, HTB0121-02, HTB0121-03

For information concerning certifications of this facility or another TestAmerica facility, please visit our website at www.TestAmericaInc.com

DATA QUALIFIERS AND DEFINITIONS

A-01	Samples ND data not impacted
B	Analyte was detected in the associated Method Blank.
M1	The MS and/or MSD were outside the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
R	The RPD exceeded the method control limit due to sample matrix effects. The individual analyte QA/QC recoveries, however, were within acceptance limits.
ND	Not detected at the reporting limit (or method detection limit if shown)

ADDITIONAL COMMENTS

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica - Honolulu
99-193 Aiea Heights Drive Suite 121 • Aiea, HI 96701-3900
808-486-LABS (5227) • Fax 808-486-2456

LABORATORY USE ONLY
LAB JOB NO. NTB0121
LOCATION
CONTAINERS

Chain of Custody / Analysis Request Form

Report to:

Company name: PVT Landfill (Steve Joseph)

Address:

City: State: ZIP:

Phone: Fax:

Sampler: Russell OkoJI

samples in shipment:

Project identification

Job name:

Job number:

P.O. number:

Contact email address: RUSSELLOKOJI@GMAIL.COM

Date results needed: 2/23/10

Indicate analyses requested

Item no.	Client sample ID	COMP	GRAB	Matrix: Water	Soil	Wastewater	Drinking water	Sludge	Liquid	Solid	Oil	Other	Preservation method	Sampling: Date	Time	No. of containers	TCLP - RCRA8	~~RCRA~~ TCLP-Pentachloro	TOTAL METALS (RCRA8) 10g	Laboratory ID no.
1	222-01	/										/		2/22/10	12PM		/	/	/	NTB0121-01
2	222-02	/										/		|	|		/	/	/	-02
3	222-03	/										/		|	|		/	/	/	-03
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Released by (print / sign)	Date / time released	Delivery method	Received by (print / sign)	Company / Agency affiliation	Date / time received	Condition noted
RUSSELL OKOJI	2/22/10 / 2:50	Hand	[signature]	TAH	2/22/10 / 2:50	no ice 25°C
	/				/	intact
	/				/	

Comments: ~~RUSH ASAP~~ - NEXTDAY METALS, ASAP TCLP.
Please charge PVT Landfill Acct

Please check one:
- ☐ Dispose by lab
- ☐ Return to client
- ☐ Archive

COC REV 06/2006   Distribution: White - TestAmerica   Yellow - TestAmerica   Pink - Client

Page 1 of 1

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Sample Receipt Checklist

Client Name: PNT landfill **Date/ Time Received:** 2/22/10 2:50

Checklist Completed By: SYC **Received By:** SYC

Matrices: **Carrier:** **Airbill# :**

Shipping container/cooler in good condition?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑ #:
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑ #:
Chain of Custody present?	Yes ☑	No ☐	
Chain of Custody Signed when relinquished and received?	Yes ☑	No ☐	
Chain of Custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☐	No ☑	
Sample containers intact?	Yes ☑	No ☐	
Sample containers on ice?	Yes ☐	No ☑	Type:
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Water - VOA Vials have Zero Headspace?	Yes ☐	No ☐	No VOA vials present: ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Checked: ☑
pH Adjusted?	Yes ☐	No ☑	Final pH:
Encores / 5035 Vials Present?	Yes ☐	No ☑	
Sample Filtration Needed?	Yes ☐	No ☑	Filtered in Field: ☐
Dry Weight Corrected Results?	Yes ☐	No ☑	Take Action: ☐
DODQSM / QAPP Project?	Yes ☐	No ☑	Type:

Temperature Blank Present? Yes ☐ No ☑

Sample Container/Blank Temperature Range (Minimum 3 sample containers if available): 25 °C

Comments/ Sampling Handling Notes:

two buckets of samples but do 3X as 3 samples 222-01 → 03.
SYC 2/22/10
record ~~both~~ time spend on sample in order to charge client

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-17956-1
Client Project/Site: HTB0121

For:
TestAmerica Laboratories, Inc
99-193 Aiea Heights Drive
Suite 121
Aiea, Hawaii 96701

Attn: Marvin D Heskett III

Pamela R. Johnson

Authorized for release by:
2/26/2010 12:55 PM

Pam Johnson
Project Manager I
pamr.johnson@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Client Sample ID: HTB0121-01

Lab Sample ID: 580-17956-1
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.5		ug/L		02/25/10 12:00	02/25/10 15:36	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*65*		*44 - 148*	*02/25/10 12:00*	*02/25/10 15:36*	*1*
Phenol-d5	*45*		*33 - 147*	*02/25/10 12:00*	*02/25/10 15:36*	*1*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/25/10 12:00*	*02/25/10 15:36*	*1*

Client Sample ID: HTB0121-02

Lab Sample ID: 580-17956-2
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.9		ug/L		02/25/10 12:00	02/25/10 15:58	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 15:58*	*1*
Phenol-d5	*47*		*33 - 147*	*02/25/10 12:00*	*02/25/10 15:58*	*1*
2,4,6-Tribromophenol	*100*		*47 - 158*	*02/25/10 12:00*	*02/25/10 15:58*	*1*

Client Sample ID: HTB0121-03

Lab Sample ID: 580-17956-3
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.3		ug/L		02/25/10 12:00	02/25/10 16:19	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 16:19*	*1*
Phenol-d5	*42*		*33 - 147*	*02/25/10 12:00*	*02/25/10 16:19*	*1*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/25/10 12:00*	*02/25/10 16:19*	*1*

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Lab Sample ID: LCS 580-59037/2-A
Matrix: Water
Analysis Batch: 59033

Client Sample ID: LCS 580-59037/2-A
Prep Type: Total/NA
Prep Batch: 59037

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	9.82	9.03		ug/L	92	23 - 166

Surrogate	*LCS % Recovery*	*LCS Qualifier*	*Limits*
2-Fluorophenol	*65*		*44 - 148*
Phenol-d5	*42*		*33 - 147*
2,4,6-Tribromophenol	*95*		*47 - 158*

Lab Sample ID: MB 580-59025/1-B
Matrix: Solid
Analysis Batch: 59033

Client Sample ID: MB 580-59025/1-B
Prep Type: SPLP West
Prep Batch: 59037

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.6		ug/L		02/25/10 12:00	02/25/10 14:54	1

Surrogate	*MB % Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 14:54*	*1*
Phenol-d5	*49*		*33 - 147*	*02/25/10 12:00*	*02/25/10 14:54*	*1*
2,4,6-Tribromophenol	*84*		*47 - 158*	*02/25/10 12:00*	*02/25/10 14:54*	*1*

Client Sample ID: HTB0121-01
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 15:36	CM	TestAmerica Seattle

Client Sample ID: HTB0121-02
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 15:58	CM	TestAmerica Seattle

Client Sample ID: HTB0121-03
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-3
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 16:19	CM	TestAmerica Seattle

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Laboratory	Program	Authority	EPA Region	Certification ID	Expiration Date
TestAmerica Seattle	DoD ELAP	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	ISO/IEC 17025	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	NELAC Primary AB	Oregon	10	WA100007	11/06/09
TestAmerica Seattle	NELAC Secondary AB	California	9	1115CA	01/31/10
TestAmerica Seattle	State Program	Alaska	10	UST-022	03/04/10
TestAmerica Seattle	State Program	Washington	10	C1226	02/17/11
TestAmerica Seattle	USDA			P330-08-00099	05/22/11

Accreditation may not be offered or required for all methods and analytes reported in this package. Please contact your project manager for the laboratory's current list of certified methods and analytes.

Method Summary

Method	Method Description	Protocol	Laboratory
8270C	Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	SW846	TAL TAC

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL TAC = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Sample Summary

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Lab Sample ID	Client Sample ID	Matrix	Sampled	Received
580-17956-1	HTB0121-01	Solid	02/22/10 12:00	02/25/10 09:50
580-17956-2	HTB0121-02	Solid	02/22/10 12:00	02/25/10 09:50
580-17956-3	HTB0121-03	Solid	02/22/10 12:00	02/25/10 09:50

1 2 3 4 5 6 7 8 9

SUBCONTRACT ORDER
TestAmerica Honolulu
HTB0121

17956

SENDING LABORATORY:

TestAmerica Honolulu
99-193 Aiea Heights Drive, Suite 121
Aiea, HI 96701
Phone: 808-486-5227
Fax: 808-486-2456
Project Manager: Samuel A. Lui
Client: PVT Land Company

RECEIVING LABORATORY:

TestAmerica Tacoma
5755 8th Street East
Tacoma,, WA 98424
Phone :(253) 922-2310
Fax: 253
Project Location: HI - HAWAII
Receipt Temperature:________°C Ice: Y / N

CC results to russellokoji@gmail.com

Analysis	Units	Due	Expires	Interlab Price	Surch	Comments
Sample ID: HTB0121-01 (222-01 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	SL 2/23/10 ~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied:						
~~1 L Amber Glass Unpreserved (B)~~ SL 2/23/10	1 L Amber Glass Unpreserved (C)					
Sample ID: HTB0121-02 (222-02 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	SL 2/23/10 ~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied:						
~~1 L Amber Glass Unpreserved (B)~~ 2/23/10	1 L Amber Glass Unpreserved (C)					
Sample ID: HTB0121-03 (222-03 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	SL 2/23/10 ~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied:						
~~1 L Amber Glass Unpreserved (B)~~ SL 2/23/10	1 L Amber Glass Unpreserved (C)					

* SPLP for this shipment only.

TCLP was already send in a previous shipment arrive to Tacoma ~2/24/10
SYL 2/23/10

[signature]	2/24/10	Tom Blankenship	2/25/10 0950
Released By	Date/Time	Received By	Date/Time
Released By	Date/Time	Received By	Date/Time

Lg Blue/wh wet, bubble FedEx StJON -0.3°C

Page 1 of 1

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc

Job Number: 580-17956-1

Login Number: 17956

List Source: TestAmerica Tacoma

Creator: Blankinship, Tom

List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	N/A	
Sample Preservation Verified	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-17956-1
Client Project/Site: HTB0121

For:
TestAmerica Laboratories, Inc
99-193 Aiea Heights Drive
Suite 121
Aiea, Hawaii 96701

Attn: Marvin D Heskett III

Pamela R. Johnson

Authorized for release by:
2/26/2010 12:55 PM

Pam Johnson
Project Manager I
pamr.johnson@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

1 2 3 4 5 6 7 8 9

Client Sample ID: HTB0121-01 — Lab Sample ID: 580-17956-1

Date Collected: 02/22/10 12:00 — **Matrix: Solid**
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.5		ug/L		02/25/10 12:00	02/25/10 15:36	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*65*		*44 - 148*	*02/25/10 12:00*	*02/25/10 15:36*	*1*
Phenol-d5	*45*		*33 - 147*	*02/25/10 12:00*	*02/25/10 15:36*	*1*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/25/10 12:00*	*02/25/10 15:36*	*1*

Client Sample ID: HTB0121-02 — Lab Sample ID: 580-17956-2

Date Collected: 02/22/10 12:00 — **Matrix: Solid**
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.9		ug/L		02/25/10 12:00	02/25/10 15:58	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 15:58*	*1*
Phenol-d5	*47*		*33 - 147*	*02/25/10 12:00*	*02/25/10 15:58*	*1*
2,4,6-Tribromophenol	*100*		*47 - 158*	*02/25/10 12:00*	*02/25/10 15:58*	*1*

Client Sample ID: HTB0121-03 — Lab Sample ID: 580-17956-3

Date Collected: 02/22/10 12:00 — **Matrix: Solid**
Date Received: 02/25/10 09:50

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.3		ug/L		02/25/10 12:00	02/25/10 16:19	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 16:19*	*1*
Phenol-d5	*42*		*33 - 147*	*02/25/10 12:00*	*02/25/10 16:19*	*1*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/25/10 12:00*	*02/25/10 16:19*	*1*

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Lab Sample ID: LCS 580-59037/2-A
Matrix: Water
Analysis Batch: 59033

Client Sample ID: LCS 580-59037/2-A
Prep Type: Total/NA
Prep Batch: 59037

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	9.82	9.03		ug/L	92	23 - 166

Surrogate	*LCS % Recovery*	*LCS Qualifier*	*Limits*
2-Fluorophenol	*65*		*44 - 148*
Phenol-d5	*42*		*33 - 147*
2,4,6-Tribromophenol	*95*		*47 - 158*

Lab Sample ID: MB 580-59025/1-B
Matrix: Solid
Analysis Batch: 59033

Client Sample ID: MB 580-59025/1-B
Prep Type: SPLP West
Prep Batch: 59037

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		4.6		ug/L		02/25/10 12:00	02/25/10 14:54	1

Surrogate	*MB % Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2-Fluorophenol	*76*		*44 - 148*	*02/25/10 12:00*	*02/25/10 14:54*	*1*
Phenol-d5	*49*		*33 - 147*	*02/25/10 12:00*	*02/25/10 14:54*	*1*
2,4,6-Tribromophenol	*84*		*47 - 158*	*02/25/10 12:00*	*02/25/10 14:54*	*1*

Lab Chronicle

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Client Sample ID: HTB0121-01
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 15:36	CM	TestAmerica Seattle

Client Sample ID: HTB0121-02
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 15:58	CM	TestAmerica Seattle

Client Sample ID: HTB0121-03
Date Collected: 02/22/10 12:00
Date Received: 02/25/10 09:50

Lab Sample ID: 580-17956-3
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
SPLP West	Leach	1312		1	59025	02/25/10 11:00	SP	TestAmerica Seattle
SPLP West	Prep	3510C		1	59037	02/25/10 12:00	SP	TestAmerica Seattle
SPLP West	Analysis	8270C		1	59033	02/25/10 16:19	CM	TestAmerica Seattle

Certification Summary

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Laboratory	Program	Authority	EPA Region	Certification ID	Expiration Date
TestAmerica Seattle	DoD ELAP	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	ISO/IEC 17025	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	NELAC Primary AB	Oregon	10	WA100007	11/06/09
TestAmerica Seattle	NELAC Secondary AB	California	9	1115CA	01/31/10
TestAmerica Seattle	State Program	Alaska	10	UST-022	03/04/10
TestAmerica Seattle	State Program	Washington	10	C1226	02/17/11
TestAmerica Seattle	USDA			P330-08-00099	05/22/11

Accreditation may not be offered or required for all methods and analytes reported in this package. Please contact your project manager for the laboratory's current list of certified methods and analytes.

Method Summary

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Method	Method Description	Protocol	Laboratory
8270C	Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	SW846	TAL TAC

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL TAC = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Sample Summary

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17956-1

Lab Sample ID	Client Sample ID	Matrix	Sampled	Received
580-17956-1	HTB0121-01	Solid	02/22/10 12:00	02/25/10 09:50
580-17956-2	HTB0121-02	Solid	02/22/10 12:00	02/25/10 09:50
580-17956-3	HTB0121-03	Solid	02/22/10 12:00	02/25/10 09:50

SUBCONTRACT ORDER
TestAmerica Honolulu
HTB0121

179556

SENDING LABORATORY:	RECEIVING LABORATORY:
TestAmerica Honolulu	TestAmerica Tacoma
99-193 Aiea Heights Drive, Suite 121	5755 8th Street East
Aiea, HI 96701	Tacoma,, WA 98424
Phone: 808-486-5227	Phone :(253) 922-2310
Fax: 808-486-2456	Fax: 253
Project Manager: Samuel A. Lui	Project Location: HI - HAWAII
Client: PVT Land Company	Receipt Temperature:_______°C Ice: Y / N

CC results to russellokoji@gmail.com

Analysis	Units	Due	Expires	Interlab Price	Surch	Comments
Sample ID: HTB0121-01 (222-01 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~ SL 2/23/10	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied: ~~1 L Amber Glass Unpreserved (B)~~ SL 2/23/10	1 L Amber Glass Unpreserved (C)					
Sample ID: HTB0121-02 (222-02 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~ SL 2/23/10	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied: ~~1 L Amber Glass Unpreserved (B)~~ SL 2/23/10	1 L Amber Glass Unpreserved (C)					
Sample ID: HTB0121-03 (222-03 - Solid/Soil) 2/26/10			**Sampled: 02/22/10 12:00**			
8270D SPLP	mg/L	~~02/25/10~~ SL 2/23/10	03/01/10 12:00	$260.00	75%	PCP only
~~8270D TCLP Semivols~~	~~mg/L~~	~~02/25/10~~	~~03/01/10 12:00~~	~~$260.00~~	~~75%~~	~~PCP only~~ SL 2/23/10
Containers Supplied: ~~1 L Amber Glass Unpreserved (B)~~ SL 2/23/10	1 L Amber Glass Unpreserved (C)					

* SPLP for this shipment only.

TCLP was already send in a previous shipment arrive to Tacoma ~2/24/10

SYL 2/23/10

Released By	Date/Time	Received By	Date/Time
[signature]	2/24/10	Tom Blank [signature]	2/25/10 0950
Released By	Date/Time	Received By	Date/Time

Lg Blue/wh wet, bubble FedEx SfJON -0.3°C

Page 1 of 1

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc Job Number: 580-17956-1

Login Number: 17956 **List Source: TestAmerica Tacoma**
Creator: Blankinship, Tom
List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	N/A	
Sample Preservation Verified	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-17929-1
Client Project/Site: HTB0121

For:
TestAmerica Laboratories, Inc
99-193 Aiea Heights Drive
Suite 121
Aiea, Hawaii 96701

Attn: Marvin D Heskett III

Pamela R. Johnson

Authorized for release by:
2/25/2010 12:08 PM

Pam Johnson
Project Manager I
pamr.johnson@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

1 2 3 4 5 6 7 8 9 10

Job Narrative
580-17929-1

Comments
No additional comments.

Receipt
All samples were received in good condition within temperature requirements.

GC/MS Semi VOA - Method 8270C
The continuing calibration verification (CCV) for analytical batch 58958 exceeded control criteria for CCC compound di-n-octylphthalate. All associated samples are being analyzed for PCP only. PCP passes within 20%D.

Phenol-d5 surrogate recovery was outside control limits for the following sample: 58947/1B MB, 580-17929-3MS, 580-17929-3. The samples are analyzed for PCP only, so only 2,4,6-TBP surrogate is needed.

No other analytical or quality issues were noted.

General Chemistry
No analytical or quality issues were noted.

Organic Prep
No analytical or quality issues were noted.

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Client Sample ID: HTB0121-01
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-1
Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:14	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*109*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:14*	*1*

Client Sample ID: HTB0121-02
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-2
Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:35	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*103*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:35*	*1*

Client Sample ID: HTB0121-03
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-3
Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:56	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:56*	*1*

1 2 3 4 5 6 7 8 9 10

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Lab Sample ID: LCS 580-58946/2-A
Matrix: Water
Analysis Batch: 58958

Client Sample ID: LCS 580-58946/2-A
Prep Type: Total/NA
Prep Batch: 58946

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	98.2	82.3		ug/L	84	23 - 166

Surrogate	*LCS % Recovery*	*LCS Qualifier*	*Limits*
2,4,6-Tribromophenol	*106*		*47 - 158*

Lab Sample ID: MB 580-58947/1-B
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: MB 580-58947/1-B
Prep Type: TCLP
Prep Batch: 58946

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 15:33	1

Surrogate	*MB % Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*83*		*47 - 158*	*02/24/10 11:40*	*02/24/10 15:33*	*1*

Lab Sample ID: 580-17929-3 MS
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: HTB0121-03
Prep Type: TCLP
Prep Batch: 58946

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	ND		98.2	117		ug/L	119	23 - 166

Surrogate	*MS % Recovery*	*MS Qualifier*	*Limits*
2,4,6-Tribromophenol	*105*		*47 - 158*

Lab Sample ID: 580-17929-3 DU
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: HTB0121-03
Prep Type: TCLP
Prep Batch: 58946

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	RPD	RPD Limit
Pentachlorophenol	ND		ND		ug/L	NC	45

Surrogate	*DU % Recovery*	*DU Qualifier*	*Limits*
2,4,6-Tribromophenol	*106*		*47 - 158*

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17929-1

Client Sample ID: HTB0121-01
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:14	CM	TestAmerica Seattle

Client Sample ID: HTB0121-02
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:35	CM	TestAmerica Seattle

Client Sample ID: HTB0121-03
Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Lab Sample ID: 580-17929-3
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:56	CM	TestAmerica Seattle

Certification Summary

Laboratory	Program	Authority	EPA Region	Certification ID	Expiration Date
TestAmerica Seattle	DoD ELAP	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	ISO/IEC 17025	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	NELAC Primary AB	Oregon	10	WA100007	11/06/09
TestAmerica Seattle	NELAC Secondary AB	California	9	1115CA	01/31/10
TestAmerica Seattle	State Program	Alaska	10	UST-022	03/04/10
TestAmerica Seattle	State Program	Washington	10	C1226	02/17/11
TestAmerica Seattle	USDA			P330-08-00099	05/22/11

Accreditation may not be offered or required for all methods and analytes reported in this package. Please contact your project manager for the laboratory's current list of certified methods and analytes.

Method Summary

Method	Method Description	Protocol	Laboratory
8270C	Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	SW846	TAL TAC

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL TAC = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Sample Summary

Lab Sample ID	Client Sample ID	Matrix	Sampled	Received
580-17929-1	HTB0121-01	Solid	02/22/10 12:00	02/24/10 08:40
580-17929-2	HTB0121-02	Solid	02/22/10 12:00	02/24/10 08:40
580-17929-3	HTB0121-03	Solid	02/22/10 12:00	02/24/10 08:40

SUBCONTRACT ORDER
TestAmerica Honolulu
HTB0121

17929

SENDING LABORATORY:

TestAmerica Honolulu
99-193 Aiea Heights Drive, Suite 121
Aiea, HI 96701
Phone: 808-486-5227
Fax: 808-486-2456
Project Manager: Samuel A. Lui
Client: PVT Land Company

RECEIVING LABORATORY:

TestAmerica Tacoma
5755 8th Street East
Tacoma,, WA 98424
Phone :(253) 922-2310
Fax: 253
Project Location: HI - HAWAII
Receipt Temperature:________°C Ice: Y / N

CC results to russellokoji@gmail.com

Analysis	Units	Due	Expires	Interlab Price	Surch	Comments
Sample ID: HTB0121-01 (222-01 - Solid/Soil)		2/25/10	Sampled: **02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ or ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						
Sample ID: HTB0121-02 (222-02 - Solid/Soil)		2/25/10	Sampled: **02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						
Sample ID: HTB0121-03 (222-03 - Solid/Soil)		2/25/10	Sampled: **02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						

Lg blue wh.
w/o
IR: 1.7
Temp: 2.4

Released By	Date/Time	Received By	Date/Time
[signature]	2/23/10	Cathy Gamble	2/24/10 8:40
Released By	Date/Time	Received By	Date/Time

Page 1 of 1

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc

Job Number: 580-17929-1

Login Number: 17929
List Source: TestAmerica Tacoma
Creator: Gamble, Cathy
List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	N/A	
Sample Preservation Verified	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories Inc.
TestAmerica Seattle
5755 8th Street East
Tacoma, WA 98424
Tel: (253)922-2310

TestAmerica Job ID: 580-17929-1
Client Project/Site: HTB0121

For:
TestAmerica Laboratories, Inc
99-193 Aiea Heights Drive
Suite 121
Aiea, Hawaii 96701

Attn: Marvin D Heskett III

Authorized for release by:
2/25/2010 12:08 PM

Pam Johnson
Project Manager I
pamr.johnson@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

1 2 3 4 5 6 7 8 9 10

Job Narrative
580-17929-1

Comments
No additional comments.

Receipt
All samples were received in good condition within temperature requirements.

GC/MS Semi VOA - Method 8270C
The continuing calibration verification (CCV) for analytical batch 58958 exceeded control criteria for CCC compound di-n-octylphthalate. All associated samples are being analyzed for PCP only. PCP passes within 20%D.

Phenol-d5 surrogate recovery was outside control limits for the following sample: 58947/1B MB, 580-17929-3MS, 580-17929-3. The samples are analyzed for PCP only, so only 2,4,6-TBP surrogate is needed.

No other analytical or quality issues were noted.

General Chemistry
No analytical or quality issues were noted.

Organic Prep
No analytical or quality issues were noted.

Analytical Data

Client: TestAmerica Laboratories, Inc
Project/Site: HTB0121

TestAmerica Job ID: 580-17929-1

Client Sample ID: HTB0121-01

Lab Sample ID: 580-17929-1

Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:14	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*109*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:14*	*1*

Client Sample ID: HTB0121-02

Lab Sample ID: 580-17929-2

Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:35	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*103*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:35*	*1*

Client Sample ID: HTB0121-03

Lab Sample ID: 580-17929-3

Date Collected: 02/22/10 12:00
Date Received: 02/24/10 08:40

Matrix: Solid

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) - TCLP

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 16:56	1

Surrogate	*% Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*99*		*47 - 158*	*02/24/10 11:40*	*02/24/10 16:56*	*1*

Method: 8270C - Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Lab Sample ID: LCS 580-58946/2-A
Matrix: Water
Analysis Batch: 58958

Client Sample ID: LCS 580-58946/2-A
Prep Type: Total/NA
Prep Batch: 58946

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	98.2	82.3		ug/L	84	23 - 166

Surrogate	*LCS % Recovery*	*LCS Qualifier*	*Limits*
2,4,6-Tribromophenol	*106*		*47 - 158*

Lab Sample ID: MB 580-58947/1-B
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: MB 580-58947/1-B
Prep Type: TCLP
Prep Batch: 58946

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pentachlorophenol	ND		35		ug/L		02/24/10 11:40	02/24/10 15:33	1

Surrogate	*MB % Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
2,4,6-Tribromophenol	*83*		*47 - 158*	*02/24/10 11:40*	*02/24/10 15:33*	*1*

Lab Sample ID: 580-17929-3 MS
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: HTB0121-03
Prep Type: TCLP
Prep Batch: 58946

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	% Rec.	% Rec. Limits
Pentachlorophenol	ND		98.2	117		ug/L	119	23 - 166

Surrogate	*MS % Recovery*	*MS Qualifier*	*Limits*
2,4,6-Tribromophenol	*105*		*47 - 158*

Lab Sample ID: 580-17929-3 DU
Matrix: Solid
Analysis Batch: 58958

Client Sample ID: HTB0121-03
Prep Type: TCLP
Prep Batch: 58946

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	RPD	RPD Limit
Pentachlorophenol	ND		ND		ug/L	NC	45

Surrogate	*DU % Recovery*	*DU Qualifier*	*Limits*
2,4,6-Tribromophenol	*106*		*47 - 158*

Client Sample ID: HTB0121-01
Lab Sample ID: 580-17929-1
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/24/10 08:40

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:14	CM	TestAmerica Seattle

Client Sample ID: HTB0121-02
Lab Sample ID: 580-17929-2
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/24/10 08:40

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:35	CM	TestAmerica Seattle

Client Sample ID: HTB0121-03
Lab Sample ID: 580-17929-3
Date Collected: 02/22/10 12:00
Matrix: Solid
Date Received: 02/24/10 08:40

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared Or Analyzed	Analyst	Lab
TCLP	Leach	1311		1	58947	02/24/10 11:35	SP	TestAmerica Seattle
TCLP	Prep	3510C		1	58946	02/24/10 11:40	SP	TestAmerica Seattle
TCLP	Analysis	8270C		1	58958	02/24/10 16:56	CM	TestAmerica Seattle

Certification Summary

Laboratory	Program	Authority	EPA Region	Certification ID	Expiration Date
TestAmerica Seattle	DoD ELAP	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	ISO/IEC 17025	L-A-B	0	L2236	01/19/13
TestAmerica Seattle	NELAC Primary AB	Oregon	10	WA100007	11/06/09
TestAmerica Seattle	NELAC Secondary AB	California	9	1115CA	01/31/10
TestAmerica Seattle	State Program	Alaska	10	UST-022	03/04/10
TestAmerica Seattle	State Program	Washington	10	C1226	02/17/11
TestAmerica Seattle	USDA			P330-08-00099	05/22/11

Accreditation may not be offered or required for all methods and analytes reported in this package. Please contact your project manager for the laboratory's current list of certified methods and analytes.

Method Summary

Method	Method Description	Protocol	Laboratory
8270C	Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	SW846	TAL TAC

Protocol References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL TAC = TestAmerica Seattle, 5755 8th Street East, Tacoma, WA 98424, TEL (253)922-2310

Lab Sample ID	Client Sample ID	Matrix	Sampled	Received
580-17929-1	HTB0121-01	Solid	02/22/10 12:00	02/24/10 08:40
580-17929-2	HTB0121-02	Solid	02/22/10 12:00	02/24/10 08:40
580-17929-3	HTB0121-03	Solid	02/22/10 12:00	02/24/10 08:40

1
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SUBCONTRACT ORDER
TestAmerica Honolulu

HTB0121 17929

SENDING LABORATORY:

TestAmerica Honolulu
99-193 Aiea Heights Drive, Suite 121
Aiea, HI 96701
Phone: 808-486-5227
Fax: 808-486-2456
Project Manager: Samuel A. Lui
Client: PVT Land Company

RECEIVING LABORATORY:

TestAmerica Tacoma
5755 8th Street East
Tacoma,, WA 98424
Phone :(253) 922-2310
Fax: 253
Project Location: HI - HAWAII
Receipt Temperature:________°C Ice: Y / N

CC results to russellokoji@gmail.com

Analysis	Units	Due	Expires	Interlab Price	Surch	Comments
Sample ID: HTB0121-01 (222-01 - Solid/Soil) 2/25/10			**Sampled: 02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ or ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						
Sample ID: HTB0121-02 (222-02 - Solid/Soil) 2/25/10			**Sampled: 02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						
Sample ID: HTB0121-03 (222-03 - Solid/Soil) 2/25/10			**Sampled: 02/22/10 12:00**			
8270D TCLP Semivols	mg/L	~~02/23/10~~ ASAP	03/01/10 12:00	$260.00	200%	PCP only
Containers Supplied: 1 L Amber Glass Unpreserved (B)						

lg blue wh.
w/o
IR: 1.7
Temp: 2.4

[signature]	2/23/10	Cathy Gamble	2/24/10 8:40
Released By	Date/Time	Received By	Date/Time
Released By	Date/Time	Received By	Date/Time

Page 1 of 1

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc

Job Number: 580-17929-1

Login Number: 17929

List Source: TestAmerica Tacoma

Creator: Gamble, Cathy

List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	N/A	
Sample Preservation Verified	N/A	

Appendix C. Air Dispersion Modeling

Wet Season

Wet Season - Barium

Soil Disposal Emission Rate

$$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$$

where:	Q:	PM_{10} emission rate ($g/s\text{-}m^2$)
	E10:	PM_{10} concentration ($\mu g/m^3$)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	0.49	
L =	50	site-specific
h =	10	
u_{mean} =	2.68	site-specific
Q=	2.6264E-07	

04/05/15
23:11:01

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 13043 ***

Wet Ba

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE                 =        AREA
   EMISSION RATE (G/(S-M**2))  =    0.262640E-06
   SOURCE HEIGHT (M)           =      0.1000
   LENGTH OF LARGER SIDE (M)   =     50.0000
   LENGTH OF SMALLER SIDE (M)  =     20.0000
   RECEPTOR HEIGHT (M)         =      1.8000
   URBAN/RURAL OPTION          =       RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

   MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


BUOY. FLUX =    0.000 M**4/S**3;  MOM. FLUX =    0.000 M**4/S**2.

*** STABILITY CLASS  1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF   2.68 M/S ONLY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	0.2143E-01	1	2.7	2.7	857.6	0.10	0.
300.	0.9163E-02	1	2.7	2.7	857.6	0.10	2.
400.	0.4715E-02	1	2.7	2.7	857.6	0.10	0.
500.	0.2629E-02	1	2.7	2.7	857.6	0.10	0.
600.	0.1527E-02	1	2.7	2.7	857.6	0.10	0.
700.	0.9602E-03	1	2.7	2.7	857.6	0.10	0.
800.	0.6428E-03	1	2.7	2.7	857.6	0.10	0.
900.	0.4513E-03	1	2.7	2.7	857.6	0.10	0.
1000.	0.3295E-03	1	2.7	2.7	857.6	0.10	0.
1100.	0.2514E-03	1	2.7	2.7	857.6	0.10	0.
1200.	0.2045E-03	1	2.7	2.7	857.6	0.10	0.
1300.	0.1783E-03	1	2.7	2.7	857.6	0.10	0.
1400.	0.1632E-03	1	2.7	2.7	857.6	0.10	0.
1500.	0.1527E-03	1	2.7	2.7	857.6	0.10	0.
1600.	0.1442E-03	1	2.7	2.7	857.6	0.10	0.
1700.	0.1367E-03	1	2.7	2.7	857.6	0.10	0.
1800.	0.1300E-03	1	2.7	2.7	857.6	0.10	0.
1900.	0.1240E-03	1	2.7	2.7	857.6	0.10	0.
2000.	0.1186E-03	1	2.7	2.7	857.6	0.10	0.
2100.	0.1136E-03	1	2.7	2.7	857.6	0.10	0.
2200.	0.1091E-03	1	2.7	2.7	857.6	0.10	0.
2300.	0.1049E-03	1	2.7	2.7	857.6	0.10	0.
2400.	0.1011E-03	1	2.7	2.7	857.6	0.10	0.
2500.	0.9757E-04	1	2.7	2.7	857.6	0.10	0.
2600.	0.9429E-04	1	2.7	2.7	857.6	0.10	0.
2700.	0.9124E-04	1	2.7	2.7	857.6	0.10	0.
2800.	0.8839E-04	1	2.7	2.7	857.6	0.10	0.
2900.	0.8574E-04	1	2.7	2.7	857.6	0.10	0.

```
  3000.   0.8324E-04    1     2.7    2.7   857.6    0.10      0.
  3500.   0.7281E-04    1     2.7    2.7   857.6    0.10      0.
  4000.   0.6485E-04    1     2.7    2.7   857.6    0.10      0.
  4500.   0.5857E-04    1     2.7    2.7   857.6    0.10      0.
  5000.   0.5347E-04    1     2.7    2.7   857.6    0.10      0.
  5500.   0.4925E-04    1     2.7    2.7   857.6    0.10      0.
  6000.   0.4570E-04    1     2.7    2.7   857.6    0.10      0.
  6500.   0.4266E-04    1     2.7    2.7   857.6    0.10      0.
  7000.   0.4003E-04    1     2.7    2.7   857.6    0.10      0.
  7500.   0.3773E-04    1     2.7    2.7   857.6    0.10      0.
  8000.   0.3570E-04    1     2.7    2.7   857.6    0.10      0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   200. M:
   200.   0.2143E-01    1     2.7    2.7   857.6    0.10      0.

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
   402.   0.4658E-02    1     2.7    2.7   857.6    0.10      0.

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   ---------   -------
SIMPLE TERRAIN      0.2143E-01      200.        0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Wet Season - Lead

Soil Disposal Emission Rate

$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$

where:	Q:	PM_{10} emission rate ($g/s\text{-}m^2$)
	E10:	PM_{10} concentration ($\mu g/m^3$)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	0.27	
L =	50	site-specific
h =	10	
u_{mean} =	2.68	site-specific
Q=	1.4472E-07	

04/06/15
00:43:05

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Wet Pb

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = AREA
EMISSION RATE (G/(S-M**2)) = 0.144720E-06
SOURCE HEIGHT (M) = 0.1000
LENGTH OF LARGER SIDE (M) = 50.0000
LENGTH OF SMALLER SIDE (M) = 20.0000
RECEPTOR HEIGHT (M) = 1.8000
URBAN/RURAL OPTION = RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX = 0.000 M**4/S**3; MOM. FLUX = 0.000 M**4/S**2.

*** STABILITY CLASS 1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF 2.68 M/S ONLY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	0.1181E-01	1	2.7	2.7	857.6	0.10	0.
300.	0.5049E-02	1	2.7	2.7	857.6	0.10	2.
400.	0.2598E-02	1	2.7	2.7	857.6	0.10	0.
500.	0.1449E-02	1	2.7	2.7	857.6	0.10	0.
600.	0.8412E-03	1	2.7	2.7	857.6	0.10	0.
700.	0.5291E-03	1	2.7	2.7	857.6	0.10	0.
800.	0.3542E-03	1	2.7	2.7	857.6	0.10	0.
900.	0.2487E-03	1	2.7	2.7	857.6	0.10	0.
1000.	0.1816E-03	1	2.7	2.7	857.6	0.10	0.
1100.	0.1385E-03	1	2.7	2.7	857.6	0.10	0.
1200.	0.1127E-03	1	2.7	2.7	857.6	0.10	0.
1300.	0.9824E-04	1	2.7	2.7	857.6	0.10	0.
1400.	0.8990E-04	1	2.7	2.7	857.6	0.10	0.
1500.	0.8414E-04	1	2.7	2.7	857.6	0.10	0.
1600.	0.7944E-04	1	2.7	2.7	857.6	0.10	0.
1700.	0.7532E-04	1	2.7	2.7	857.6	0.10	0.
1800.	0.7164E-04	1	2.7	2.7	857.6	0.10	0.
1900.	0.6833E-04	1	2.7	2.7	857.6	0.10	0.
2000.	0.6533E-04	1	2.7	2.7	857.6	0.10	0.
2100.	0.6260E-04	1	2.7	2.7	857.6	0.10	0.
2200.	0.6011E-04	1	2.7	2.7	857.6	0.10	0.
2300.	0.5782E-04	1	2.7	2.7	857.6	0.10	0.
2400.	0.5571E-04	1	2.7	2.7	857.6	0.10	0.
2500.	0.5376E-04	1	2.7	2.7	857.6	0.10	0.
2600.	0.5196E-04	1	2.7	2.7	857.6	0.10	0.
2700.	0.5027E-04	1	2.7	2.7	857.6	0.10	0.
2800.	0.4871E-04	1	2.7	2.7	857.6	0.10	0.
2900.	0.4724E-04	1	2.7	2.7	857.6	0.10	0.

```
  3000.   0.4587E-04    1     2.7    2.7   857.6    0.10      0.
  3500.   0.4012E-04    1     2.7    2.7   857.6    0.10      0.
  4000.   0.3573E-04    1     2.7    2.7   857.6    0.10      0.
  4500.   0.3227E-04    1     2.7    2.7   857.6    0.10      0.
  5000.   0.2946E-04    1     2.7    2.7   857.6    0.10      0.
  5500.   0.2714E-04    1     2.7    2.7   857.6    0.10      0.
  6000.   0.2518E-04    1     2.7    2.7   857.6    0.10      0.
  6500.   0.2351E-04    1     2.7    2.7   857.6    0.10      0.
  7000.   0.2206E-04    1     2.7    2.7   857.6    0.10      0.
  7500.   0.2079E-04    1     2.7    2.7   857.6    0.10      0.
  8000.   0.1967E-04    1     2.7    2.7   857.6    0.10      0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   200. M:
   200.   0.1181E-01    1     2.7    2.7   857.6    0.10      0.

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC             U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
   402.   0.2567E-02    1     2.7    2.7   857.6    0.10      0.

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   ---------   -------
SIMPLE TERRAIN      0.1181E-01      200.        0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Wet Season - Respirable Dust (PM10)

Soil Disposal Emission Rate

$$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$$

where:	Q:	PM_{10} emission rate ($g/s\text{-}m^2$)
	E10:	PM_{10} concentration ($\mu g/m^3$)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	90	
L =	50	site-specific
h =	10	
u_{mean} =	2.68	site-specific

Q=	0.00004824	

04/06/15
09:00:56

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Wet PM10

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = AREA
EMISSION RATE (G/(S-M**2)) = 0.482400E-04
SOURCE HEIGHT (M) = 0.1000
LENGTH OF LARGER SIDE (M) = 50.0000
LENGTH OF SMALLER SIDE (M) = 20.0000
RECEPTOR HEIGHT (M) = 1.8000
URBAN/RURAL OPTION = RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX = 0.000 M**4/S**3; MOM. FLUX = 0.000 M**4/S**2.

*** STABILITY CLASS 1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF 2.68 M/S ONLY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	3.936	1	2.7	2.7	857.6	0.10	0.
300.	1.683	1	2.7	2.7	857.6	0.10	2.
400.	0.8661	1	2.7	2.7	857.6	0.10	0.
500.	0.4829	1	2.7	2.7	857.6	0.10	0.
600.	0.2804	1	2.7	2.7	857.6	0.10	0.
700.	0.1764	1	2.7	2.7	857.6	0.10	0.
800.	0.1181	1	2.7	2.7	857.6	0.10	0.
900.	0.8290E-01	1	2.7	2.7	857.6	0.10	0.
1000.	0.6052E-01	1	2.7	2.7	857.6	0.10	0.
1100.	0.4618E-01	1	2.7	2.7	857.6	0.10	0.
1200.	0.3755E-01	1	2.7	2.7	857.6	0.10	0.
1300.	0.3275E-01	1	2.7	2.7	857.6	0.10	0.
1400.	0.2997E-01	1	2.7	2.7	857.6	0.10	0.
1500.	0.2805E-01	1	2.7	2.7	857.6	0.10	0.
1600.	0.2648E-01	1	2.7	2.7	857.6	0.10	0.
1700.	0.2511E-01	1	2.7	2.7	857.6	0.10	0.
1800.	0.2388E-01	1	2.7	2.7	857.6	0.10	0.
1900.	0.2278E-01	1	2.7	2.7	857.6	0.10	0.
2000.	0.2178E-01	1	2.7	2.7	857.6	0.10	0.
2100.	0.2087E-01	1	2.7	2.7	857.6	0.10	0.
2200.	0.2004E-01	1	2.7	2.7	857.6	0.10	0.
2300.	0.1927E-01	1	2.7	2.7	857.6	0.10	0.
2400.	0.1857E-01	1	2.7	2.7	857.6	0.10	0.
2500.	0.1792E-01	1	2.7	2.7	857.6	0.10	0.
2600.	0.1732E-01	1	2.7	2.7	857.6	0.10	0.
2700.	0.1676E-01	1	2.7	2.7	857.6	0.10	0.
2800.	0.1624E-01	1	2.7	2.7	857.6	0.10	0.
2900.	0.1575E-01	1	2.7	2.7	857.6	0.10	0.

```
  3000.   0.1529E-01    1     2.7    2.7   857.6    0.10       0.
  3500.   0.1337E-01    1     2.7    2.7   857.6    0.10       0.
  4000.   0.1191E-01    1     2.7    2.7   857.6    0.10       0.
  4500.   0.1076E-01    1     2.7    2.7   857.6    0.10       0.
  5000.   0.9821E-02    1     2.7    2.7   857.6    0.10       0.
  5500.   0.9047E-02    1     2.7    2.7   857.6    0.10       0.
  6000.   0.8394E-02    1     2.7    2.7   857.6    0.10       0.
  6500.   0.7836E-02    1     2.7    2.7   857.6    0.10       0.
  7000.   0.7353E-02    1     2.7    2.7   857.6    0.10       0.
  7500.   0.6930E-02    1     2.7    2.7   857.6    0.10       0.
  8000.   0.6558E-02    1     2.7    2.7   857.6    0.10       0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   200. M:
   200.    3.936        1     2.7    2.7   857.6    0.10       0.

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC             U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
   402.   0.8555        1     2.7    2.7   857.6    0.10       0.

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------  ---------  -------
SIMPLE TERRAIN       3.936         200.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Dry Season

Dry Season - Barium

Soil Disposal Emission Rate

$$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$$

where:	Q:	PM_{10} emission rate (g/s-m^2)
	E10:	PM_{10} concentration (µg/m^3)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	0.49	
L =	50	site-specific
h =	10	
u_{mean} =	2.26	site-specific

Q= 2.2148E-07

04/06/15
14:22:39

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 13043 ***

Dry Pb

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE                  =        AREA
   EMISSION RATE (G/(S-M**2))  =     0.122040E-06
   SOURCE HEIGHT (M)            =       0.1000
   LENGTH OF LARGER SIDE (M)   =      50.0000
   LENGTH OF SMALLER SIDE (M)  =      20.0000
   RECEPTOR HEIGHT (M)          =       1.8000
   URBAN/RURAL OPTION           =        RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

   MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


BUOY. FLUX =    0.000 M**4/S**3;  MOM. FLUX =    0.000 M**4/S**2.

*** STABILITY CLASS  1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF   2.26 M/S ONLY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	0.1181E-01	1	2.3	2.3	723.2	0.10	0.
300.	0.5049E-02	1	2.3	2.3	723.2	0.10	2.
400.	0.2598E-02	1	2.3	2.3	723.2	0.10	0.
500.	0.1449E-02	1	2.3	2.3	723.2	0.10	0.
600.	0.8412E-03	1	2.3	2.3	723.2	0.10	0.
700.	0.5291E-03	1	2.3	2.3	723.2	0.10	0.
800.	0.3542E-03	1	2.3	2.3	723.2	0.10	0.
900.	0.2489E-03	1	2.3	2.3	723.2	0.10	0.
1000.	0.1836E-03	1	2.3	2.3	723.2	0.10	0.
1100.	0.1454E-03	1	2.3	2.3	723.2	0.10	0.
1200.	0.1250E-03	1	2.3	2.3	723.2	0.10	0.
1300.	0.1137E-03	1	2.3	2.3	723.2	0.10	0.
1400.	0.1060E-03	1	2.3	2.3	723.2	0.10	0.
1500.	0.9969E-04	1	2.3	2.3	723.2	0.10	0.
1600.	0.9419E-04	1	2.3	2.3	723.2	0.10	0.
1700.	0.8932E-04	1	2.3	2.3	723.2	0.10	0.
1800.	0.8495E-04	1	2.3	2.3	723.2	0.10	0.
1900.	0.8103E-04	1	2.3	2.3	723.2	0.10	0.
2000.	0.7747E-04	1	2.3	2.3	723.2	0.10	0.
2100.	0.7424E-04	1	2.3	2.3	723.2	0.10	0.
2200.	0.7128E-04	1	2.3	2.3	723.2	0.10	0.
2300.	0.6856E-04	1	2.3	2.3	723.2	0.10	0.
2400.	0.6606E-04	1	2.3	2.3	723.2	0.10	0.
2500.	0.6375E-04	1	2.3	2.3	723.2	0.10	0.
2600.	0.6161E-04	1	2.3	2.3	723.2	0.10	0.
2700.	0.5962E-04	1	2.3	2.3	723.2	0.10	0.
2800.	0.5776E-04	1	2.3	2.3	723.2	0.10	0.
2900.	0.5602E-04	1	2.3	2.3	723.2	0.10	0.

3000.	0.5439E-04	1	2.3	2.3	723.2	0.10	0.
3500.	0.4757E-04	1	2.3	2.3	723.2	0.10	0.
4000.	0.4237E-04	1	2.3	2.3	723.2	0.10	0.
4500.	0.3827E-04	1	2.3	2.3	723.2	0.10	0.
5000.	0.3494E-04	1	2.3	2.3	723.2	0.10	0.
5500.	0.3218E-04	1	2.3	2.3	723.2	0.10	0.
6000.	0.2986E-04	1	2.3	2.3	723.2	0.10	0.
6500.	0.2787E-04	1	2.3	2.3	723.2	0.10	0.
7000.	0.2616E-04	1	2.3	2.3	723.2	0.10	0.
7500.	0.2465E-04	1	2.3	2.3	723.2	0.10	0.
8000.	0.2333E-04	1	2.3	2.3	723.2	0.10	0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 200. M:

200.	0.1181E-01	1	2.3	2.3	723.2	0.10	0.

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
402.	0.2567E-02	1	2.3	2.3	723.2	0.10	0.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	0.1181E-01	200.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Dry Season - Lead

Soil Disposal Emission Rate

$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$

where:	Q:	PM_{10} emission rate ($g/s\text{-}m^2$)
	E10:	PM_{10} concentration ($\mu g/m^3$)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	0.27	
L =	50	site-specific
h =	10	
u_{mean} =	2.26	site-specific
Q=	1.2204E-07	

04/06/15
13:59:53

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 13043 ***

Dry Ba

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE                  =        AREA
   EMISSION RATE (G/(S-M**2))  =     0.221480E-06
   SOURCE HEIGHT (M)            =       0.1000
   LENGTH OF LARGER SIDE (M)   =      50.0000
   LENGTH OF SMALLER SIDE (M)  =      20.0000
   RECEPTOR HEIGHT (M)          =       1.8000
   URBAN/RURAL OPTION           =        RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

   MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


BUOY. FLUX =    0.000 M**4/S**3;  MOM. FLUX =    0.000 M**4/S**2.

*** STABILITY CLASS  1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF   2.26 M/S ONLY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	0.2143E-01	1	2.3	2.3	723.2	0.10	0.
300.	0.9163E-02	1	2.3	2.3	723.2	0.10	2.
400.	0.4715E-02	1	2.3	2.3	723.2	0.10	0.
500.	0.2629E-02	1	2.3	2.3	723.2	0.10	0.
600.	0.1527E-02	1	2.3	2.3	723.2	0.10	0.
700.	0.9602E-03	1	2.3	2.3	723.2	0.10	0.
800.	0.6428E-03	1	2.3	2.3	723.2	0.10	0.
900.	0.4517E-03	1	2.3	2.3	723.2	0.10	0.
1000.	0.3332E-03	1	2.3	2.3	723.2	0.10	0.
1100.	0.2638E-03	1	2.3	2.3	723.2	0.10	0.
1200.	0.2268E-03	1	2.3	2.3	723.2	0.10	0.
1300.	0.2063E-03	1	2.3	2.3	723.2	0.10	0.
1400.	0.1923E-03	1	2.3	2.3	723.2	0.10	0.
1500.	0.1809E-03	1	2.3	2.3	723.2	0.10	0.
1600.	0.1709E-03	1	2.3	2.3	723.2	0.10	0.
1700.	0.1621E-03	1	2.3	2.3	723.2	0.10	0.
1800.	0.1542E-03	1	2.3	2.3	723.2	0.10	0.
1900.	0.1470E-03	1	2.3	2.3	723.2	0.10	0.
2000.	0.1406E-03	1	2.3	2.3	723.2	0.10	0.
2100.	0.1347E-03	1	2.3	2.3	723.2	0.10	0.
2200.	0.1294E-03	1	2.3	2.3	723.2	0.10	0.
2300.	0.1244E-03	1	2.3	2.3	723.2	0.10	0.
2400.	0.1199E-03	1	2.3	2.3	723.2	0.10	0.
2500.	0.1157E-03	1	2.3	2.3	723.2	0.10	0.
2600.	0.1118E-03	1	2.3	2.3	723.2	0.10	0.
2700.	0.1082E-03	1	2.3	2.3	723.2	0.10	0.
2800.	0.1048E-03	1	2.3	2.3	723.2	0.10	0.
2900.	0.1017E-03	1	2.3	2.3	723.2	0.10	0.

3000.	0.9871E-04	1	2.3	2.3	723.2	0.10	0.
3500.	0.8634E-04	1	2.3	2.3	723.2	0.10	0.
4000.	0.7690E-04	1	2.3	2.3	723.2	0.10	0.
4500.	0.6945E-04	1	2.3	2.3	723.2	0.10	0.
5000.	0.6341E-04	1	2.3	2.3	723.2	0.10	0.
5500.	0.5841E-04	1	2.3	2.3	723.2	0.10	0.
6000.	0.5419E-04	1	2.3	2.3	723.2	0.10	0.
6500.	0.5059E-04	1	2.3	2.3	723.2	0.10	0.
7000.	0.4747E-04	1	2.3	2.3	723.2	0.10	0.
7500.	0.4474E-04	1	2.3	2.3	723.2	0.10	0.
8000.	0.4234E-04	1	2.3	2.3	723.2	0.10	0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 200. M:

200.	0.2143E-01	1	2.3	2.3	723.2	0.10	0.

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
402.	0.4658E-02	1	2.3	2.3	723.2	0.10	0.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	0.2143E-01	200.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Dry Season - Respirable Dust (PM10)

Soil Disposal Emission Rate

$$Q = (E_{10} \times h \times u_{mean})/(L \times 10^6)$$

where:	Q:	PM_{10} emission rate (g/s-m^2)
	E10:	PM_{10} concentration (µg/m^3)
	h:	mixing height
	u_{mean}:	mean wind speed (m/s), and
	L:	landfill length.

E_{10} =	90	
L =	50	site-specific
h =	10	
u_{mean} =	2.26	site-specific
Q=	0.00004068	

04/06/15
15:53:06

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Dry PM10

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE                   =        AREA
   EMISSION RATE (G/(S-M**2))  =     0.406800E-04
   SOURCE HEIGHT (M)             =       0.1000
   LENGTH OF LARGER SIDE (M)     =      50.0000
   LENGTH OF SMALLER SIDE (M)    =      20.0000
   RECEPTOR HEIGHT (M)           =       1.8000
   URBAN/RURAL OPTION            =        RURAL
```

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX =   0.000 M**4/S**3; MOM. FLUX =   0.000 M**4/S**2.

*** STABILITY CLASS 1 ONLY ***
*** ANEMOMETER HEIGHT WIND SPEED OF   2.26 M/S ONLY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF   0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
200.	3.936	1	2.3	2.3	723.2	0.10	0.
300.	1.683	1	2.3	2.3	723.2	0.10	2.
400.	0.8661	1	2.3	2.3	723.2	0.10	0.
500.	0.4829	1	2.3	2.3	723.2	0.10	0.
600.	0.2804	1	2.3	2.3	723.2	0.10	0.
700.	0.1764	1	2.3	2.3	723.2	0.10	0.
800.	0.1181	1	2.3	2.3	723.2	0.10	0.
900.	0.8296E-01	1	2.3	2.3	723.2	0.10	0.
1000.	0.6119E-01	1	2.3	2.3	723.2	0.10	0.
1100.	0.4846E-01	1	2.3	2.3	723.2	0.10	0.
1200.	0.4166E-01	1	2.3	2.3	723.2	0.10	0.
1300.	0.3789E-01	1	2.3	2.3	723.2	0.10	0.
1400.	0.3533E-01	1	2.3	2.3	723.2	0.10	0.
1500.	0.3323E-01	1	2.3	2.3	723.2	0.10	0.
1600.	0.3140E-01	1	2.3	2.3	723.2	0.10	0.
1700.	0.2977E-01	1	2.3	2.3	723.2	0.10	0.
1800.	0.2832E-01	1	2.3	2.3	723.2	0.10	0.
1900.	0.2701E-01	1	2.3	2.3	723.2	0.10	0.
2000.	0.2582E-01	1	2.3	2.3	723.2	0.10	0.
2100.	0.2475E-01	1	2.3	2.3	723.2	0.10	0.
2200.	0.2376E-01	1	2.3	2.3	723.2	0.10	0.
2300.	0.2285E-01	1	2.3	2.3	723.2	0.10	0.
2400.	0.2202E-01	1	2.3	2.3	723.2	0.10	0.
2500.	0.2125E-01	1	2.3	2.3	723.2	0.10	0.
2600.	0.2054E-01	1	2.3	2.3	723.2	0.10	0.
2700.	0.1987E-01	1	2.3	2.3	723.2	0.10	0.
2800.	0.1925E-01	1	2.3	2.3	723.2	0.10	0.
2900.	0.1867E-01	1	2.3	2.3	723.2	0.10	0.

3000.	0.1813E-01	1	2.3	2.3	723.2	0.10	0.
3500.	0.1586E-01	1	2.3	2.3	723.2	0.10	0.
4000.	0.1412E-01	1	2.3	2.3	723.2	0.10	0.
4500.	0.1276E-01	1	2.3	2.3	723.2	0.10	0.
5000.	0.1165E-01	1	2.3	2.3	723.2	0.10	0.
5500.	0.1073E-01	1	2.3	2.3	723.2	0.10	0.
6000.	0.9954E-02	1	2.3	2.3	723.2	0.10	0.
6500.	0.9292E-02	1	2.3	2.3	723.2	0.10	0.
7000.	0.8719E-02	1	2.3	2.3	723.2	0.10	0.
7500.	0.8218E-02	1	2.3	2.3	723.2	0.10	0.
8000.	0.7776E-02	1	2.3	2.3	723.2	0.10	0.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 200. M:

200.	3.936	1	2.3	2.3	723.2	0.10	0.

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
402.	0.8555	1	2.3	2.3	723.2	0.10	0.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.936	200.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Appendix D. Risk Characterization Spreadsheets

CHILD RESIDENT - DUST INHALATION
RISK CHARACTERIZATION
PVT LANDFILL

Scenario:	Current Operations
Receptor:	Child Resident
Medium:	Dust from Recycling Operations
Exposure Pathway:	Inhalation

Cdust = Chemical Concentration in Air
AT (noncancer)= ED in years x 365 days/year x 24 hours/day
AT (cancer)= lifetime in years (70 years) x 365 days/year x 24 hours/day
EC (ug/m3) = (Cdust x ET x EF x ED) / AT

Hazard Quotient (HQ) = EC (ug/m3) / RfC (ug/m3)
Cancer Risk (ELCR) = EC (ug/m3) * IUR (ug/m3)^-1

Parameter (units)	Value
EC: Exposure Concentration (ug/m3)	See Below
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific
ET: Exposure Time - dust (hr/d)	24
EF: Exposure Frequency (days/year)	350
ED: Exposure Duration (years)	6
AT: Averaging Time (hours) (noncancer)	52560
AT: Averaging Time (hours) (cancer)	613200
RfC: Reference Concentrations Inhalation (ug/m3)	Chemical-Specific
IUR: Inhalation Unit Risk Factor [(ug/m3)^-1]	Chemical-Specific
CF: Conversion Factor (kg/mg)	1.00E-06

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Dust Concentration at Emission Source (mg/m3)	Chemical Concentration in Air at Residential Location (mg/m3)	Inhalation RAF (noncancer)	EC (noncancer) (ug/m3)	RFC (non-cancer) (ug/m3)	Soil-Dust HQ	Inhalation RAF (cancer)	EC (cancer) (ug/m3)	IUR (ug/m3)^-1	Soil- Dust Risk
METALS										
Barium	4.90E-04	9.32E-07	1	8.93E-04	5.00E-01	1.79E-03	1	NA	NA	NA
						1.79E-03				0.00E+00

ADULT RESIDENT - DUST INHALATION
RISK CHARACTERIZATION
PVT LANDFILL

Scenario:	Current Operations
Receptor:	Adult Resident
Medium:	Dust from Recycling Operations
Exposure Pathway:	Inhalation

Cdust = Chemical Concentration in Air
AT (noncancer)= ED in years x 365 days/year x 24 hours/day
AT (cancer)= lifetime in years (70 years) x 365 days/year x 24 hours/day
EC (ug/m3) = $\frac{\text{Cdust x ET x EF x ED}}{\text{AT}}$

Hazard Quotient (HQ) = EC (ug/m3) / RfC (ug/m3)
Cancer Risk (ELCR) = EC (ug/m3) * IUR (ug/m3)^-1

Parameter (units)	Value
EC: Exposure Concentration (ug/m3)	See Below
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific
ET: Exposure Time - dust (hr/d)	24
EF: Exposure Frequency (days/year)	350
ED: Exposure Duration (years)	20
AT: Averaging Time (hours) (noncancer)	175200
AT: Averaging Time (hours) (cancer)	613200
RfC: Reference Concentrations Inhalation (ug/m3)	Chemical-Specific
IUR: Inhalation Unit Risk Factor [(ug/m3)^-1]	Chemical-Specific
CF: Conversion Factor (kg/mg)	1.00E-06

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Dust Concentration at Emission Source (mg/m3)	Chemical Concentration in Air at Residential Location (mg/m3)	Inhalation RAF (noncancer)	EC (noncancer) (ug/m3)	RFC (non-cancer) (ug/m3)	Soil-Dust HQ	Inhalation RAF (cancer)	EC (cancer) (ug/m3)	IUR (ug/m3)^-1	Soil- Dust Risk
METALS										
Barium	4.90E-04	9.32E-07	1	8.93E-04	5.00E-01	1.79E-03	1	NA	NA	NA
						1.79E-03				0.00E+00

LEAD MODEL FOR WINDOWS Version 1.1

==
Model Version: 1.1 Build11
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research
==

****** Air ******

Indoor Air Pb Concentration: 100.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.001
1-2	2.000	3.000	32.000	0.001
2-3	3.000	5.000	32.000	0.001
3-4	4.000	5.000	32.000	0.001
4-5	4.000	5.000	32.000	0.001
5-6	4.000	7.000	32.000	0.001
6-7	4.000	7.000	32.000	0.001

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 51.151 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	73.000	51.151
1-2	73.000	51.151
2-3	73.000	51.151
3-4	73.000	51.151
4-5	73.000	51.151
5-6	73.000	51.151
6-7	73.000	51.151

******** Alternate Intake ********

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

******** Maternal Contribution: Infant Model ********

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.000	1.092	0.000	0.387
1-2	0.000	0.944	0.000	0.963
2-3	0.001	1.031	0.000	1.006
3-4	0.001	0.992	0.000	1.031
4-5	0.001	0.955	0.000	1.077
5-6	0.001	1.007	0.000	1.139
6-7	0.001	1.092	0.000	1.160

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	1.503	2.983	1.6
1-2	2.379	4.287	1.8
2-3	2.390	4.428	1.7
3-4	2.402	4.425	1.6
4-5	1.792	3.825	1.3
5-6	1.617	3.764	1.2
6-7	1.529	3.782	1.1

Appendix E. Arsenic and Chromium Modeling

APPENDIX D

ARSENIC AND CHROMIUM EPCs

DUST SAMPLES, RECYCLING OPERATIONS

PVT LANDFILL, NANAKULI, HAWAII

Exposure Point	Chemical of Potential Concern	Maximum Concentration in Bulk Material (mg/kg)	Respirable Dust Concentration at Receptor Location (mg/m3)	Chemical Exposure Point Concentration at Receptor Location (ug/m3)
Dust from Recycling Operations	Arsenic	233	0.0001711	3.99E-08
	Chromium*	11.96	0.0001711	2.05E-09

The chemical concentration in bulk material is based on the maximum detected concentration.

* This assessment assumed that hexavalent chromium exists at 4% of the total chromium detected, which is the upper end value of speciation studies which detected hexavalent chromium from disposed CCA treated wood samples in concentrations of approximately 0.7 to 4% of the total chromium. Additional details provided in Section 5.1

CHILD RESIDENT - DUST INHALATION
RISK CHARACTERIZATION
PVT LANDFILL

Scenario:	Current Operations
Receptor:	Child Resident
Medium:	Dust from Recycling Operations
Exposure Pathway:	Inhalation

Cdust = Chemical Concentration in Air = CS x RP x CF
AT (noncancer)= ED in years x 365 days/year x 24 hours/day
AT (cancer)= lifetime in years (70 years) x 365 days/year x 24 hours/day
EC (ug/m3) = (Cdust x ET x EF x ED) / AT

Hazard Quotient (HQ) = EC (ug/m3) / RfC (ug/m3)
Cancer Risk (ELCR) = EC (ug/m3) * IUR (ug/m3)^-1

Parameter (units)	Value	
EC: Exposure Concentration (ug/m3)	See Below	
CS: Chemical Concentration in Bulk Material (mg/kg)	Chemical-Specific	
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated	
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific	
ET: Exposure Time - dust (hr/d)	24	
EF: Exposure Frequency (days/year)	350	
ED: Exposure Duration (years)	6	
AT: Averaging Time (hours) (noncancer)	52560	
AT: Averaging Time (hours) (cancer)	613200	
RfC: Reference Concentrations Inhalation (ug/m3)	Chemical-Specific	
IUR: Inhalation Unit Risk Factor [(ug/m3)^-1]	Chemical-Specific	
RP: Respirable particulate conc. in air (mg/m3)	1.71E-04	(SCREEN3 Results)
CF: Conversion Factor (kg/mg)	1.00E-06	

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Bulk Material Concentration (mg/kg)	Chemical Concentration in Air (mg/m3)	Inhalation RAF (noncancer)	EC (noncancer) (ug/m3)	RFC (non-cancer) (ug/m3)	Soil-Dust HQ	Inhalation RAF (cancer)	EC (cancer) (ug/m3)	IUR (ug/m3)^-1	Soil- Dust Risk
METALS										
Arsenic	2.33E+02	3.99E-08	1	3.82E-05	1.50E-02	2.55E-03	1	3.28E-06	4.30E-03	1.41E-08
Chromium VI*	1.20E+01	2.05E-09	1	1.96E-06	1.00E-01	1.96E-05	1	1.68E-07	8.40E-02	1.41E-08
						2.57E-03				2.82E-08

ADULT RESIDENT - DUST INHALATION
RISK CHARACTERIZATION
PVT LANDFILL

Scenario:	Current Operations
Receptor:	Adult Resident
Medium:	Dust from Recycling Operations
Exposure Pathway:	Inhalation

Cdust = Chemical Concentration in Air = CS x RP x CF
AT (noncancer)= ED in years x 365 days/year x 24 hours/day
AT (cancer)= lifetime in years (70 years) x 365 days/year x 24 hours/day

$$EC\ (ug/m3) = \frac{(Cdust \times ET \times EF \times ED)}{AT}$$

Hazard Quotient (HQ) = EC (ug/m3) / RfC (ug/m3)
Cancer Risk (ELCR) = EC (ug/m3) * IUR (ug/m3)^-1

Parameter (units)	Value	
EC: Exposure Concentration (ug/m3)	See Below	
CS: Chemical Concentration in Bulk Material (mg/kg)	Chemical-Specific	
Cdust: Concentration of dust-bound chemical in air (mg/m3)	Calculated	
RAF: Relative Absorption Factor (Inhalation) (unitless)	Chemical-Specific	
ET: Exposure Time - dust (hr/d)	24	
EF: Exposure Frequency (days/year)	350	
ED: Exposure Duration (years)	20	
AT: Averaging Time (hours) (noncancer)	175200	
AT: Averaging Time (hours) (cancer)	613200	
RfC: Reference Concentrations Inhalation (ug/m3)	Chemical-Specific	
IUR: Inhalation Unit Risk Factor [(ug/m3)^-1]	Chemical-Specific	
RP: Respirable particulate conc. in air (mg/m3)	1.71E-04	(SCREEN3 Results)
CF: Conversion Factor (kg/mg)	1.00E-06	

			Noncancer Hazard Quotient				Excess Lifetime Cancer Risk			
Compound	Bulk Material Concentration (mg/kg)	Chemical Concentration in Air (mg/m3)	Inhalation RAF (noncancer)	EC (noncancer) (ug/m3)	RFC (non-cancer) (ug/m3)	Soil-Dust HQ	Inhalation RAF (cancer)	EC (cancer) (ug/m3)	IUR (ug/m3)^-1	Soil- Dust Risk
METALS										
Arsenic	2.33E+02	3.99E-08	1	3.82E-05	1.50E-02	2.55E-03	1	1.09E-05	4.30E-03	4.70E-08
Chromium VI*	1.20E+01	2.05E-09	1	1.96E-06	1.00E-01	1.96E-05	1	5.61E-07	8.40E-02	4.71E-08
						2.57E-03				9.41E-08

Appendix F. PVT 3rd Party Waste Profile

Table 1
Proposed Material Mixtures

MATERIAL	TEST 1		TEST 2		TOTAL kg
Wood	Percent	kg	Percent	kg	
Untreated / Unpainted Wood	40.4%	311	42.8%	329	640
Painted / Stained Wood	8.0%	62	8.5%	65	127
Treated CCA	5.5%	42	0.0%	0	42
Treated Hi-Bor (may be untreated)	13.0%	100	13.8%	106	206
Paper					
Corrugated Cardboard	4.1%	32	4.3%	33	65
Other Waste Paper	1.7%	13	1.8%	14	27
Yard Waste					
Logs/stumps	2.4%	18	2.5%	20	38
Other yard waste	1.2%	9	1.3%	10	19
Furniture	9.5%	73	10.1%	77	151
Plastic					
HDPE, PET, misc.	7.1%	55	7.5%	58	113
PVC	2.0%	15	2.1%	16	32
Styrofoam	0.4%	3	0.4%	3	6
Carpet	4.0%	31	4.2%	33	63
Rubber	0.7%	5	0.7%	6	11
Total Material	**100.0%**	**770**	**100%**	**770**	**1540**

Relative percentages of various C&D waste accepted by PVT Landfill

Element Environmental. 2010. Waste Stream Analysis

Department of Business, Economic Development, & Tourism

State of Hawaii

Construction and Demolition Waste Composition Study

Final Report

April 1999

Report Prepared by

Cascadia Consulting Group, Inc.

In Association with

Sky Valley Associates
Solid Waste Associates

Printed on recycled paper

Table 3-1 Construction and Demolition Waste Composition Estimates, by Weight

Calculated at 90% confidence interval	Composition *Mean*	*+/-*
Wood		
New Lumber	3.1%	2.0%
New Panelboard	1.2%	0.9%
Demo Lumber	5.7%	1.7%
Demo Panelboard	2.5%	0.9%
Remanufacturing Scrap	0.0%	0.0%
Pallets & Crates	3.6%	1.5%
Wood Roofing & Siding	1.8%	1.5%
Creosote Wood	0.1%	0.1%
Pressure Treated Wood	2.6%	2.0%
Painted/Stained Wood	8.1%	2.6%
Contaminated Demo Wood	1.2%	1.0%
Wood & Other Materials	0.6%	0.3%
Other Wood	0.1%	0.1%
Aggregates		
Asphalt Paving	1.3%	2.1%
Built-Up Roofing	5.2%	3.4%
Composition Shingles	0.4%	0.4%
Tarpaper/Asphalt Felt	0.9%	0.6%
Concrete with Rebar	2.2%	1.8%
Concrete without Rebar	9.1%	4.4%
Bricks	0.0%	0.0%
Concrete Masonry Unit	4.1%	2.4%
Masonry Tile	0.6%	0.9%
Mortar	0.7%	0.5%
Plaster	5.5%	6.9%
Clay Roofing Tile	0.1%	0.1%
Slate/Quarry Tile	0.1%	0.1%
New Gypsum Scrap	10.5%	5.3%
Mixed/Demo Gypsum Scrap	1.0%	0.7%
Metals		
Aluminum	0.2%	0.3%
Other Nonferrous	0.1%	0.1%
Tin Cans	0.0%	0.0%
Galvanized Steel	5.4%	4.0%
Other Ferrous	3.9%	1.5%
Mixed Metal/Other Materials	1.5%	0.8%
Paper		
Corrugated Cardboard	1.6%	0.6%
Tyvek Vapor Barrier	0.0%	0.0%
Other Paper	0.6%	0.2%
Yard Waste		
Logs/Stumps	0.0%	0.0%
Large Prunings	0.6%	0.5%
Other Yard Waste	1.0%	1.0%
Other Inorganics		
Sand/Soil/Dirt	3.6%	2.2%
Ceramic Products	0.9%	0.8%
Miscellaneous Inorganics	3.4%	2.1%
Other		
Furniture/Mattresses	0.3%	0.6%
Other Organics	1.4%	0.9%
Plastic	2.6%	1.0%
Glass	0.3%	0.2%
Hazardous/Chemical	0.1%	0.1%
Number of Samples	**80**	

Appendix A Sorting Categories and Definitions

1 Wood

New Lumber: New dimension lumber scraps. Includes materials such as 2x4's, 2x6's, 2x12's and other residual materials from framing and related construction activities.

New Panelboard: New scrap from sheet goods such as plywood, particle board, wafer board, oriented strand board and other residual materials used for sheathing and related construction uses.

Demo Lumber: Dimensional lumber resulting from demolition and/or remodeling activities. May be characterized by nails, paint, or other trace contaminants.

Demo Panelboard: Used sheet goods resulting from demolition and/or remodeling activities. May be characterized by nails, paint, or other trace contaminants.

Remanufacturing Scrap: Scrap from production of pre-fabricated wood products such as cabinets.

Pallets and Crates: Wood pallets, crates, and packaging lumber/panelboard.

Wood Roofing and Siding: New or used untreated wood that is commonly used for siding or roofing applications, such as cedar shingles or shakes. Commonly characterized by trace amounts of tarpaper and nails.

Creosote Wood: New and used lumber or panelboard that has been treated with creosote. May include railroad ties, marine timbers and pilings, some landscape timbers, and telephone poles.

Pressure Treated Wood: New and used lumber or panelboard which has been treated with pentachlorophenol, copper-chrome arsenate or other chemical preservatives. May be characterized by small linear indentations.

Painted/Stained Wood: New and used lumber or panelboard materials with a significant portion of their surface treated with paint or stain products.

Contaminated Demo Wood: Used wood contaminated with other wastes in such a way that they cannot easily be separated, but consisting primarily (over 50 percent) of wood. An examples is wood with sheetrock attached.

Wood & Other Materials: New wood or wood-related products contaminated with or containing other materials.

Other Wood: Products made primarily of wood, not otherwise classified above.

2 Aggregates

Asphalt Paving: Paving material for roads and other surfaces composed of aggregates and asphalt binders. Commonly known as "blacktop" pavement.

Built-Up Roofing: Roofing material composed of several layers of heavy asphalt-saturated felt. Includes torch-down and hot tar roofs.

APPENDIX D - AIR QUALITY IMPACT REPORT

AIR QUALITY IMPACT REPORT (AQIR)

PROPOSED OPERATIONS EXPANSION
PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

PREPARED FOR:

PVT Land Company

PREPARED BY:

J. W. MORROW
Environmental Management Consultant
1481 South King Street, Suite 548
Honolulu, Hawaii 96814

June 2015

1. INTRODUCTION

The PVT Land Company (PVT) is proposing to expand operations at its existing solid waste management facility at Nanakuli on the island of Oahu (Figure 1). The proposed expansion includes increased recycling and materials recovery operations, increased height of its landfill, and installation of renewable energy capabilities for the recycling operations.

The purpose of this report is to assess the potential air quality impact of fugitive dust associated with the proposed increase in landfill height.

2. METHODOLOGY

The U.S. Environmental Protection Agency (EPA) recommended computer model AERMOD[1, 2] was used to assess the ambient air quality impact of landfill operations at changing elevations. Input to the model included:

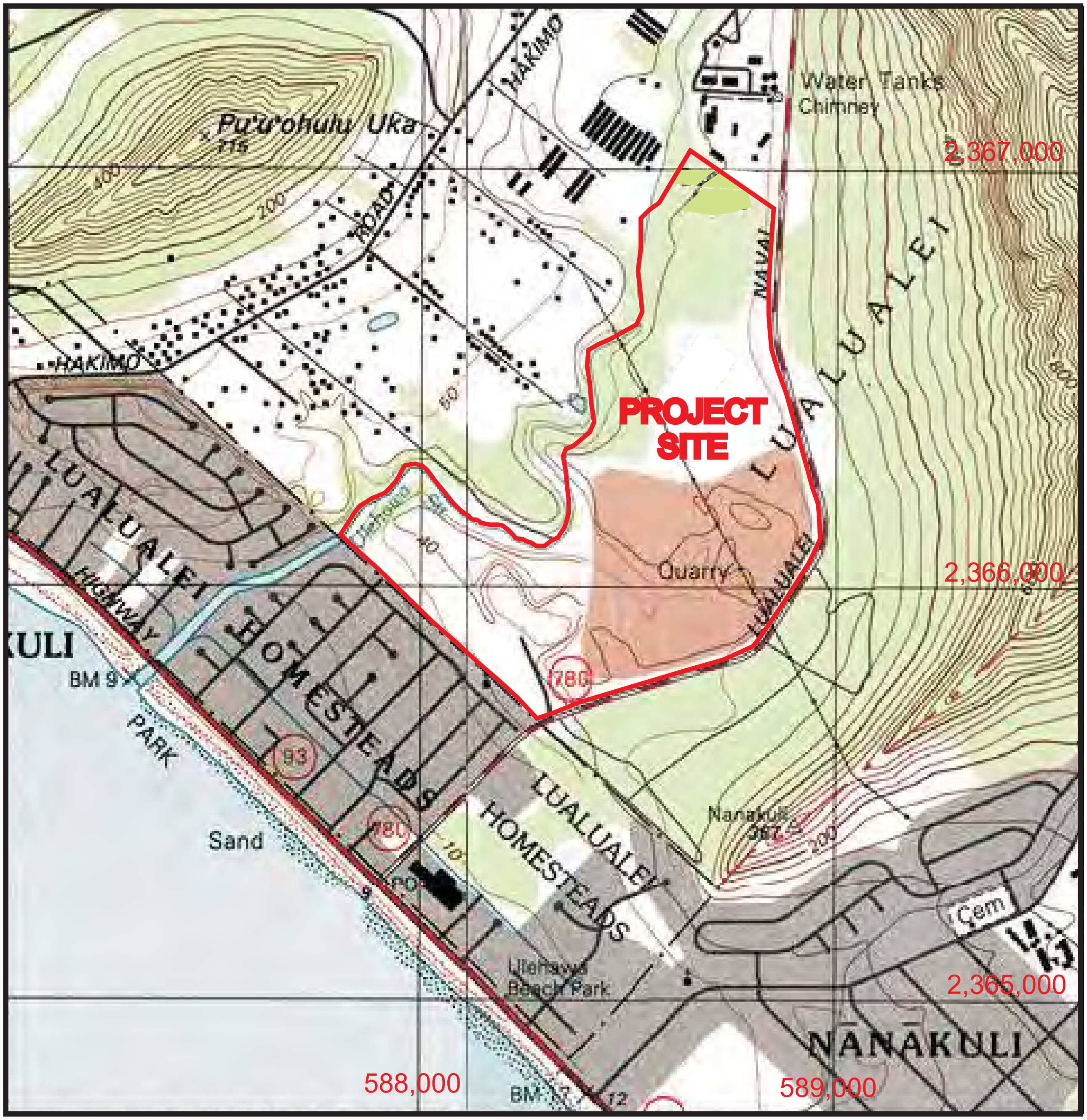
- dimensions and elevations of the nine (9) landfill operational cells and reclamation area at PVT (Figure 2).
- an emission factor for fugitive dust, i.e., particulate matter, in grams per square meter per second ($g/m^2/sec$) derived from a heavy construction (including ground excavation and other earth moving operations) emission factor obtained from EPA's Compilation of Air Pollutant Emission Factors (AP-42).[3]
- wind speed and direction data from one (1) year of onsite meteorological monitoring at PVT.
- a array of 205 receptors with 30-meter spacing along PVT's property boundary.

Since the EPA emission factor was based on total suspended particulate matter (TSP) for which there is no longer an air quality standard, the factor was adjusted to estimate emission rates for particulate matter with effective aerodynamic diameters of 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$) for which there are current air quality standards (Table 1). Based on previous measurement studies, one can estimate PM_{10} by multiplying the TSP value by a factor of 0.51.[4] Similarly, $PM_{2.5}$ can be estimated by multiplying the PM_{10} value by a factor of 0.10.[5] Dust control by water spray is a routine activity at PVT and a conservative control efficiency of 70% was assumed based on past experience as evidenced by the low TSP levels measured during a 1-year monitoring study at the PVT landfill.[6]

The model was run twice for each year from 2015 through 2024, with each model run including only those cells and/or the reclamation area being "worked" in the given year. The first run was at

FIGURE 1

PROJECT LOCATION



USGS Quad Schofield Barracks (1998)
1:24,000 (NAD-83)

FIGURE 2

Plot Plan

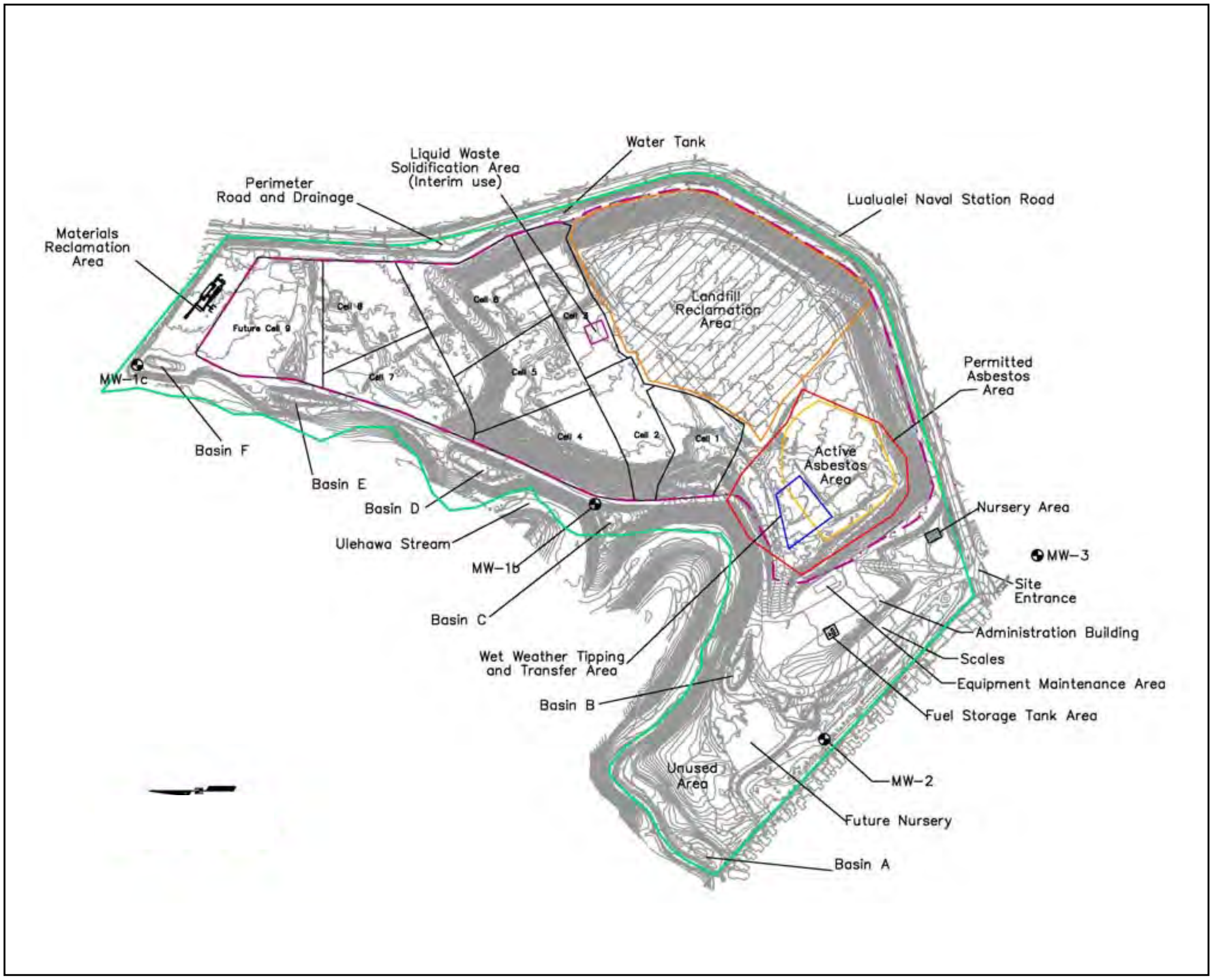


TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER [7, 8]

POLLUTANT	AVERAGING PERIOD	NAAQS PRIMARY	NAAQS SECONDARY	HAWAII STANDARDS
PM_{10}	24-hr Annual	150 --	-- --	150 50
$PM_{2.5}$	24-hr Annual	25 12	35 15	--- ---

KEY: NAAQS - national ambient air quality standards
PM_{10} - particulate matter ≤ 10 microns
$PM_{2.5}$- particulate matter ≤ 2.5 microns

All concentrations in micrograms per cubic meter (μg/m^3).

initial elevation and the second run was at the final elevation for each year. The nearest Hawaii Department of Health air monitoring site is at Kapolei and PM_{10} and $PM_{2.5}$ data were used as background values to be combined with the AERMOD modeling results.

3. RESULTS AND CONCLUSIONS

The results of the modeling analysis are summarized in Tables 2 and 3 and indicate compliance with federal and state ambient air quality standards. Raising the elevation of a single source in flat terrain would normally result in lower groundlevel concentrations due to dilution in a greater air volume. In this case, the situation was complicated by multiple sources at different elevations and surrounding terrain that was not perfectly flat; thus the changes in concentration due to change in source elevation, besides being very small, were not consistently positive or negative.

The results can also be considered conservative given that the previously cited 1-year onsite monitoring program [6] at three (3) PVT sites yielded low concentrations of total suspended particulate matter (TSP). The monitored annual TSP average of 25.4 μg/m^3 and a maximum 24-hr concentration of 88.9 μg/m^3 when converted to PM_{10} levels would be approximately 12.9 μg/m^3 and 45.3 μg/m^3, respectively, and thus significantly lower than the modeled PM_{10} concentrations presented herein. We therefore conclude that PVT's proposed expansion with increased elevations at the landfill will not have a significant impact on air quality.

TABLE 2

AERMOD PM_{10} MODELING RESULTS

Year	Landfill Cells Working [1]	Elevations Range (ft)	Maximum Concentration (ug/m^3) [2] Model 24-hr	DOH Background [5]	Total 24-hr	Model Annual	DOH Background [4]	Total Annual
2015 Start	C-3,7,8,9	100 - 120	63.8	39.0	**102.8**	5.5	14.5	**20.0**
2015 End	"	103 - 124	63.8	39.0	**102.8**	5.4	14.5	**19.9**
2016 Start	C-7,9, RA [3]	103 - 160	76.5	39.0	**115.5**	4.9	14.5	**19.4**
2016 End	"	105 - 142	76.8	39.0	**115.8**	4.9	14.5	**19.4**
2017 Start	RA [3]	142	76.6	39.0	**115.6**	4.5	14.5	**19.0**
2017 End	"	128	76.9	39.0	**115.9**	4.6	14.5	**19.1**
2018 Start	RA [3]	128	76.9	39.0	**115.9**	4.6	14.5	**19.1**
2018 End	"	114	77.3	39.0	**116.3**	4.7	14.5	**19.2**
2019 Start	C-6,8,9,RA [3]	105 - 150	77.8	39.0	**116.8**	4.8	14.5	**19.3**
2019 End	"	100 - 155	78.1	39.0	**117.1**	5.0	14.5	**19.5**
2020 Start	C-5,6,7,8,9,RA [4]	100 - 160	78.1	39.0	**117.1**	6.4	14.5	**20.9**
2020 End	"	110 - 180	77.6	39.0	**116.6**	6.4	14.5	**20.9**
2021 Start	C-5,6,7,8,9,RA [4]	110 - 180	77.6	39.0	**116.6**	6.4	14.5	**20.9**
2021 End	"	113 - 200	77.2	39.0	**116.2**	6.4	14.5	**20.9**
2022 Start	C-5,6,7,8,9,RA [4]	113 - 200	77.2	39.0	**116.2**	6.4	14.5	**20.9**
2022 End	"	115 - 220	77.2	39.0	**116.2**	6.4	14.5	**20.9**
2023 Start	C-6,7,8,9,RA [4]	115 - 178	77.2	39.0	**116.2**	6.0	14.5	**20.5**
2023 End	"	118 - 204	76.7	39.0	**115.7**	6.0	14.5	**20.5**
2024 Start	C-6,7,8,9,RA [4]	118 - 204	76.7	39.0	**115.7**	6.0	14.5	**20.5**
2024 End	"	120 - 230	76.5	39.0	**115.5**	6.0	14.5	**20.5**

Notes:
1. See Figure 2 for cell locations
2. ug/m^3 - micrograms per cubic meter
3. RA - reclamation area excavating
4. RA - reclamation area filling
5. Kapolei Monitoring Site, 2013 (Reference 9)

TABLE 3

AERMOD $PM_{2.5}$ MODELING RESULTS

			Maximum Concentration (ug/m^3) [2]					
Year	**Landfill Cells Working** [1]	**Elevations Range (ft)**	**Model 24-hr**	**DOH Background** [5]	**Total 24-hr**	**Model Annual**	**DOH Background** [4]	**Total Annual**
2015 Start	C-3,7,8,9	100 - 120	7.70	16.2	**23.9**	0.54	2.8	**3.3**
2015 End	"	103 - 124	7.69	16.2	**23.9**	0.54	2.8	**3.3**
2016 Start	C-7,9, RA [3]	103 - 160	10.21	16.2	**26.4**	0.49	2.8	**3.3**
2016 End	"	105 - 142	10.25	16.2	**26.5**	0.49	2.8	**3.3**
2017 Start	RA [3]	142	10.25	16.2	**26.5**	0.49	2.8	**3.3**
2017 End	"	128	10.29	16.2	**26.5**	0.46	2.8	**3.3**
2018 Start	RA [3]	128	10.29	16.2	**26.5**	0.47	2.8	**3.3**
2018 End	"	114	10.34	16.2	**26.5**	0.46	2.8	**3.3**
2019 Start	C-6,8,9,RA [3]	105 - 150	10.34	16.2	**26.5**	0.48	2.8	**3.3**
2019 End	"	100 - 155	10.41	16.2	**26.6**	0.49	2.8	**3.3**
2020 Start	C-5,6,7,8,9,RA [4]	100 - 160	10.41	16.2	**26.6**	0.64	2.8	**3.4**
2020 End	"	110 - 180	10.29	16.2	**26.5**	0.64	2.8	**3.4**
2021 Start	C-5,6,7,8,9,RA [4]	110 - 180	10.29	16.2	**26.5**	0.64	2.8	**3.4**
2021 End	"	113 - 200	10.22	16.2	**26.4**	0.64	2.8	**3.4**
2022 Start	C-5,6,7,8,9,RA [4]	113 - 200	10.40	16.2	**26.6**	0.66	2.8	**3.5**
2022 End	"	115 - 220	10.22	16.2	**26.4**	0.64	2.8	**3.4**
2023 Start	C-6,7,8,9,RA [4]	115 - 178	10.22	16.2	**26.4**	0.60	2.8	**3.4**
2023 End	"	118 - 204	10.15	16.2	**26.4**	0.60	2.8	**3.4**
2024 Start	C-6,7,8,9,RA [4]	118 - 204	10.30	16.2	**26.5**	0.62	2.8	**3.4**
2024 End	"	120 - 230	10.12	16.2	**26.3**	0.59	2.8	**3.4**

Notes:
1. See Figure 2 for cell locations
2. ug/m^3 - micrograms per cubic meter
3. RA - reclamation area excavating
4. RA - reclamation area filling
5. Kapolei Monitoring Site, 2013 (Reference 9)

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APPENDIX E - ENVIRONMENTAL NOISE ASSESSMENT REPORT

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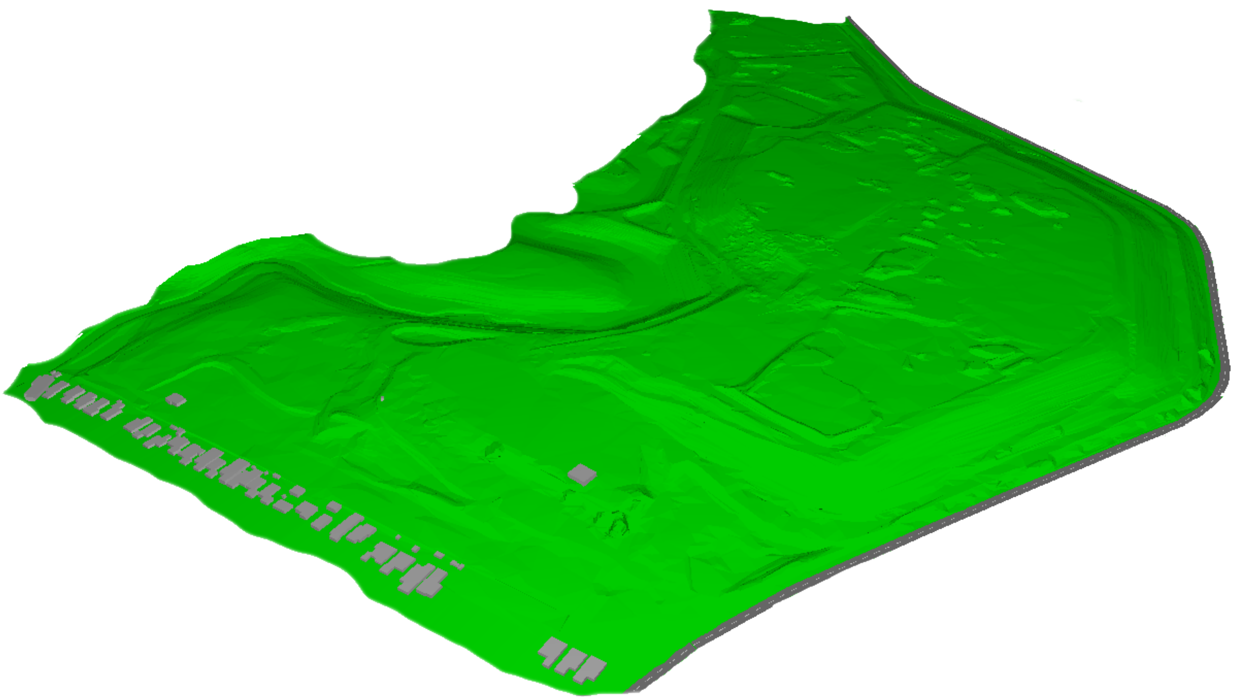
Environmental Noise Assessment Report
PVT Integrated Solid Waste Management Facility – Expanded Recycling, Landfill Grading, and Renewable Energy Project

Nanakuli, Island of Oahu, Hawaii



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C&D	Construction and Demolition
HDOH	Hawaii Department of Health
ISO	International Standards Organization
ISWMF	Integrated Solid Waste Management Facility
MRF	Material Recovery Facility

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

1.1 The PVT Integrated Solid Waste Management Facility (ISWMF) is located in Nanakuli, Oahu approximately 1600 feet northeast of the intersection of Farrington Highway and Lualualei Naval Road. The site presently has approximately 200 acres of land used for C&D landfill operations west of Lualualei Naval Road. The currently operational part of the site is bordered by an aggregate recycling facility operation to the north, agricultural zoned area to the west, residentially zoned development to the south and southwest, and undeveloped area to the east. Key factors of the proposed project are (1) expand its reuse, recycling and materials recovery operation; (2) allow the site grade to reach a maximum elevation of up to 250 ft. above mean sea level (AMSL) at the mauka portion of the Site; and (3) use renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. This assessment focuses on evaluating the noise impacts from the proposed reclamation operations, operational noise at the proposed mauka elevation increases, and estimated traffic volume increase due to the proposed project.

1.2 Noise from the PVT site must comply with the Hawaii Department of Health (HDOH) Community Noise Control Rule, which stipulates maximum permissible noise limits at the property line based on zoning. The operations of the facility will only take place during what the HDOH considers “daytime” hours (7:00 AM-10:00 PM), so only the daytime operational noise were assessed. HDOH maximum permissible daytime noise levels are 70 dBA for a Class C industrial/agricultural zoned area.

1.3 Long term noise measurements of the current operations were conducted at the southern and northern end of the C&D landfill areas. The measurement data was used to validate the sound propagation model developed to calculated noise levels of the current and proposed operations. The measurements showed an average L_{eq} of 58 dBA during operation hours at the southern end of the site near the scale house. At the northern end of the project site between the material recovery facility (MRF) and active land fill, an average L_{eq} of 66 was measured.

1.4 The operations of the existing C&D landfill and proposed future operations will involve several stages which utilize various types of equipment operating in multiple locations at various times. The actual sound levels that will be experienced in the vicinity of the project site will vary greatly and are a function of the distance from the noise source, the duration of the activities, and the number and type of equipment being used. A sound propagation model was developed to predict the likely operational noise effects to receptor locations surrounding the project site. Key stages of the proposed PVT ISWMF project are an the increase to the maximum permitted elevations for the refuse fill, reclamation of recyclable materials currently existing on the site, and an increase in the overall volume and capacity of the site’s recycling throughput. Therefore, four sound propagation models were created to simulate the project site under the various operating stages: Current Operations, Reclamation, Future Operations with Proposed Project, and Future Operations without Proposed Project. The sound propagation model calculated maximum noise levels at multiple receptor locations in the vicinity of the PVT ISWMF project site. The sound propagation models were created with a conservative approach that assumed worst case scenarios. Parameter were set for predictions of noise levels based on all sources of noise operating simultaneously and continuously through the operational time period.

1.5 Noise levels are projected to comply with the HDOH maximum permissible noise limit for Class C agricultural/industrial zoned land at all property lines except the north property line. However, the neighboring aggregate recycling facility is also a source of significant noise and existing noise levels during the daytime are likely in excess of the maximum permissible noise limit. Since there are homes on some of the agricultural zoned property, future noise levels were also compared to the more stringent residential zoning criteria of 55 dBA maximum noise levels during daytime hours. Although future noise levels are projected to slightly exceed this criteria in the areas northwest of the PVT site (near Kuualoha Road) with maximum operational noise levels projected at 59 dBA, existing ambient noise levels in this area may already be higher due to other activities typically found in industrial and agriculturally zoned areas that take place in the vicinity. No measurements of the current ambient noise levels in the agriculturally zoned area adjacent to the project site were taken to confirm this because the more restrictive 55 dBA requirement is only used for comparative purposes and is not the actual zoning requirement of the area. 70 dBA, which predicted levels are well below.

1.6 Predicted future noise levels due to the vertical expansion of the C&D landfill were compared to future noise levels without the proposed project to determine whether a noise impact occurs. An insignificant increase in noise level, i.e., less than 3 dB, is expected due to the proposed project at the PVT ISWMF. Therefore, a noise impact is not anticipated.

1.7 Noise mitigation due to the proposed project will not be required. However, mitigation methods have been provided for informational purposes as “best practices” to reduce noise within the site and to neighboring properties.

2.0 PROJECT DESCRIPTION

The PVT Integrated Solid Waste Management Facility (ISWMF) is located in Nanakuli, Oahu, approximately 1600 feet northeast of the intersection of Farrington Highway and Lualualei Naval Road. The site presently has approximately 200 acres of land used for C&D landfill operations west of Lualualei Naval Road. The currently operational part of the site is bordered by an aggregate recycling facility operation to the north, agricultural zoned area to the west, residentially zoned development to the south and southwest, and undeveloped area to the east.

Key factors of the proposed project are (1) expand its reuse, recycling and materials recovery operation; (2) allow the site grade to reach a maximum elevation of up to 250 ft. AMSL at the mauka portion of the Site; and (3) use renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. This assessment focuses on evaluating the noise impacts from the proposed reclamation operations, operational noise at the proposed elevation increases, and estimated traffic volume increase due to the proposed PVT ISWMF project.

The proposed project will take the permitted maximum elevation of the landfill from the currently permitted 135 feet AMSL up to approximately 255 feet AMSL. The increase of up to 120 feet in elevation will not include any increase to the foot print of the facility, and is only on the north-side of the ISWMF. Most locations will remain at the 135 foot level as a 3 to 1 slope is maintained.

The reclamation process will first lower the existing elevation levels in the reclamation area before they are raised to the final permitted levels. Through the process, multiple truckloads of material from this area will be transported to the MRF sorting area on the north western side of the property.

Additionally, an increase of incoming truck traffic up to 300 trucks total per day is expected from the increased recycling and material recovery operations.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A. For this project, the most important and applicable guidelines are those presented below in section 3.1 pertaining to the Hawaii Department of Health Title 11 Chapter 46.

3.1 State of Hawaii, Community Noise Control (HDOH)

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, aircraft noise, or rail transit noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels for stationary mechanical equipment are enforced by the HDOH for any location at or beyond the property line and shall not be exceeded for more than 10 percent (%) of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by HDOH.

3.2 Community Response to Change in Noise Level

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, the average ability of an individual to perceive changes in noise levels is well documented and has been summarized in Table 1 [Reference 2, 3]. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 1. Average Ability to Perceive Changes in Noise Level

Sound Level Change (dB)	Human Perception of Sound
0	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	Two times (or 1/2) as loud
20	Four times (or 1/4) as loud

A commonly applied criterion for estimating a community's response to changes in noise level is the 'community response scale' proposed by the International Standards Organization (ISO) of the United Nations [Reference 4]. The scale shown in Table 2 relates changes in noise level to the degree of community response and allows for direct estimation of the probable response of a community to a predicted change in noise level.

Table 2. Community Response to Increases in Noise Levels

Sound Level Change (dB)	Category	Response Description
0	None	No observed reaction
5	Little	Sporadic Complaints
10	Medium	Widespread Complaints
15	Strong	Threats of Community Action
20	Very Strong	Vigorous Community Action

The values stated in Tables 1 and 2 should not be considered regulatory requirements because they are not associated with a specific governing document for this project. However, these tables are very useful in assessing the human perception to changes in sound levels and they are considered to be supplemental information to the governing State of Hawaii Community Noise Control Rule, which does not discuss community response to changes in noise levels.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Continuous long-term noise level measurements were conducted to assess the existing acoustical environment of the project site. Long-term measurements (taken continuously over the course of multiple days) offer a baseline for establishing existing noise levels in the area and are used for verifying the validity and accuracy of the acoustical model being used to predict future noise levels and noise levels under various operational conditions.

The methodology, location, and results for each of the measurements are described below and the measurement locations are illustrated in Figure 2. Photographs of the measurement locations can be viewed in Appendix B.

4.1 Long Term Noise Measurements

4.1.1 Long-Term Noise Measurement Procedure

Noise level measurements were conducted in two different locations from August 27, 2014 to September 3, 2014. Continuous, hourly equivalent sound levels, L_{eq}, were recorded at each location. The measurements were taken using a Larson-Davis, Model 831, Type 1 Sound Level Meter together with a Larson-Davis, Model 377B20 Type 1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended 2-year calibration period. The microphone was mounted on a tripod, approximately 5 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather-resistant case.

4.1.2 Long-Term Noise Measurement Locations

Location L1: The sound level meter was located at the south end of the project site near the property line, approximately 325 feet southwest of the scale house along the entrance and exit way that commercial traffic takes when utilizing the site. During the daytime, dominant noise sources included vehicular traffic to and from the scale house/landfill area. Secondary noise sources included traffic from the Lualualei Naval Road. During non-operation times, noise sources included environmental sources such as wind and birds.

Location L2: The sound level meter was located at the north end of the project site approximately 450 feet south of the northern property line and approximately centered in the site from east to west. During the day, the dominant noise sources were a combination of the MRF equipment and vehicular traffic from the internal access route. When the MRF was not in operation, activities from the neighboring recycling facility were audible. Secondary noise sources during non-operation times include environmental sources such as wind and birds.

4.1.3 Long-Term Noise Measurement Results

The measured L_{eq}, and the 90 percent exceedance level, L_{90}, in dBA are graphically presented in Figures 3 and 4 for each location. The range of L_{eq} during operational days and non-operational days between the hours of 7:00 AM and 3:00 PM are summarized for each location in Table 3 below. The L_{eq} was also averaged for the same time range over the operational days and non-operational days and is presented in the table. It should be noted that during the long term measurements part of the data set from Location L2 was removed as it was corrupted by security alarm noise.

Table 3. Summary of Long Term Noise Measurement Results (dBA)

Measurement Location	Operational Days (7:00 AM – 3:00 PM)		Non-Operational Days (7:00 AM – 3:00 PM)	
	L_{eq} Range	Average L_{eq}	L_{eq} Range	Average L_{eq}
L1 - Near Scale House	52-57	55	42-48	45
L2 – Near MRF	37-70	63	40-48	43

5.0 SOUND PROPAGATION MODEL

5.1 Sound Propagation Model Overview

The operations of the existing C&D landfill and proposed future operations will involve several stages which utilize various types of equipment operating in multiple locations at various times. The actual sound levels that will be experienced in the vicinity of the project site will vary greatly and are a function of the distance from the noise source, the duration of the activities, and the number and types of equipment used. The CadnaA noise prediction software by DataKustik GMBH [Reference 5] was used to predict the likely operational noise effects to receptor locations surrounding the project site. The software is based on the international standard ISO 9613, Part 2, which is a standard for calculating outdoor noise propagation. The input parameters for the sound propagation model are summarized in Table 4 below.

Table 4. Sound Propagation Model Calculation Parameters

Input Parameter	Source
Calculation Standard	ISO-9613
Site Topography	Surrounding Area – State Office of Planning Project Site – Provided by PVT and LYON
Ground Absorption	Hard packed soil – Ground Absorption = 0.0
Meteorological Conditions	Downwind 9.84 ft/s (3 m/s) per ISO-9613, 70° F, 64% relative humidity per PVT Operations Plan and Oahu historical weather data
Receptor Height	5 feet
Num. of Reflections	2
Bitmap	Provided by PVT
Sound Source Quantity and Location	Operations plan and figures provided by LYON and PVT, refer to Table 6

Topography of the site was incorporated into the model, therefore line-of-sight and any shielding effects are considered in the model. Additionally, the trees and foliage to the west side of the site were included in the acoustical model at an average height of approximately 15 feet about ground level.

5.2 Site Operations Overview

Key stages of the proposed PVT ISWMF project are (1) expand its reuse, recycling and materials recovery operation; (2) allow the site grade to reach a maximum elevation of up to 250 ft. AMSL at the *mauka* portion of the Site; and (3) use renewable energy (a gasification unit and/or PV panels) to provide power to the ISWMF. Therefore, four sound propagation models were created to simulate the project site under the various operating stages. The four operational stages are summarized as follows. The site plan shown in Figure 5 can also be referenced for an overview of the various areas of the site. Figures 6 and 7 show the existing and proposed landfill grades of the PVT ISWMF site.

A. Current Operations – Landfill operates (i.e., active disposal operations occur in Cells 1 to 8A and asbestos area, MRF/materials sorting operations occur at the materials recovery area) at existing elevations.

B. Reclamation – Reclamation operations occur in the proposed reclamation area, active landfill operations occur in Cells 1 to 8A and asbestos area, and MRF/materials sorting operations occur in the materials recovery area) at existing elevations.

C. Future Operations with Proposed Project– Standard operations occur throughout the site after reclamation has ceased, including future operating area Cell 9B, future traffic volume conditions, and proposed vertical expansion elevation levels reached (250 feet above sea level). The proposed renewable energy operations are active.

D. Future Operations without Proposed Project – Standard operations throughout the site, including future operating area Cell 9B, existing on site traffic volume conditions, and currently permitted elevation levels reached (135 feet above sea level).

Table 5 is a summary of the general parameters utilized for each model, including site operations, elevation, and internal traffic volumes.

Table 5. Site Parameters per Operational Stage

	Operational Stage			
	A	B	C	D
Parameter	Current Operations	Reclamation	Future With Proposed Project	Future No Change
Active Landfill Operations	X	X	X	X
Reclamation		X		
MRF/Materials Sorting	X	X	X	X
Renewable Energy			X	
Cell 9B Active			X	X
Existing On-Site Traffic	X	X		X
Future On Site Traffic			X	
Current Elevations	X	X		
Future Elevations			X	
Permitted Elevations				X

PVT ISWMF is typically in operation between 7:00 AM and 4:00 PM, which is within the daytime hours defined by the HDOH. In this case nighttime and evening noise calculations are not needed. It should be noted though, that if the site extends its hours of operation before 7:00 AM or beyond 10:00 PM that nighttime evaluations may be required.

5.3 Source Sound Data

The sound power data for the various equipment utilized for each activity is described in Table 6 below. All sound power levels shown are un-weighted linear decibel levels (dB). The mobile equipment sound power levels were obtained from UK Department of Environment, Food, and Rural Affairs Noise Database for Prediction of Noise on Construction and Open Sites [Reference 6]. This database includes individual octave band measurement data, which provide a more accurate noise spectrum than individual dBA values with equal octave contribution assumptions or at limited octave band inclusion. The sound power levels included in the model were all converted from the sound pressure measurement data at known distances, and assuming hemispherical radiation from the source.

Individual equipment noise levels in the database that matched parameters of specific pieces of equipment on the proposed site, such as the general equipment type and horsepower, were taken directly from the reported sound pressure levels in the database. More generalized equipment such as the external over the road trucks and dump trucks had values arithmetically averaged among all reported data sets of a similar equipment type in the database. Noise levels from dump trucks, heavy trucks, and water trucks were taken from the pass-by levels provided in the database. Pass-by data points are the un-weighted octave band L_{Amax} levels from the equipment pass-by. All other equipment noise levels were taken from the non-pass-by operating conditions, which are more relevant for stationary and semi-mobile activities and operations (as will be the case on the project site for most of the heavy equipment). Non-pass-by data points provided in the database are the un-weighted octave band L_{eq} levels.

Sound power levels for the MRF were obtained from linear weighted slow response field measurements taken at the site. Due to the MRF's elongated size, it was treated as a line source in the model. Eight noise measurements were taken in 40 foot increments at both 40 ft. and 70 ft. distance parallel to the MRF equipment down the length of the equipment on both sides. The data was then logarithmically averaged after being converted to sound power from sound pressure at known distances, also assuming hemispherical radiation. The meter and calibration was the same used for the long term measurements referenced in this report in section 4.1.1.

The sound levels for the gasification units were taken from field measurements conducted by DLAA on a Community Power Corporation 100 kW BioMax unit at their facility in Colorado. The 100 kW BioMax unit is the specific gasification unit anticipated at the time of this report for the renewable energy portion of the proposed project.

The photovoltaic system that will be utilized as part of the renewable energy portion of the proposed project is still in a very preliminary stage of design. The photovoltaic panels themselves are not expected to make any noise, but the system will utilize at least one inverter which will have some noise associated with it. Depending on the specifics of the photovoltaic system utilized, multiple inverters may be required. It is expected that the inverters will be located relatively close to the area the panels are installed. Presently, this is planned to be spread across the mauka side of the landfill at the foot of the proposed elevation change near the parking lot and equipment storage area. Inverter noise is typically noise driven by the 60 Hz voltage cycling producing low frequency noise at 60 Hz and a larger peak at 120 Hz and then higher frequency noise at harmonics of these frequencies. Additionally, depending on the unit itself, it may come with internal cooling fans, which will produce their own noise. The specific noise of the unit will depend on the manufacturer and model selected. Due to the lack of the information necessary to accurately identify the specific noise levels of the photovoltaic equipment, the noise model does not include any potential noise from this system. However, if there is any excessive noise from the inverters, it can easily be addressed as the design is finalized by the application of barrier walls or earth berm acoustical barriers installed in the noise pathway between the inverters and the closest receiving positions to them.

Table 6. Sound Power Levels for Site Activities

Activity	Equipment (Qty)	Sound Power Level (dB)[N1]						
		63	**125**	**250**	**500**	**1000**	**2000**	**4000**
Active Dump Operations	Compactor (1)	98	106	107	100	105	96	94
	Loader (1)	113	111	104	105	105	100	100
	Water Truck (1)	108	109	103	107	101	102	98
	Bulldozer (2)	117	118	109	101	102	98	96
Reclamation	Excavator (1)	113	106	105	105	101	99	96
	Bulldozer (1)	117	118	109	101	102	98	96
	Dump Truck (3)	117	115	110	108	106	104	98
MRF/Materials Sorting	MRF Time Avg[N2] (1)	120	124	116	114	110	107	105
	MRF L_{Amax}[N3] (1)	124	126	118	117	113	110	108
	Loader (1)	113	111	104	105	105	100	100
	Excavator[N4] (3)	113	106	105	105	101	99	96
On-Site Traffic	Heavy Truck (Variable)	113	106	105	105	101	99	96

Notes:

N1. The sound power levels for each equipment type represent a unit of equipment.

N2. MRF Time Averaged levels are based on overall 1 minute L_{eq} time weighted octave band values attained from measurements and are used in the Time Averaged acoustical model to simulate an overall time weighted L_{eq} value.

N3. MRF L_{Amax} levels are based on $L_{Amax\ x}$ octave band measurement values attained from measurements and are used in the Loudest Event acoustical model to simulate the noise levels that to be expected from the loudest individual moments of the equipment operations.

N4. The excavators modeled at the MRF location include one excavator operating on top of a refuse pile at an elevation per the refuse pile height provided in the current topographical maps from the fly over surveys. Additionally, this refuse pile topography was included in the model at its current location.

5.4 Vehicular Traffic

A vehicular traffic noise analysis of the primary roadways near the project site was also incorporated into the sound propagation model. In keeping with the methodology defined in Section 5.2, traffic noise was modeled for each of the key operational stages, existing, future with the proposed project, and future without the proposed project. For the reclamation stage, existing traffic volumes were used. The noise analysis for traffic external to the PVT site was based on the average of the hourly traffic volumes from the turning movement data tables provided by the Traffic Consultant in the Traffic Impact Analysis Report [Reference 7] at the intersection of Farrington Highway and Lualualei Naval Road as well as the intersection of Lualualei Naval Road and the PVT Site Access. The annual growth rate of 1% noted in the Traffic Report was applied for both future operations stages. The volume increase of up to 300 trucks total per day projected for future operations was applied to the Future Operations Stage with Proposed Project as described below.

Commercial traffic internal to the PVT site was also modeled based on the PVT Site Access Driveway traffic count provided by the Traffic Consultant. In order to approximate the maximum noise levels from the commercial traffic inside the site, a peak traffic noise hour based on heavy truck traffic was established. The volumes from this peak hour, which was used for the existing, reclamation, and no change stages of the noise model, was taken from the largest continuous 60-minute period of heavy vehicle traffic presented in the traffic report. For the Future Operations Stage with Proposed Project, the peak hour volume was used to project the hourly distribution of the additional 100 trucks per day. The traffic data was normalized to determine the percentage of overall truck traffic volume data that existed in the peak hour. This percentage was then applied to the 100 additional trucks to approximate the total number of additional trucks that is expected during the peak traffic noise hour.

5.5 Noise Receptor Locations

The sound propagation model calculated noise levels at multiple receptor locations in the vicinity of the PVT ISWMF project site, as seen in Figure 8. Two additional receptors were located at the long term measurement locations L1 and L2 as seen in Figure 2 and were used to verify the results produced by the sound propagation model.

R1 Residence on Mohihi Street near Lualualei Naval Road
R2 Residence on Mohihi Street near PVT scale house
R3 Agricultural lot at end of Ulehawa Road
R4 Agricultural lot at end of Kapiki Road
R5 Agricultural lot at end of Kuualoha Road
R6 Northern property line near MRF
R7 Residence on Lualualei Naval Road
R8 Residence on Farrington Highway (south of Lualualei Naval Road)
R9 Residence on Farrington Highway (north of Lualualei Naval Road)

Sound levels at the receptor locations have been calculated at approximately 5 feet above ground. This is representative of an average standing ear height and typically measurements would most often be made this height if testing for compliance with the HDOH Community Noise Control Rule.

5.6 Validation of Sound Propagation Model

In order to validate the results of the sound propagation model, the measured ambient noise environment in the vicinity of the project site was compared to the results of the sound propagation model under the "Current Operations" condition. The L_{eq} range measured on site (shown in Table 3) when the waste facility is operational was used as the metric for comparison.

The results of the sound propagation model show good conformance between the measurements conducted at the long term measurement locations and the calculated values of the current conditions. At Location L1, the calculated maximum operational noise level is 58 dBA which is slightly higher but an acceptable amount of error to consider the model valid. At Location L2, the calculated level is 66 dBA which is consistent with upper range of the measured levels.

5.7 Predicted Noise Levels due to Site Operations

Maximum operating noise levels (L_{Amax}) were calculated at each receptor location for each of the key operational stages. Although most of the stationary equipment (e.g., MRF and excavators) are not expected to run continuously for extended periods of time, the L_{Amax} was calculated assuming continuous operation of the equipment. For the non-stationary equipment (e.g., heavy trucks), the L_{Amax} was calculated based on a moving point source. Maximum operating noise levels represent the maximum noise levels at any one moment in time that a receptor would expect to experience from the landfill based on typical daily operations. In addition, worst case conditions were assumed for each stage, meaning that the equipment for each activity runs simultaneously in all of the designated areas for that operational stage. In reality, site operations will only occur in fractional sections (or cells) of the active landfill site which will move over time based on reaching the maximum fill for that cell.

Table 7 below summarizes the results of the staged operational noise analysis calculations for six of the noise receptor locations. The table also presents the change in future noise levels for the community due to the proposed action.

Table 7. Operational Noise Analysis Results

		Max. Operational Noise per Stage (dBA)				Change due to Proposed Project (dB)
ID	**Receptor Location**	**A**	**B**	**C**	**D**	**(C-D)**
R1	Mohihi St (SE)	62	62	64	62	+2
R2	Mohihi St (NW)	53	54	55	53	+2
R3	Ulehawa Rd	53	53	58	56	+2
R4	Kapiki Rd	54	55	57	55	+2
R5	Kuualoha Rd	59	59	58	57	+1
R6	North property line	79	79	79	79	+0

In addition to the receptor locations above, maximum noise level area contours were calculated throughout the project site and the surrounding community for each of the operational stages. These contours are shown graphically in Figures 9 to 12.

The change in future noise levels due to the proposed project (future with proposed project minus future without proposed project) is also graphically represented in Figure 13. The green contours signify an increase of up to 3 dB which is less than the threshold of human perception. Most of the properties surrounding the PVT site fall within this range.

5.8 Predicted Noise Levels due to Vehicular Traffic

Vehicular traffic noise level contours were calculated at three receptor locations along the major roadways in the vicinity of the project site. The results of the traffic noise analysis for the existing and future stages are shown in Table 8 for the peak traffic noise hour.

Table 8. Vehicular Traffic Noise Analysis Results

ID	Noise Receptor Location	Peak Hour Traffic Noise per Stage (dBA)				Change due to Future Traffic Volumes (dB)
		A	B	C	D	(C-D)
R7	Lualualei Naval Rd	64	64	66	65	+1
R8	Farrington Hwy (S)	71	71	72	72	+0
R9	Farrington Hwy (N)	71	71	71	71	+0

6.0 POTENTIAL SOUND IMPACTS

6.1 Predicted Noise due to Site Operations Noise

A sound impact due to the proposed PVT ISWMF site operations may occur if the sound levels generated by the project exceed applicable standards and regulations. However, the sound level alone cannot determine if a sound impact occurs. The noise receptor or typical listener must also be considered, along with the land use, to determine the compatibility of the sound and sound receiver. Even if the sound level complies with all standards and regulations, the sound generated by the project may still be audible at the noise receptor. However, most regulations regarding sound levels are written with the intent to limit excessive sound levels for which the general public may be adversely affected.

6.1.1 Residential Receptor Locations South of the Site

Noise levels in the residential zoned area located on the southeastern portion of Mohihi Street near Lualualei Naval Road show noise levels in excess of the HDOH maximum daytime noise limit for residentially zoned areas (55 dBA) for all operational stages. Excess levels were calculated to be 9 dB above the daytime limit. However, the primary noise source in this area is traffic from Lualualei Naval Road and vehicular traffic noise is not enforced by the HDOH. Residences located farther northwest of the major roadway are expected to be exposed to noise levels less than 55 dBA.

The heavy truck traffic from vehicles entering and leaving the landfill site is a primary source of noise for the Mohihi Street residences located near the scale house. Noise levels in this area are projected to increase by approximately 2 dB due to the increased customer traffic within the project site. A change of 3 dB or less is generally considered just below the threshold of human perception and therefore insignificant.

6.1.2 Agriculture/Industrial Zoned Receptor Locations West of the Site

The properties to the west of the project site are zoned for agricultural uses, although there appear to be some dwellings built on these properties. The HDOH considers agricultural zoned land to be a Class 3 zoning and the requirements for this type of land use is a maximum noise level of 70 dBA. All of the properties to the west of the project site are in compliance with the 70 dBA maximum noise levels for this particular zoning. If the predicted noise levels are compared to the HDOH residential zoning criteria of 55 dBA, noise from the site would not be in compliance at the properties on Kuualoha Road closest to the

MRF. However, the existing noise levels in this area may likely be higher than the levels shown in Table 7 due to other agricultural and industrial activities that take place in the vicinity.

Noise from the MRF is the primary source of noise for the properties closest to the northern tip of the project site and the properties at the end of Kuualoha Road are projected to experience noise levels close to 60 dBA. However, the overall change in noise level between various operation stages is not significant. This is because the MRF will operate at the same elevation and under the same conditions as the existing and future no expansion stages. Since it is the dominant noise source in the area, MRF noise will likely mask noises from other operations.

The active disposal operations and heavy truck traffic on the project site from vehicles travelling along the site access route are the primary sources of noise for the properties at the end of Ulehawa Road and Kapiki Road. The projected increase in noise level to the neighboring properties is primarily due to the additional heavy truck traffic volumes. However, noise level increases are projected to be up to 2 dB which is not a significant increase.

6.1.3 Agriculture/Industrial Zoned Receptor Locations North of the Site

The property to the north of the project site is also zoned for agricultural/industrial uses and is currently utilized as an aggregate recycling facility. Although noise levels from the project site are projected to be well over the HDOH maximum permissible noise limit of 70 dBA at the property line, the neighboring property is also a source of significant noise and existing noise levels during the daytime are likely in excess of the maximum permissible noise limit.

6.2 Predicted Noise Levels due to Vehicular Traffic

Based on the results of the traffic noise analysis, traffic volume increases due to the proposed expanded operations at the PVT site are not expected to increase traffic noise by a significant amount in the community surrounding the project site.

6.3 Operational Noise vs. Vibration

Heavy equipment activities generate not only audible airborne sounds, but can also result in varying degrees of ground vibration depending on the equipment and methods employed. While the previous section of this report evaluates the airborne sound of operational activities at the project site, it does not assess human or structural responses to potential ground borne vibration due to these activities.

Vibration induced by the specific mobile equipment utilized for this project would not usually result in adverse effects on people or structures. During the site operations, noise from the C&D debris moving equipment will likely be more noticeable than any perceived vibration. The MRF equipment itself does operate with a large shaker section that produces large vibrations in the equipment. The concrete pad that supports the MRF equipment meets similar standards that the federal aviation administration (FAA) requires for airport runway, taxiway, and apron areas at airports. This increased standard for design and construction of the MRF (i.e. higher quality Portland cement, seamless thicker pad) provides added sound vibration damping qualities as a PVT best practices measure. It is not expected that this equipment will produce any adverse effects to the surrounding area, but the vibration produced by this equipment was not part of the acoustical modeling and are therefore not included in the results in this report.

7.0 NOISE IMPACT MITIGATION

7.1 Mitigation of Operational Noise

The predicted operational noise levels from the PVT ISWMF site comply with the HDOH maximum permissible noise limits at the property line for Class 3 zoning. Furthermore, a significant increase in noise levels due to the proposed project is not expected in the community surrounding the project site. Therefore, a noise impact due to the proposed project is not anticipated and noise mitigation should not be required. The mitigation methods described below are provided for informational purposes as “best practices” to reduce noise.

- Require all site owned and customer owned vehicles traveling internally on the site to be operating with fully functional mufflers and in a state of good repair.
- Encourage quiet operating techniques and practices.
- Maintain the commonly traveled pathways to keep a smooth evenly sloped surface free from major bumps and potholes that cause noise when traveled over.
- Grade all pathways at a low enough slopes that they do not require excessive throttle to navigate.
- Post signage to inform drivers of “no engine braking” and “no horn unless emergency” areas close to noise critical areas.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.

2. *Highway Noise Policy and Abatement Guidelines*, Department of Transportation, Highways Division, State of Hawaii, April 25, 2011.

3. M. David Egan, *Architectural Acoustics*, McGraw-Hill Book Company, 1998

4. International Standards Organization ISO/TC 43, *Noise Assessment with Respect to Community Responses*, New York: United Nations, November 1969.

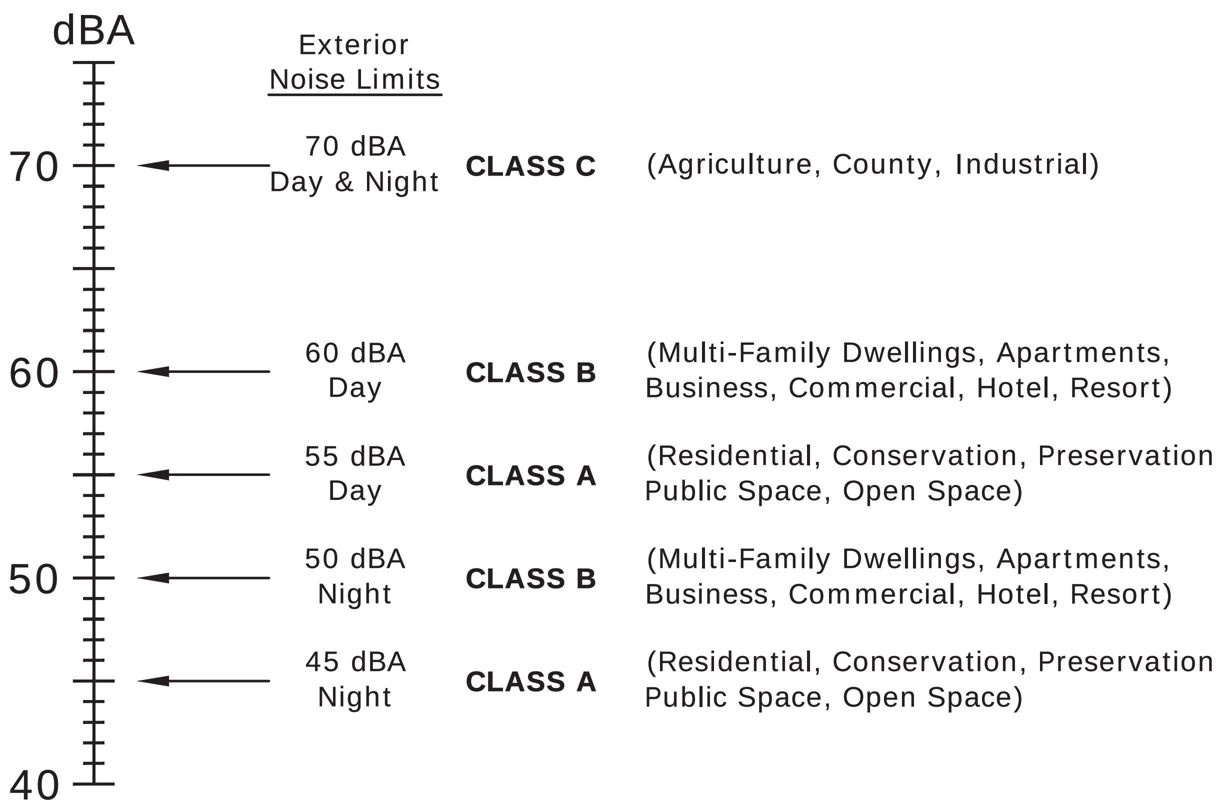
5. *DataKustik CadnaA software program*, Version 4.4.146; DataKustik GmbH, 2014.

6. *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, Department for Environment, Food and Rural Affairs, 2005.

7. *Traffic Impact Analysis Report for the Proposed Expanded Recycling, Landfill Grading and Renewable Energy Project*, The Traffic Management Consultant, December 22, 2014.

HAWAII DEPARTMENT OF HEALTH MAXIMUM PERMISSIBLE SOUND LEVELS FOR VARIOUS ZONING DISTRICTS

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



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PROJECT NO: 14-39

DATE: April 2015

FIGURE: 1

Site Location and Noise Measurement Locations

Legend

PVT Landfill Project Site

Noise Measurement Location

L1: 325 feet southwest of PVT scale house along the commercial truck entrance and exit roadway

L2: 450 feet south of Northern property line

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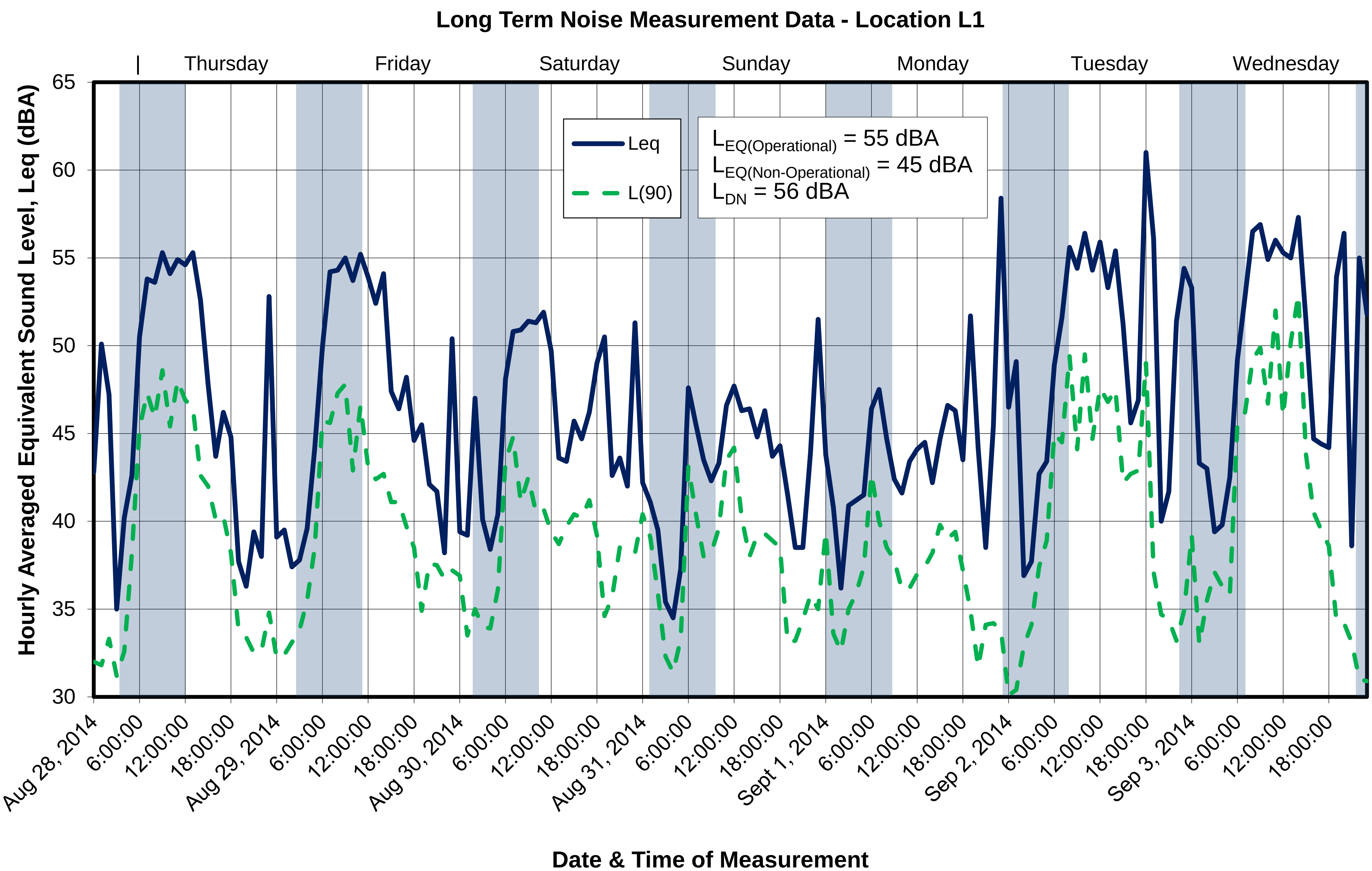
PROJECT NO: 14-39	DATE: April 2015	FIGURE: 2



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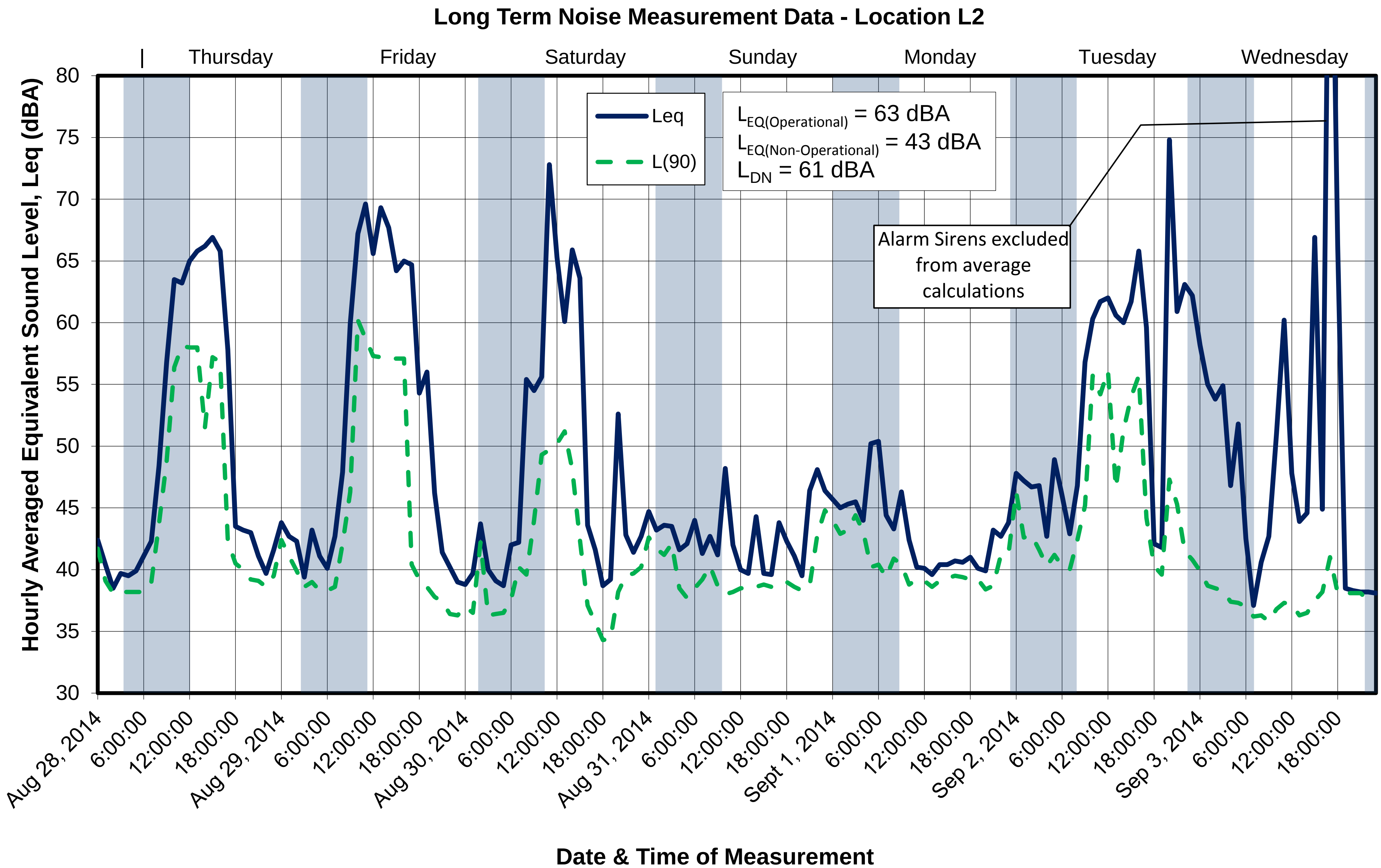
	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 3



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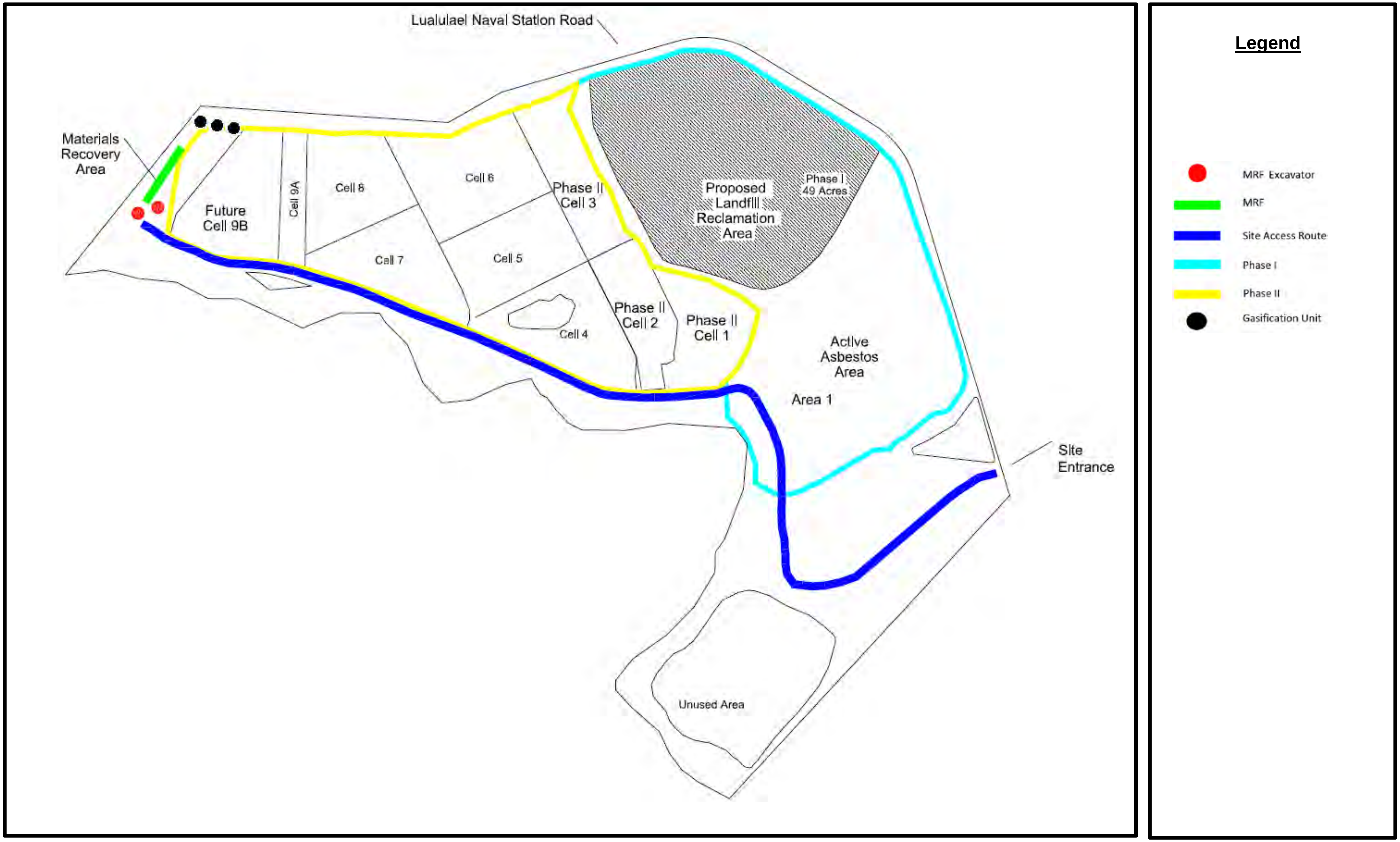
	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 4

Project Site Plan



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	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 5

Existing Refuse Grades

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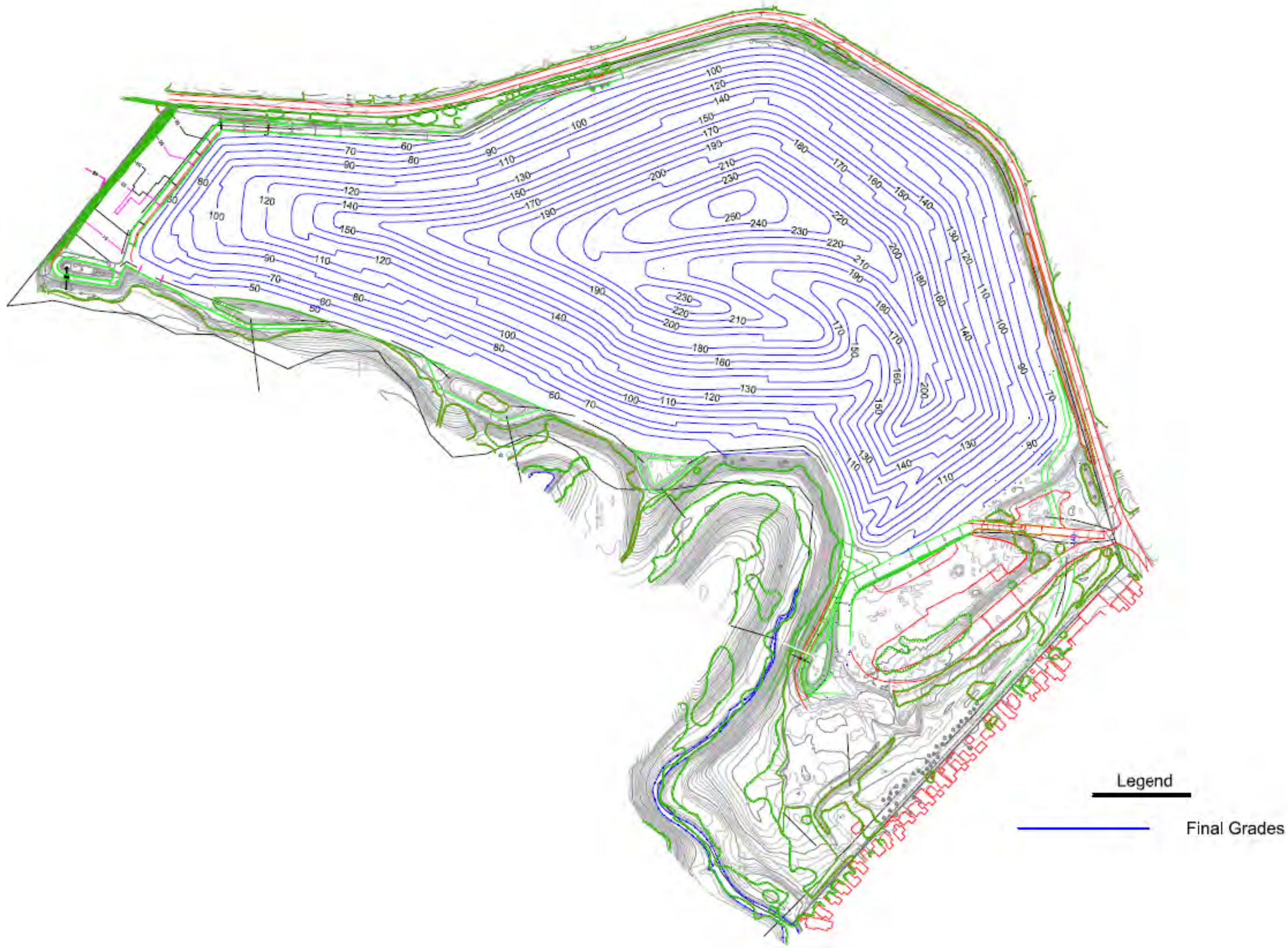
PROJECT NO:	DATE:	FIGURE:
14-39	April 2015	6

Proposed Final Refuse Grades



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Noise Model Receiver Locations

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	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 8

Maximum Noise Contours – Currently Existing Operating Conditions

Noise Level Contour Key (dBA)

Green	> 45
Yellow	> 50
Orange	> 55
Red	> 60
Pink	> 65
Blue	> 70
Dark blue	> 75
Navy	> 80

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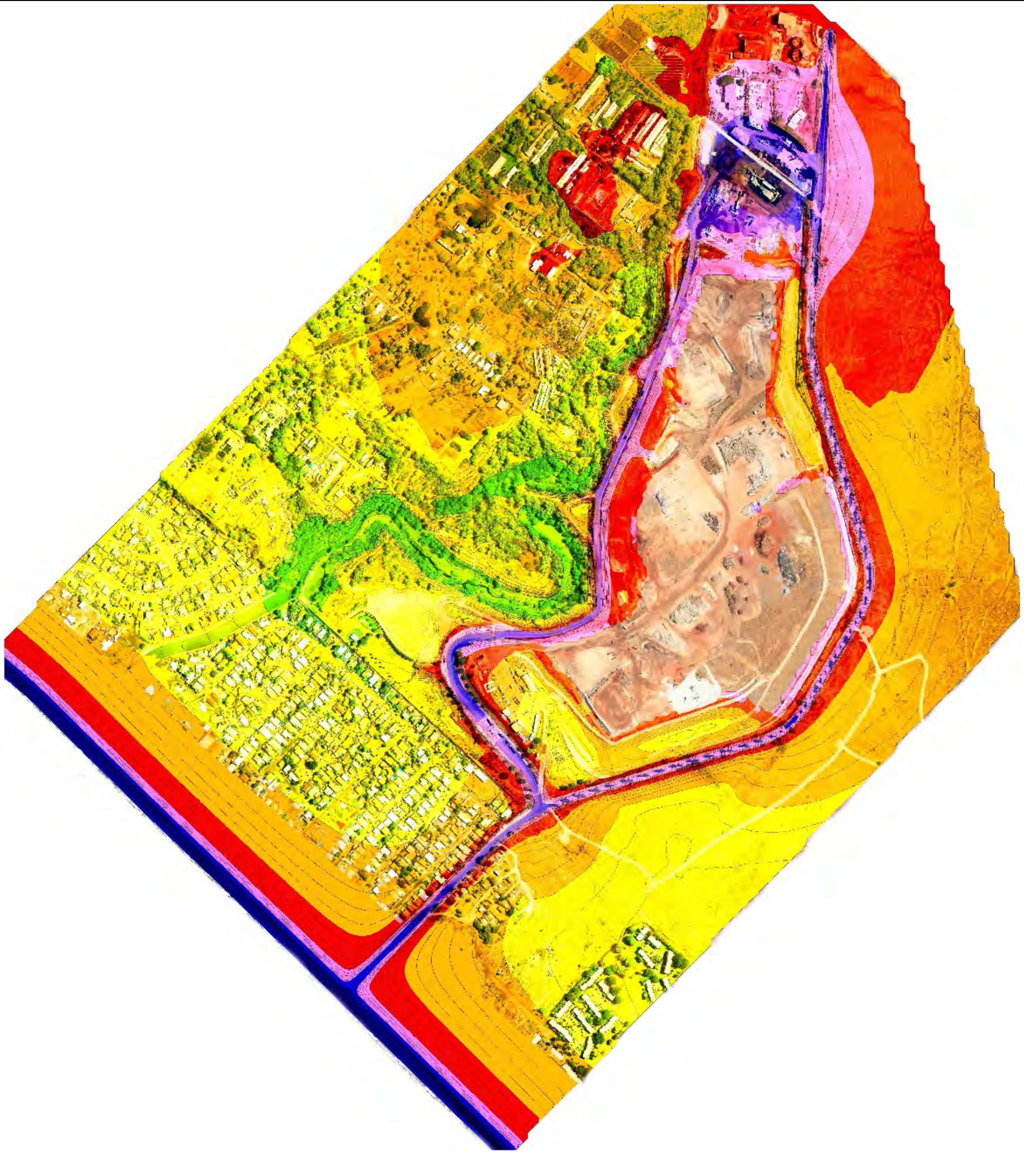
	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 9

Maximum Noise Contours – Beginning Of Reclamation Operations



Noise Level Contour Key (dBA)

Green	> 45
Yellow	> 50
Orange	> 55
Red	> 60
Pink	> 65
Blue	> 70
Dark blue	> 75
Navy	> 80

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	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 10

Maximum Noise Contours - Future Operations With Proposed Project

Noise Level Contour Key (dBA)

Green	> 45
Yellow	> 50
Orange	> 55
Red	> 60
Pink	> 65
Blue	> 70
Dark blue	> 75
Navy	> 80

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	PROJECT NO: 14-39	DATE: April 2015	FIGURE: 11

Maximum Noise Contours – Future Operations Without Proposed Project

Noise Level Contour Key (dBA)

Green	> 45
Yellow	> 50
Orange	> 55
Red	> 60
Pink	> 65
Blue	> 70
Dark blue	> 75
Navy	> 80

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PVT Integrated Solid Waste Management Facility – Expanded Recycling, Landfill Grading and Renewable Energy Project

PROJECT NO:	DATE:	FIGURE:
14-39	April 2015	12

PVT Site Noise Contours – Delta Noise Contours – Future with Proposed Project vs. Future without Proposed Project

Delta Noise Contour Key (dB)

(light green)	Δ 1
(green)	Δ 2
(pale yellow)	Δ 3
(yellow)	Δ 4
(orange)	Δ 5
(magenta)	Δ 6
(dark magenta)	Δ 7

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PVT Integrated Solid Waste Management Facility – Expanded Recycling, Landfill Grading and Renewable Energy Project		
PROJECT NO: 14-39	DATE: April 2015	FIGURE: 13

APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as Aunwanted@ sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

[1] D.W. Robinson and R.S. Dadson, AA Re-Determination of the Equal-Loudness Relations for Pure Tones,@ *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

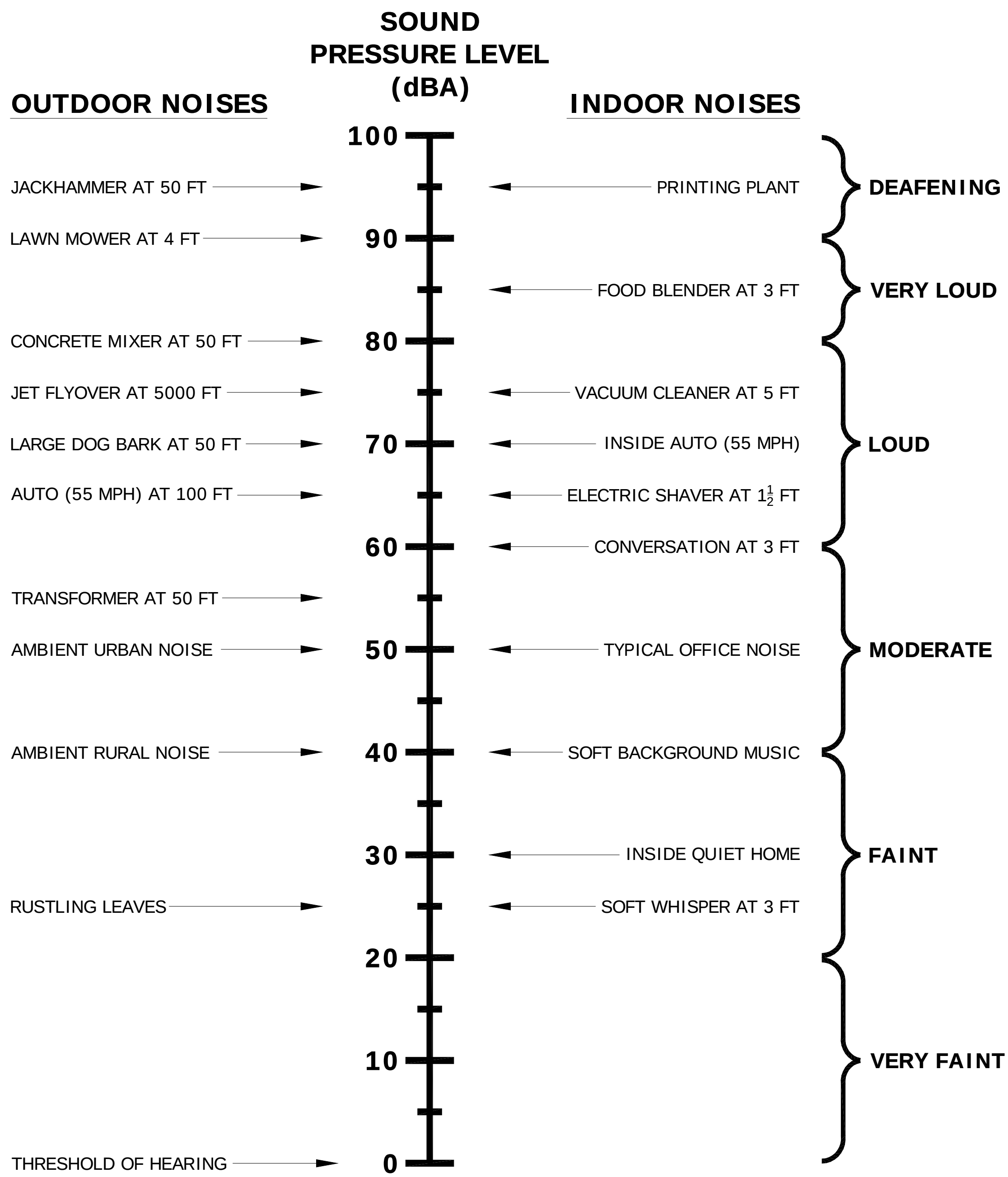

Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level
The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

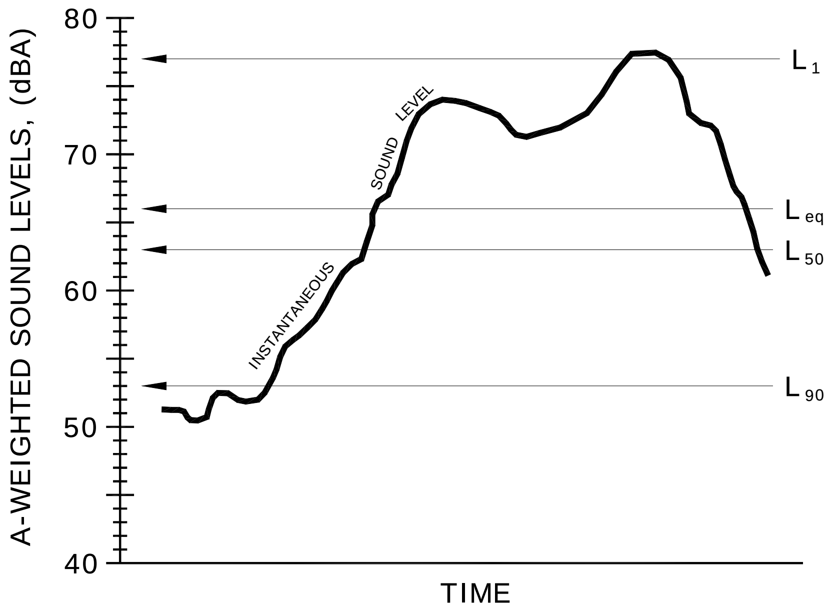

Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level
The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

A-Weighted Maximum Sound Level
The A-Weighted Maximum Sound Level, L_{Amax}, is the greatest sound level measured during a designated time or event.

APPENDIX B

Photographs at Project Site

Location L1

Microphone mounted on a tripod near the southern border of the landfill approximately 300 feet south of the scale house.

Location L2

Microphone mounted on tripod near the northern side of the project site, approximately 470 feet south of the MRD.

APPENDIX F - BIOLOGICAL SURVEYS REPORT

Biological Surveys Conducted for the PVT Integrated Solid Waste Management Facility Expanded Recycling, Landfill Grading and Renewable Energy Project, TMK: 8-7-009:025 & 8-7-021:026, Nānākuli, Island of Oʻahu

Prepared by:

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February 3, 2015

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Table of Contents

Introduction

PVT Land Company is proposing to (1) expand its reuse, recycling and materials recovery operation; (2) allow the site grade to reach a maximum elevation of up to 76 meters above mean sea level at the *mauka* portion of the Site; and (3) use renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. The Proposed Project will allow PVT to continue to provide essential disposal services to the construction industry, to participate in the City's disaster response efforts, provide recycled products and fuel to other businesses, and to be energy self-sufficient (Figures 1, 2 and 3)

This report describes the methods used and the results of the botanical, avian and mammalian surveys conducted on the subject property as part of the environmental disclosure process associated with the proposed project. The primary purpose of the surveys was to determine if there are any botanical, avian or mammalian species currently listed, or proposed for listing under either federal or State of Hawaiʻi endangered species statutes within or adjacent to the study area. The federal and State of Hawaiʻi listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS) 2014). Fieldwork was conducted on November 25, 2014.

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

General Site Description

The PVT Integrated Solid Waste Management Facility (ISWMF) is a construction and demolition debris management facility located in the community of Nānākuli, in the Waiʻanae District of Oahu (Figure 1). The facility property begins approximately 488 meters, northeast of the intersection of Farrington Highway and Lualualei Naval Road and extends northerly approximately 1.6 kilometers along Lualualei Naval Road. The PVT ISWMF property covers approximately 200-acres of land. Phase I of the landfill consists of approximately 49 acres of land which received debris prior to October 9, 1993. Phase II of the landfill consists of 104 acres of land (Figure 2).

Vegetation within the survey area is nearly all ruderal in nature; that is, plants colonizing recently or regularly disturbed ground (Figures 4, 5 and 6).

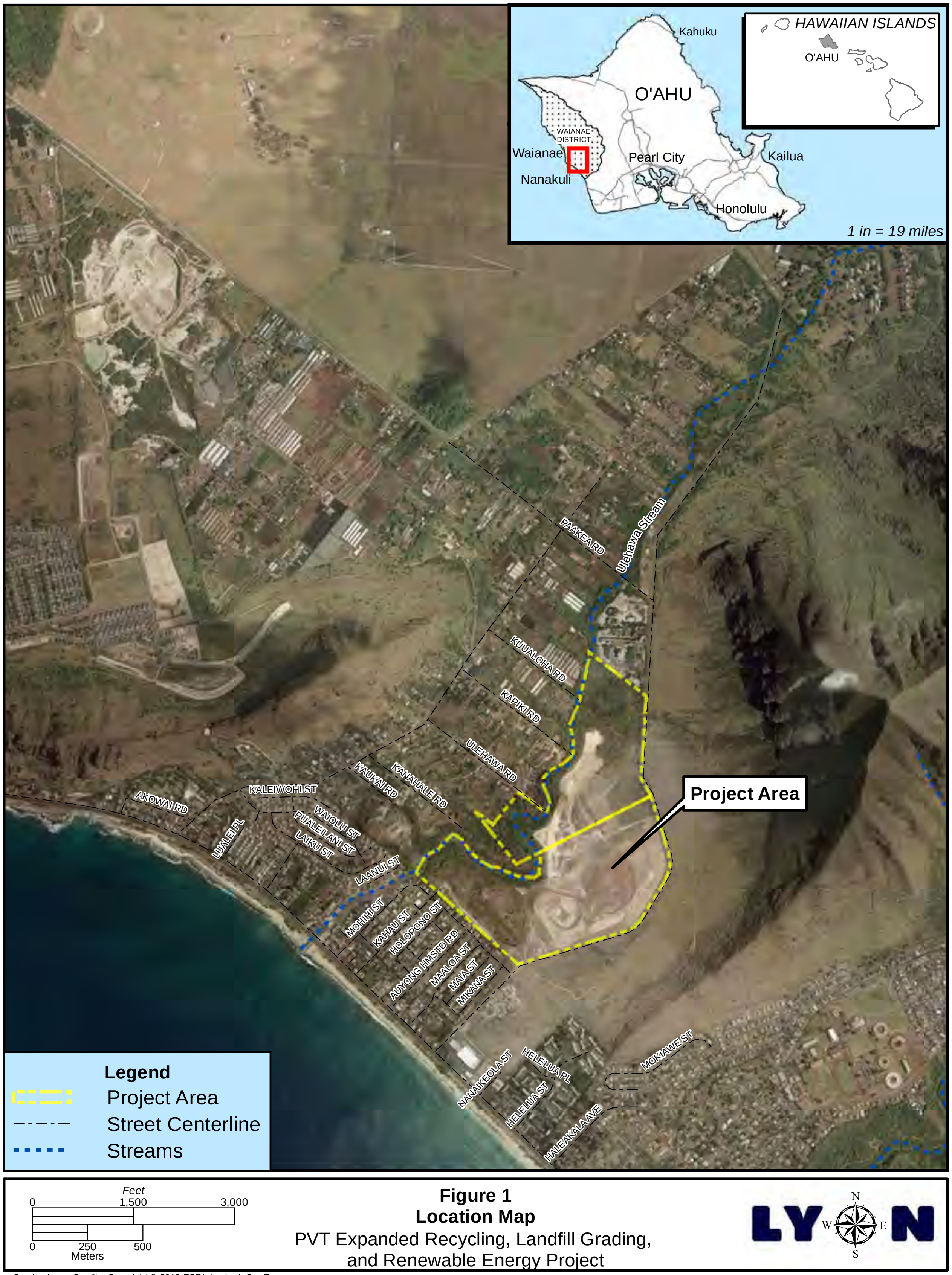

Figure 1
Location Map
PVT Expanded Recycling, Landfill Grading, and Renewable Energy Project

Figure 2
Parcel Map
PVT Expanded Recycling, Landfill Grading, and Renewable Energy Project

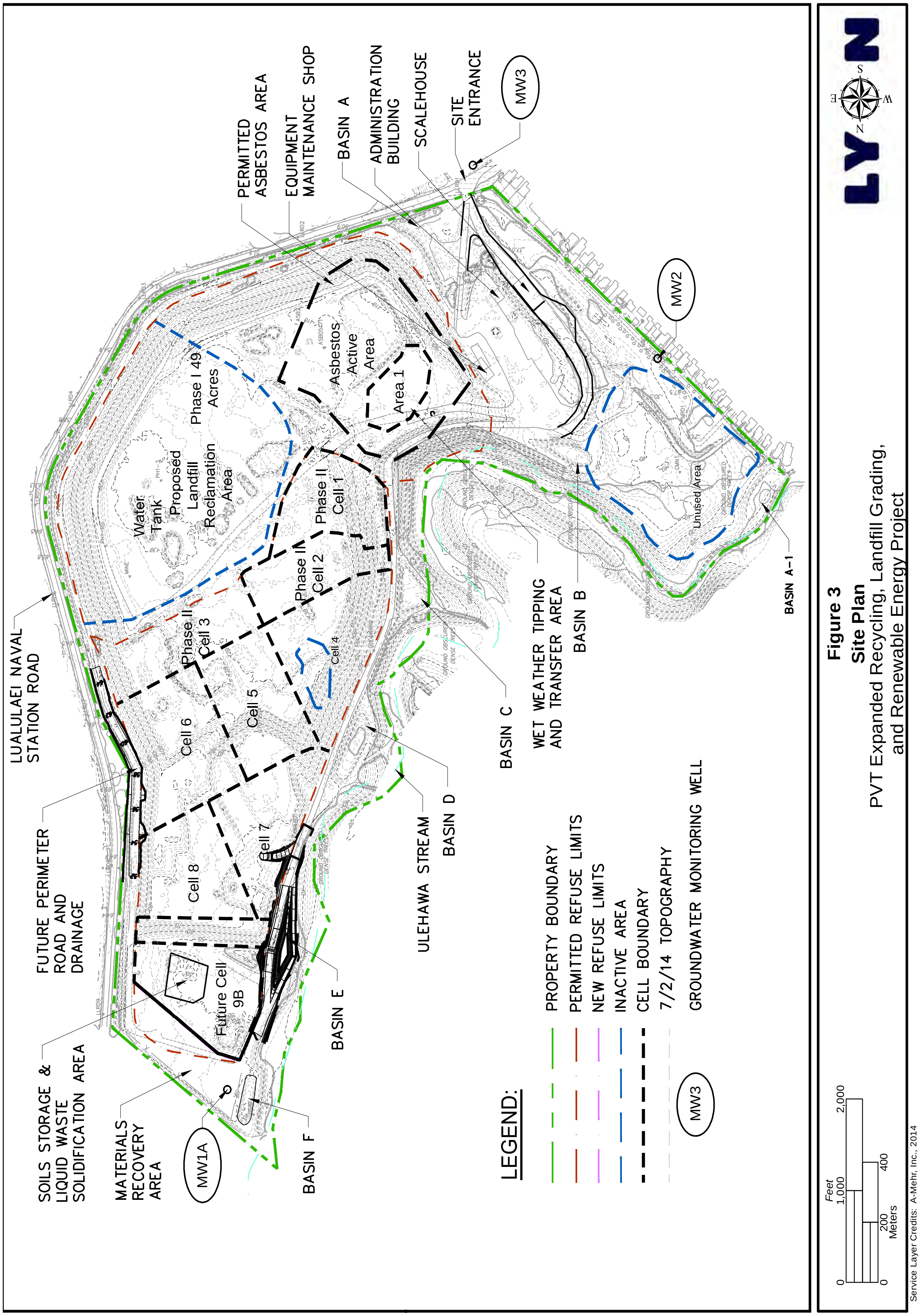

Figure 3
Site Plan
PVT Expanded Recycling, Landfill Grading, and Renewable Energy Project

Figure 4 – Recycle area, showing lack of ground cover

Figure 5 – Top of the landfill showing grassy ruderal vegetation

Figure 6 – Northern end of the facility showing lack of vegetation

Methods

Plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner *et al*., 1990, 1999) for native and naturalized flowering plants, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for crop and ornamental plants. Some plant species names have been updated following more recently published literature as summarized in Imada (2012). The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 55th supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser *et al*., 2009, 2010, 2011, 2012, 2013, 2014). Mammal scientific names follow (Wilson and Reeder, 2005). Place names follow (Pukui *et al.*, 1976).

Botanical Survey Methods

The botanical survey involved a wandering pedestrian transect that traversed most parts of the property. Coverage was concentrated along vegetated hill slopes and within the five detention basins located along the west side of the property. A GNSS unit (Trimble, GeoXH 6000 Series) was used to record the progress track of the botanist and provide real time feedback on survey area coverage. Plant species were identified as they were encountered. For a few species not immediately recognized in the field, photographs were taken and/or material was collected for identification in the laboratory.

The survey period encompassed the early wet season on O'ahu, with rainfall about 95 percent of average for the period October through December (USGS, 2015). However, between June and August, rainfall was about 167percent of average. The three-month zone map provided by NOAA (2014) through November 2014 shows rainfall on leeward O'ahu was about average. The vegetation on the survey site was not stressed due to a lack of rainfall.

Avian Survey Methods

Eight avian count stations were sited equidistant from each other within the project site. A single eight-minute avian point count was made at each count station. The stations were each counted once. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The point counts were conducted between 8:30am and 10:45 am. Time not spent counting the point count stations was used to search the rest of the site for species and habitats not detected during the point counts.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of O'ahu are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area during the time spent on the site.

Results

Botanical Surveys, Flora

Vegetation — Vegetation on the PVT site is nearly all ruderal plants growing on highly disturbed ground (Figure 5) or bare ground in areas of active operations (Figures 4 and 6). The site is bordered on the west by a riparian forest along Ulehawa Stream, and more open shrub and grassland around the margins to the south and east. Developing grasslands occur along slopes of the landfill not recently disturbed and are seeded to minimize soil erosion.

Flora — "Flora" is the diversity of plant species living in the survey area. A plant checklist (Table 1) was compiled from field observations, with entries arranged alphabetically under plant family names (standard practice). Included in the list are scientific name, common name, and status (for example, whether native or non-native, naturalized or ornamental) for each species observed during the survey. Qualitative estimates of plant abundance were developed for each species.

A total of 75 species were recorded as growing in the survey area. The ratio of native plants to non-native ones (as a percent of the total number of species recorded) was 5.3 percent native (**Ind** or **End**). This percentage of natives is low compared with most lowland areas on Oʻahu, and the occurrence of these natives in the survey area was recorded as "rare" (one to three individuals seen), except for *ʻilima* (*Sida fa*llax), seen somewhat more frequently, yet still uncommon in the survey area.

Table 1 - Flora for the PVT Expanded Operations Project, Nānākuli, Oʻahu.

Species listed by family	Common name	Status	Abundance	Notes
	FLOWERING PLANTS			
	DICOTYLEDONS			
ACANTHACEAE				
Asystasia gangetica (L.) T. Anderson	Chinese violet	Nat	R	
AIZOACEAE				
Sesuvium portulacastrum (L.) *L.*	*ʻākulikuli*	Ind	R	
Tetragonia tetragonioides (Pall.) Kuntze	*New Zealand spinach*	Nat	R	
Trianthema tetragonioides (Pall.) Kuntze	---	Nat	U	

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Table 1 continued

Species listed by family	Common name	Status	Abundance	Notes
AMARANTHACEAE				
Amaranthus spinosus L.	spiny amaranth	Nat	R	
APOCYNACEAE				
Nerium oleander L.	oleander	Orn	O	<1,2>
ASCLEPIADACEAE				
Stapelia gigantea N. E. Brown	giant toad plant	Nat	R	
ASTERACEAE (COMPOSITAE)				
Eclipta prostrata (L.) L.	false daisy	Nat	R	
Emilia fosbergii Nicolson	Flora's paintbrush, *pualele*	Nat	R	
Flaveria trinerva (Spreng.) C. Mohr	---	Nat	O	
Lactuca serriola L.	prickly lettuce	Nat	U	
Pluchia carolinensis (Jacq.) G. Don	sourbush	Nat	C	
Sonchus oleraceus L.	sow thistle	Nat	U	
Sphagneticola trilobata (L.) Pruski	wedelia	Nat	R	
Tridax procumbens L.	coat buttons	Nat	U	
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	Nat	U	
Xanthium strumarium L.	*kīkānia*, cockleburr	Nat	O	
BIGNONIACEAE				
Tecoma stans (L.) Juss. ex Kunth	yellow elder	Nat	R	
BORAGINACEAE				
Heliotropum procumbens Mill.	---	Nat	U	
CHENOPODIACEAE				
Atriplex suberecta Verd.	---	Nat	A	
Salsola tragus L.	Russian thistle	Nat	O	
CONVOLVULACEAE				
Ipomoea obscura (L.) Ker-Gawl	---	Nat	O	
Ipomoea triloba L.	little bell	Nat	U	
Jacquemontia ovalifolia (Choisy) H. Hallier	*pāʻūohiʻiaka*	**Ind**	R	
Merremia aegyptica (L.) Urb.	hairy merremia	Nat	R	
CUCURBITACEAE				
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	Nat	R	
Cucumis dipsaceus Ehrenb. ex Spach	teasel gourd	Nat	R	
CRASSULACEAE				
Kalanchoë pinnata (Lam.) Pers.	airplant	Nat	U	<2>
EUPHORBIACEAE				
Ricinus communis L.	castor bean	Nat	O	
FABACEAE				
Acacia farnesiana (L.) Willd.	*klu*	Nat	U	
Chamaecrista nictitans (L.) Moench	partridge pea	Nat	U	
Crotalaria incana L.	fuzzy rattlepod	Nat	R	
Crotalaria pallida Aiton	smooth rattlepod	Nat	U	
Desmanthus pernambucanus (L.) Thellung	virgate mimosa	Nat	U	
Mimosa pudica L.	sensitive plant	Nat	U	

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Table 1 continued

Species listed by family	Common name	Status	Abundance	Notes
FABACEAE continued				
Neonotonia wightii (Wight & Arnott) Lackey	glycine vine	Nat	R	<3>
Indigofera hendicaphyla Jacq.	creeping indigo	Nat	R	
Indigofera suffruticosa Mill.	indigo	Nat	R	
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	C	
Macroptilium lathyroides (L.) Urb.	cow pea	Nat	R	
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	A	<2>
LAMIACEAE				
Leonotis nepetifolia (L.) R. Br.	lion's ear	Nat	U	
MALVACEAE				
Abutilon grandifolium (Wild.) Sweet	hairy abutilon	Nat	R	
Gossypium tomentosum Nutt. ex Seem.	*ma'o*	**End**	R	<2>
Malvastrum coromandelianum (L.) Garcke	false mallow	Nat	U	
Sida ciliaris L.	---	Nat	A	
Sida fallax Walp.	*'ilima*	**Ind**	U	
Sida rhombifolia L.	---	Nat	U	
Sida spinosa L.	prickly sida	Nat	O	
Waltheria indica L.	*'uhaloa*	Nat	C	
NYCTAGINACEAE				
Boerhavia coccinea Mill.	false *alena*	Nat	R	
Bougainvillea cf. *spectabilis* Wild.	bougainvillea	Orn	O	<1,2>
SOLANACEAE				
Datura stramonium L.	jimson weed	Nat	R	
Nicotiana glauca R.C. Graham	tree tobacco	Nat	R	<3>
Nicotiana tabacum L.	tobacco	Nat	R	<3>
Solanum torvum Sw.	---	Nat	R	

FLOWERING PLANTS
MONOCOTYLEDONES

CYPERACEAE				
Cyperus rotundus L.	nut grass	Nat	O	
POACEAE				
Cenchrus ciliaris L.	buffelgrass	Nat	AA	
Cenchrus echinatus L.	sand bur	Nat	U	
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	A	
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat	A	
Dactyloctenium aegypticum (L.) Willd.	beach wiregrass	Nat	R	
Dichanthium sericeum (R. Br.) A,Camus	Australian bluestem	Nat	U	
Echinochloa crusgalli (L.) P. Beauv.	barnyard grass	Nat	O	
Eleusine indica (L.) Gaertn.	wiregrass	Nat	O	
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	Nat	R	

Table 1 continued

Species listed by family	Common name	Status	Abundance	Notes
POACEAE Continued				
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	Nat	R	
Leptochloa fusca uninerva (K. Presl.) N. Snow	sprangletop	Nat	U	
Melinus repens (Willd.) Zizka	Natal redtop	Nat	C	
Setaria verticillata (L.) P. Beauv.	bristly foxtail	Nat	U	
Sporobolus diandrus (Retz.) P. Beauv.	Indian dropseed	Nat	A	
Urochloa maxima (Jacq.) R. Webster	Guinea grass	Nat	C	
Urochloa maxima var. *trichoglume* (K. Schum.) C.E. Hibberd	green panic	Nat	C	
Urochloa mutica (Forssk.) T.Q. Nguyen	California grass	Nat	O	
Urochloa distachya (L.) T. W. Nguyen	---	Nat	R	

Legend to Table 1

STATUS = distributional status for the Hawaiian Islands:

End = Endemic; naive to Hawaiʻi and uniquely so.

Ind = Indigenous; native to Hawai'i, but not unique to the Hawaiian Islands.

Nat = Naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.

Orn = A cultivated plant; a species not thought to be naturalized (spreading on its own) in Hawaiʻi.

ABUNDANCE = occurrence ratings for plant species:

-- - Species not present in area.

R – Rare, seen in only one or perhaps two locations.

U – Uncommon, seen at most in several locations

O – Occasional, seen with some regularity

C – Common, observed numerous times during the survey

A – Abundant, found in large numbers; may be locally dominant.

AA - Very abundant, abundant and dominant; defining vegetation type.

NOTES:

<1> – Landscape planting.

<2> - All or majority of plants observed outside actual landfill areas.

<3> – Plant lacking key diagnostic characteristics (flower, fruit); identification, therefore, uncertain.

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Avian Survey

A total of 215 individual birds of 16 species, representing 12 separate families, were recorded during point counts. One additional species, Pacific Golden-Plover (*Pluvialis fulva*), was recorded on the property as an incidental observation. All but one of the species 17 of the avian species detected on the site are alien to the Hawaiian Islands (Table 2). The lone Pacific Golden-Plover is an indigenous migratory shorebird species. No avian species currently listed or proposed for listing under either the federal of State of Hawaii endangered species statutes were recorded during the course of this survey (DLNR, 1998; USFWS, 2014).

Avian diversity and densities were low, though in keeping with the location and the minimal vegetation present on the site. Three species, Zebra Dove (*Geopelia striata*), Common Waxbill (*Estrilda astrild*), and House Finch (*Haemorhous mexicanus*), accounted for 49-percent of the total number of birds recorded. Zebra Dove was the most commonly tallied species, and accounted for 20-percent of the birds recorded during point counts. An average of 27 birds were recorded per station count, which is a relatively low number and reflects the depauperate habitats available on and the site.

Table 2 – Avian Species Detected During Point Counts PVT, Nānākuli, Oʻahu

Common Name	***Scientific Name***	***ST***	***RA***
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.63
	PELECANIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	1.50
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	**I-1**
	COLUMBIFORMES		
	COLUMBIDAE – Pigeons & Doves		
Rock Pigeon	*Columba livia*	A	1.50
Spotted Dove	*Streptopelia chinensis*	A	1.38
Zebra Dove	*Geopelia striata*	A	5.38

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Table 2 Continued

Common Name	Scientific Name	ST	RA
	PASSERIFORMES		
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	1.13
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	1.75
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	*Mimus polyglottos*	A	0.13
	STURNIDAE – Starlings		
Common Myna	*Acridotheres tristis*	A	1.88
	THRAUPIDAE - Tanagers		
Red-crested Cardinal	*Paroaria coronata*	A	0.50
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.13
	FRINGILLIDAE – Fringilline and Carduleline Finches & Allies		
	Carduelinae – Carduline Finches		
House Finch	*Haemorhous mexicanus*	A	2.75
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	1.13
	ESTRILDIDAE – Estrildid Finches		
Common Waxbill	*Estrilda astrild*	A	5.13
African Silverbill	*Euodice cantans*	A	0.50
Java Sparrow	*Lonchura oryzivora*	A	1.50

Legend to Table 2

ST = Status
A = Alien – Introduced to the Hawaiian Islands by humans
IM = Indigenous Migratory – Native migratory species, not unique to the Hawaiian Islands
RA = Relative Abundance - Number of birds detected divided by the number of point counts (~8)
I - Incidental – A species only recorded as an incidental observation outside of point count periods + number of individuals recorded

Mammalian Survey

Two terrestrial mammalian species were detected during the course of this survey. Multiple dogs (*Canis familiaris*) were heard barking from properties to the northwest and southwest of the site. Additionally domestic pigs (*Sus scrofa*) were heard from the piggery located to the northwest of the study site.

No mammalian species currently proposed for listing or listed under either the federal or State of Hawaiʻi endangered species statutes was recorded on this site (DLNR, 1998; USFWS, 2014).

Discussion

Botanical Resources

Only one plant observed during the survey could be considered a plant of any particular concern: *maʻo* or Hawaiian cotton (*Gossypium tomentosum*). A large *maʻo* was observed in the vegetated border that lies between the PVT fence and Lualualei Naval Road (State Route 780) along the east side of the property. This plant is outside the fence marking the active landfill area, approximately 1.28 kilometers north on Lualualei Naval Rd. from the entrance to the PVT Land Company, Ltd. facility.

Avian Resources

The findings of the avian survey are consistent with the current habitats present within the ISWMF. During the course of this survey 17 avian species, were recorded, 16 during point count periods and one as an incidental observation by biologists transiting the site. One species recorded Pacific Golden-Plover is an indigenous migratory shorebird species. Pacific Golden-Plover nest in the high Arctic during the late spring and summer months, returning to Hawaiʻi and the tropical Pacific to spend the fall and winter months each year. This species usually leaves Hawaiʻi and returns to the Arctic in late April or the very early part of May. They are commonly encountered throughout the state during the fall and winter months. The lone individual recorded was in alternative plumage likely an unsuccessful nester that returned to Hawaii earlier than the majority of the successful breeders usually do. The remaining 16 species all recorded during point counts are alien to the Hawaiian Islands. No avian species currently listed or proposed for listing under either the federal of State of Hawaii endangered species statutes were recorded during the course of this survey (Table 2).

Although not detected and not expected on the site two seabird species, Wedge-tailed Shearwater (*Puffinus pacificus*) and Newell's Shearwater (*Puffinus auricularis newelli*) have been downed on Oʻahu due to light attraction during the annual seabird fledging season. The primary cause of mortality in resident seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley *et al.,* 2001). Collision with man-made structures is considered to be the second most significant cause of mortality in locally nesting seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed *et al.*, 1985; Telfer *et al.*, 1987; Cooper and Day, 1998; Podolsky *et al*. 1998; Ainley *et al.,* 2001; Hue *et al.,* 2001; Day *et al* 2003).

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We did not record the Hawaiian endemic subspecies of the Short-Eared Owl (*Asio flammeus sandwichensis*) during the course of this survey. This State of Hawai'i listed species has been recorded within the greater Lualualei area, especially on the Navy property located to the west of the site (David 2014). There is no suitable nesting habitat for this species within the PVT site, and the lack of rodent prey within the facility likely precludes this species foraging within the site.

Mammalian Resources

The findings of the mammalian survey are consistent with the current habitat present on the site. All of the mammalian species detected are alien species.

No Hawaiian hoary bats were detected during the course of this survey. It is only in recent years that this species is being recorded on a regular basis on the Island of O'ahu. It is within the realm of possibility that this species may use resources within the project area on a seasonal basis. There is no vegetation within the site, which is suitable as bat roost sites (Figures 4, 5 and 6).

Potential Impacts to Protected Species

Botanical

Hawaiian cotton (*Gossypium tomentosum*) or *ma'o* is not a listed species (USFWS, 2015). It is presently considered "vulnerable" (Wagner, Herbst, and Sohmer, 1990; Wagner, 2015). Although not protected by federal statute, care should be taken not to impact the plant, which in the present case is located on the PVT parcel but outside the fence bounding present landfill and recycling operations.

Seabirds

The principal potential impact that the construction of the project poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction, if it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential use of streetlights or other exterior lighting during the seabird nesting season.

As currently proposed the project is not likely to impact any species currently listed, or proposed for listing under the federal ESA or under the State of Hawaii's equivalent statute. Simple minimization measures to avoid impacts are presented in the following section.

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Recommendations

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- If streetlights or exterior facility lighting is installed in conjunction with the project, it is recommended that the lights be shielded to reduce the potential for interactions of nocturnally flying seabirds with external lights and man-made structures (Reed et al., 1985; Telfer et al., 1987).

- It is recommended that, where appropriate and practicable, native plant species should be used in landscaping efforts. Not only is this ecologically prudent, but also will likely save maintenance and watering costs over the long term. *Ma'o* (Hawaiian cotton) would be an excellent choice for areas around more permanent structures.

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the property. Thus the modification of the site will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under state law.

Glossary

Alien – Introduced to Hawai'i by humans
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native to the Hawaiian Islands and unique to Hawai'i
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Naturalized – A plant or animal that has become established in an area that it is not native to
Nocturnal – Night-time, after dark
'Ōpe'ape'a – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Phylogenetic – The evolutionary order that organisms are arranged by
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species

Acronyms List

DLNR – Hawai'i State Department of Land & Natural Resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
USFWS – United State Fish & Wildlife Service

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APPENDIX G - TRAFFIC IMPACT ANALYSIS REPORT

TRAFFIC IMPACT ANALYSIS REPORT

FOR THE PROPOSED

EXPANDED RECYCLING, LANDFILL GRADING AND RENEWABLE ENERGY PROJECT

PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

TAX MAP KEYS: (1) 8-7-009:025 & (1) 8-7-021:026

PREPARED FOR

PVT LAND COMPANY

APRIL 17, 2015

PREPARED BY

TMC THE TRAFFIC MANAGEMENT CONSULTANT

TRAFFIC IMPACT ANALYSIS REPORT

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FOR THE PROPOSED

EXPANDED RECYCLING, LANDFILL GRADING AND RENEWABLE ENERGY PROJECT

PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

TAX MAP KEYS: (1) 8-7-009:025 & (1) 8-7-021:026

I. Introduction

A. Project Description

PVT Land Company (PVT) proposes to expand the operations at its existing solid waste management facility in Nanakuli, Oahu, Hawaii. PVT will be applying for the necessary permits to expand its recycling and materials recovery operations; increase the height of its landfill; and install renewable energy capabilities for its recycling operations.

The PVT Integrated Solid Waste Management Facility is located on the north side of Lualualei Naval Road, about 0.35 miles mauka (east) of Farrington Highway. The 200-acre project site is identified as Tax Map Keys: (1) 8-7-009:025 & (1) 8-7-021:026. Figures 1 and 2 depict the location map and the site plan, respectively.

The expanded recycling operation will process and/or store reclaimed combustible material for feedstock to support renewable energy providers, as well as provide for PVT's own energy needs. PVT will be able to increase the processing of up to 3,000 tons per day of recycled wastes, which will yield approximately 1,500 tons of feedstock per day. The recycling and materials recovery operation is expected to generate an increase of about 300 trucks per day, and will require an additional 25 personnel. The renewable energy operations will add 2 personnel, for a total of 27 additional personnel.

The proposed grading will provide an additional landfill capacity of approximately 4,500,000 cubic yards by increasing the landfill site elevation from 135 feet above mean sea level to 255 feet above mean sea level. For the purpose of this traffic impact analysis report, the planning horizon for the proposed action at the PVT Facility is the Year 2024.

Figure 1. Location Map

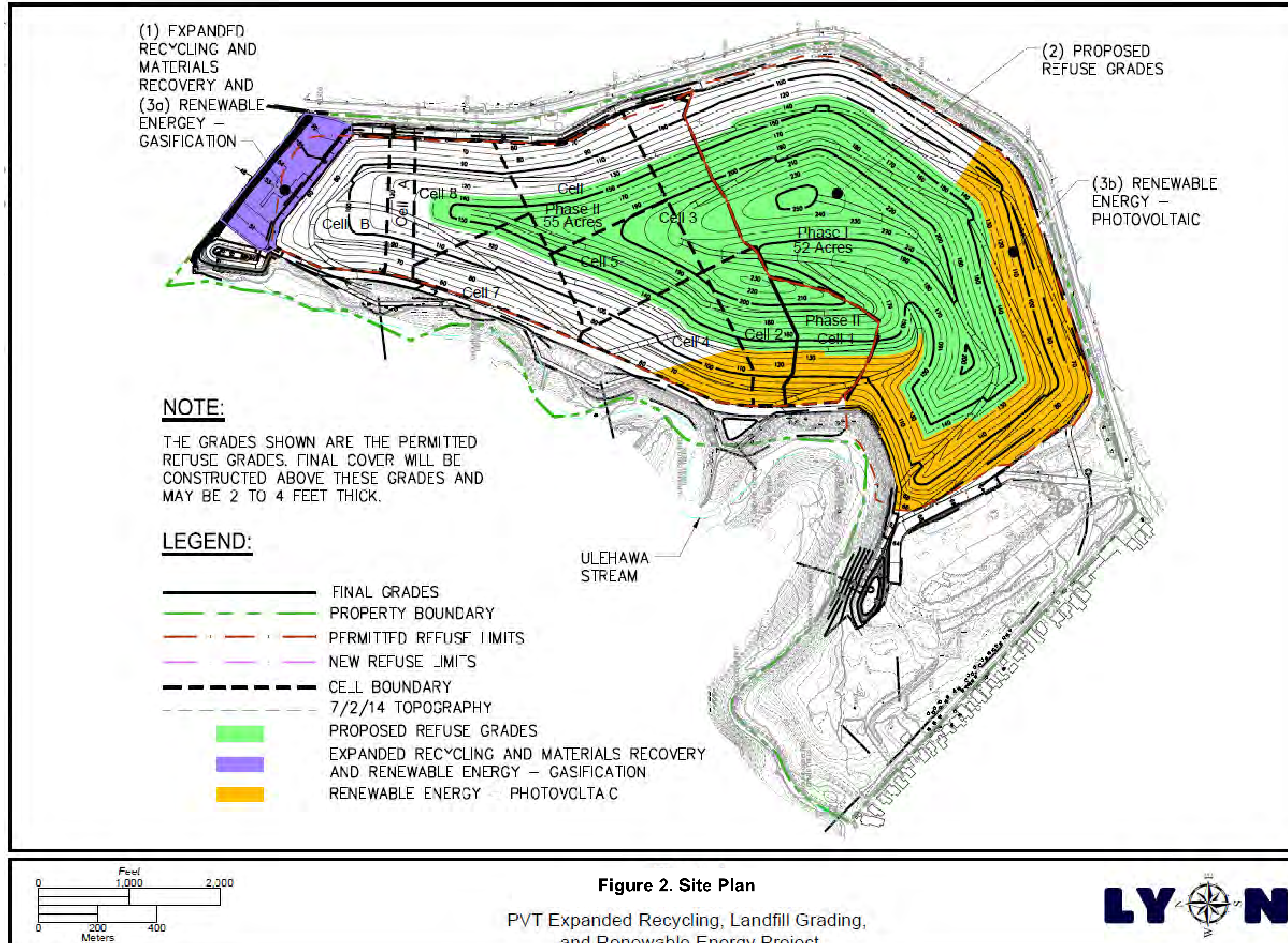

Figure 2. Site Plan

PVT Expanded Recycling, Landfill Grading, and Renewable Energy Project

B. Purpose and Scope of the Study

The purpose of this study is to analyze the traffic impacts resulting from the proposed action at the PVT Integrated Solid Waste Management Facility. This report presents the findings and recommendations of the study, the scope of which includes:

1. Description of the proposed action.
2. Evaluation of existing roadways and traffic conditions.
3. Analysis of the Year 2024 traffic conditions without the proposed action.
4. Development of trip generation characteristics of the proposed action.
5. Identification and analysis of the traffic impacts resulting from the proposed action.
6. Recommendations of improvements, as necessary, that would mitigate the traffic impacts identified in this study.

C. Methodologies

1. Capacity Analysis Methodology

The highway capacity analysis, performed for this study, is based upon procedures presented in the Highway Capacity Manual (HCM), published by the Transportation Research Board, 2010. HCM defines the Level of Service (LOS) as a qualitative measure, which describes the operational conditions within a traffic stream. Several factors may be included in determining the LOS, such as: speed, travel time, freedom to maneuver, traffic interruptions, and driver comfort and convenience. LOS's "A", "B", and "C" are considered satisfactory Levels of Service. LOS "D" is generally considered a "desirable minimum" operating Level of Service. LOS "E" is an undesirable condition, and LOS "F" is an unacceptable condition. Intersection LOS is primarily based upon average delay, which is measured in seconds per vehicle (sec/veh). Table 1 summarizes the LOS criteria.

Table 1. Level of Service Criteria (HCM)

	Signalized Intersections	Unsignalized Intersections
LOS	Control Delay (sec/veh)	Control Delay (sec/veh)
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

"Volume-to-capacity" ratio (v/c) is a measure indicating the relative traffic demand to the roadway's carrying capacity. HCM defines capacity as the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway conditions. A v/c ratio of 0.50 indicates that the traffic demand is utilizing 50 percent of the roadway's capacity.

Synchro is a traffic analysis software that was developed by Trafficware Corporation. Synchro is an intersection analysis program that is based upon HCM methodology. Synchro was used to calculate the Levels of Service, v/c ratios, and the delays at the intersections in the study area. Worksheets for the capacity analysis, performed throughout this study, are compiled in the Appendix.

SimTraffic is a microscopic traffic simulation software developed by Trafficware Corporation. Microscopic traffic simulation is a stochastic process, which can analyze the interactions of individual vehicles as they pass through the roadway network. SimTraffic was used to analyze the vehicle queuing and overall traffic operations.

2. Trip Generation Methodology

The trip generation methodology is based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in Trip Generation.

Site-specific trip generation rates were developed from the existing PVT Integrated Solid Waste Management Facility in Nanakuli, Hawaii. The site-specific trip generation rates were developed by correlating the total vehicle trip generation data with various activity/land use characteristics, such as the vehicle trips per hour (vph) per employee. The trip generation characteristics for the proposed project are based upon the site-specific trip rates.

II. Existing Conditions

A. Roadways

Farrington Highway is the primary arterial highway on the Leeward coast of Oahu, which carries about 48,000 vehicles per day, total for both directions. Farrington Highway is a two-way, four-lane highway, which is oriented in the north-south directions. An exclusive left-turn lane is not provided on southbound Farrington Highway at Lualualei Naval Road. The posted speed on Farrington Highway is 35 miles per hour (mph) in the vicinity of the project.

Lualualei Naval Road is a two-lane, two-way roadway, which provides access to the U. S. Navy Radio Transmitter Facility in Lualualei. Lualualei Naval Road is signalized at its Tee-intersection with Farrington Highway. The Lualualei Naval Road approach at Farrington Highway operates with separate left-turn and right-turn lanes. The posted speed on Lualualei Naval Road varies between 25 mph and 45 mph.

The PVT Integrated Solid Waste Management Facility access driveway is stop-controlled at it Tee-intersection with Lualualei Naval Road.

B. Existing Traffic Volumes and Operating Conditions

1. Field Investigation and Data Collection

Turning movement count surveys were conducted at the intersections of Farrington Highway at Lualualei Naval Road and Lualualei Naval Road at the PVT Facility driveway, on August 26, 2014, during the peak periods of traffic – from 6:00 AM to 8:00 AM, from 11:00 AM to 1:00 PM, and from 3:00 PM to 5:00 PM. A vehicle type classification survey also was conducted at the existing PVT driveway from 6:00 AM to 6:00 PM on August 26, 2014. The traffic data are presented in the Appendix.

2. Existing AM Peak Hour Traffic

The AM peak hour of traffic on Farrington Highway occurred from 6:15 AM to 7:15 AM. Farrington Highway carried about 2,800 vehicles per hour (vph), total for both directions. The AM peak direction of traffic on Farrington Highway was southbound (67 percent). Lualualei Naval Road carried a total of about 300 vph at Farrington Highway, during the existing AM peak hour of traffic. At the project site, the traffic volume on Lualualei Naval Road decreased to about 130 vph.

The intersection of Farrington Highway and Lualualei Naval Road operated at an overall Level of Service "D", during the existing AM peak hour of traffic. Southbound Farrington Highway at Lualualei Naval Road and the left-turn movement from Lualualei Naval Road onto Farrington Highway operated at LOS "E".

The PVT access driveway operated at LOS "A". The PVT Facility generated a total of 56 vph, which included six (6) trucks, during the existing AM peak hour of traffic. Figure 3 depicts the existing AM peak hour traffic volumes.

3. Existing PM Peak Hour Traffic

The PM peak hour of traffic occurred between 3:15 PM and 4:15 PM. Farrington Highway carried over 3,000 vph, total for both directions. The PM peak direction of traffic on Farrington Highway was northbound (57 percent). Lualualei Naval Road carried over 400 vph, during the existing PM peak hour of traffic. At the project site, the traffic volume on Lualualei Naval Road decreased to about 130 vph.

During the existing PM peak hour of traffic, the intersection of Farrington Highway and Lualualei Naval Road operated at an overall LOS "C". The makai bound approach of Lualualei Naval Road operated at LOS "F" at Farrington Highway.

The PVT access driveway operated at LOS "A". The PVT Facility generated a total of 60 vph, which included four (4) trucks, during the existing PM peak hour of traffic. The existing PM peak hour traffic volumes are depicted on Figure 4.

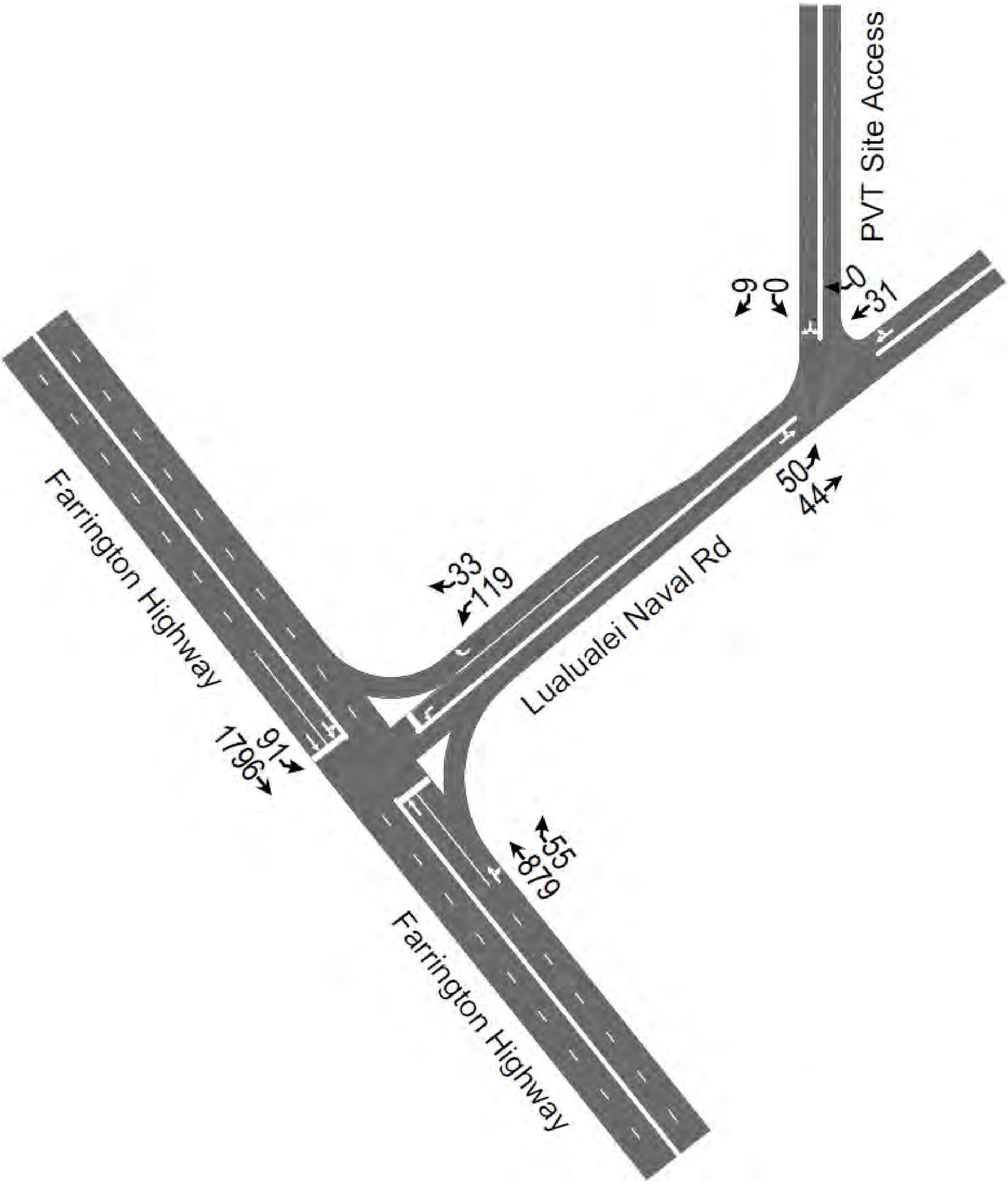

Figure 3. Existing AM Peak Hour Traffic

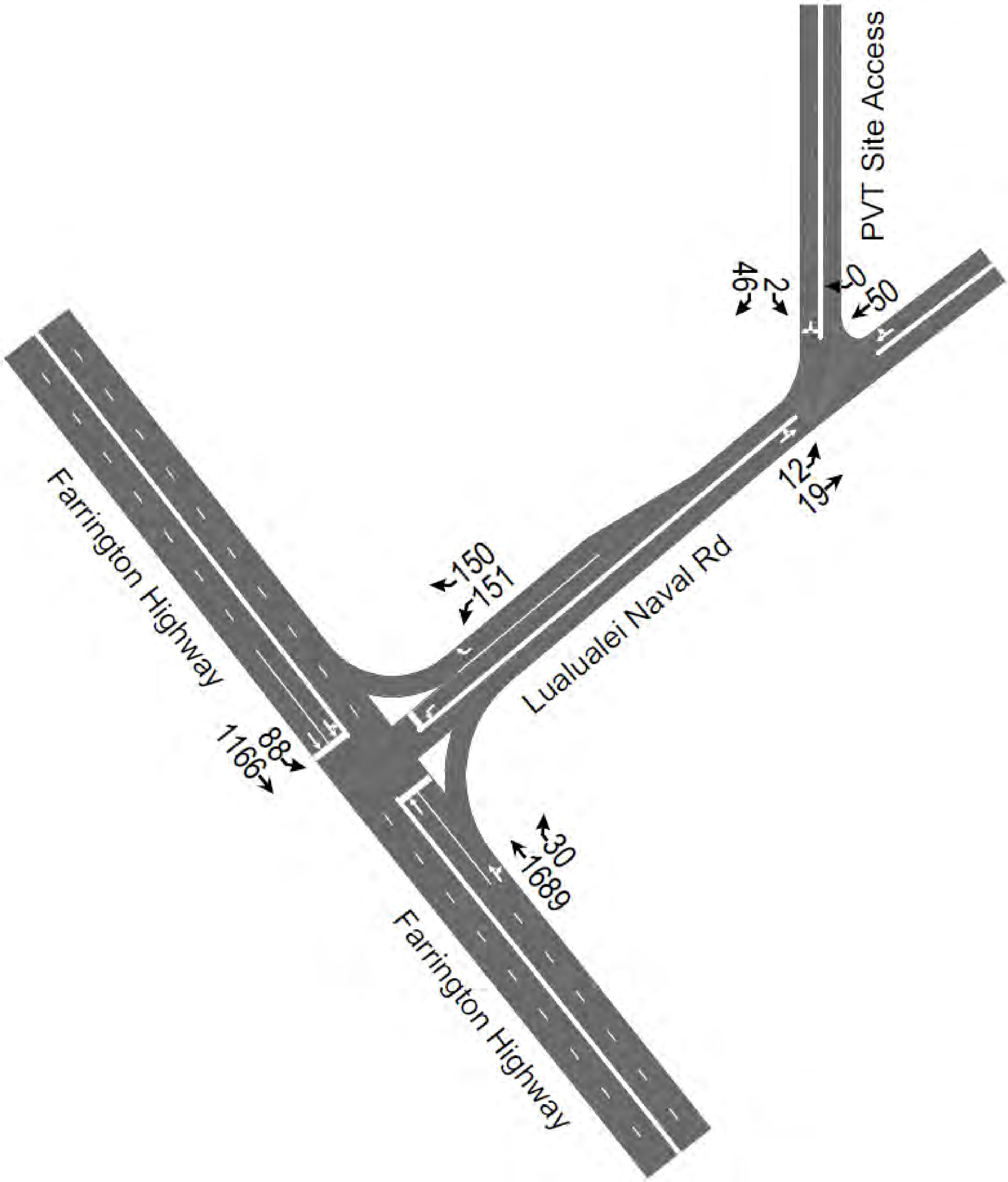

Figure 4. Existing PM Peak Hour Traffic

C. Existing Trip Generation

The existing peak hour trip generation characteristics for the PVT Integrated Solid Waste Management Facility are based upon its 75 employees, which were reported by PVT Land Company on the day of the field investigation. Table 2 summarizes the existing trip generation at the PVT Integrated Solid Waste Management Facility. The ITE rates for light and heavy industrial uses are included for comparison purposes.

Table 2. Trip Generation Rates

Peak Hour	Trips/Trip Rates	Enter	Exit	Total
AM	**Vehicle Trips**	50	6	56
	Observed Trips/Employee	0.67	0.08	0.75
	ITE Light Industrial (110)	0.37	0.07	0.44
	ITE Heavy Industrial (120)	N/A	N/A	0.51
PM	**Vehicle Trips**	12	48	60
	Observed Trips/Employee	0.16	0.64	0.80
	ITE Light Industrial (110)	0.09	0.33	0.42
	ITE Heavy Industrial (120)	N/A	N/A	0.88

III. Future Traffic Conditions

A. Oahu Transportation Regional Plan

The Oahu Regional Transportation Plan 2035 (ORTP), was prepared for the Oahu Metropolitan Planning Organization (OMPO). The Year 2035 socio-economic forecasts estimated about a 0.6 percent annual increase in population, a 0.2 percent annual increase in employment, and a 0.9 percent increase in the number of households on the Waianae coast. Based upon the ORTP socio-economic forecast, an annual growth in traffic of 1.0 percent was uniformly applied to the existing peak hour traffic to estimate the Year 2024 peak hour traffic demands without the proposed action at the PVT Facility.

The ORTP long-range (Year 2021-2035) project list includes the widening of Farrington Highway from four lanes to six lanes from Hakimo Road, north of Lualualei Naval Road, to Kalaeloa Boulevard in Kapolei. The ORTP project was assumed to be beyond the time frame of the proposed action at the PVT Facility, and was not taken into account for this traffic impact analysis.

B. Site Traffic Without Proposed Action

Without the proposed action at the PVT Facility, the number of employees at the facility are expected to remain the same as the existing condition. The increase in truck traffic volumes, without the proposed action, are not expected to significantly affect the AM and PM peak hour traffic, since less than 2 percent of the daily truck traffic arrive or depart during the peak hours of traffic.

C. Year 2024 AM Peak Hour Traffic Analysis Without Proposed Action

During the AM peak hour of traffic without the proposed action at the PVT Facility, the intersection of Farrington Highway and Lualualei Naval Road is expected to operate at an overall LOS "F". The southbound approach of Farrington Highway at Lualualei Naval Road and the left-turn movement from Lualualei Naval Road onto Farrington Highway are expected to operate at LOS "F". Figure 5 depicts the AM peak hour traffic without the proposed action at the PVT Facility.

D. Year 2024 PM Peak Hour Traffic Analysis Without Proposed Action

The intersection of Farrington Highway and Lualualei Naval Road is expected to operate at LOS "D", during the PM peak hour of traffic without the proposed action at the PVT Facility. The makai bound approach of Lualualei Naval Road is expected to operate at LOS "F" at Farrington Highway. Southbound Farrington Highway is expected to operate at LOS "E". The PM peak hour traffic without the proposed action at the PVT Facility is depicted on Figure 6.

IV. Traffic Impact Analysis

A. Site-Generated Traffic

The increase in site traffic is based upon the additional 27 employees, resulting from the proposed action at the PVT site. An additional 100 trucks per day for a total of about 320 also are expected to be generated by the recycling and renewable energy operations. However, over 98 percent of the truck traffic are expected to occur outside the peak hours of traffic, based upon current conditions. Table 3 summarizes the PVT trip generation characteristics with the proposed action.

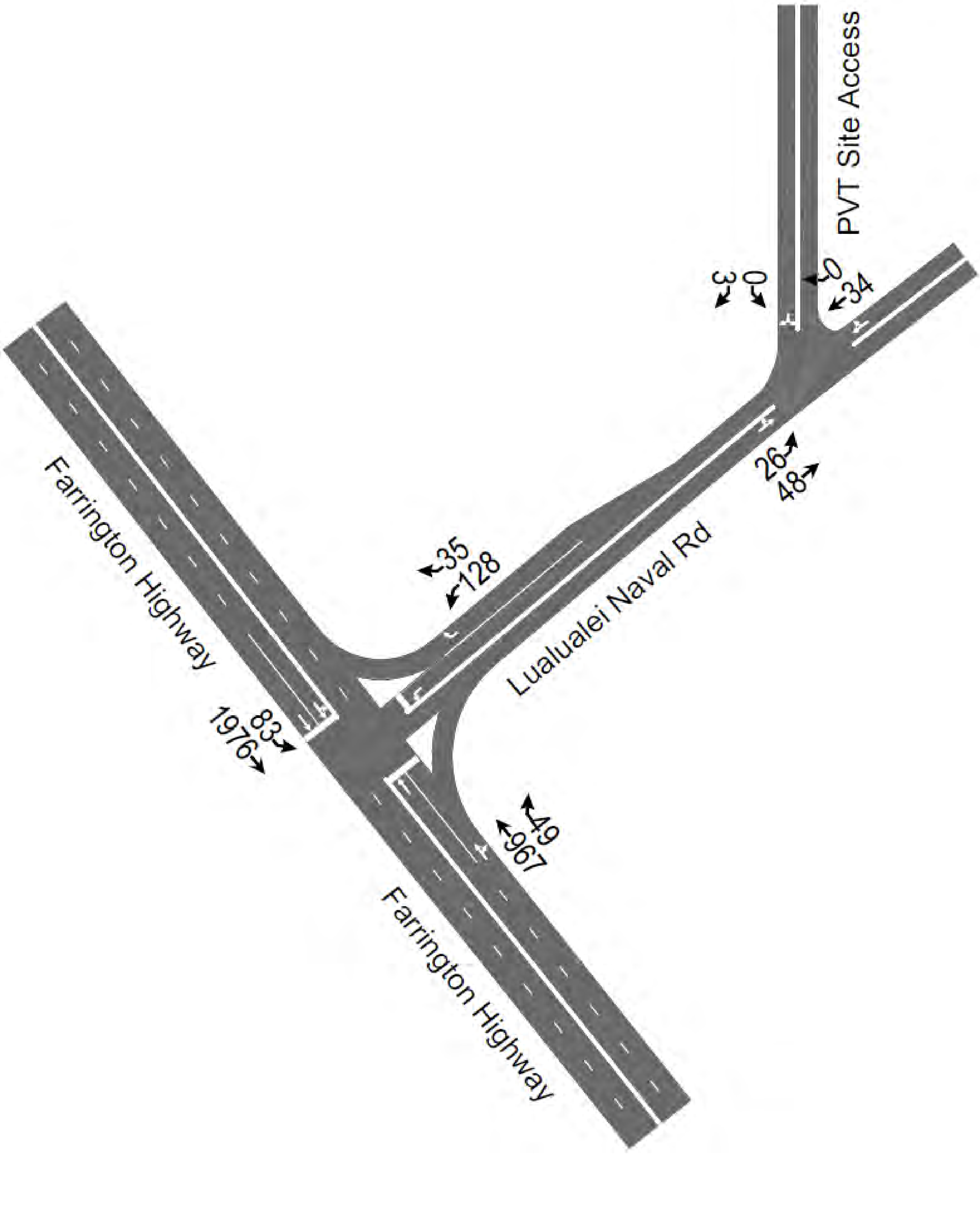

Figure 5. AM Peak Hour Traffic Without Proposed Action

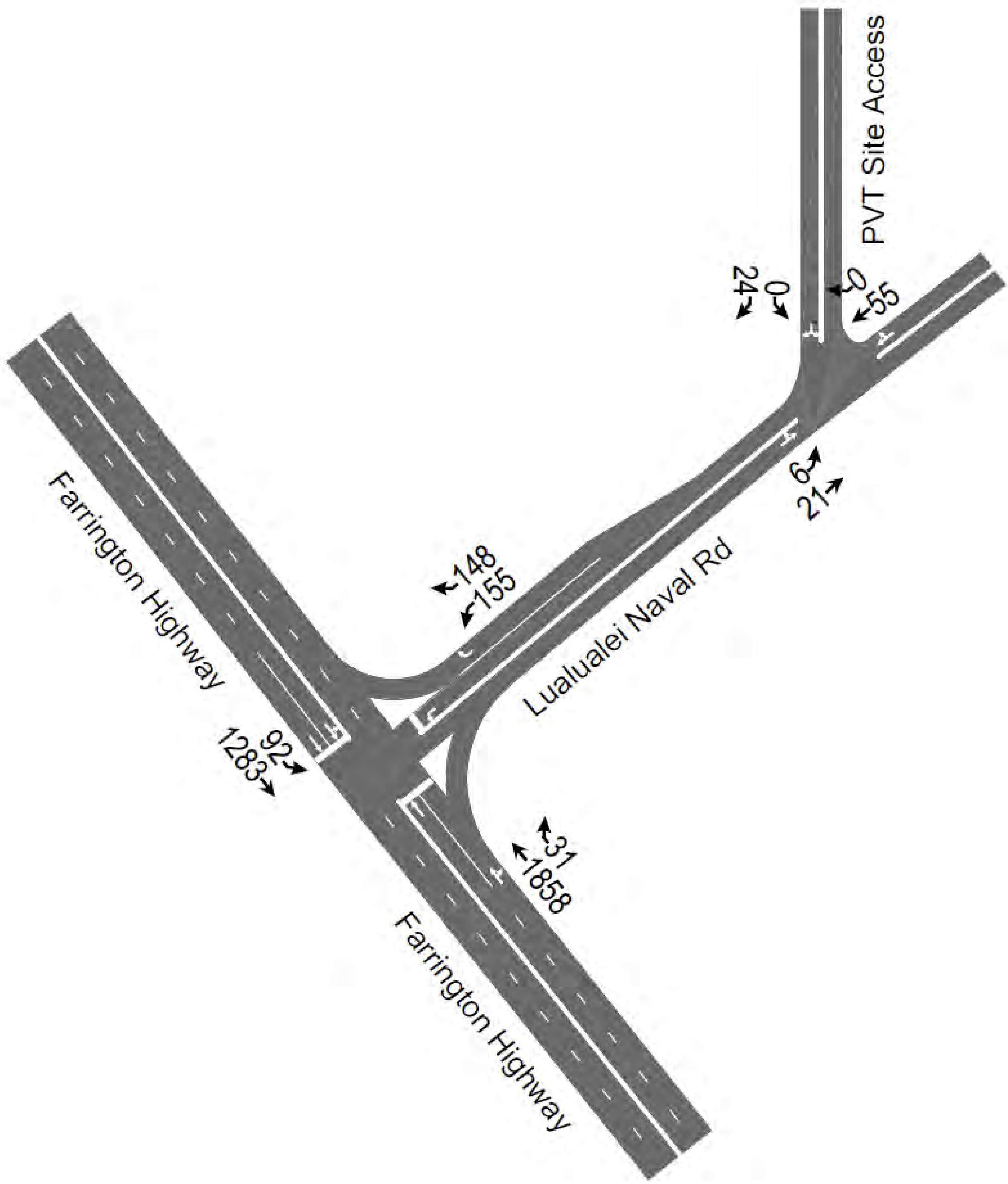

Figure 6. PM Peak Hour Traffic Without Proposed Action

Table 3. PVT Trip Generation Characteristics With Proposed Action				
Peak Hour	**Trips/Trip Rates**	**Enter**	**Exit**	**Total**
AM	**Observed Trips/Employee**	0.67	0.08	0.75
	Vehicle Trips With Project	68	8	76
	Existing Vehicle Trips	50	6	56
	Increase in Trips W/Project	18	2	20
PM	**Observed Trips/Employee**	0.16	0.64	0.80
	Vehicle Trips With Project	16	65	81
	Existing Vehicle Trips	12	48	60
	Increase in Trips W/Project	4	17	21

The traffic assignment is based upon the existing PVT employee distribution, as reported by PVT Land Company, i.e., 60 percent of the employees reside north of Lualualei Naval Road and 40 percent reside south of Lualualei Naval Road.

B. AM Peak Hour Traffic Impact Analysis With Proposed Action

The intersection of Farrington Highway and Lualualei Naval Road is expected to continue to operate at an overall LOS "F", during the AM peak hour of traffic with the proposed action at the PVT Facility. Southbound Farrington Highway and the left-turn movement from Lualualei Naval Road are expected to operate at LOS "F". Figure 7 depicts the AM peak hour traffic with the proposed action at the PVT Facility.

C. PM Peak Hour Traffic Impact Analysis With Proposed Action

During the PM peak hour of traffic with the proposed action at the PVT Facility, the intersection of Farrington Highway and Lualualei Naval Road is expected to continue to operate at LOS "D". The makai bound approach of Lualualei Naval Road is expected to operate at LOS "F" at Farrington Highway. Southbound Farrington Highway is expected to operate at LOS "E". The left lane on southbound Farrington Highway is expected to operate as default (exclusive) left-turn lane, i.e., the left-turn demand and the delays resulting from the northbound (opposing) traffic on Farrington Highway, southbound Farrington Highway is expected to operate with one through lane and one left-turn lane. The PM peak hour traffic with the proposed action at the PVT Facility is depicted on Figure 8.

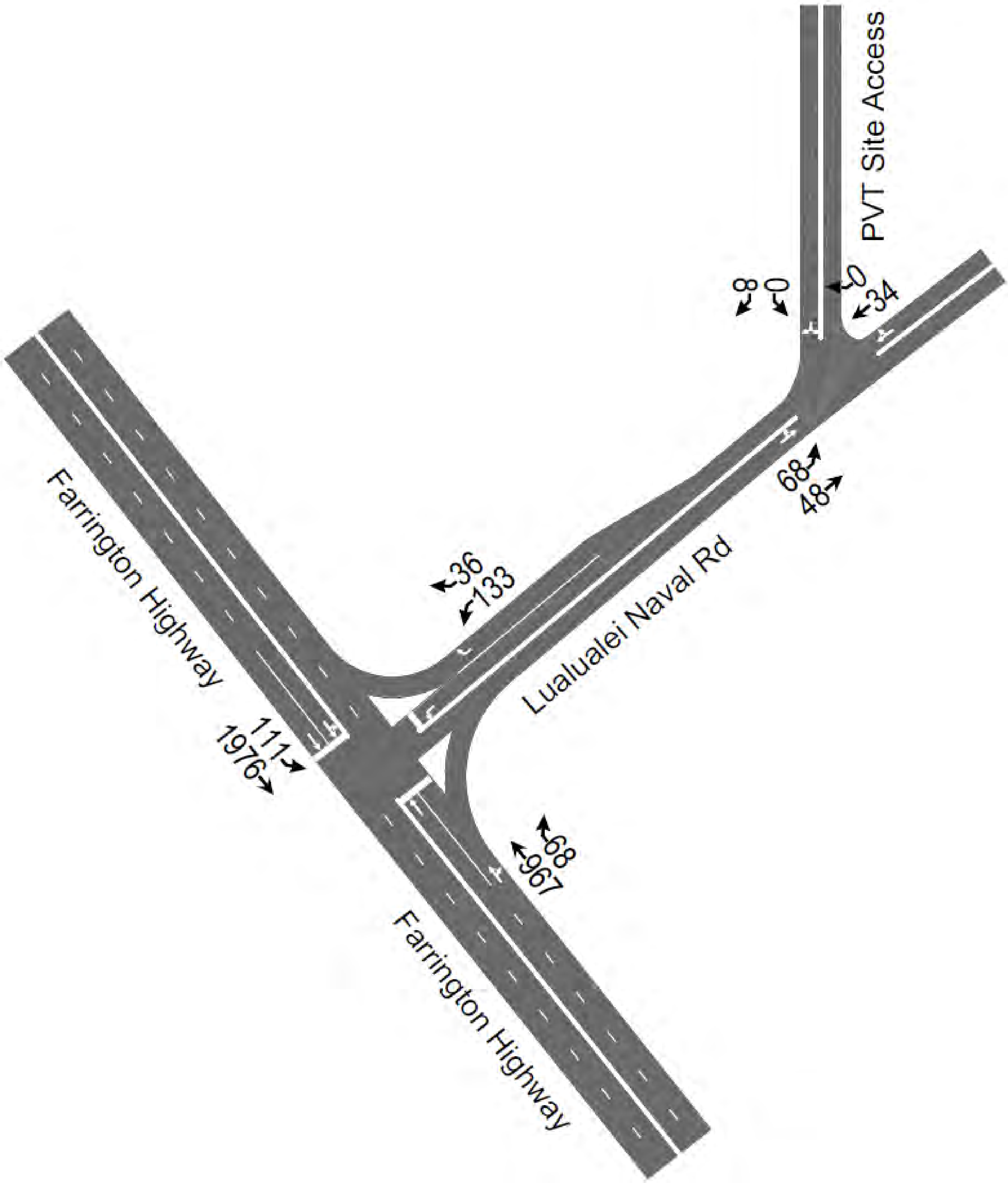

Figure 7. AM Peak Hour Traffic With Proposed Action

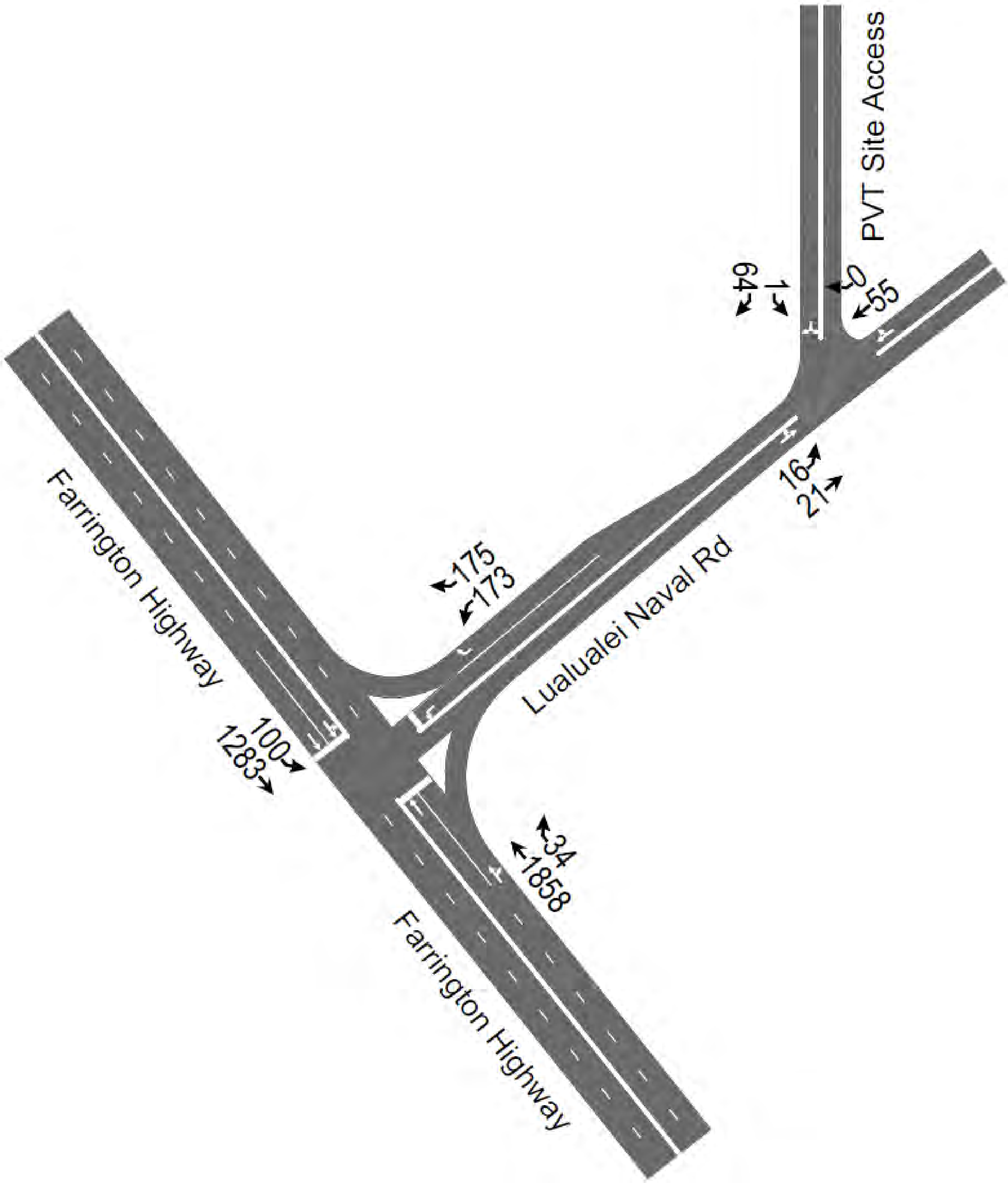

Figure 8. PM Peak Hour Traffic With Proposed Action

V. Recommendations and Conclusions

A. Recommendations

The following traffic improvements are recommended at the intersection of Farrington Highway and Lualualei Naval Road to mitigate the existing traffic congestion:

1. Widen southbound Farrington Highway at Lualualei Naval Road to provide an exclusive left-turn storage lane (200-foot storage length).

2. Modify traffic signal timing, as necessary.

These recommendations are expected to improve peak hour traffic operations with the proposed project at the intersection of Farrington Highway and Lualualei Naval Road from LOS "F" to LOS "B", during the AM peak hour of traffic, and from LOS "D" to LOS "C", during the PM peak hour of traffic. The left-turn movement from Lualualei Naval Road onto Farrington Highway is expected to improve from LOS "F" to LOS "D", during both peak hours of traffic.

B. Conclusions

The existing traffic congestion at the intersection of Farrington Highway and Lualualei Naval Road is a result of the traffic turning left from the shared through/left-turn lane on southbound Farrington Highway into Lualualei Naval Road. The left-turn movement reduces the through capacity of southbound Farrington Highway to a single lane.

The proposed action at the PVT Integrated Solid Waste Management Facility is expected to increase the traffic at the intersection of Farrington Highway and Lualualei Naval Road by about 0.6 percent, during both the AM and PM peak hours of traffic. South of this study intersection, the relative impact of site-generated traffic on Farrington Highway is expected to decrease. The proposed action is <u>not</u> expected to significantly impact the traffic operations during the AM and PM peak hours of traffic.

The traffic improvements, recommended herein, are expected to mitigate the existing traffic impacts, resulting in LOS "D", or better, during the peak hours of traffic. Table 4 summarizes the traffic analysis for the intersection of Farrington Highway and Lualualei Naval Road in terms of the measures of effectiveness (MOE): LOS, v/c ratio, and delay (seconds/vehicle).

Table 4. Summary of Capacity Analysis

Scenario	MOE	SBL	SBT	NBT	NBR	WBL	WBR	Intersection
Existing AM Peak Hour Traffic	**LOS**	E		A		E	B	D
	v/c	1.10		0.44		0.77	0.19	1.10 (max.)
	Delay	73.1		6.8		78.7	14.2	50.3
Existing PM Peak Hour Traffic	**LOS**	C		A		F	F	C
	v/c	0.93		0.63		0.86	0.77	0.93 (max.)
	Delay	28.7		8.4		137.3	83.4	26.6
AM Peak Hour Traffic Without Proposed action	**LOS**	F		A		F	B	F
	v/c	1.31		0.49		0.81	0.19	1.31
	Delay	163.0		7.8		81.3	13.6	104.4
PM Peak Hour Traffic Without Proposed Action	**LOS**	E		B		F	F	D
	v/c	1.07		0.70		0.89	0.86	1.07
	Delay	67.6		10.4		140.1	103.0	43.7
AM Peak Hour Traffic With Proposed Action	**LOS**	F		A		F	B	F
	v/c	1.35		0.50		0.81	0.19	1.35
	Delay	180.5		7.9		81.8	13.5	115.0
PM Peak Hour Traffic With Proposed Action	**LOS**	E		B		F	F	D
	v/c	1.11dl		0.71		0.91	0.89	1.08
	Delay	71.0		10.7		142.7	109.3	46.0
AM Peak Hour Traffic W/Proposed Action W/Improvements	**LOS**	B	B	B		D	B	B
	v/c	0.50	0.84	0.66		0.75	0.18	0.84 (max.)
	Delay	10.1	14.7	16.5		52.7	10.4	17.1
PM Peak Hour Traffic W/Proposed Action W/Improvements	**LOS**	D	A	C		D	C	C
	v/c	0.78	0.55	0.92		0.72	0.67	0.92 (max.)
	Delay	46.2	7.5	25.4		52.7	30.8	21.6

Legend
MOE - Measures of Effectiveness
WBL - Westbound Left-Turn Movement
WBR - Westbound Right-turn Movement
NBT - Northbound Through Movement NBR - Northbound Right-turn Movement
SBL - Southbound Left-Turn Movement
SBT - Southbound Through Movement
LOS - Level of Service
Delay - average delay (seconds/vehicle)
v/c - Volume to Capacity ratio
dl - default exclusive left-turn lane

References

1. Highway Capacity Manual, Transportation Research Board of the National Academies, Washington D.C., December, 2010.

2. Trip Generation An ITE Informational Report, 8th Edition, Institute of Transportation Engineers, Washington, D.C., 2008.

TRAFFIC IMPACT ANALYSIS REPORT

FOR THE PROPOSED

EXPANDED RECYCLING, LANDFILL GRADING AND RENEWABLE ENERGY PROJECT

PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

APPENDIX A

TRAFFIC COUNT DATA

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Turning Movement Data

Start Time	Lualualei Naval Rd Westbound			Farrington Hwy Northbound			Farrington Hwy Southbound			
	Left-Turn	Right-Turn	App. Total	Thru	Right-Turn	App. Total	Left-Turn	Thru	App. Total	Int. Total
6:00 AM	20	8	28	128	7	135	27	491	518	681
6:15 AM	44	5	49	168	12	180	33	459	492	721
6:30 AM	31	6	37	217	11	228	16	460	476	741
6:45 AM	20	10	30	259	15	274	19	456	475	779
Hourly Total	115	29	144	772	45	817	95	1866	1961	2922
7:00 AM	24	12	36	235	17	252	23	421	444	732
7:15 AM	43	9	52	243	12	255	16	335	351	658
7:30 AM	30	9	39	265	12	277	18	380	398	714
7:45 AM	41	11	52	216	7	223	27	415	442	717
Hourly Total	138	41	179	959	48	1007	84	1551	1635	2821
*** BREAK ***	-	-	-	-	-	-	-	-	-	-
11:00 AM	40	20	60	204	23	227	22	262	284	571
11:15 AM	48	27	75	202	11	213	17	228	245	533
11:30 AM	43	25	68	217	16	233	28	229	257	558
11:45 AM	44	31	75	230	30	260	20	223	243	578
Hourly Total	175	103	278	853	80	933	87	942	1029	2240
12:00 PM	41	22	63	205	14	219	19	235	254	536
12:15 PM	53	21	74	227	19	246	25	223	248	568
12:30 PM	60	23	83	198	15	213	11	218	229	525
12:45 PM	38	25	63	242	13	255	24	232	256	574
Hourly Total	192	91	283	872	61	933	79	908	987	2203
*** BREAK ***	-	-	-	-	-	-	-	-	-	-
3:00 PM	30	33	63	447	19	466	17	234	251	780
3:15 PM	42	29	71	409	8	417	18	287	305	793
3:30 PM	41	38	79	439	8	447	29	304	333	859
3:45 PM	39	34	73	428	8	436	19	294	313	822
Hourly Total	152	134	286	1723	43	1766	83	1119	1202	3254
4:00 PM	29	49	78	413	6	419	22	281	303	800
4:15 PM	29	44	73	429	6	435	15	266	281	789
4:30 PM	41	38	79	430	7	437	27	262	289	805
4:45 PM	39	33	72	424	1	425	18	240	258	755
Hourly Total	138	164	302	1696	20	1716	82	1049	1131	3149
Grand Total	910	562	1472	6875	297	7172	510	7435	7945	16589
Approach %	61.8	38.2	-	95.9	4.1	-	6.4	93.6	-	-
Total %	5.5	3.4	8.9	41.4	1.8	43.2	3.1	44.8	47.9	-
Lights	711	544	1255	6608	126	6734	501	7135	7636	15625
% Lights	78.1	96.8	85.3	96.1	42.4	93.9	98.2	96.0	96.1	94.2
Buses	3	5	8	113	3	116	2	118	120	244
% Buses	0.3	0.9	0.5	1.6	1.0	1.6	0.4	1.6	1.5	1.5
Single-Unit Trucks	81	10	91	133	92	225	5	138	143	459
% Single-Unit Trucks	8.9	1.8	6.2	1.9	31.0	3.1	1.0	1.9	1.8	2.8
Articulated Trucks	115	3	118	21	76	97	2	44	46	261
% Articulated Trucks	12.6	0.5	8.0	0.3	25.6	1.4	0.4	0.6	0.6	1.6

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Farrington Hwy [N]

Exit	Enter	Total
7152	7636	14788
118	120	238
143	143	286
24	46	70
7437	**7945**	**15382**

7135	501
118	2
138	5
44	2
7435	**510**
Th	LT

Fake Approach [W]

Exit	Enter	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

08/26/2014 6:00 AM
Ending At
08/26/2014 5:00 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

RT	LT
544	711
5	3
10	81
3	115
562	**910**

Lualualei Naval Rd [E]

Exit	Enter	Total
627	1255	1882
5	8	13
97	91	188
78	118	196
807	**1472**	**2279**

Th	RT
6608	126
113	3
133	92
21	76
6875	**297**

7846	6734	14580
121	116	237
219	225	444
159	97	256
8345	**7172**	**15517**
Exit	Enter	Total

Farrington Hwy [S]

Turning Movement Data Plot

The Traffic Management Consultant
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Turning Movement Peak Hour Data (6:15 AM)

Start Time	Lualualei Naval Rd Westbound			Farrington Hwy Northbound			Farrington Hwy Southbound			
	Left-Turn	Right-Turn	App. Total	Thru	Right-Turn	App. Total	Left-Turn	Thru	App. Total	Int. Total
6:15 AM	44	5	49	168	12	180	33	459	492	721
6:30 AM	31	6	37	217	11	228	16	460	476	741
6:45 AM	20	10	30	259	15	274	19	456	475	779
7:00 AM	24	12	36	235	17	252	23	421	444	732
Total	119	33	152	879	55	934	91	1796	1887	2973
Approach %	78.3	21.7	-	94.1	5.9	-	4.8	95.2	-	-
Total %	4.0	1.1	5.1	29.6	1.8	31.4	3.1	60.4	63.5	-
PHF	0.676	0.688	0.776	0.848	0.809	0.852	0.689	0.976	0.959	0.954
Lights	93	28	121	824	39	863	91	1755	1846	2830
% Lights	78.2	84.8	79.6	93.7	70.9	92.4	100.0	97.7	97.8	95.2
Buses	0	3	3	29	2	31	0	18	18	52
% Buses	0.0	9.1	2.0	3.3	3.6	3.3	0.0	1.0	1.0	1.7
Single-Unit Trucks	5	2	7	26	14	40	0	13	13	60
% Single-Unit Trucks	4.2	6.1	4.6	3.0	25.5	4.3	0.0	0.7	0.7	2.0
Articulated Trucks	21	0	21	0	0	0	0	10	10	31
% Articulated Trucks	17.6	0.0	13.8	0.0	0.0	0.0	0.0	0.6	0.5	1.0

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Peak Hour Data

08/26/2014 6:15 AM
Ending At
08/26/2014 7:15 AM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

Farrington Hwy [N]

Exit	Enter	Total
852	1846	2698
32	18	50
28	13	41
0	10	10
912	**1887**	**2799**

1755	91
18	0
13	0
10	0
1796	**91**
Th	LT

Fake Approach [W]

Exit	Enter	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Lualualei Naval Rd [E]

Exit	Enter	Total
130	121	251
2	3	5
14	7	21
0	21	21
146	**152**	**298**

RT	LT
28	93
3	0
2	5
0	21
33	**119**

Th	RT
824	39
29	2
26	14
0	0
879	**55**

1848	863	2711
18	31	49
18	40	58
31	0	31
1915	**934**	**2849**
Exit	Enter	Total

Farrington Hwy [S]

Turning Movement Peak Hour Data Plot (6:15 AM)

The Traffic Management Consultant
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Turning Movement Peak Hour Data (11:30 AM)

Start Time	Lualualei Naval Rd Westbound			Farrington Hwy Northbound			Farrington Hwy Southbound			
	Left-Turn	Right-Turn	App. Total	Thru	Right-Turn	App. Total	Left-Turn	Thru	App. Total	Int. Total
11:30 AM	43	25	68	217	16	233	28	229	257	558
11:45 AM	44	31	75	230	30	260	20	223	243	578
12:00 PM	41	22	63	205	14	219	19	235	254	536
12:15 PM	53	21	74	227	19	246	25	223	248	568
Total	181	99	280	879	79	958	92	910	1002	2240
Approach %	64.6	35.4	-	91.8	8.2	-	9.2	90.8	-	-
Total %	8.1	4.4	12.5	39.2	3.5	42.8	4.1	40.6	44.7	-
PHF	0.854	0.798	0.933	0.955	0.658	0.921	0.821	0.968	0.975	0.969
Lights	117	97	214	828	25	853	89	849	938	2005
% Lights	64.6	98.0	76.4	94.2	31.6	89.0	96.7	93.3	93.6	89.5
Buses	0	0	0	15	0	15	0	14	14	29
% Buses	0.0	0.0	0.0	1.7	0.0	1.6	0.0	1.5	1.4	1.3
Single-Unit Trucks	28	2	30	30	20	50	2	38	40	120
% Single-Unit Trucks	15.5	2.0	10.7	3.4	25.3	5.2	2.2	4.2	4.0	5.4
Articulated Trucks	36	0	36	6	34	40	1	9	10	86
% Articulated Trucks	19.9	0.0	12.9	0.7	43.0	4.2	1.1	1.0	1.0	3.8

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Peak Hour Data

08/26/2014 11:30 AM
Ending At
08/26/2014 12:30 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

Farrington Hwy [N]

Exit	Enter	Total
925	938	1863
15	14	29
32	40	72
6	10	16
978	**1002**	**1980**

849	89
14	0
38	2
9	1
910	**92**
Th	LT

Fake Approach [W]

Exit	Enter	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Lualualei Naval Rd [E]

Exit	Enter	Total
114	214	328
0	0	0
22	30	52
35	36	71
171	**280**	**451**

97	117
0	0
2	28
0	36
99	**181**
RT	LT

Th	RT
828	25
15	0
30	20
6	34
879	**79**

966	853	1819
14	15	29
66	50	116
45	40	85
1091	**958**	**2049**
Exit	Enter	Total

Farrington Hwy [S]

Turning Movement Peak Hour Data Plot (11:30 AM)

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Turning Movement Peak Hour Data (3:15 PM)

Start Time	Lualualei Naval Rd Westbound			Farrington Hwy Northbound			Farrington Hwy Southbound			
	Left-Turn	Right-Turn	App. Total	Thru	Right-Turn	App. Total	Left-Turn	Thru	App. Total	Int. Total
3:15 PM	42	29	71	409	8	417	18	287	305	793
3:30 PM	41	38	79	439	8	447	29	304	333	859
3:45 PM	39	34	73	428	8	436	19	294	313	822
4:00 PM	29	49	78	413	6	419	22	281	303	800
Total	151	150	301	1689	30	1719	88	1166	1254	3274
Approach %	50.2	49.8	-	98.3	1.7	-	7.0	93.0	-	-
Total %	4.6	4.6	9.2	51.6	0.9	52.5	2.7	35.6	38.3	-
PHF	0.899	0.765	0.953	0.962	0.938	0.961	0.759	0.959	0.941	0.953
Lights	136	149	285	1659	15	1674	88	1119	1207	3166
% Lights	90.1	99.3	94.7	98.2	50.0	97.4	100.0	96.0	96.3	96.7
Buses	0	0	0	15	0	15	0	34	34	49
% Buses	0.0	0.0	0.0	0.9	0.0	0.9	0.0	2.9	2.7	1.5
Single-Unit Trucks	6	0	6	13	6	19	0	13	13	38
% Single-Unit Trucks	4.0	0.0	2.0	0.8	20.0	1.1	0.0	1.1	1.0	1.2
Articulated Trucks	9	1	10	2	9	11	0	0	0	21
% Articulated Trucks	6.0	0.7	3.3	0.1	30.0	0.6	0.0	0.0	0.0	0.6

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Count Name: Farrington Hwy Lualualei Naval Rd
Site Code: Nanakuli
Start Date: 08/26/2014
Page No: 8

Farrington Hwy [N]

Exit	Enter	Total
1808	1207	3015
15	34	49
13	13	26
3	0	3
1839	**1254**	**3093**

Th	LT
1119	88
34	0
13	0
0	0
1166	**88**

Fake Approach [W]

Total	Enter	Exit
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Peak Hour Data

08/26/2014 3:15 PM
Ending At
08/26/2014 4:15 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

RT	LT
149	136
0	0
0	6
1	9
150	**151**

Lualualei Naval Rd [E]

Exit	Enter	Total
103	285	388
0	0	0
6	6	12
9	10	19
118	**301**	**419**

Th	RT
1659	15
15	0
13	6
2	9
1689	**30**

Exit	Enter	Total
1255	1674	2929
34	15	49
19	19	38
9	11	20
1317	**1719**	**3036**

Farrington Hwy [S]

Turning Movement Peak Hour Data Plot (3:15 PM)

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Count Name: PVT Landfill
Lualualei Naval Rd
Site Code: Nanakuli
Start Date: 08/26/2014

Turning Movement Data

Start Time	Lualualei Naval Rd Eastbound			Lualualei Naval Rd Westbound				PVT Landfill Southbound			
	Left-Turn	Thru	App. Total	Left	Thru	Right-Turn	App. Total	Left-Turn	Right-Turn	App. Total	Int. Total
6:00 AM	7	14	21	0	5	0	5	0	3	3	29
6:15 AM	8	20	28	0	11	0	11	0	1	1	40
6:30 AM	18	12	30	0	10	0	10	0	1	1	41
6:45 AM	11	7	18	0	5	0	5	0	0	0	23
Hourly Total	44	53	97	0	31	0	31	0	5	5	133
7:00 AM	13	5	18	0	5	0	5	0	4	4	27
7:15 AM	6	7	13	0	4	0	4	0	5	5	22
7:30 AM	5	9	14	0	2	0	2	0	6	6	22
7:45 AM	2	2	4	0	3	0	3	0	1	1	8
Hourly Total	26	23	49	0	14	0	14	0	16	16	79
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-
11:00 AM	10	14	24	0	10	0	10	0	9	9	43
11:15 AM	8	8	16	0	11	0	11	1	8	9	36
11:30 AM	10	10	20	0	12	0	12	3	18	21	53
11:45 AM	14	19	33	0	10	0	10	1	10	11	54
Hourly Total	42	51	93	0	43	0	43	5	45	50	186
12:00 PM	10	5	15	0	10	1	11	1	10	11	37
12:15 PM	11	8	19	0	15	0	15	0	8	8	42
12:30 PM	9	2	11	0	10	0	10	1	11	12	33
12:45 PM	3	9	12	0	4	0	4	0	11	11	27
Hourly Total	33	24	57	0	39	1	40	2	40	42	139
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	2	10	12	0	6	0	6	0	4	4	22
3:15 PM	1	7	8	0	9	0	9	1	2	3	20
3:30 PM	3	7	10	0	25	0	25	0	4	4	39
3:45 PM	7	2	9	0	12	0	12	1	15	16	37
Hourly Total	13	26	39	0	52	0	52	2	25	27	118
4:00 PM	0	3	3	0	4	0	4	0	25	25	32
4:15 PM	1	3	4	0	5	0	5	0	3	3	12
4:30 PM	3	8	11	1	7	0	8	0	5	5	24
4:45 PM	0	2	2	0	7	0	7	0	3	3	12
Hourly Total	4	16	20	1	23	0	24	0	36	36	80
Grand Total	162	193	355	1	202	1	204	9	167	176	735
Approach %	45.6	54.4	-	0.5	99.0	0.5	-	5.1	94.9	-	-
Total %	22.0	26.3	48.3	0.1	27.5	0.1	27.8	1.2	22.7	23.9	-
Lights	82	96	178	1	94	0	95	3	85	88	361
% Lights	50.6	49.7	50.1	100.0	46.5	0.0	46.6	33.3	50.9	50.0	49.1
Buses	3	0	3	0	0	0	0	0	0	0	3
% Buses	1.9	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Single-Unit Trucks	45	23	68	0	29	1	30	5	50	55	153
% Single-Unit Trucks	27.8	11.9	19.2	0.0	14.4	100.0	14.7	55.6	29.9	31.3	20.8
Articulated Trucks	32	74	106	0	79	0	79	1	32	33	218
% Articulated Trucks	19.8	38.3	29.9	0.0	39.1	0.0	38.7	11.1	19.2	18.8	29.7

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PVT Landfill [N]

Exit	Enter	Total
82	88	170
3	0	3
46	55	101
32	33	65
163	**176**	**339**

85	3
0	0
50	5
32	1
167	**9**
RT	LT

Lualualei Naval Rd [W]

Exit	Enter	Total
179	178	357
0	3	3
79	68	147
111	106	217
369	**355**	**724**

82	96
3	0
45	23
32	74
162	**193**
LT	Th

08/26/2014 6:00 AM
Ending At
08/26/2014 5:00 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

Lualualei Naval Rd [E]

Exit	Enter	Total
99	95	194
0	0	0
28	30	58
75	79	154
202	**204**	**406**

0	94	1
0	0	0
1	29	0
0	79	0
1	**202**	**1**
RT	Th	LT

1	0	1
0	0	0
0	0	0
0	0	0
1	**0**	**1**
Exit	Enter	Total

Fake Approach [S]

Turning Movement Data Plot

The Traffic Management Consultant
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Turning Movement Peak Hour Data (6:15 AM)

Start Time	Lualualei Naval Rd Eastbound			Lualualei Naval Rd Westbound				PVT Landfill Southbound			
	Left-Turn	Thru	App. Total	Left	Thru	Right-Turn	App. Total	Left-Turn	Right-Turn	App. Total	Int. Total
6:15 AM	8	20	28	0	11	0	11	0	1	1	40
6:30 AM	18	12	30	0	10	0	10	0	1	1	41
6:45 AM	11	7	18	0	5	0	5	0	0	0	23
7:00 AM	13	5	18	0	5	0	5	0	4	4	27
Total	50	44	94	0	31	0	31	0	6	6	131
Approach %	53.2	46.8	-	0.0	100.0	0.0	-	0.0	100.0	-	-
Total %	38.2	33.6	71.8	0.0	23.7	0.0	23.7	0.0	4.6	4.6	-
PHF	0.694	0.550	0.783	0.000	0.705	0.000	0.705	0.000	0.375	0.375	0.799
Lights	40	39	79	0	9	0	9	0	4	4	92
% Lights	80.0	88.6	84.0	-	29.0	-	29.0	-	66.7	66.7	70.2
Buses	2	0	2	0	0	0	0	0	0	0	2
% Buses	4.0	0.0	2.1	-	0.0	-	0.0	-	0.0	0.0	1.5
Single-Unit Trucks	7	2	9	0	2	0	2	0	1	1	12
% Single-Unit Trucks	14.0	4.5	9.6	-	6.5	-	6.5	-	16.7	16.7	9.2
Articulated Trucks	1	3	4	0	20	0	20	0	1	1	25
% Articulated Trucks	2.0	6.8	4.3	-	64.5	-	64.5	-	16.7	16.7	19.1

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Count Name: PVT Landfill
Lualualei Naval Rd
Site Code: Nanakuli
Start Date: 08/26/2014

PVT Landfill [N]

Exit	Enter	Total
40	4	44
2	0	2
7	1	8
1	1	2
50	**6**	**56**

RT	LT
4	0
0	0
1	0
1	0
6	**0**

Lualualei Naval Rd [W]

Exit	Enter	Total
13	79	92
0	2	2
3	9	12
21	4	25
37	**94**	**131**

LT	Th
40	39
2	0
7	2
1	3
50	**44**

Peak Hour Data

08/26/2014 6:15 AM
Ending At
08/26/2014 7:15 AM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

RT	Th	LT
0	9	0
0	0	0
0	2	0
0	20	0
0	**31**	**0**

Lualualei Naval Rd [E]

Exit	Enter	Total
39	9	48
0	0	0
2	2	4
3	20	23
44	**31**	**75**

Exit	Enter	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Fake Approach [S]

Turning Movement Peak Hour Data Plot (6:15 AM)

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Turning Movement Peak Hour Data (11:30 AM)

Start Time	Lualualei Naval Rd Eastbound			Lualualei Naval Rd Westbound				PVT Landfill Southbound			
	Left-Turn	Thru	App. Total	Left	Thru	Right-Turn	App. Total	Left-Turn	Right-Turn	App. Total	Int. Total
11:30 AM	10	10	20	0	12	0	12	3	18	21	53
11:45 AM	14	19	33	0	10	0	10	1	10	11	54
12:00 PM	10	5	15	0	10	1	11	1	10	11	37
12:15 PM	11	8	19	0	15	0	15	0	8	8	42
Total	45	42	87	0	47	1	48	5	46	51	186
Approach %	51.7	48.3	-	0.0	97.9	2.1	-	9.8	90.2	-	-
Total %	24.2	22.6	46.8	0.0	25.3	0.5	25.8	2.7	24.7	27.4	-
PHF	0.804	0.553	0.659	0.000	0.783	0.250	0.800	0.417	0.639	0.607	0.861
Lights	13	14	27	0	18	0	18	2	11	13	58
% Lights	28.9	33.3	31.0	-	38.3	0.0	37.5	40.0	23.9	25.5	31.2
Buses	0	0	0	0	0	0	0	0	0	0	0
% Buses	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Single-Unit Trucks	14	3	17	0	7	1	8	3	21	24	49
% Single-Unit Trucks	31.1	7.1	19.5	-	14.9	100.0	16.7	60.0	45.7	47.1	26.3
Articulated Trucks	18	25	43	0	22	0	22	0	14	14	79
% Articulated Trucks	40.0	59.5	49.4	-	46.8	0.0	45.8	0.0	30.4	27.5	42.5

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Count Name: PVT Landfill
Lualualei Naval Rd
Site Code: Nanakuli
Start Date: 08/26/2014

PVT Landfill [N]

Exit	Enter	Total
13	13	26
0	0	0
15	24	39
18	14	32
46	**51**	**97**

11	2
0	0
21	3
14	0
46	**5**
RT	LT

Lualualei Naval Rd [W]

Exit	Enter	Total
29	27	56
0	0	0
28	17	45
36	43	79
93	**87**	**180**

14	13
0	0
3	14
25	18
42	**45**
Th	LT

Peak Hour Data

08/26/2014 11:30 AM
Ending At
08/26/2014 12:30 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

0	18	0
0	0	0
1	7	0
0	22	0
1	**47**	**0**
RT	Th	LT

Lualualei Naval Rd [E]

Exit	Enter	Total
16	18	34
0	0	0
6	8	14
25	22	47
47	**48**	**95**

0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**
Exit	Enter	Total

Fake Approach [S]

Turning Movement Peak Hour Data Plot (11:30 AM)

The Traffic Management Consultant
1188 Bishop Street, Suite 1907

Honolulu, Hawaii, United States 96813
808-536-0223 tmchawaii@aol.com

Turning Movement Peak Hour Data (3:15 PM)

Start Time	Lualualei Naval Rd Eastbound			Lualualei Naval Rd Westbound				PVT Landfill Southbound			
	Left-Turn	Thru	App. Total	Left	Thru	Right-Turn	App. Total	Left-Turn	Right-Turn	App. Total	Int. Total
3:15 PM	1	7	8	0	9	0	9	1	2	3	20
3:30 PM	3	7	10	0	25	0	25	0	4	4	39
3:45 PM	7	2	9	0	12	0	12	1	15	16	37
4:00 PM	0	3	3	0	4	0	4	0	25	25	32
Total	11	19	30	0	50	0	50	2	46	48	128
Approach %	36.7	63.3	-	0.0	100.0	0.0	-	4.2	95.8	-	-
Total %	8.6	14.8	23.4	0.0	39.1	0.0	39.1	1.6	35.9	37.5	-
PHF	0.393	0.679	0.750	0.000	0.500	0.000	0.500	0.500	0.460	0.480	0.821
Lights	11	4	15	0	36	0	36	1	44	45	96
% Lights	100.0	21.1	50.0	-	72.0	-	72.0	50.0	95.7	93.8	75.0
Buses	0	0	0	0	0	0	0	0	0	0	0
% Buses	0.0	0.0	0.0	-	0.0	-	0.0	0.0	0.0	0.0	0.0
Single-Unit Trucks	0	1	1	0	4	0	4	0	2	2	7
% Single-Unit Trucks	0.0	5.3	3.3	-	8.0	-	8.0	0.0	4.3	4.2	5.5
Articulated Trucks	0	14	14	0	10	0	10	1	0	1	25
% Articulated Trucks	0.0	73.7	46.7	-	20.0	-	20.0	50.0	0.0	2.1	19.5

Peak Hour Data

08/26/2014 3:15 PM
Ending At
08/26/2014 4:15 PM

Lights
Buses
Single-Unit Trucks
Articulated Trucks

PVT Landfill [N]

Exit	Enter	Total
11	45	56
0	0	0
0	2	2
0	1	1
11	**48**	**59**

RT	LT
44	1
0	0
2	0
0	1
46	**2**

Lualualei Naval Rd [W]

Exit	Enter	Total
80	15	95
0	0	0
6	1	7
10	14	24
96	**30**	**126**

LT	Th
11	4
0	0
0	1
0	14
11	**19**

Lualualei Naval Rd [E]

Exit	Enter	Total
5	36	41
0	0	0
1	4	5
15	10	25
21	**50**	**71**

RT	Th	LT
0	36	0
0	0	0
0	4	0
0	10	0
0	**50**	**0**

Fake Approach [S]

Exit	Enter	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Turning Movement Peak Hour Data Plot (3:15 PM)

Study Name PVT Site Access Driveway
Start Date 8/26/2014
Start Time 6:00 AM
Site Code Trip Generation

		Enter				Exit				Driveway
Start Time	End Time	Light Vehicles	Medium Trucks	Articulated Trucks	Enter Totals	Light Vehicles	Medium Trucks	Articulated Trucks	Exit Totals	15-min Totals
6:00 AM	6:15 AM	6	0	0	6	2	0	1	3	9
6:15 AM	**6:30 AM**	7	1	0	8	0	0	1	1	9
6:30 AM	**6:45 AM**	17	0	0	17	1	0	0	1	18
6:45 AM	**7:00 AM**	8	3	0	11	1	0	0	1	12
7:00 AM	**7:15 AM**	12	0	0	12	2	1	0	3	15
7:15 AM	7:30 AM	1	2	3	6	1	3	1	5	11
7:30 AM	7:45 AM	1	3	1	5	1	2	3	6	11
7:45 AM	8:00 AM	0	2	0	2	0	1	0	1	3
8:00 AM	8:15 AM	0	4	2	6	0	3	0	3	9
8:15 AM	8:30 AM	2	7	2	11	2	4	1	7	18
8:30 AM	8:45 AM	1	3	4	8	0	7	0	7	15
8:45 AM	9:00 AM	3	8	0	11	0	8	1	9	20
9:00 AM	9:15 AM	0	7	1	8	1	4	0	5	13
9:15 AM	9:30 AM	0	8	1	9	0	7	1	8	17
9:30 AM	9:45 AM	3	3	4	10	0	4	1	5	15
9:45 AM	10:00 AM	3	6	3	12	2	7	1	10	22
10:00 AM	10:15 AM	0	1	1	2	1	9	3	13	15
10:15 AM	10:30 AM	1	9	2	12	0	5	2	7	19
10:30 AM	10:45 AM	2	9	2	13	1	6	1	8	21
10:45 AM	11:00 AM	2	3	1	6	0	3	0	3	9
11:00 AM	11:15 AM	1	7	2	10	2	3	4	9	19
11:15 AM	11:30 AM	2	3	3	8	4	3	2	9	17
11:30 AM	11:45 AM	3	3	4	10	5	14	2	21	31
11:45 AM	12:00 PM	3	6	4	13	2	5	4	11	24
12:00 PM	12:15 PM	2	6	3	11	2	5	2	9	20
12:15 PM	12:30 PM	3	5	3	11	1	4	4	9	20
12:30 PM	12:45 PM	1	5	1	7	0	8	4	12	19
12:45 PM	1:00 PM	1	3	0	4	5	5	1	11	15
1:00 PM	1:15 PM	1	6	4	11	0	3	0	3	14
1:15 PM	1:30 PM	0	3	1	4	2	7	1	10	14
1:30 PM	1:45 PM	1	7	3	11	0	4	0	4	15
1:45 PM	2:00 PM	3	4	3	10	1	1	1	3	13
2:00 PM	2:15 PM	1	4	3	8	3	7	3	13	21
2:15 PM	2:30 PM	0	3	1	4	0	3	5	8	12
2:30 PM	2:45 PM	2	4	2	8	4	7	3	14	22
2:45 PM	3:00 PM	0	1	2	3	1	2	3	6	9
3:00 PM	3:15 PM	0	0	0	0	1	2	1	4	4
3:15 PM	**3:30 PM**	2	0	0	2	0	3	0	3	5
3:30 PM	**3:45 PM**	3	0	0	3	4	0	0	4	7
3:45 PM	**4:00 PM**	7	0	0	7	16	0	0	16	23
4:00 PM	**4:15 PM**	0	0	0	0	24	1	0	25	25
4:15 PM	4:30 PM	0	0	0	0	3	0	0	3	3
4:30 PM	4:45 PM	1	0	1	2	5	0	0	5	7
4:45 PM	5:00 PM	0	0	0	0	3	0	0	3	3
5:00 PM	5:15 PM	0	0	0	0	1	0	0	1	1
5:15 PM	5:30 PM	1	0	0	1	0	0	0	0	1
5:30 PM	5:45 PM	0	0	0	0	2	0	0	2	2
5:45 PM	6:00 PM	0	0	0	0	0	0	0	0	0
Totals		107	149	67	323	106	161	57	324	647
AM Peak Hour Traffic										
6:15 AM	7:15 AM	44	4	0	48	4	1	1	6	54
PM Peak Hour Traffic										
3:15 PM	4:15 PM	12	0	0	12	44	4	0	48	60

TRAFFIC IMPACT ANALYSIS REPORT

FOR THE PROPOSED

EXPANDED RECYCLING, LANDFILL GRADING AND RENEWABLE ENERGY PROJECT

PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY

APPENDIX B

CAPACITY ANALYSIS WORKSHEETS

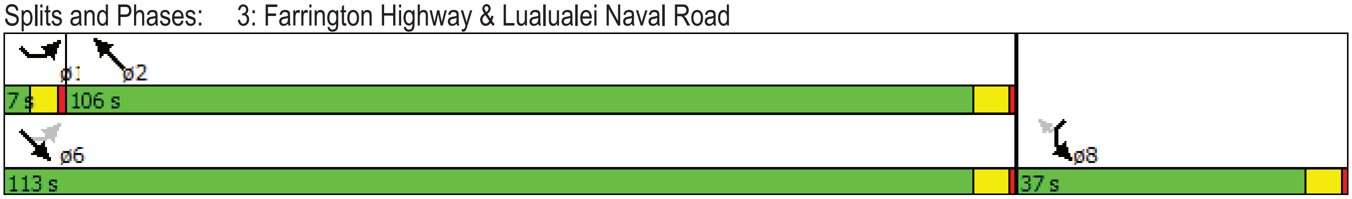
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	91	1796	879	55	119	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3415	3219	0	1430	1358
Flt Permitted		0.677			0.950	
Satd. Flow (perm)	0	2319	3219	0	1430	1358
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			10			48
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.69	0.98	0.85	0.81	0.68	0.69
Heavy Vehicles (%)	0%	2%	6%	29%	22%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1965	1102	0	175	48
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	7.0	113.0	106.0		37.0	37.0
Total Split (%)	4.7%	75.3%	70.7%		24.7%	24.7%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		108.2	108.2		22.3	22.3
Actuated g/C Ratio		0.77	0.77		0.16	0.16
v/c Ratio		1.10	0.44		0.77	0.19
Control Delay		73.1	6.8		78.7	14.2
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		73.1	6.8		78.7	14.2
LOS		E	A		E	B
Approach Delay		73.1	6.8		64.8	
Approach LOS		E	A		E	
Queue Length 50th (ft)		~1068	159		155	0

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		#1340	237		173	19
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1785	2481		326	346
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.10	0.44		0.54	0.14

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 140.5
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.10
Intersection Signal Delay: 50.3 Intersection LOS: D
Intersection Capacity Utilization 97.4% ICU Level of Service F
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	3.3

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	0	6	50	44	31	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	38	69	55	71	92
Heavy Vehicles, %	0	33	20	11	61	0
Mvmt Flow	0	16	72	80	44	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	269	44	44	0	-	0
Stage 1	44	-	-	-	-	-
Stage 2	225	-	-	-	-	-
Critical Hdwy	6.4	6.53	4.3	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.597	2.38	-	-	-
Pot Cap-1 Maneuver	725	945	1456	-	-	-
Stage 1	984	-	-	-	-	-
Stage 2	817	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	687	945	1456	-	-	-
Mov Cap-2 Maneuver	687	-	-	-	-	-
Stage 1	984	-	-	-	-	-
Stage 2	775	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	8.9	3.6	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1456	-	945	-	-
HCM Lane V/C Ratio	0.05	-	0.017	-	-
HCM Control Delay (s)	7.6	0	8.9	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	0.1	-	-

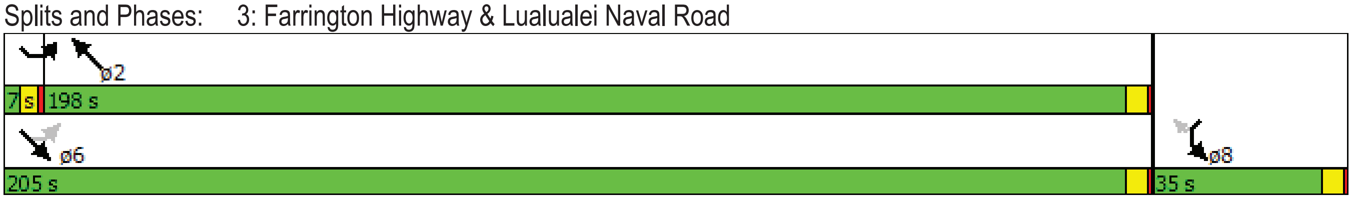
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	88	1166	1689	30	151	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3353	3383	0	1586	1546
Flt Permitted		0.510			0.950	
Satd. Flow (perm)	0	1717	3383	0	1586	1546
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			3			74
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.76	0.96	0.96	0.94	0.90	0.77
Heavy Vehicles (%)	0%	4%	2%	50%	10%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1331	1791	0	168	195
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	7.0	205.0	198.0		35.0	35.0
Total Split (%)	2.9%	85.4%	82.5%		14.6%	14.6%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		200.0	200.0		28.0	28.0
Actuated g/C Ratio		0.84	0.84		0.12	0.12
v/c Ratio		0.92	0.63		0.90	0.79
Control Delay		26.4	7.8		146.3	85.0
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		26.4	7.8		146.3	85.0
LOS		C	A		F	F
Approach Delay		26.4	7.8		113.4	
Approach LOS		C	A		F	
Queue Length 50th (ft)		736	472		266	193

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		970	510		#416	236
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1442	2843		200	259
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		0.92	0.63		0.84	0.75

Intersection Summary

Area Type: Other
Cycle Length: 240
Actuated Cycle Length: 238
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 25.9 Intersection LOS: C
Intersection Capacity Utilization 103.3% ICU Level of Service G
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	4.5

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	2	46	11	19	50	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	46	39	68	50	92
Heavy Vehicles, %	50	4	0	79	28	0
Mvmt Flow	4	100	28	28	100	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	184	100	100	0	-	0
Stage 1	100	-	-	-	-	-
Stage 2	84	-	-	-	-	-
Critical Hdwy	6.9	6.24	4.1	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.336	2.2	-	-	-
Pot Cap-1 Maneuver	707	950	1505	-	-	-
Stage 1	817	-	-	-	-	-
Stage 2	831	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	694	950	1505	-	-	-
Mov Cap-2 Maneuver	694	-	-	-	-	-
Stage 1	817	-	-	-	-	-
Stage 2	815	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	9.3	3.7	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1505	-	937	-	-
HCM Lane V/C Ratio	0.019	-	0.111	-	-
HCM Control Delay (s)	7.4	0	9.3	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.4	-	-

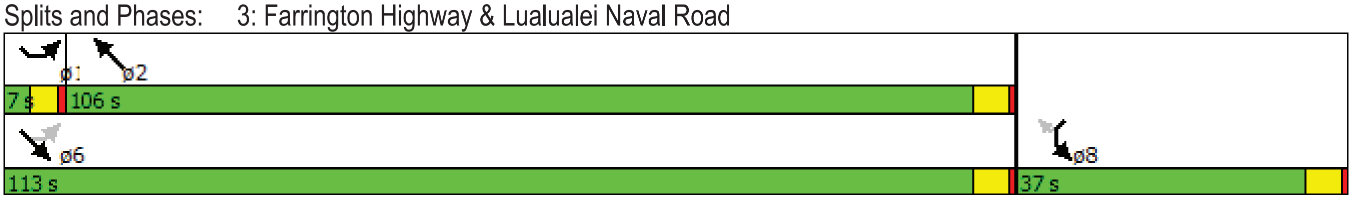
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	100	1976	967	61	131	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3415	3219	0	1430	1358
Flt Permitted		0.634			0.950	
Satd. Flow (perm)	0	2172	3219	0	1430	1358
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			10			52
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.69	0.98	0.85	0.81	0.68	0.69
Heavy Vehicles (%)	0%	2%	6%	29%	22%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	2161	1213	0	193	52
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	7.0	113.0	106.0		37.0	37.0
Total Split (%)	4.7%	75.3%	70.7%		24.7%	24.7%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		108.2	108.2		23.8	23.8
Actuated g/C Ratio		0.76	0.76		0.17	0.17
v/c Ratio		1.31	0.49		0.81	0.19
Control Delay		163.0	7.8		81.3	13.6
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		163.0	7.8		81.3	13.6
LOS		F	A		F	B
Approach Delay		163.0	7.8		66.9	
Approach LOS		F	A		E	
Queue Length 50th (ft)		~1352	199		174	0

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		#1601	274		188	19
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1654	2454		322	346
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.31	0.49		0.60	0.15

Intersection Summary	
Area Type: Other	
Cycle Length: 150	
Actuated Cycle Length: 142	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.31	
Intersection Signal Delay: 104.4	Intersection LOS: F
Intersection Capacity Utilization 106.0%	ICU Level of Service G
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	3.1

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	0	6	50	48	34	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	38	69	55	71	92
Heavy Vehicles, %	0	33	20	11	61	0
Mvmt Flow	0	16	72	87	48	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	280	48	48	0	-	0
Stage 1	48	-	-	-	-	-
Stage 2	232	-	-	-	-	-
Critical Hdwy	6.4	6.53	4.3	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.597	2.38	-	-	-
Pot Cap-1 Maneuver	714	940	1451	-	-	-
Stage 1	980	-	-	-	-	-
Stage 2	811	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	677	940	1451	-	-	-
Mov Cap-2 Maneuver	677	-	-	-	-	-
Stage 1	980	-	-	-	-	-
Stage 2	769	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	8.9	3.5	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1451	-	940	-	-
HCM Lane V/C Ratio	0.05	-	0.017	-	-
HCM Control Delay (s)	7.6	0	8.9	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	0.1	-	-

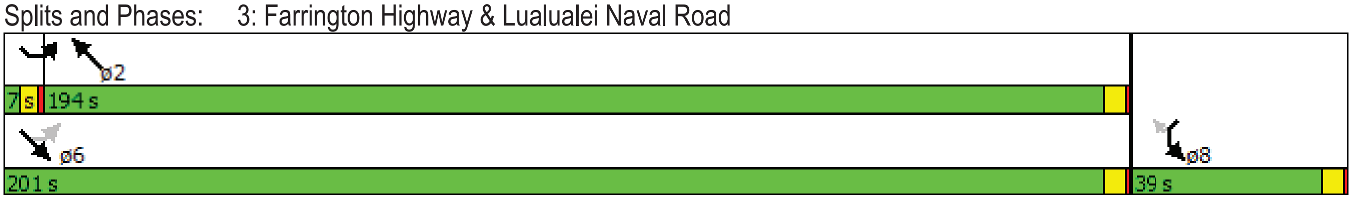
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	97	1283	1858	33	166	165
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3353	3383	0	1586	1546
Flt Permitted		0.490			0.950	
Satd. Flow (perm)	0	1650	3383	0	1586	1546
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			2			56
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.76	0.96	0.96	0.94	0.90	0.77
Heavy Vehicles (%)	0%	4%	2%	50%	10%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1464	1970	0	184	214
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	7.0	201.0	194.0		39.0	39.0
Total Split (%)	2.9%	83.8%	80.8%		16.3%	16.3%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		196.1	196.1		30.8	30.8
Actuated g/C Ratio		0.83	0.83		0.13	0.13
v/c Ratio		1.07	0.70		0.89	0.86
Control Delay		67.6	10.4		140.1	103.0
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		67.6	10.4		140.1	103.0
LOS		E	B		F	F
Approach Delay		67.6	10.4		120.1	
Approach LOS		E	B		F	
Queue Length 50th (ft)		~1363	654		289	252

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		#1489	702		#428	292
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1365	2800		227	270
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.07	0.70		0.81	0.79

Intersection Summary	
Area Type: Other	
Cycle Length: 240	
Actuated Cycle Length: 236.9	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.07	
Intersection Signal Delay: 43.7	Intersection LOS: D
Intersection Capacity Utilization 112.4%	ICU Level of Service H
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	4.4

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	1	47	12	21	55	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	46	39	68	50	92
Heavy Vehicles, %	50	4	0	79	28	0
Mvmt Flow	2	102	31	31	110	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	202	110	110	0	-	0
Stage 1	110	-	-	-	-	-
Stage 2	92	-	-	-	-	-
Critical Hdwy	6.9	6.24	4.1	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.336	2.2	-	-	-
Pot Cap-1 Maneuver	690	938	1493	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	824	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	676	938	1493	-	-	-
Mov Cap-2 Maneuver	676	-	-	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	807	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	9.4	3.7	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1493	-	931	-	-
HCM Lane V/C Ratio	0.021	-	0.112	-	-
HCM Control Delay (s)	7.5	0	9.4	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.4	-	-

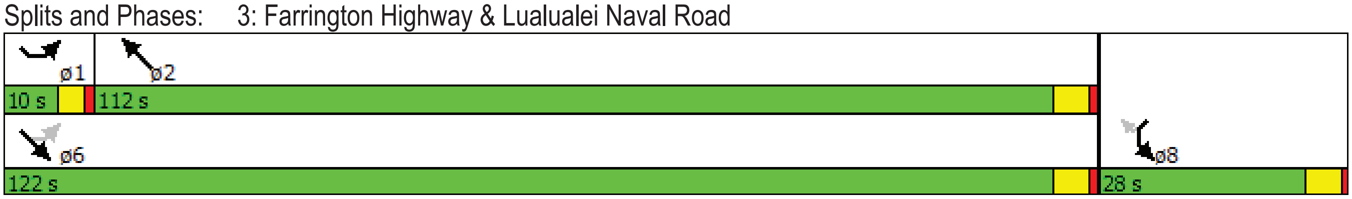
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	111	1976	967	68	133	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3413	3211	0	1430	1358
Flt Permitted		0.625			0.950	
Satd. Flow (perm)	0	2141	3211	0	1430	1358
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			13			52
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.69	0.98	0.85	0.81	0.68	0.69
Heavy Vehicles (%)	0%	2%	6%	29%	22%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	2177	1222	0	196	52
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	10.0	122.0	112.0		28.0	28.0
Total Split (%)	6.7%	81.3%	74.7%		18.7%	18.7%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		117.0	117.0		22.2	22.2
Actuated g/C Ratio		0.78	0.78		0.15	0.15
v/c Ratio		1.30	0.48		0.92	0.21
Control Delay		158.5	6.4		106.5	15.6
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		158.5	6.4		106.5	15.6
LOS		F	A		F	B
Approach Delay		158.5	6.4		87.4	
Approach LOS		F	A		F	
Queue Length 50th (ft)		~1432	192		191	0

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		#1562	206		207	21
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1678	2520		220	253
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.30	0.48		0.89	0.21

Intersection Summary	
Area Type: Other	
Cycle Length: 150	
Actuated Cycle Length: 149.2	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.30	
Intersection Signal Delay: 102.7	Intersection LOS: F
Intersection Capacity Utilization 106.6%	ICU Level of Service G
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	3.7

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	0	8	68	48	34	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	38	69	55	71	92
Heavy Vehicles, %	0	33	20	11	61	0
Mvmt Flow	0	21	99	87	48	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	332	48	48	0	-	0
Stage 1	48	-	-	-	-	-
Stage 2	284	-	-	-	-	-
Critical Hdwy	6.4	6.53	4.3	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.597	2.38	-	-	-
Pot Cap-1 Maneuver	667	940	1451	-	-	-
Stage 1	980	-	-	-	-	-
Stage 2	769	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	619	940	1451	-	-	-
Mov Cap-2 Maneuver	619	-	-	-	-	-
Stage 1	980	-	-	-	-	-
Stage 2	714	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	8.9	4.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1451	-	940	-	-
HCM Lane V/C Ratio	0.068	-	0.022	-	-
HCM Control Delay (s)	7.7	0	8.9	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	0.1	-	-

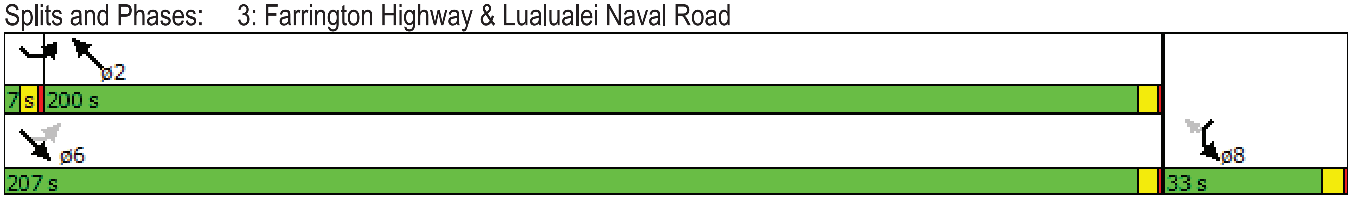
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	100	1283	1858	34	173	175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			0	0	200
Storage Lanes	0			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	0	3354	3382	0	1586	1546
Flt Permitted		0.491			0.950	
Satd. Flow (perm)	0	1653	3382	0	1586	1546
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			3			60
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.76	0.96	0.96	0.94	0.90	0.77
Heavy Vehicles (%)	0%	4%	2%	50%	10%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1468	1971	0	192	227
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	7.0	207.0	200.0		33.0	33.0
Total Split (%)	2.9%	86.3%	83.3%		13.8%	13.8%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0
Total Lost Time (s)		5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)		202.0	202.0		28.0	28.0
Actuated g/C Ratio		0.84	0.84		0.12	0.12
v/c Ratio		1.06	0.69		1.04	0.97
Control Delay		59.9	8.7		172.3	125.9
Queue Delay		0.0	0.0		0.0	0.0
Total Delay		59.9	8.7		172.3	125.9
LOS		E	A		F	F
Approach Delay		59.9	8.7		147.2	
Approach LOS		E	A		F	
Queue Length 50th (ft)		~1332	552		~326	277

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)		#1458	593		#523	#346
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)						200
Base Capacity (vph)		1391	2846		185	233
Starvation Cap Reductn		0	0		0	0
Spillback Cap Reductn		0	0		0	0
Storage Cap Reductn		0	0		0	0
Reduced v/c Ratio		1.06	0.69		1.04	0.97

Intersection Summary	
Area Type: Other	
Cycle Length: 240	
Actuated Cycle Length: 240	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.06	
Intersection Signal Delay: 43.2	Intersection LOS: D
Intersection Capacity Utilization 112.9%	ICU Level of Service H
Analysis Period (min) 15	

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



Intersection	
Int Delay, s/veh	5.2

Movement	SBL	SBR	NEL	NET	SWT	SWR
Vol, veh/h	1	64	16	21	55	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	50	46	39	68	50	92
Heavy Vehicles, %	50	4	0	79	28	0
Mvmt Flow	2	139	41	31	110	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	223	110	110	0	-	0
Stage 1	110	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.9	6.24	4.1	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.336	2.2	-	-	-
Pot Cap-1 Maneuver	670	938	1493	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	805	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	651	938	1493	-	-	-
Mov Cap-2 Maneuver	651	-	-	-	-	-
Stage 1	808	-	-	-	-	-
Stage 2	782	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	9.6	4.3	0
HCM LOS	A		

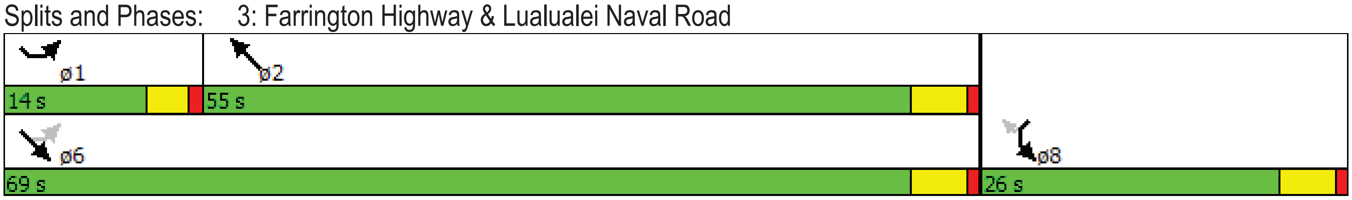
Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1493	-	932	-	-
HCM Lane V/C Ratio	0.027	-	0.151	-	-
HCM Control Delay (s)	7.5	0	9.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.5	-	-

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	111	1976	967	68	133	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			0	0	200
Storage Lanes	1			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	1745	3421	3211	0	1430	1358
Flt Permitted	0.145				0.950	
Satd. Flow (perm)	266	3421	3211	0	1430	1358
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			12			52
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.69	0.98	0.85	0.81	0.68	0.69
Heavy Vehicles (%)	0%	2%	6%	29%	22%	15%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	161	2016	1222	0	196	52
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	14.0	69.0	55.0		26.0	26.0
Total Split (%)	14.7%	72.6%	57.9%		27.4%	27.4%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)	65.1	64.1	52.0		16.7	16.7
Actuated g/C Ratio	0.72	0.71	0.57		0.18	0.18
v/c Ratio	0.50	0.84	0.66		0.75	0.18
Control Delay	10.1	14.7	16.5		52.7	10.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	10.1	14.7	16.5		52.7	10.4
LOS	B	B	B		D	B
Approach Delay		14.3	16.5		43.8	
Approach LOS		B	B		D	
Queue Length 50th (ft)	25	388	241		107	0

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)	37	581	324		129	17
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)	200					200
Base Capacity (vph)	353	2414	1842		331	354
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.46	0.84	0.66		0.59	0.15

Intersection Summary	
Area Type: Other	
Cycle Length: 95	
Actuated Cycle Length: 90.9	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.84	
Intersection Signal Delay: 17.1	Intersection LOS: B
Intersection Capacity Utilization 70.3%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 3: Farrington Highway & Lualualei Naval Road



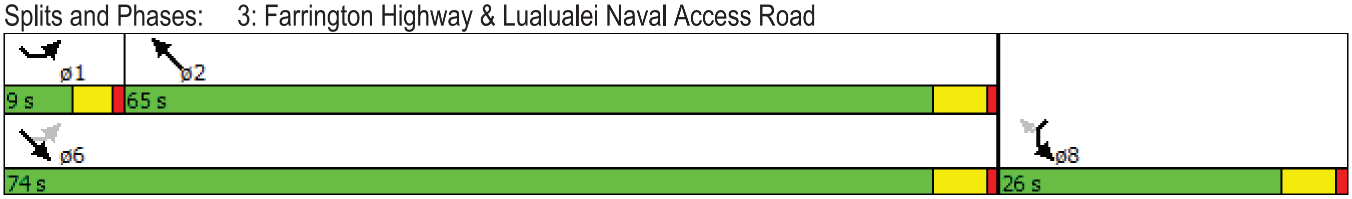
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Volume (vph)	100	1283	1858	34	173	175
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200			0	0	200
Storage Lanes	1			0	1	1
Taper Length (ft)	100				100	
Satd. Flow (prot)	1745	3355	3382	0	1586	1546
Flt Permitted	0.062				0.950	
Satd. Flow (perm)	114	3355	3382	0	1586	1546
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			3			96
Link Speed (mph)		35	35		25	
Link Distance (ft)		433	402		456	
Travel Time (s)		8.4	7.8		12.4	
Peak Hour Factor	0.76	0.96	0.96	0.94	0.90	0.77
Heavy Vehicles (%)	0%	4%	2%	50%	10%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	132	1336	1971	0	192	227
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6					8
Detector Phase	1	6	2		8	8
Switch Phase						
Minimum Initial (s)	3.0	7.0	7.0		7.0	7.0
Minimum Split (s)	7.0	12.0	37.0		26.0	26.0
Total Split (s)	9.0	74.0	65.0		26.0	26.0
Total Split (%)	9.0%	74.0%	65.0%		26.0%	26.0%
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0		5.0	5.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?						
Recall Mode	None	Max	Max		None	None
Act Effct Green (s)	70.2	69.2	60.1		16.1	16.1
Actuated g/C Ratio	0.74	0.73	0.63		0.17	0.17
v/c Ratio	0.78	0.55	0.92		0.72	0.67
Control Delay	46.2	7.5	25.4		52.7	30.8
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	46.2	7.5	25.4		52.7	30.8
LOS	D	A	C		D	C
Approach Delay		11.0	25.4		40.9	
Approach LOS		B	C		D	
Queue Length 50th (ft)	28	168	512		111	73

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Queue Length 95th (ft)	#90	256	#811		185	116
Internal Link Dist (ft)		353	322		376	
Turn Bay Length (ft)	200					200
Base Capacity (vph)	169	2434	2135		350	416
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.78	0.55	0.92		0.55	0.55

Intersection Summary	
Area Type: Other	
Cycle Length: 100	
Actuated Cycle Length: 95.3	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.92	
Intersection Signal Delay: 21.6	Intersection LOS: C
Intersection Capacity Utilization 79.2%	ICU Level of Service D
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Farrington Highway & Lualualei Naval Access Road



APPENDIX H - ARCHEOLOGICAL LITERATURE REVIEW AND FIELD INSPECTION REPORT

Draft

Archaeological Literature Review and Field Inspection Report for the PVT Integrated Solid Waste Management Facility - Expanded Recycling, Landfill Grading and Renewable Energy Project Lualualei Ahupua‘a, Wai‘anae District, O‘ahu TMKs: [1] 8-7-009:025 and 8-7-021:026

Prepared for
LYON Associates, Inc.

Prepared by
Richard T. Stark, Ph.D.,
David W. Shideler, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: LUALUALEI 21)

March 2015

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Management Summary

The scope of work for this project includes a relevant literature review, field inspection, and a companion cultural impact assessment (CIA) for a 200-acre project area (PVT Integrated Solid Waste Management Facility–Expanded Recycling, Landfill Grading and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu TMKs: [1] 8-7-009:025 and 8-7-021:026. This archaeological literature review and field inspection report supports the project's Chapter 343/Environmental Impact Statement.

Reference	Archaeological Literature Review and Field Inspection Report for the PVT Integrated Solid Waste Management Facility(ISWMF)–Expanded Recycling, Landfill Grading and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu TMKs: [1] 8-7-009:025 and 8-7-021:026, (Hammatt, Stark, and Shideler 2014).
Date	March 2015
Project Number(s)	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: LUALUALEI 21
Investigation Permit Number	CSH completed the reconnaissance-level fieldwork under archaeological permit numbers 14-04 and 15-03, issued by the Hawaiʻi State Historic Preservation Division (SHPD) per Hawaiʻi Administrative Rules (HAR) §13-13-282.
Agencies	SHPD
Land Jurisdiction	PVT Land Company
Project Funding	PVT Land Company
Project Location	The project area includes PVT Integrated Solid Waste Management Facility (ISWMF), located approximately 500 m inland on the west side of Lualualei Naval Road in Lualualei Ahupuaʻa, central Waiʻanae District, on the west or leeward coast of Oʻahu, TMKs: [1] 8-7-009:025 and 8-7-021:026. The project area is depicted on a portion of the 1998 USGS 7.5-minute topographic quadrangle.
Project Description	The project proposes to: 1) expand its reuse, recycling, and materials recovery operation; 2) allow the site grade to reach a maximum elevation of up to 250 ft amsl at the *mauka* portion of the project area; and 3) use renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. No increase in the ground footprint of the facility is anticipated.
Project Acreage	PVT ISWMF property covers approximately 200 acres (Project Area). Phase I of the landfill consists of 49 acres and received debris prior to 9 October 1993. Phase II of the landfill consists of 104 acres.
Area of Potential Effect (APE) and Survey Area Acreage	The APE is defined here as the entirety of land within the 200-acre (80.1-hectares) project area.

Document Purpose	This is a private (non-governmental) project subject to HAR §13-13-284-7. This document presents a literature review and field inspection (LRFI) for the subject parcel. While the following scope of work *does not satisfy* the Hawai‘i state requirements for archaeological inventory surveys (HAR §13-276 and §13-275/284); this scope of work can satisfy the requirement for consultation/documentation to determine appropriate further archaeological study and mitigation (if any). CSH's scope of work for this preliminary study includes: 1) Historical research to include study of archival sources, historic maps, Land Commission Awards, and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property 2) Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment identifies any sensitive areas that may require further investigation or mitigation before the project proceeds.
Fieldwork Effort	Fieldwork was accomplished on 17 September 2014 by archaeologists David Shideler, M.A. and Richard Stark, Ph.D. and cultural researchers Nicole Ishihara, B.A. and Māhealani Liborio, B.A. under the general supervision of Hallett H. Hammatt, Ph.D. This work required approximately 4 person-days to complete.
Results Summary	CSH 1 is a dry-stacked historic (ca. 1936) rock wall, 125 cm high by 80 cm wide and approximately 400 m long, extending beyond the project area to the northwest for several kilometers. CSH 1 is comprised of dry-stacked coral limestone. The wall is bi-faced with in-fill and with a rectilinear cross-section. CSH 2 is a linear pile of boulders meandering along the top margin of a break in slope so as to form a terrace and appears to have in-filling on the high side of the terrace. The pile of stones in CSH 2 is substantial (approximately 220 m long by 1.5 m wide) and appears to have been created either as a result of a mechanized bulldozer push and/or hand-piling along the top of the break in slope.
Effect Recommendation	For the proposed private (non-governmental) project, subject to HAR §13-13-284-7, no historic properties will be effected.

Mitigation Recommendations	It is understood that no increase in the active footprint of the facility is anticipated. No adverse effect and no further archaeological work is recommended. With the understanding that the proposed project will not extend outside the existing active landfill footprint, a determination of "no historic properties affected" is recommended, as per HAR §13-13-284-7. Sufficient information regarding the location, extent, function, and age of the historic features documented here has been obtained during the current archaeological investigation, which is undertaken to mitigate any adverse effect caused by proposed development activities. That said, CSH recommends no further archaeological work for this project. This recommendation is included in this LRFI for the review and concurrence of the SHPD. While no historic properties will be impacted by the current project proposal, pursuant to HAR §13-13-284-8 (private projects) CSH recommends preservation by avoidance of CSH 1, a dry-stacked rock wall (ca 1936).
Historic Property Significance	In accordance with HAR §13-13-284-6, CSH 1, a historic rock wall, is evaluated and assessed as significant under criteria "c" and "d," as it embodies "the distinctive characteristics of a type, period, or method of construction, represent the work of a master…possess high artistic value" and to "have yielded, or is likely to yield, information important for research on the history of ranching in Hawaiʻi. CSH 2, a pile of coral limestone boulders is determined to be insignificant.

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List of Abbreviations

CIA = Cultural Impact Assessment

CHS = Cultural Surveys Hawai‘i

DLNR = Department of Land and Natural Resources

GPS = Global Positioning System

HAR = Hawai‘i Administrative Rules

ISWMF = Integrated Solid Waste Management Facility

LRFI = Literature Review and Field Inspection

NOAA = National Oceanic and Atmospheric Administration

OR&L = Oahu Railway and Land Company

SHPD = State Historic Preservation Division

SIHP = State Inventory of Historic Properties

TMK = Tax Map Key

USDA = United States Department of Agriculture

USGS = United States Geological Survey

Section 1 Introduction

1.1 Project Background

At the request of LYON Associates, Inc. (LYON), Cultural Surveys Hawaiʻi, Inc., (CSH) has prepared this archaeological literature review and field inspection (LRFI) report for the PVT Integrated Solid Waste Management Facility–Expanded Recycling, Landfill Grading and Renewable Energy Project (Proposed Project). The project area is located approximately 500 m inland on the west side of Lualualei Naval Road in Lualualei Ahupuaʻa, central Waiʻanae District, on the west or leeward coast of Oʻahu, TMKs: [1] 8-7-009:025 and 8-7-021:026. The project area is outlined on a portion of the 1998 Waianae U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (Figure 1), tax map plats (Figure 2 and Figure 3), and a 2013 aerial photograph (Figure 4).

This project involves an LRFI pedestrian survey. The work presented by CSH also includes a companion cultural impact assessment (CIA) to support the project's Environmental Impact Assessment for the proposed project in Lualualei, Oʻahu (Ishihara et al. 2014). The literature review for this archaeological investigation utilizes background research regarding changes over time to related socio-environmental contexts including geology, flora and fauna, built environment, traditional accounts, mythology, history and prehistory. In addition to utilizing the one previous archaeological report conducted at this locale (Bordner 1977), 34 previous archaeological reports from the surrounding area are described.

PVT ISWMF property covers approximately 200 acres (Project Area). Phase I of the landfill consists of 49 acres and received debris prior to 9 October 1993. Phase II of the landfill consists of 104 acres. The project proposes to: 1) expand its reuse, recycling, and materials recovery operation; 2) allow the site grade to reach a maximum elevation of up to 250 ft amsl at the *mauka* portion of the site; and 3) use renewable energy (a gasification unit and/or photovoltaic panels) to provide power to the ISWMF. No increase in the ground footprint of the facility is proposed.

1.2 Historic Preservation Regulatory Context and Document Purpose

This document presents an LRFI for the subject parcel. While the following scope of work *does not satisfy* the Hawaiʻi state requirements for archaeological inventory surveys (Hawaiʻi Administrative Rules [HAR] §13-276 and §13-275/284); this scope of work can satisfy the requirement for consultation/documentation to determine appropriate further archaeological study and mitigation (if any).

CSH's scope of work for this preliminary study includes the following:

1) Historical research to include study of archival sources, historic maps, Land Commission Awards, and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.

2) Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.

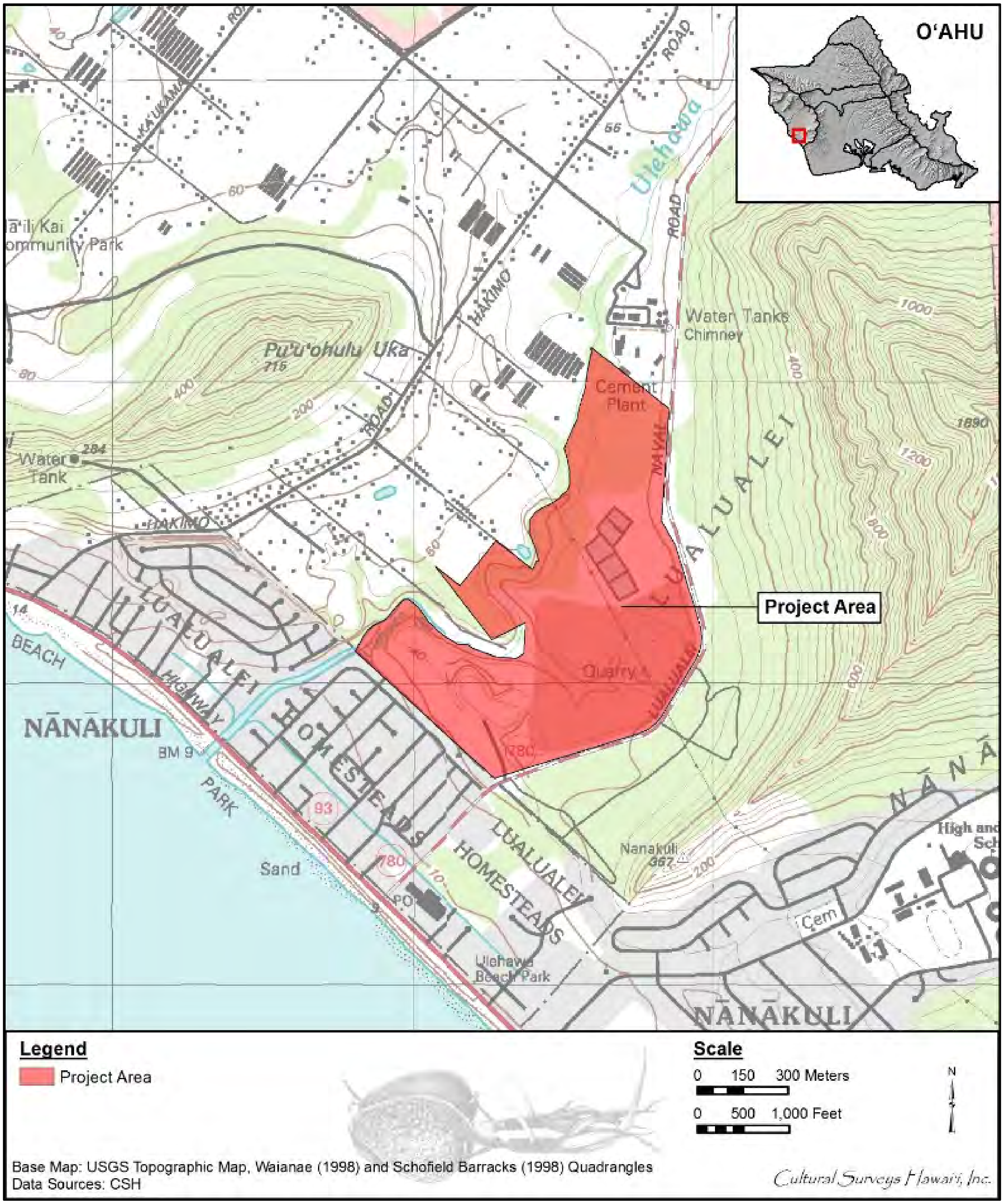

Figure 1. Portion of the 1998 Waianae and Schofield Barracks USGS 7.5-minute topographic quadrangles, indicating the location of the project area

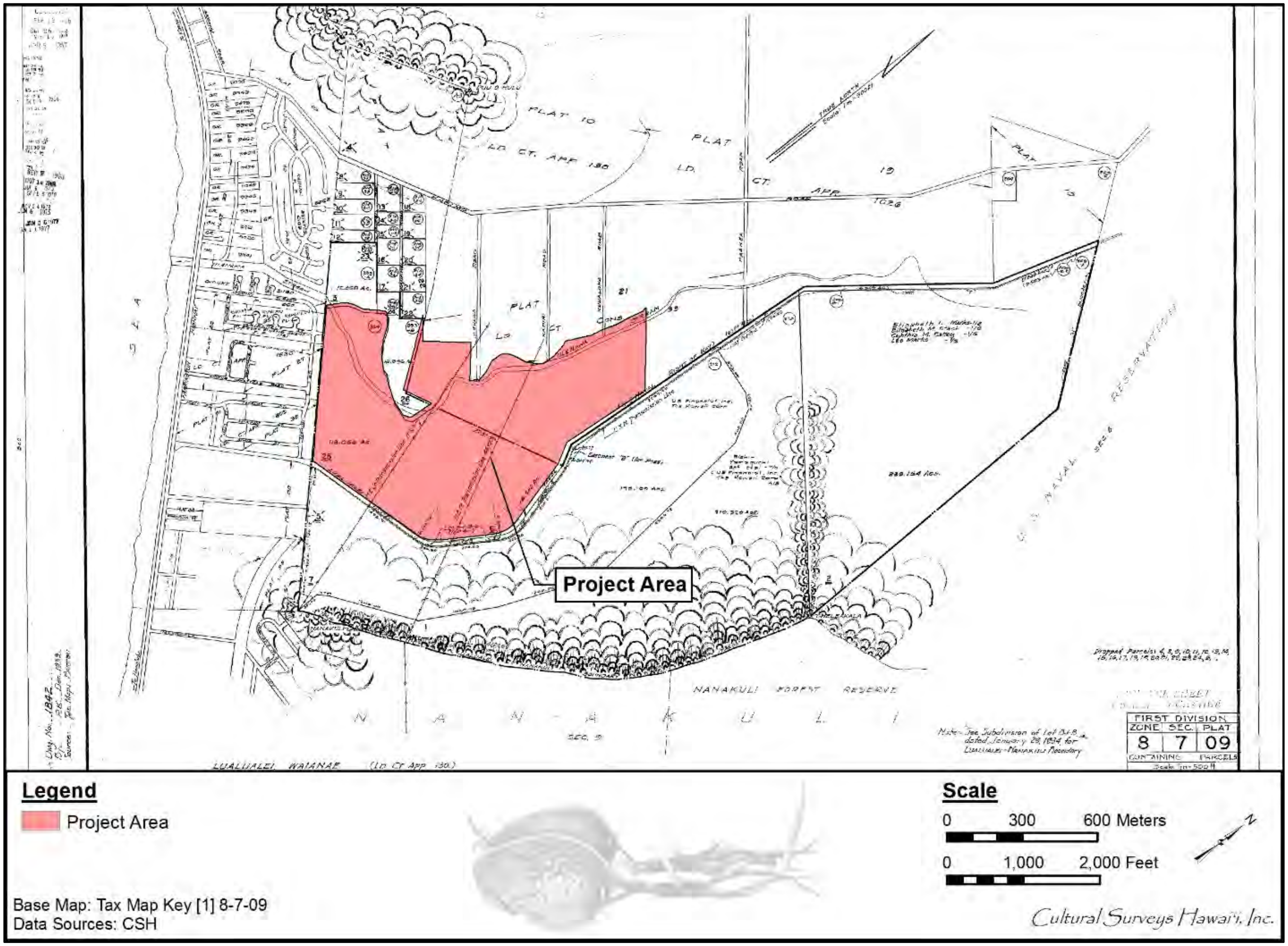

Figure 2. Tax Map Key (TMK): [1] 8-7-009 indicating the project area (Hawai'i TMK Service 2009)

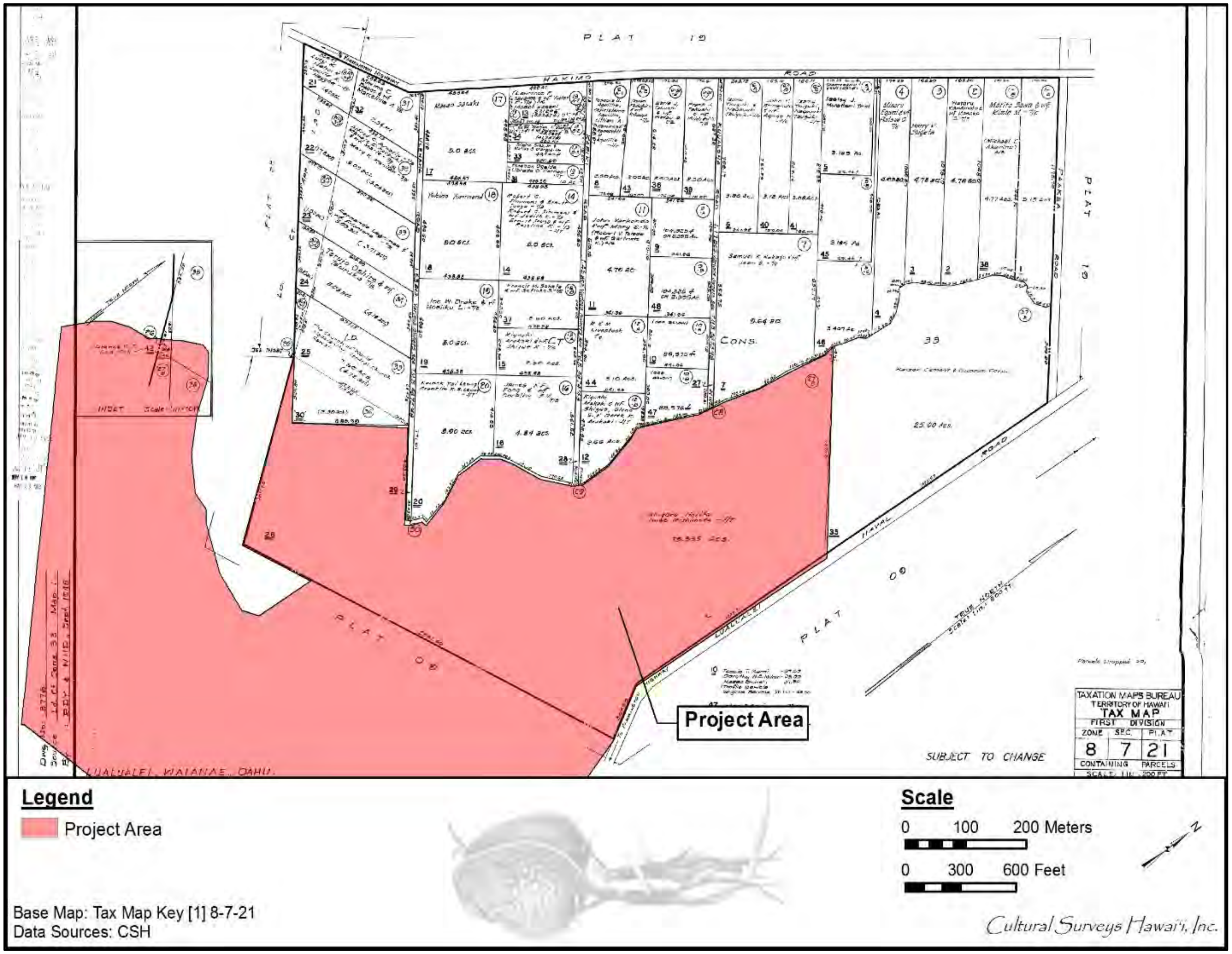

Figure 3. Tax Map Key (TMK): [1] 8-7-021 indicating the project area (Hawai‘i TMK Service 2009)

Figure 4. Aerial photograph indicating the project area and vicinity (Google Earth 2013)

3) Preparation of a report to include the results of the historical research and the limited fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. This report also provides mitigation recommendations for the Ulehawa Stream gulch riparian area for consideration.

1.3 Environmental Setting

1.3.1 Natural Environment

The project area is within a large coastal valley on the leeward (western) coast in the Wai‘anae District, in the *ahupua‘a* (traditional land division) of Lualualei on the island of O‘ahu. The geology of this region contains 3.9 million-year-old basalt flows that created the Wai‘anae Mountain Range, the oldest formation of O‘ahu. The project area is situated on alluvium and colluvium-based clays, overlying the Wai‘anae rift zone aquifer created by the eroding Wai‘anae Mountain Range (Nichols et al. 1996:61). Ecologically, the project is in O‘ahu's lowland-dry biome, with low to moderate biodiversity in forests and shrub-lands, "and includes specialized animals and plants such as the *pueo* or Hawaiian owl (*Asio flammeus sandwichensis*) and *iliahialoe* or coast sandalwood (*Santalum ellipticum*). The plants *Bidens amplectens, Doryopteris takeuchii* and *Pleomele forbesii* may also be present in this ecosystem" (Federal Register 2012).

In pre-Contact Hawai‘i, the natural vegetation found within the vicinity of the project area would have been lowland coastal dry shrub and grassland, but this area has been disturbed and transformed by human activity and dominated by a variety of introduced plant species including *mimosa (Acacia farnesiana),* wild tobacco *(Nicotiana glauca),haole koa (Leucaena glauca)*, and *kiawe (Prosopis pallida).* The project area includes the Ulehawa Stream gulch riparian zone in the western and northwestern margins of the study area. This riparian zone appears to have the lowest levels of large earth moving machine impact and thus is the most representative of pre-Contact Hawai‘i in the project area.

Pre-Contact Hawaiians recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October, a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season) continues through the end of the year from November to April. This is a much cooler period when trade winds are less frequent and widespread storms and rainfall become more common (Giambelluca et al. 1986:17). Typically the maximum rainfall occurs in January and the minimum in June; this is particularly true for the leeward areas where the project area is located (Giambelluca et al. 1986:17). The mean annual rainfall is approximately 600 mm (23.62 inches) (Giambelluca et al. 1986:138).

Based on USGS soil survey data, natural deposits within the project area are classified as LPE (Lualualei extremely stony clay), MnC (Mamala stony silty clay loam), PvC (Pulehu very stony clay loam) and QU (Quarry) (Figure 5) (Foote et al. 1972).

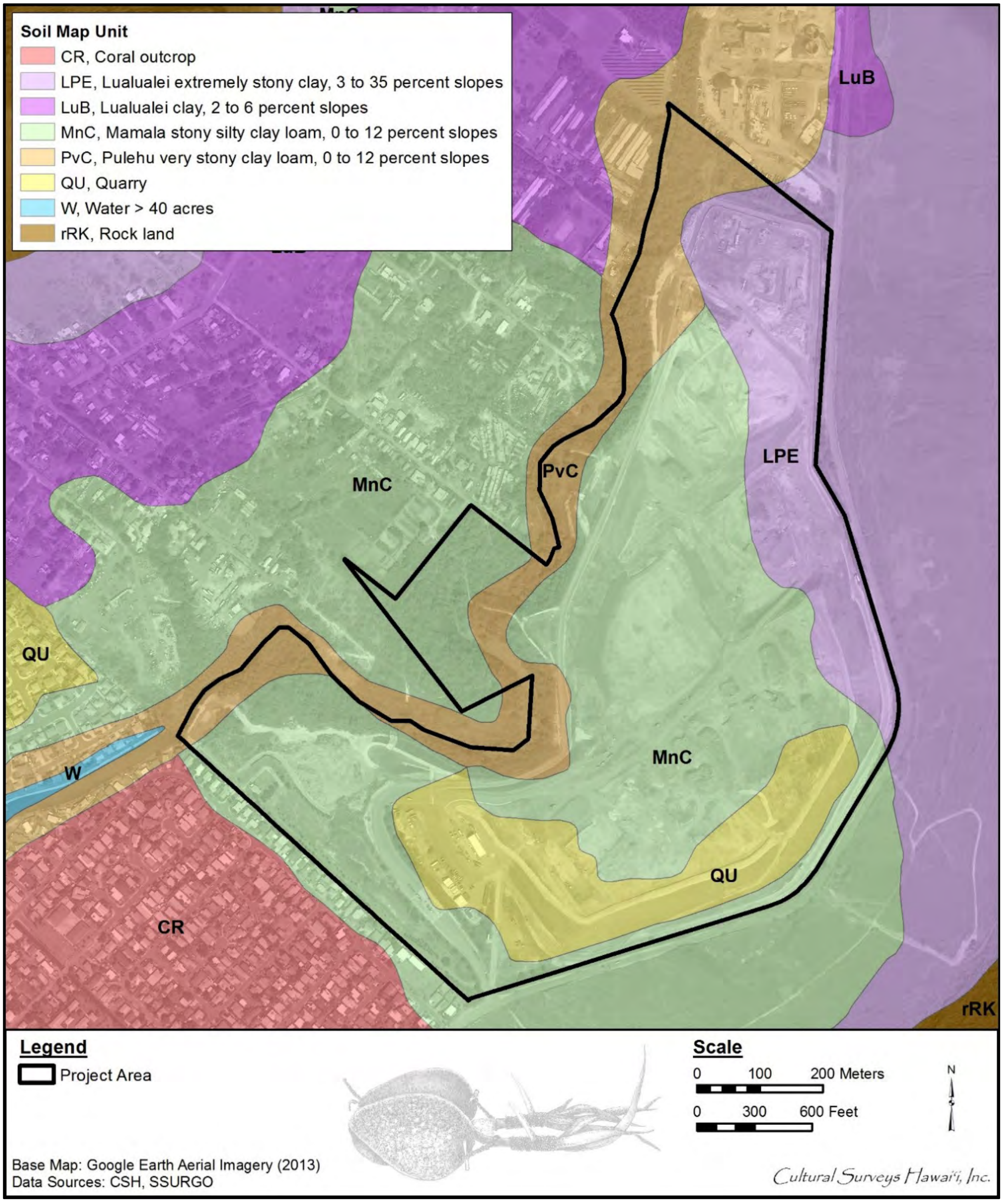

Figure 5. Overlay of the *Soil Survey of the State of Hawaii* (Foote et al. 1972) indicating sediment types within and around the project area

> Lualualei series consists of well-drained soils on the coastal plains, alluvial fans, and on talus slopes on the islands of Kauai, Oahu, Molokai and Lanai. These soils developed in alluvium and colluvium. They are nearly level and gently sloping. Elevations range from 10 to 125 feet.
>
> In most places the annual rainfall amounts to 18 to 30 inches, but it is as low as 10 inches on Lanai and as high as 50 inches on Kauai. Most of the rainfall occurs during storms in the period from November to April. There is a prolonged dry period in summer. The mean annual soil temperature IS 75° F. Lualualei soils are geographically associated with Honouliuli, Jaucas, and Kekaha soils . . . The natural vegetation consists of kiawe, koa haole, bristly foxtail, uhaloa, and fingergrass. [Foote et al.1972:87]
>
> Lualualei extremely stony clay, 3 to 35 percent slopes (LPE)—This soil occurs on talus slopes on Oahu and Kauai. The slope range is 3 to 35 percent, but in most places the soil is moderately sloping to steep. This soil is similar to Lualualei clay, 0 to 2 percent slopes, except that there are many stones on the surface and in the profile. It is impractical to cultivate this soil unless the stones are removed. Runoff is medium to rapid, and the erosion hazard is moderate to severe. [Foote et al. 1972:88]
>
> Mamala stony silty clay loam, 0 to 12 percent slopes (MnC) . . . mostly coral rock fragments, are common in the surface layer and in the profile. Included in mapping were areas of Ewa soils. Also included were non-stony areas and areas where the slope is as much as 20 percent. In a representative profile the surface layer is dark reddish-brown stony silty clay loam about 8 inches thick. The subsoil is dark reddish-brown silty clay loam about 11 inches thick. The soil is underlain by coral limestone and consolidated calcareous sand at depths of 8 to 20 inches. This soil is neutral to mildly alkaline. [Foote et al. 1972:96]
>
> PvC (Pulehu very stony clay loam)—This series consists of well-drained soils on alluvial fans and stream terraces and in basins. These soils . . . developed in alluvium washed from basic igneous rock. The soils are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 10 to 35 inches. The mean annual soil temperature is 74° F. [Foote et al. 1972:116]

The contrast between the raised reef limestone deposits and associated limestone derived MnC soils with the igneous soils is a striking feature of the landscape (Figure 6).

1.3.1 Built Environment

Lualualei Ahupuaʻa is comprised of agricultural, residential, and commercial developments including the farm-lot communities along Hakimo Road and Lualualei Valley Road, the village of Māʻili, and two large U.S. Navy installations, one of which occupies approximately 7,498 acres of land in the Lualualei Valley. Farms and a residential neighborhood are immediately west of the project area. Immediately to the southwest of the project area is the Princess Kahanu Estates subdivision, a Hawaiian Homestead community.

A portion of the project area was once used agriculturally for sugar cane, quarrying, and cement production. Bordner notes that “the lower half of the study area has been cleared by bulldozer on several occasions in the past, apparently for use as pasture for grazing” (Bordner 1977:4).

Bulldozing and quarrying activities present in the southern portion of the project area in a 1965 aerial photograph (Figure 7) expand through time and are eventually augmented by landfill activities evident in 1993 and 2000 aerial photographs (Figure 8 and Figure 9).

Figure 6. Profile photograph of exposed ‘Ulehawa Stream bank stratigraphy in the west-central portion of the study area showing MnC soil derived from raised reef limestone overlying PvC soil derived from igneous rock with 100 cm tape measure for scale

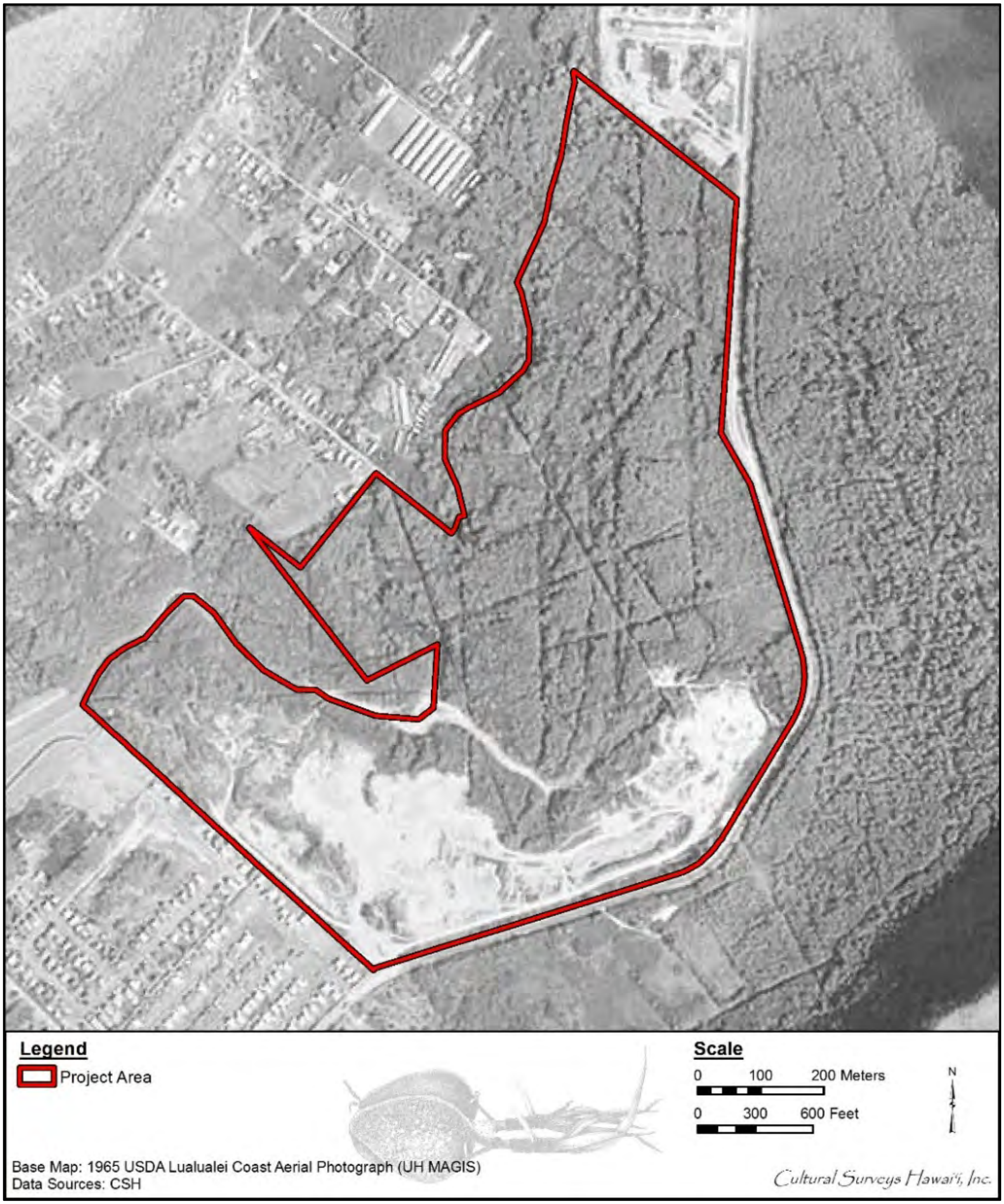

Figure 7. 1965 U.S. Department of Agriculture (USDA) Lualualei coast aerial photograph indicating the project area

Figure 8. 1993 National Oceanic and Atmospheric Administration (NOAA) Lualualei coast aerial photograph indicating the project area

Figure 9. 2000 NOAA aerial photograph indicating the project area

The project area is currently utilized for the PVT ISWMF with substantial related ground disturbance activities. The project area is currently being used as a comprehensive solid waste management facility for construction and demolition waste and other recyclable waste products. It does not accept hazardous waste or municipal solid waste. The landfill facility's daily activities involve various types of waste management:

- A "location used for the handling, processing, or storage of recoverable material, including but not limited to composting and remediation." Recoverable material is defined as "material that can be diverted from disposal for recycling or bioconversion."
- A materials recovery facility
- A construction and demolition waste landfill

Primary existing and future planned operations at the landfill include:

- Segregation of incoming loads into materials for processing, recycling, on-site usage or disposal
- Mixed waste sorting to remove and separate recyclable materials
- Processing to produce feedstock for bioconversion of organic wastes
- Production of aggregate materials including rock, gravel, and crushed asphalt
- Solidification of liquid wastes
- Reclamation of previously landfilled construction and demolition waste to minimize the potential to fire, to prevent settlement, to minimize leachate potential, and to remove voids
- Storage and marketing of recyclable materials
- Landfill disposition of residual non-recoverable waste materials, including primarily composition/asphalt roofing shingles, tile, gypsum board, lead painted concrete, and cement siding

Section 2 Methods

2.1 Field Methods

CSH completed the fieldwork component of this study under archaeological permit numbers 14-04 and 15-03 issued by the SHPD pursuant to HAR §13-13-282. Fieldwork was conducted on 17 September 2014 by CSH archaeologists Richard Stark Ph.D. and David W. Shideler, M.A., and cultural researchers Nicole Ishihara B.A. and Māhealani Liborio B.A. under the general supervision of Hallett H. Hammatt, Ph.D. This work required approximately 4 person-days to complete. Fieldwork included a thorough pedestrian and vehicular inspection of the project area.

Planning and coordination for this project involved a meeting on 17 September 2014, prior to fieldwork, with CSH, LYON, and PVT personnel at the PVT ISWMF. The meeting involved introductions followed by a discussion led by Karl Bromwell of the project scope, challenges, and hazards. A group discussion ensued with questions, answers, and comments from the floor. The meeting was attended by PVT V.P. Steve Joseph, LYON V.P. Karl Bromwell, managing consultant Joseph Hernandez, CSH cultural researchers Nicole Ishihara and Māhealani Liborio and CSH archaeologists David Shideler and Richard Stark. This meeting was followed by a vehicular tour of the PVT landfill facility given by PVT representative Stephen Joseph.

The pedestrian and vehicular archaeological inspection of the project area was undertaken for the purpose of historic property identification and documentation. The archaeological survey focused on relatively undisturbed areas beyond the footprint of the active landfill. This was accomplished in the western and northwestern portions of the project area with systematic pedestrian sweeps spaced at 5-m intervals (Figure 10 and Figure 11) and vehicular-based surveillance of the eastern perimeter and central portions of the project area. A GPS was utilized for location tracking in addition to the collection of photographic and written data and a track log is presented (Figure 12).

The bulk of the project area represents a dynamically flowing active landscape of O‘ahu's contemporary material culture. This archaeological investigation examines generally the active PVT archaeo-scape and specifically documents the encountered potential historic properties. Based upon the nature of the substantial ground surface modifications of the built environment, realistic expectations of encountering historic or ancient traditional features and artifacts were relegated to the relatively undisturbed margins of the project area. Thus, while the pedestrian survey for this vertical landfill expansion project does examine the internal features of the active landfill, the specific focus of the survey inspection was on the project area perimeter, with special attention to the relatively undisturbed ‘Ulehawa Stream riparian area (see Figure 11).

2.2 Research Methods

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai‘i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Aina database (Waihona ‘Aina 2000). This research provided the environmental, cultural, historic, and archaeological background for the project area, used to formulate a predictive model (Section 4.2) regarding the expected types and locations of historic properties in the project area.

Figure 10. CSH cultural researchers assist in the pedestrian survey, view to the northwest

Figure 11. Owl in-flight over the ‘Ulehawa Stream riparian area during the CSH reconnaissance survey, view to the southeast

Figure 12. 2013 aerial photograph indicating the project area and showing a "track-log" of the archaeological survey GPS route, CSH 1 and CSH 2 (Google Earth 2013)

Section 3 Background Research

This section begins with an overview of documentary evidence for the general character of Lualualei Ahupuaʻa as it evolved before Western Contact in the later eighteenth century. This section is meant to give the reader a general cultural history of the project area vicinity. The development of Lualualei and its environment during the nineteenth century and into the twentieth century was recorded in increasingly abundant documentation—including government records, private accounts, newspapers, maps, and photographs. These documents, which allow a more precise focus on the project area, are discussed in the remainder of this section.

The District of Waiʻanae extends from Nānākuli on the west coast of Oʻahu north to Kaʻena Point, and once incorporated eight *ahupuaʻa* including Lualualei. In ancient times, the District of Waiʻanae was known for its multitude of fish and especially for deep-sea fishing off Kaʻena, where the ocean currents meet. The meaning of Waiʻanae (mullet water) also implies an abundance of fish—*ʻanae*, which is the full-grown mullet (*Mugil cephalus*) (Pukui et al. 1974). In 1840, Wilkes made the following comment: "The natives are much occupied in catching and drying fish, which is made a profitable business, by taking them to Oahu, where they command a ready sale" (Wilkes 1845:81-82). Handy and Handy (1972) attribute the naming of Waiʻanae to a large fresh water pond for mullet called *Pueha* [*sic*] (*Puehu*). Today, Waiʻanae is still considered one of the best fishing grounds on Oʻahu.

Waiʻanae was also known for the independent lifestyle and attitudes of its inhabitants, another trend that continues into the modern day. This independence was a factor in many of the political struggles of the prehistoric and early historic period when the district was the scene of battles and rebellions and often served as a refuge for dissident and/or contentious factions. This independent spirit is often attributed to the conditioning of generations having to cope with marginal environments, as many areas of Waiʻanae, especially Lualualei, were notorious for their inhospitable climate.

The *ahupuaʻa* of Lualualei is located on the west coast of Oʻahu in the *moku* or district of Waiʻanae. Lualualei Ahupuaʻa is bounded by four *ahupuaʻa*, on the north by Waiʻanae Kai Ahupuaʻa, on the south by Nānākuli Ahupuaʻa, on the east by Honouliuli Ahupuaʻa, and on the northeast by Waiʻanae Uka Ahupuaʻa. Lualualei is more commonly known as Māʻili and is home to two popular surf spots—Māʻili Point, located near the project area in the southern portion of the *ahupuaʻa*, and Green Lanterns, located in the northern portion.

3.1 Mythological and Traditional Accounts

There are two traditional meanings given to the name Lualualei. One meaning, "flexible wreath," is attributed to a battle formation used by Māʻilikūkahi against four invading armies in the battle of Kīpapa in the early fifteenth century (Sterling and Summers 1978:68). A second, and perhaps more recent meaning, offered by John Papa ʻĪʻī, is "beloved one spared." This meaning relates to a story of a relative who was suspected of wearing the king's *malo* (loincloth). The punishment was death by fire. ʻĪʻī writes the following:

> The company, somewhat in the nature of prisoners, spent a night at Lualualei near the fish pond on the plain. The next day they reached the southern side of

> Kanepuniu, and there they encamped for eight days to await an announcement concerning the death and burning of the wrongdoers. Finally, a proclamation from the king was given by Kaulainamoku, stating that there would be no deaths, for Kalakua had not worn the king's malo. Thus was the Luluka family spared a cruel fate. A child born in the family later was named Lualualei. [ʻĪʻī 1959:23]

Mary Pukui believed the first meaning, "flexible wreath," to be the more appropriate one for Lualualei (Sterling and Summers 1978:63). According to Kelly (1991:317), the fishpond on the plain is Puehu Fishpond, which is actually located just over the border in Waiʻanae. The fishpond no longer exists and was probably destroyed during the sugar plantation era. A third association of the name Lualualei is an older reference to one of Māui's sisters, who went by the same name.

Puʻu Heleakalā is located on the southern *ahupuaʻa* boundary of Lualualei, which is the northern boundary for Nānākuli Ahupuaʻa. Heleakalā translates to "snare by the sun" as the hill blocks rays of the setting sun (Pukui et al. 1974:44).

Numerous Hawaiian legends, in addition to archaeological evidence, reveal the Waiʻanae coast and *mauka* (toward the mountains) interior to be an important center of Hawaiian history. It is here in Waiʻanae that the famous exploits of Māuiakalana (Māui) are said to have originated. Traditional accounts of Lualualei focus on the mischievous adventures of the demi-god Māui. It was here that Māui learned the secret of making fire for mankind and perfected his fishing skills. Other famous accounts tell of the place where Māui's adzes were made, of Mānaiakalani the magic fishhook, the snare for catching the sun, and his kite-flying expedition. Puʻu Heleakalā is the ridge separating Nānākuli from Lualualei. It was at Puʻu Heleakalā where Hina, Māui's mother, lived in a cave and made her *kapa* (bark cloth) (Sterling and Summers 1978:62).

Samuel Kamakau tells us that Māui's genealogy can be traced from the ʻUlu line through Nanaʻie:

> Wawena lived with Hina-mahuia, and Akalana, a male, was born; Akalana lived with Hina-kawea, and Maui-mua, Maui-waena, Maui-kiʻikiʻi, and Maui-akalana, all males, were born. . . . ʻUlehawa and Kaolae, on the south side of Waianae, Oahu, was their birthplace. There may be seen the things left by Maui-akalana and other famous things: the tapa-beating cave of Hina, the fishhook called Manai-a-kalani, the snare for catching the sun, and the places where Maui's adzes were made and where he did his deeds. However, Maui-akalana went to Kahiki after the birth of his children in Hawaiʻi. [Kamakau 1991:135]

3.2 Early Historic Period

In January 1778, Captain James Cook sighted Waiʻanae from a distance, but chose to continue his journey and landed off Waimea, Kauaʻi instead. Fifteen years later, Captain George Vancouver approached the coast of Waiʻanae from Puʻuloa and wrote in his log:

> The few inhabitants who visited us [in canoes] from the village, earnestly entreated our anchoring, and [they] told us, that if we would stay until morning, their chief would be on board with a number of hogs, and a great quantity of vegetables; but that he would not visit us then because the day was *taboo-poory* [a kapu day]. The

> face of the country did not however promise an abundant supply [of water]; the situation was exposed . . . [Vancouver 1967:218]

Vancouver (1967:217) was not impressed with what he saw of the Wai‘anae coastline, stating in his log that the entire coast was “one barren rocky waste, nearly destitute of verdure, cultivation or inhabitants.”

Vancouver did not anchor at Wai‘anae but had he done so, he would have been pleasantly surprised, at least by portions of the coastline. Even though the dry, arid coast presented a dismal forecast, the ocean provided an abundant supply of fish, the lowlands provided *‘uala* (*Ipomoea batatas*; sweet potato) and *niu* (*Cocos nucifera*; coconut), and the inland valley areas were planted in *kalo* (*Colocasia esculenta*; taro) and *wauke* (*Broussonetia papyrifera*; paper mulberry). The upland forest regions provided various woods needed for weapons and canoes.

By 1811, sandalwood merchants began actively exploiting the Hawai‘i market and huge amounts of sandalwood were exported to China. Traditionally, Hawaiians used sandalwood for medicinal purposes and as a scent to perfume their *kappa* (bark cloth). Kamehameha I and a few other chiefs controlled the bulk of the sandalwood trade. Kamakau (1992:204) writes, “The chiefs also were ordered to send out their men to cut sandalwood. The chief immediately declared all sandalwood to be the property of the government.”

The sandalwood trade greatly impacted Hawaiian culture, and the traditional lifestyle Hawaiians had always pursued was altered drastically. In an effort to acquire western goods, ships, guns, and ammunition, the chiefs had acquired massive debts to the American merchants (‘Ī‘ī 1983:155). These debts were paid off in shiploads of sandalwood. When Kamehameha found out how valuable the sandalwood trees were, he ordered the people not to let the felled trees fall on the young saplings, to ensure their protection for future trade (Kamakau 1992:209-210). According to Samuel Kamakau:

> The debts were met by the sale of sandalwood. The chiefs, old and young, went into the mountains with their retainers, accompanied by the king and his officials, to take charge of the cutting, and some of the commoners cut while others carried the wood to the ships at the various landings; none was allowed to remain behind. Many of them suffered for food . . . and many died and were buried there. The land was denuded of sandalwood by this means. [Kamakau 1992:252]

Kamakau comments about the plight of the common people and the general state of the land during this time:

> This rush of labor to the mountains brought about a scarcity of cultivated food throughout the whole group. The people were forced to eat herbs and tree ferns, hence the famine called Hīlaulele, Hāhāpilau, Laulele, Pualele, ‘Ama‘u, or Hāpu‘u, from the wild plants resorted to. [Kamakau 1992:204]

In 1816, Boki Kama‘ule‘ule was made governor of O‘ahu (and chief of the Wai‘anae district) and served in that capacity until 1829, when he sailed to New Hebrides in search of sandalwood.

‘Ī‘ī writes, “It was Boki’s privilege to assign work, for he had been governor of the island of O‘ahu from the time Kamehameha I ordered all the chiefs to O‘ahu in 1816 to expel the Russians” (‘Ī‘ī 1983:145).

The sandalwood era was short-lived and by 1829, the majority of the sandalwood trees had been harvested, and trading could no longer be sustained. It is unclear how extensive Lualaulei's sandalwood resources had been; however, the effects of the sandalwood harvest, the population shifts, and disruption of traditional lifestyles and subsistence patterns would undoubtedly have affected the population of Lualualei.

The Reverend William Ellis visited the Hawaiian Islands in 1823. At that time, he estimated the population on the island of O‘ahu to be about 20,000 (Ellis 1963:19). The missionaries were the first to gather systematic figures regarding population statistics throughout the various districts on each island. The first census figures were gathered from 1831-1832 and 1835-1836. Population figures for Lualualei were not given, however population numbers given for all of Wai‘anae were 1,868 and 1,654 respectively (Schmitt 1973:9).

Following the western encroachment into the Wai‘anae Coast, a swift decline in population occurred due to disease and a "tendency to move to the city where there was more excitement" (McGrath et al. 1973:25). The *‘ōku‘u* epidemic of 1804 (thought to be cholera) undoubtedly had a major effect on the native population, not only in Wai‘anae, but throughout the rest of the Islands as well. John Papa ‘Ī‘ī (1959:16) relates that the *‘ōku‘u* "broke out, decimating the armies of Kamehameha I [on O‘ahu]." Other diseases also took their toll. In 1835, a missionary census listed 1,654 residents on the Wai‘anae Coast. The population of the Wai‘anae Coast was decimated by a smallpox epidemic in late 1853. In 1855, the Wai‘anae tax collector recorded 183 taxpayers on the leeward coast, which is thought to represent a total population of about 800 people. This catastrophic depopulation facilitated the passing of large tracts of land into the hands of a few landholders, and led to the decline of the traditional economy that once supported the region (Hammatt et al. 1993:10–11).

3.3 The Māhele and the Kuleana Act

The Organic Acts of 1845 and 1846 initiated the process of the Māhele—the division of Hawaiian lands—that introduced private property into Hawaiian society. In 1848, the crown and the *ali‘i* (royalty) received their land titles. *Kuleana* awards to commoners for individual parcels within the *ahupua‘a* were subsequently granted in 1850. At the time of the Māhele, the *ahupua‘a* of Wai‘anae, which included Lualualei, was listed as Crown lands and was claimed by King Kamehameha III as his personal property (Board of Commissioners 1929:28). As such, the land was under the direct control of the King. Many of the chiefs had run up huge debts to American merchants throughout the early historic period and continuing up into the mid-1800s. A common practice at the time was to lease (or mortgage) large portions of unused land to other high chiefs and foreigners to generate income and pay off these earlier debts. Until the passage of the Act of 3 January 1865, which made Crown Lands inalienable, Kamehameha III and his successors did as they pleased with the Crown Lands, selling, leasing, and mortgaging them at will (Chinen 1958:27).

In 1850, the Privy Council passed resolutions that would affirm the rights of commoners or native tenants. To apply for fee-simple title to their lands, native tenants were required to file their claims with the Land Commission within the specified time period of February 1846 to 14 February 1848. The Kuleana Act of 1850 confirmed and protected the rights of native tenants. Under this act, the claimant was required to have two witnesses who could testify they knew the claimant and the boundaries of the land, knew the claimant had lived on the land for a minimum of two years, and knew no one had challenged the claim. The land also had to be surveyed.

Not everyone who was eligible to apply for *kuleana* lands did so and, likewise, not all claims were awarded. Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. For whatever reason, out of the potential 2,500,000 acres of Crown and Government lands, "less than 30,000 acres of land were awarded to the native tenants" (Chinen 1958:31).

A total of 12 land claims were made in Lualualei, but only six were actually awarded. All six awards were located upland in the *'ili* (land division smaller than an *ahupua'a*) of Pūhāwai, far *mauka* of the current project area. No quiet land titles were claimed near the coast. From the claims, it can be determined that at least eight families were living in Pūhāwai at the time of the Māhele in 1848. Together, they cultivated a minimum of 163 *lo'i* (wetland agriculture plot). The numerous *lo'i* mentioned in the claims indicate the land was ideal for growing wetland taro and that this livelihood was actively pursued by the awardees. In addition, dryland crops were grown on the *kula* (plains), *wauke* (paper mulberry, *Broussonetia papyrifera*), was being cultivated, and one claimant was making salt.

Information on the occupation of Lualualei at the time of the Māhele, aside from the historical accounts of scattered coastal hamlets, is from archival records indicating there were nine taxpayers at Mā'ili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy et al. 1998:36). Mā'ili is located along the eastern edge of the *ahupua'a* and Pūhāwai is well *mauka*. Based on these numbers, Cordy et al. estimate a population of 90 people for coastal Lualualei and 55 people for the upper valley in 1855 (Cordy et al. 1998:36). Regardless of the exact population estimate, the existence of 20 taxpaying adults in Lualualei indicates the area was being inhabited and worked. In this case, the Māhele documents are only a partial reflection of the population and actual land use during the time.

3.4 Mid- to Late 1800s

With strong financial backing from King Kalākaua, Hermann A. Widemann, a German immigrant, was able to initiate the Waianae Sugar Plantation in 1879. This plantation would extend into Lualualei. Although it was never a large-scale plantation by modern standards, it was one of the first and last to be served by a plantation railroad. Some 15 miles of 30-inch narrow-gauge railroad delivered harvested cane to the mill. All the sugar was shipped by inter-island vessels to Honolulu departing from Wai'anae Landing, until the Oahu Railway and Land Company (OR&L) railroad was extended to Wai'anae and beyond in 1889. The OR&L railroad ran along the *makai* side (toward the sea) of Farrington Highway. In 1931, the J.M. Dowsett Estate sold the plantation to American Factors (which later became Amfac/JMB-Hawai'i).

The first longhorn cattle were brought to O'ahu from Hawai'i Island in 1809 by John Young and Kamehameha I (Kamakau 1992:268). One of the first areas to be utilized for ranching on the Wai'anae coast was in Lualualei. Hawai'i Bureau of Land Conveyances (1845-1869) records show that William Jarrett leased approximately 17,000 acres of land from Kamehameha III in 1851. This was the beginning of Lualualei Ranch. The lease was written for 30 years with a lease fee of $700 per year (DLNR 1845–1903:4:616-618). It seems Jarrett sold Paul F. Marin, son of Don Francisco de Paula Marin, half of his interest in the ranch. Marin lived on the ranch and managed it until

1864, when a dispute arose over the profits of the ranch. Apparently, Marin had never turned over any ranch profits to Jarrett during the time he managed it. After the dispute was settled, Jarrett took on George Galbraith as a new partner (DLNR 1845–1903:18:31).

In 1869, Jarrett sold the remaining years of his son's interest in Lualualei Ranch to James Dowsett (DLNR 1845–1903:29:16-18). James Dowsett was a descendant of a British sea captain and is noted for being the first Anglo-Saxon child born in Honolulu (Nakamura and Pantaleo 1994:21). Dowsett was an entrepreneur of sorts and dabbled in many different business ventures, such as "a whaling fleet, a dairy, a salt works, an extensive trade in *awa* (a Hawaiian narcotic drink) and numerous land holdings . . . He also ran cattle at different times in Nanakuli, Mikilua and Lualualei" (McGrath et al. 1973:32).

In 1880, George Bowser traveled through Waiʻanae and described Lualualei in his journal:

> Leaving Waiʻanae, a ride of about two miles brought me to the Lualualei Valley, another romantic place opening to the sea and surrounded in every direction by high mountains. This valley is occupied as a grazing farm by Messrs. Dowsett & Galbraith, who lease some sixteen thousand acres from the Crown. Its dimensions do not differ materially from those of the Waianae Valley, except that it is broader —say, two miles in width by a length of six or seven miles. The hills which enclose it, however, are not so precipitous as those at Waianae, and have, therefore, more grazing land on their lower slopes, a circumstance which adds greatly to the value of the property as a stock farm. Although only occupied for grazing purposes at present, there is nothing in the nature of the soil to prevent the cultivation of the sugar cane, Indian corn, etc. Arrangements for irrigation, however, will be a necessary preliminary to cultivation. [Bowser 1880:493-494]

Bowser's comments imply that though water was still a problem, Lualualei seemed to have some potential for development.

In 1894, Link McCandless entered the ranching scene:

> . . . he and a man named Tom King chartered the brigantine Oakland in Seattle, filled her hole with cattle and the cabins with feed, and sailed for Hawaiʻi. By the turn of the century, McCandless' ranching empire covered much of the Waianae Coast, including land at Nanakuli, 4,000 acres at Lualualei, San Andrews' property in Makua and pastures toward Kaena Point. [McGrath et al. 1973:68]

An 1894 description of Lualualei by the Commissioner of Crown Lands (1894:36) described the land as "one of the best and most valuable of the Crown lands on the Island of Oahu . . . surpassing any of the other lands for richness and great fertility of the soil."

The sugar industry came to the Waiʻanae coast in 1878 when the first sugar cane was planted in upper Waiʻanae Valley. By 1892, at least 300 acres of cane were planted in Lualualei. In addition to the cultivated lands, a railroad, irrigation ditches, flumes, reservoirs, and plantation housing were constructed to support the sugar industry. The cane from the *mauka* areas of Lualualei was loaded onto a railroad and transported to the mill at Waiʻanae.

3.4.1 Oahu Railway and Land Company

Benjamin Dillingham, a prominent business man and developer, envisioned populating the western side of Oʻahu by introducing agriculture; however, the lack of water proved to be an obstacle until the discovery of artesian water solved the issue in the early 1880s. Dillingham foresaw an economic opportunity in providing reliable transportation that was needed to move crops from the west side of the island into Honolulu. The railway was a means to provide transportation to the country and promote development of unoccupied lands, as well as connect with the sugar plantations in ʻEwa, Waiʻanae, Waialua, and Kahuku. With the help of several other businessmen and the legislature, Dillingham formed the OR&L in February 1889. The first few miles of track were laid and functional by the end of that year and the first length of the railway was completed and opened to the public by 1 January 1890. Along with James Castle and others, Dillingham had invested in large tracts of land for speculation and resale, but the idea was slow to catch on because "the land lay too far from Honolulu, at least 12 miles" (McGrath et al. 1973:54). Five years later, on 4 July 1895, the railway finally reached Waiʻanae. The OR&L stretched as far as Kahuku by 1899 and agricultural interests were using the rail to ship produce to Honolulu for the benefit of all. By 1914, track had been laid to Wahiāwa to ship pineapple from the Dole Plantation.

The military also used the rail system during development of Pearl Harbor and Schofield Barracks, and during World War II the OR&L carried ammunition, supplies, troops, and defense workers. Passenger fares also added to the profitability of the rail in the early part of the twentieth century. After World War II the railroad was utilized less as motorized vehicles became more economical. The 1946 tsunami destroyed long sections of track on the cliffs near Kaʻena Point and along the Waiʻanae Coast. The lines were not rebuilt and by 1947 all rail operations ceased outside of Honolulu. The Department of the Navy assumed control of the tracks from the Lualualei ammunition depot to Pearl Harbor (Chiddix and Simpson 2004:270). In 1970 the Hawaiian Railway Society formed "to save what remained of Hawaiʻi's railroad history." The group has restored some 6.5 miles of track and placed the intact portion of the system, extending from Nānākuli to ʻEwa, on the National and State Registers of Historic Places (Chiddix and Simpson 2004:273).

3.5 1900s

3.5.1 Sugar and Ranching

An 1883 article from the *Honolulu Daily Bulletin* illustrates the *paniolo* (Hawaiian cowboy) lifestyle on the Mikilua Ranch within a kilometer of the project area.

> Early Thursday morning, a number of natives started from the Hon. J. Dowsett's ranch at Mikilua, a drove of cattle for the market. On reaching Halawa, several of the animals got into a patch of Mimosa scrub. Two of the drivers dismounted their horses and proceeded on foot to drive the cattle out. While doing so a young bullock charged at Maia, one of the men goring him on the right side just above the collar bone. Dr. Wood was at once sent for and after making the injured man comfortable and had him removed to Queen's Hospital. He is resting easily today and his condition is favorable. [*Honolulu Daily Bulletin Weekly Summary*, 16 October 1883]

By 1901, the Waianae Sugar Company had obtained a five-year lease on 3,332 acres of land at Lualualei to be used for raising cane as well as for ranching (DLNR 1902). Sugar and ranching continued to dominate the Lualualei landscape during the early years of the twentieth century. The determining factor in the success of Lualualei for sugar production was always the water.

Throughout the first half of the twentieth century, the Waianae Sugar Company continued cultivating their sugar lands in Lualualei. However, by the 1940s the Waianae Sugar Company could no longer compete with foreign labor. The combination of drought problems, labor unions, and land battles undermined the Waianae Sugar Company. In 1946 the Company was liquidated and the land was sold.

3.5.2 Homesteading and Residential Development

Following the overthrow of the Hawaiian monarchy in 1893, Crown Lands and Government Lands were combined to become Public Lands. The Crown Lands were no longer indistinguishable and inalienable. In 1895, the Republic of Hawaii decided to open up lands for homesteading in the hopes of attracting a "desirable class of immigrants" — Americans and those of Caucasian decent (Kuykendall and Day 1961:204). In anticipation of the Dowsett-Galbraith lease expiring in 1901, the Government intended to auction off these lands to the highest bidder.

There were two waves of homesteading on the Waiʻanae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Waiʻanae Kai. In 1902, the Government ran ads in the local newspapers stating their intent to open up land in Lualualei for homesteads (Kelly 1991:328). Due to the lack of water, the lots were classified as second-class pastoral land, rather than agricultural land. The homesteads were sold in three series between the years 1903 and 1912. In Lualualei, the first series was for *mauka* lots purchased by McCandless, who ranched most of his land until 1929, subletting use rights to the Sandwich Island Honey Company. The second and third series were for lots in the lower valley and along the coast, *mauka* of the government road.

Figure 13 shows the Lualualei Homesteads adjacent to the project area in 1914. By the early 1920s, about 40 families had settled on homestead lots in Lualualei (Kelly 1991:331-332). A 1919 U.S. Army War Department Fire Control map (Figure 14) shows a general lack of development within the project area vicinity, but does indicate sugar cane production within at least the northwestern portion of the project area. Figure 14 also shows a side track extending north from the OR&L near the western corner of the project area. This portion of track may be related to a cattle loading zone and then would be related to the development of the ranching to market activities of Mikilua Ranch. The railway served the Waiʻanae coast until 1946 when the Waianae Sugar Plantation closed.

Despite promises by the government to supply water to Lualualei, what little there was, was not enough to go around. Competition between the Waianae Plantation and the homesteaders for water caused friction within the community. Homesteaders had to carry their water in and many lost their crops. The Waianae Sugar Company had secured a lease with the Government to take 2.5 million gallons of water daily from Government lands; however, despite the expiration of their lease, the plantation continued to take the water. Finally in 1924, the Government made an agreement with the plantation to release 112,000 gallons of water daily for the homesteaders.

A 1936 U.S. Army War Department Terrain map (Figure 15) shows a road (the present Lualualei Naval Road) established along the east edge of the project area. A 1943 U.S. Army War Department topographic map (Figure 16) shows little change over time within the project area vicinity. A 1953/1954 USGS map (Figure 17) shows substantial increase in development with the establishment of Lualualei Road extending from the coast into the valley just to the west of the project area and several unimproved roads running southeast off Lualualei Road. This new road network is associated with a number of new homes. Generally speaking, development lagged until a reliable water supply was established in 1964. An aerial photograph from 1965 (see Figure 7) and a 1963-1969 USGS topographic map of the project area (Figure 18), show quarry activity in much of the southeast portion of the project area (understood as in support of cement production), and also portrays the increased local development and construction of ʻUlehawa Drainage Channel southwest of the project area. The built environment appears to be similar to the current setting.

3.5.3 The Government Road

Farrington Highway was originally constructed in the 1930s. Its predecessor along the Waiʻanae Coast was variously termed the “Government Road” or “Old Waiʻanae Road” and provided less than ideal travel and transport conditions for the District. Farrington Highway’s predecessor was described as a “mud hole in the winter and billowed dust in the summer” (McGrath et al. 1973:50). The Old Waiʻanae Road was not paved and there were no bridges to cross streams. Prior to the construction of Farrington Highway, most transport and travel between Waiʻanae and Honolulu was made by steamer ship or the OR&L Railroad due to transport limitations over the Old Waiʻanae Road (McGrath et al. 1973).

The construction of Farrington Highway was a component of the overall Territorial Highway System. It was only after 1925 that Territorial officials made use of available federal funding assistance for road and bridge construction. This led to abundant bridge and road construction after 1925 in Hawaiʻi. Further federal assistance became available in the 1930s as part of the Works Progress Administration and National Reclamation Association programs; this funding lead to additional standardization and improvement of the Territorial Highway System (Thompson 1983: III-15). These improvements were significant events that greatly facilitated intra-island travel, transportation, and communication. Farrington Highway was eventually named after Wallace Rider Farrington (1871–1933), a former Honolulu newspaper man, Mayor of Honolulu, and

Territorial Governor of Hawaiʻi (1921–1929) who was influential in expanding Hawaiʻi's roadways.

Once constructed, Farrington Highway became an important transportation and communication corridor that connected Oʻahu's Waiʻanae District with Honolulu and the rest of the island. Figure 19 is an undated photograph of the "Old Waiʻanae Road" in Mākaha, in the vicinity of the project area, facing south toward Waiʻanae. Figure 20 shows the rural nature of Farrington Highway along the Waiʻanae Coast in the 1940s. Figure 21 shows tanks on the Farrington Highway in Nānākuli, just south of the current project area, during World War II.

3.5.4 Military

Another major influence in Lualualei during the twentieth century was the United States military. By 1929 over 8,184 acres of the McCandless Cattle Ranch had been condemned and purchased by the U.S. Navy for the construction of a Naval Ammunition Depot for ships of the Pearl Harbor Naval Base. The construction of Naval Magazine LLL and Radio Transmission Facility (RTF) took place in Lualualei between 1930 and 1935 (Kelly 1991:339-341). The number of troops stationed and trained on the Waiʻanae Coast during World War II at times reached 15,000 to 20,000 (McGrath et al. 1973:136). Waiʻanae beaches were fortified with barbed wire and concrete bunkers—many of which are still visible today. At the time, martial law severely curtailed the movements of the local population.

After World War II, the lower portions of Lualualei Valley that had been utilized by the military were developed into residential lots. In 1971, the Navy began subleasing some of their lands for agricultural uses, primarily for grazing and bee keeping. The presence of the military at Lualualei also boosted the local economy by providing jobs to residents over the years.

3.5.5 Modern Land Use

The construction of the ʻUlehawa Stream bridge, the southern limit of the project area, was completed in 1964. At the same time, the ʻUlehawa Drainage Channel was constructed. This channel transports water from ʻUlehawa Stream's upper reaches in Lualualei Valley to the ocean. In our field excursion we noted the presence of standing water in the ʻUlehawa Stream gulch, likely related to the channelization of the mouth of this stream in 1964. The 1965 aerial photo shows the project area in much the same condition as it exists today (see Figure 7).

The proposed project area is comprised primarily of the active footprint of the PVT Landfill, with noted margin boundary in the western and northwestern portions of the project relating to the ʻUlehawa riparian zone. Residential areas and local businesses, including a pig farm and a used automobile parts yard make up the western project boundary neighbors to the west and northwest of the project area. The U.S. Naval Road comprises the entire project boundary margin to the east. Opposite the U.S. Naval Road is owned by Tropic Land LLC (Hammatt, Robins and Stride 1993; Hammatt and Shideler 2010). Immediately to the southwest of the project area is the Princess Kahanu Estates subdivision, a Hawaiian Homestead community.

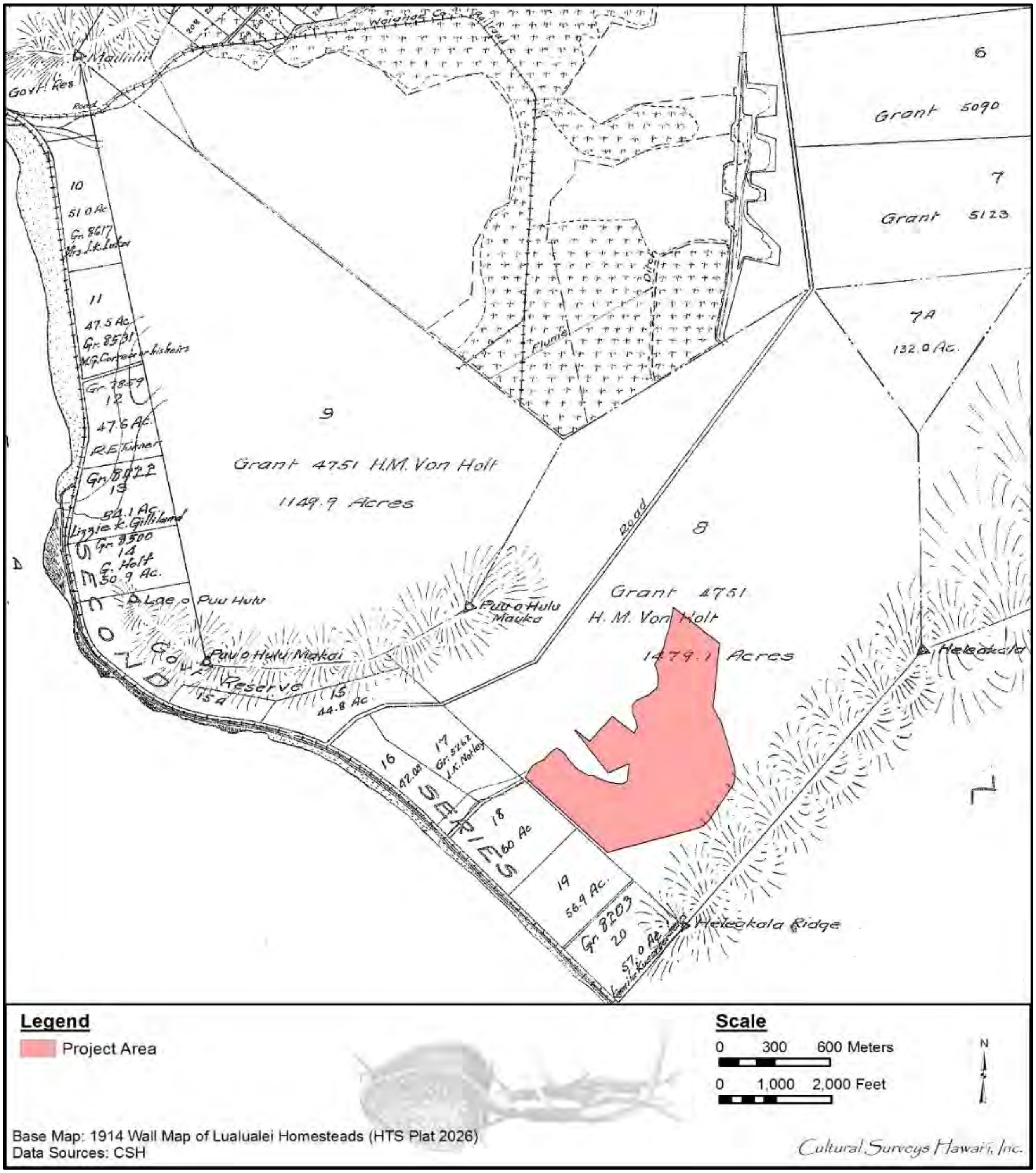

Figure 13. Portion of the 1914 Wall map of Lualualei Homesteads, indicating the project area

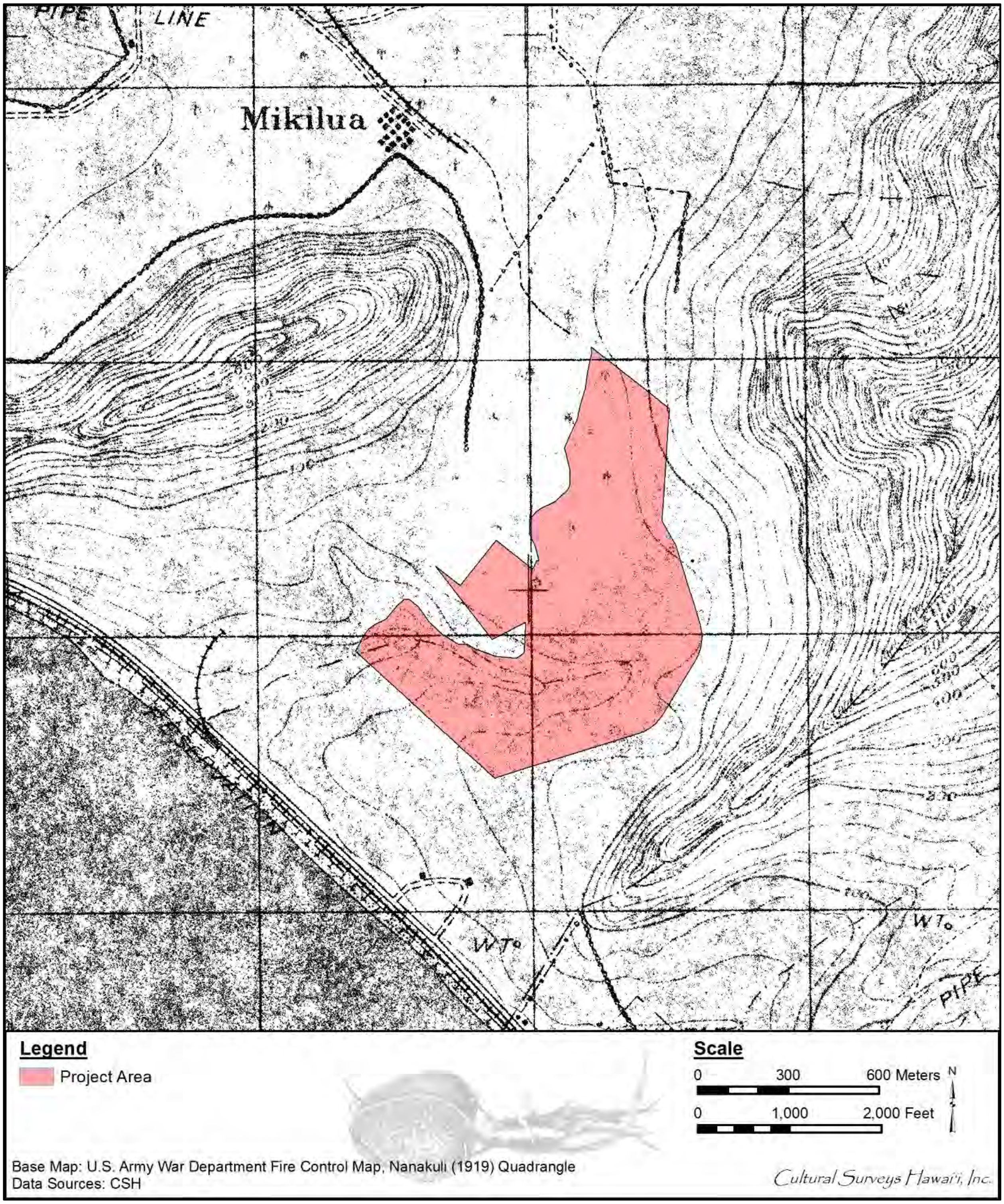

Figure 14. Portion of the 1919 U.S Army War Department fire control map, Nanakuli Quadrangle, indicating sugar cane production in the northwest portion of the project area

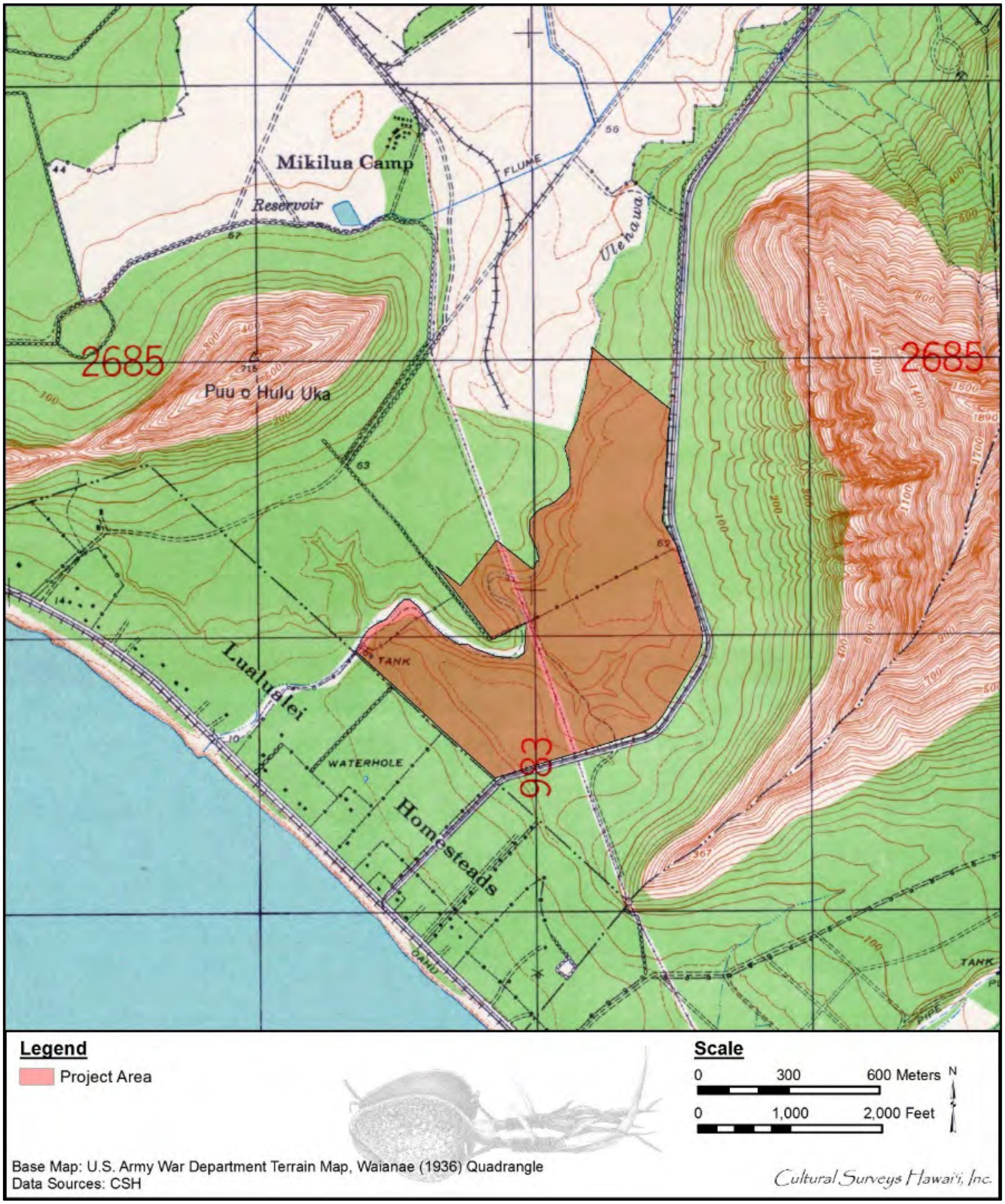

Figure 15. Portion of the 1936 U.S. Army War Department terrain map, Waianae Quadrangle, indicating the project area

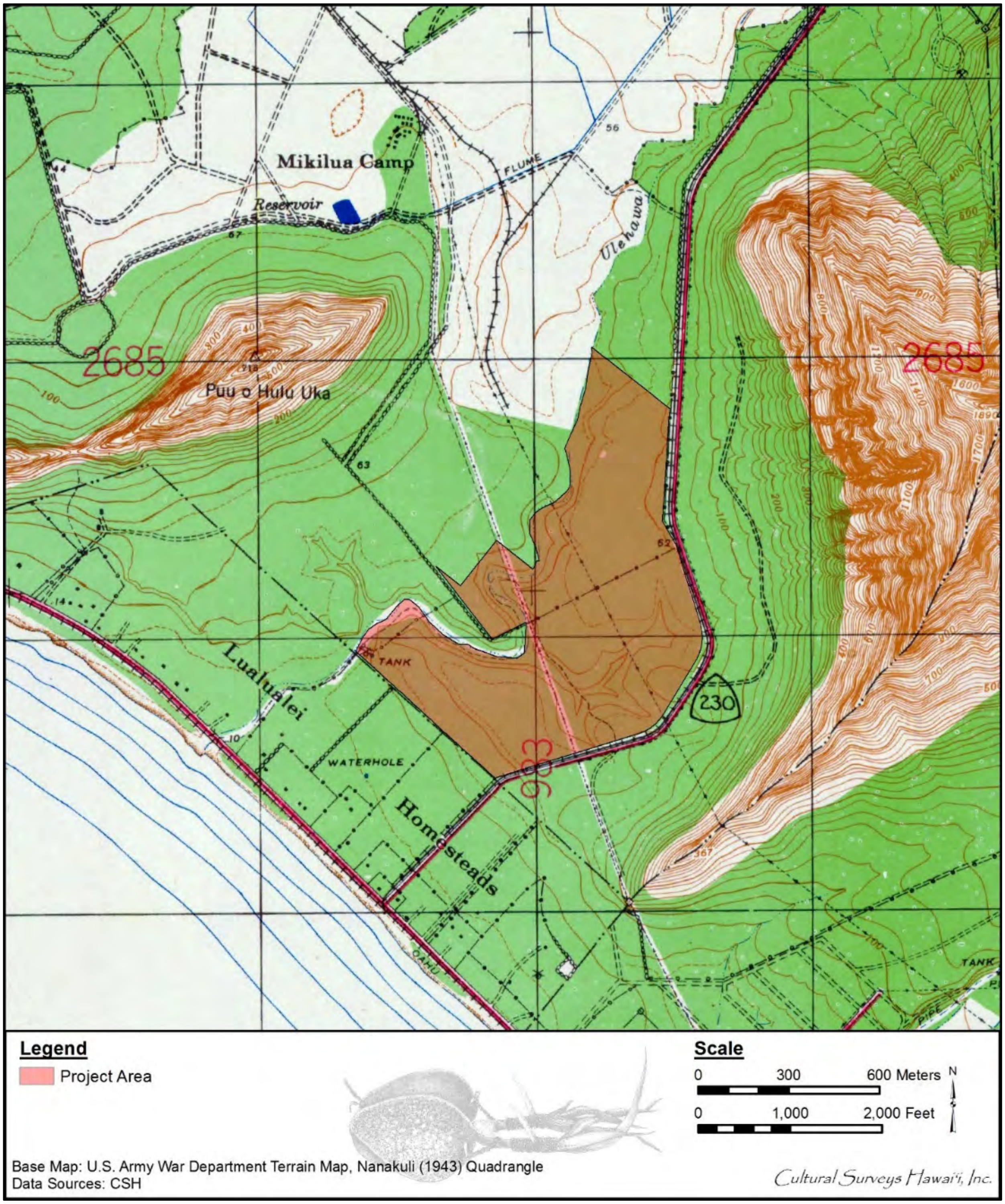

Figure 16. Portion of the 1943 U.S. Army topographic map, Nanakuli Quadrangle, indicating the project area

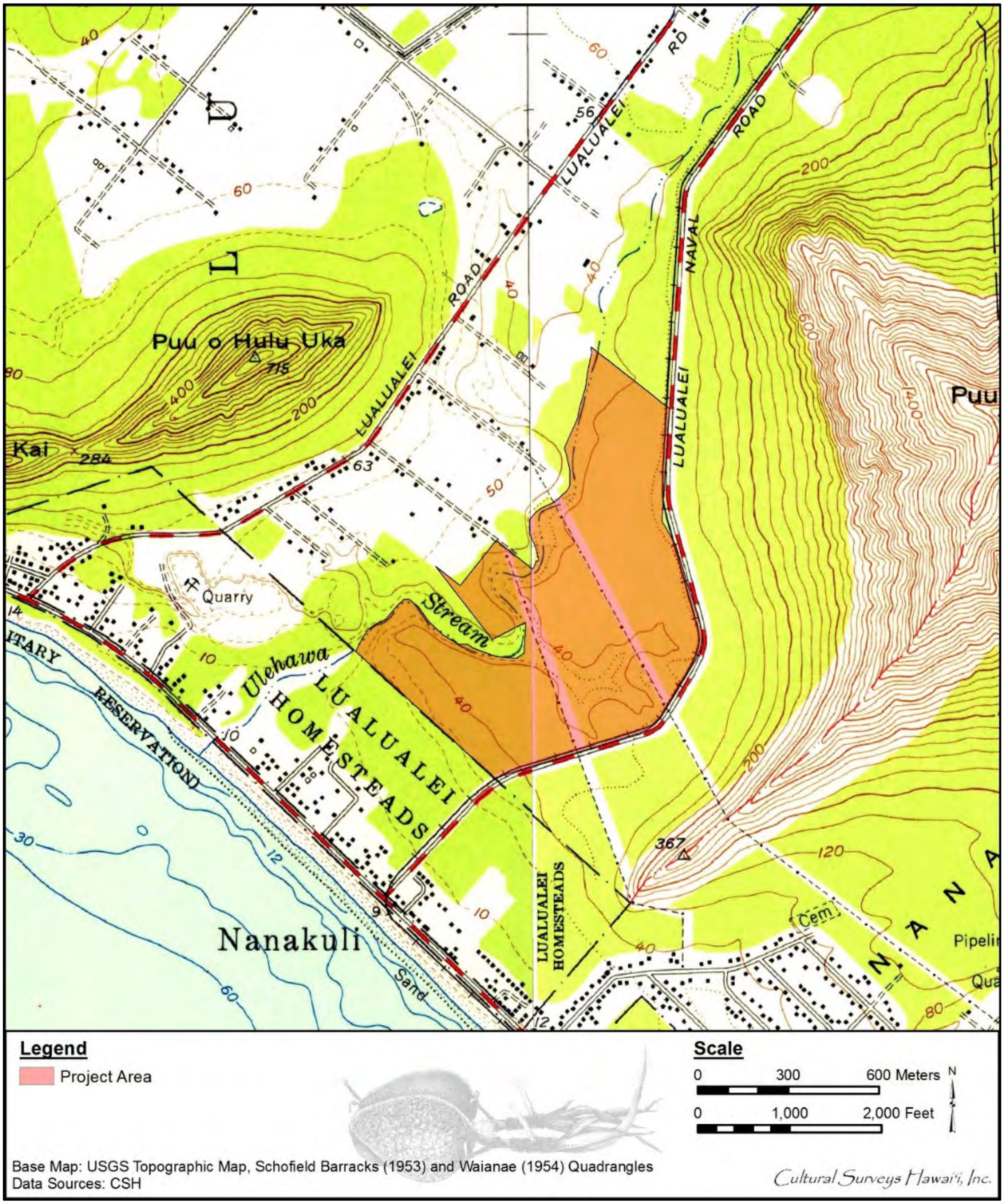

Figure 17. Portion of the 1953 Schofield Barracks and 1954 Waianae USGS topographic quadrangles, indicating the project area

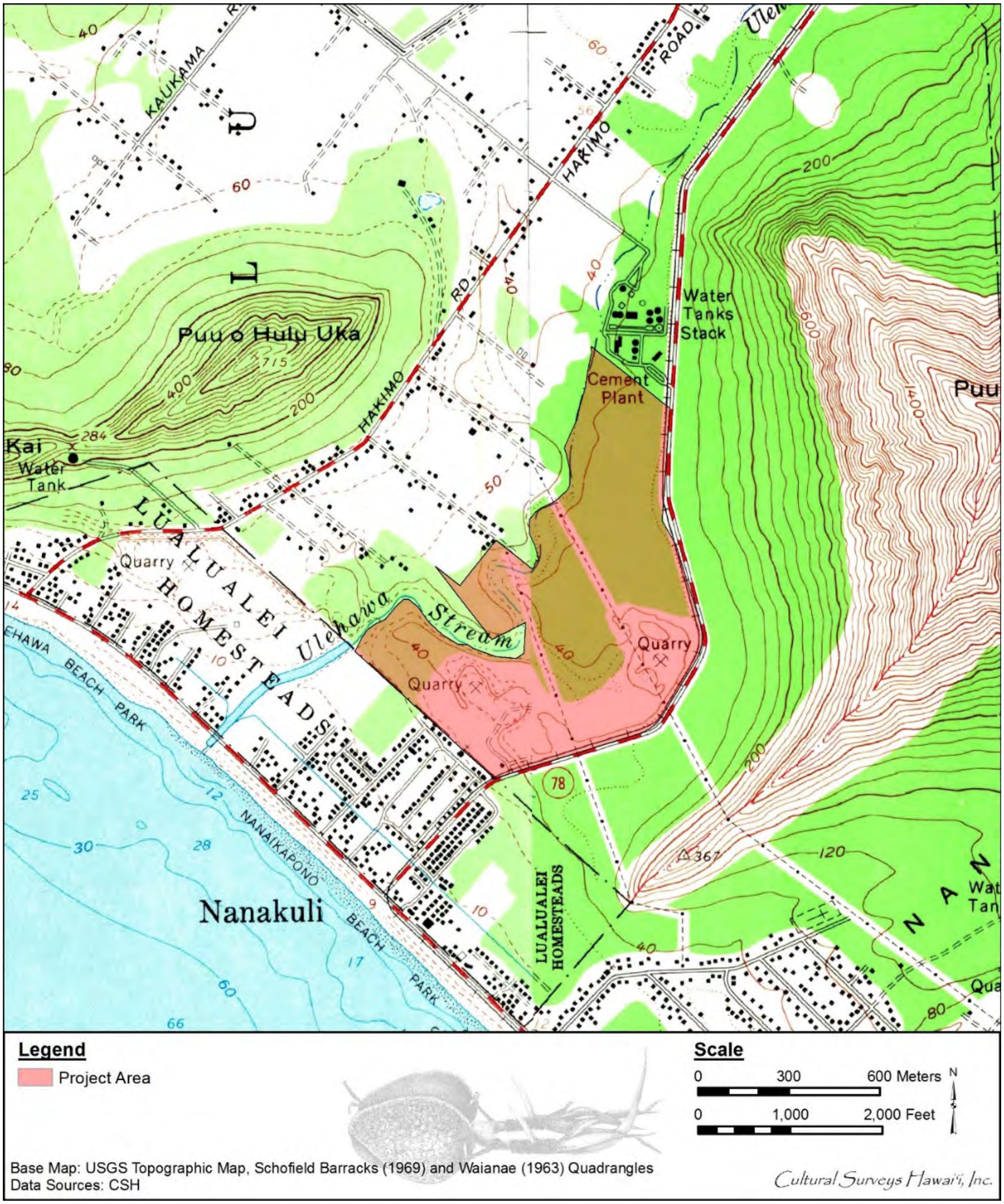

Figure 18. Portion of the 1969 Schofield Barracks and 1963 Waianae USGS topographic quadrangles, indicating the project area

Figure 19. Undated photograph of the crushed coral Wai‘anae Road in Mākaha (McGrath et al. 1973:51)

Figure 20. Farrington Highway, late 1940s, along the Wai‘anae Coast

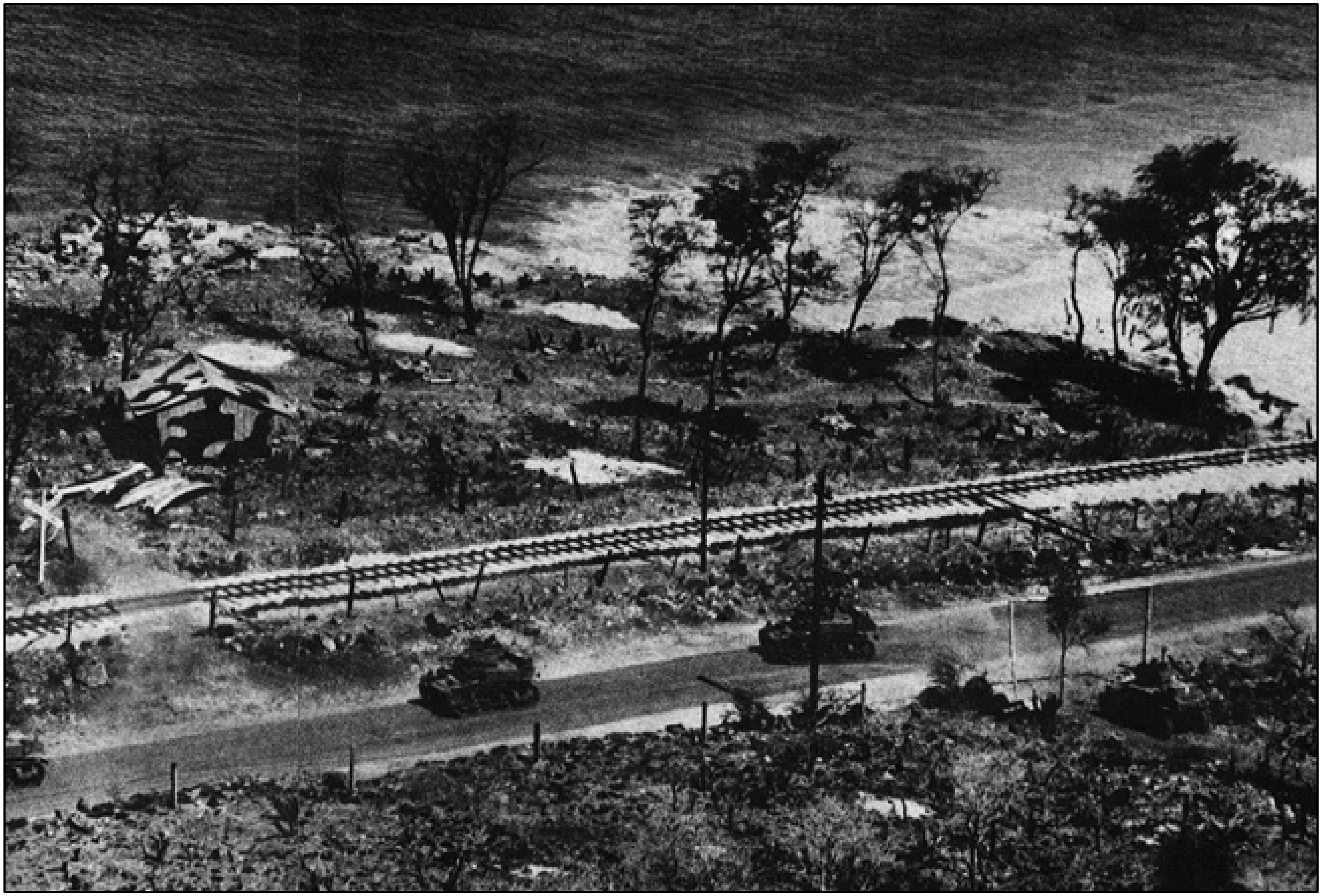

Figure 21. Photograph of Farrington Highway in Nānākuli, just south of the project area, taken during World War II (McGrath et al. 1973:138-139

Section 4 Previous Archaeological Research

This section is an overview of the 35 known archaeological studies (Figure 22 and Table 1) and associated 49 recorded archaeological sites in Lualualei Ahupuaʻa (Figure 23). A discussion of the earliest findings in the area is followed by archaeological investigations and their relevance to the current project area. Bordner (1977) completed the initial intensive archaeological reconnaissance survey on the proposed Nānākuli Landfill and found no historic properties. He comments, "…much of the area was at one time involved in either quarrying operations or ranching, both resulting in extensive modification of the surface. In the areas not damaged through these activities, no sites of archaeological interest were found" (Bordner 1977:iv).

4.1 Early Research

The earliest attempt to record archaeological sites in Lualualei was made in the early 1900s by Thomas G. Thrum in his development of compendia of Hawaiian *heiau* (pre-Christian places of worship). In the early 1930s, J. Gilbert McAllister conducted a survey of archaeological sites on Oʻahu. One of McAllister's tasks was to try to confirm the *heiau* Thrum had recorded decades earlier, as well as locate any other archaeological sites such as house sites and petroglyphs. McAllister provided detailed information on two of the *heiau* Thrum located near the current project area in Lualualei. Thrum describes *heiau* as belonging to certain classifications such as *poʻo kanaka* and *luakini*, both of which were considered high importance and were only built by chiefs on sites where temples had previously been constructed (Stokes 1991:32–33). These two types of *heiau* were considered sacrificial. When this type of *heiau* was being built, "its consecration required not merely hundreds of pigs, bunches of bananas and coconuts, with numerous other offerings and gifts, but also a human victim" (Stokes 1991:33).

Approximately 600 m south/southeast of the project area is McAllister (1933:110) Site 147, Ilihune Heiau, "of which nothing remains." In reference to Ilihune Heiau, Thrum (1906:79) notes that it was "a small walled heiau of pookanaka class; used by Frank Manini as a cattle pen, for which the natives prophesied his poverty and death."

Approximately 2,400 m east/northeast of the project area and 1.1 miles from the Nānākuli Station going towards Puʻuʻohulu (Sterling and Summers 1978:64) is McAllister Site 148, a large rock said to be named Maui (or Māui). McAllister states the following:

> Northeast of the road on the property of E.P. Fogarty is a rock said to be named after the Hawaiian hero, Maui, who is said to have landed here when he first came to the Hawaiian Islands from the south. This stone at the time was surrounded by water and it was here that Maui reposed and sunned himself. In the bluff just northeast of the rock is a shelter in which he lived, and in the vicinity was a spring where he obtained water. The large rock is now split in half and adorned with many small, oddly shaped rocks. It is said to be bad fortune to build one's house across a line drawn directly from the rock to the shore. J.J. Mathews is said to have collected detailed information in regard to this site. [McAllister 1933:110]

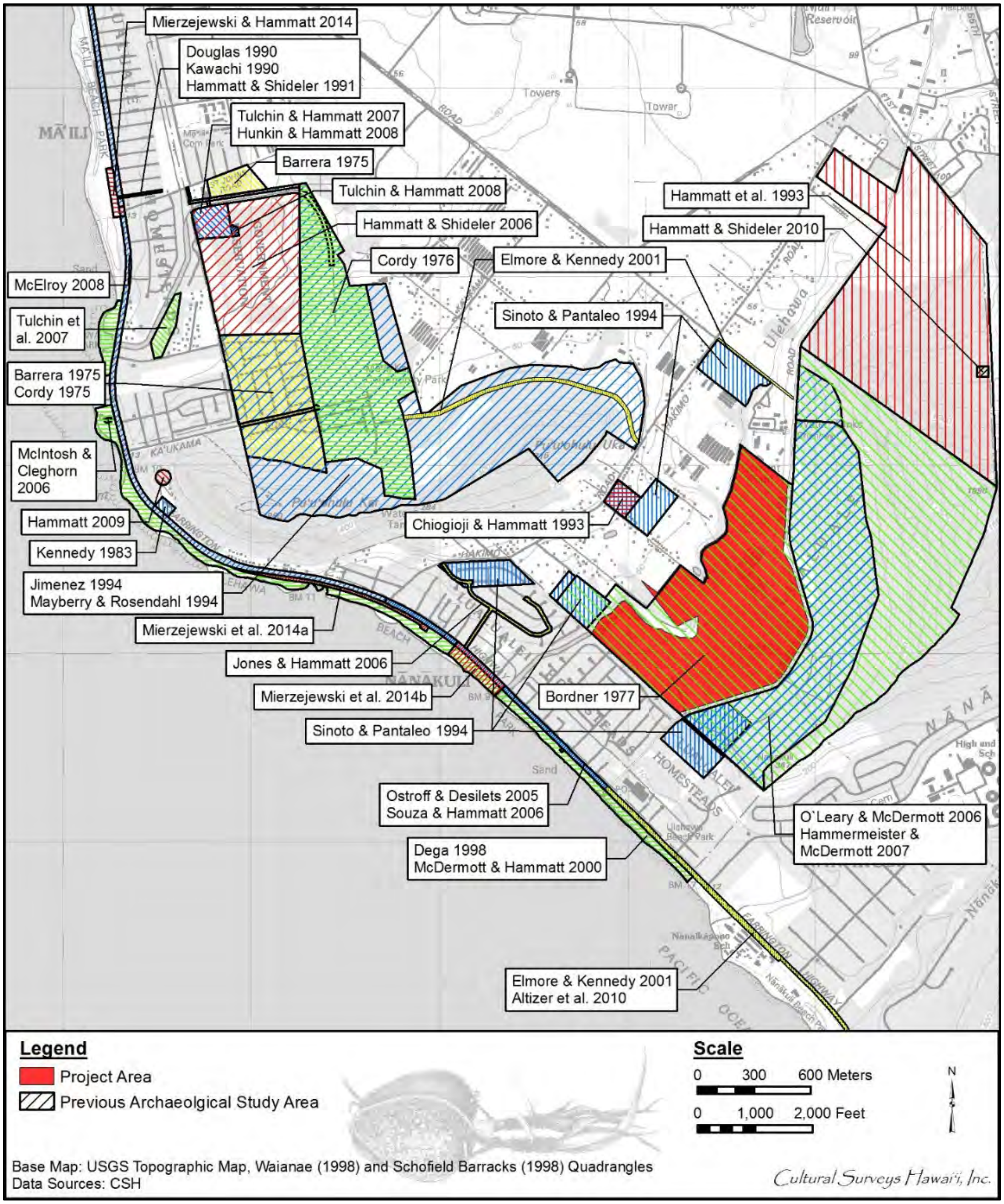

Figure 22. Previous archaeological studies in the vicinity of the project area

Table 1. Previous Archaeological Studies in in Lualualei Ahupuaʻa

Reference	Type of Study	Location	Description and Results
McAllister 1933	Island-wide survey	Lualualei Ahupuaʻa	Recorded eight sites in or near Lualualei: Site 147, Ilihune Heiau; Site 148, rock called Maui; Site 149, Nioiula Heiau on Hālona ridge; Site 150, house sites or *heiau* at Pahoa cliffs; Site 151, Kakioe Heiau at Pūhāwai; Site 152 Puʻu Pāheʻeheʻe Heiau; Site 153, Kūʻīlioloa Heiau; Site 162, Mauna Kūwale burial cave, house sites and petroglyph rock in ʻUlehawa Beach Park
Barrera 1975	Archaeological survey	Māʻili, Kaiser Pacific Properties Corp. Land	Six sites identified including a religious structure, C-shaped feature, two house site features, possible site and midden scatter
Cordy 1975	Excavation report	Māʻili, Kaiser Pacific Properties	Excavation of Site CH-0A, the religious structure identified by Barrera (1975); no evidence recovered to confirm site as a religious structure; Cordy concluded it was a modern structure built no earlier than 1930 or 1940
Cordy 1976	Archaeological survey	Kaiser Pacific Properties Land, Maili Kai	16 sites including walls, enclosures, platforms, and trail
Bordner 1977	Archaeological reconnaissance survey	Nānākuli landfill, TMK: [1] 8-7-009	No historic properties observed
Kennedy 1983	Archaeological reconnaissance survey	Waiʻanae Corporation Yard, Māʻili	No historic properties observed
Douglas 1990	Report on human skeletal remains	Kualoa Beach Park	Nearly complete remains of two individuals, incomplete remains of a male and a child, and two unassociated bone fragments
Kawachi 1990	Report on habitation and historic burials	Kalauao, ʻEwa	Two historic human burials and a traditional habitation site including a pit hearth *imu* (earth oven)

Reference	Type of Study	Location	Description and Results
Hammatt and Shideler 1991	Archaeological inventory survey	TMK: [1] 9-17:056 por., Honouliuli, ‘Ewa	No historic properties observed
Haun 1991	Archaeological survey	Lualualei Naval Magazine and Naval Communications Area Transmission Facility	A total of 119 sites, consisting of 477 features, including indigenous Hawaiian stacked rock feature types, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces and paved terraces as well as historic and recent structures associated with cattle ranching and the military (not shown in Figure 22)
Chiogioji and Hammatt 1993	Archaeological survey and testing	5-acre parcel between Pu‘u o Hulu and ‘Ulehawa Stream; TMK: [1] 8-7-021:017	No historic properties observed
Hammatt et al. 1993	Archaeological inventory survey	Lualualei Golf Course	Identified eight sites including two traditional Hawaiian sites (one habitation complex and remnants of one wall) and six historic sites (cattle wall, furnace, wells, house lot, cement foundation structure)
Jimenez 1994	Additional inventory survey	Mā‘ili Kai, TMK: [1] 8-7-010:002	Conducted at four previously inventoried sites in Mā‘ili Kai project area (Mayberry and Rosendahl 1994); Jimenez (1994) identified intact pre-Contact and historic cultural deposits at two sites; intact prehistoric and historic cultural deposits identified at two of the four sites tested; TU-4 site deemed significate enough for future data collection; TU-4 included a C-shaped enclosure with a radiocarbon age of AD 1426-1676 and chert flakes

Reference	Type of Study	Location	Description and Results
Mayberry and Rosendahl 1994	Reconnaissance survey	Māʻili Kai, TMK: [1] 8-7-010:002, 014	In a Māʻili Kai project area; 26 sites identified, 24 dated to twentieth century and 22 dated from 1930 to present; remaining two sites consisted of rock features possibly pre-dating twentieth century
Sinoto and Pantaleo 1994	Reconnaissance survey	Lualualei Homesteads	No historic properties observed
Dega 1998	Letter report regarding archival and field reconnaissance	ʻUlehawa Beach Park project, Nānākuli	Pedestrian survey identified 10 m x 8-10 cm thick cultural horizon in stabilized dune profile consisting of charcoal flecks, bird and fish bone plus historic structures including abandoned WWII bunkers; report also commented on 2 x 2 ft sandstone petroglyphic rock with three figures removed from beach park area to Bishop Museum
McDermott and Hammatt 2000	Archaeological inventory survey	Māʻili, ʻUlehawa Beach Park	Conducted at ʻUlehawa Beach Park; three sites, including features of WWII-era bunker (SIHP # -5761) and two subsurface cultural layers (SIHP #s -5762 and -5763), documented during test excavations; deposits consisted of midden (e.g., marine shell, fish bone) and both indigenous (fishhooks, volcanic glass, basalt flakes) and historic (glass, metal and concrete fragments) artifacts; both layers appeared to date to late pre-Contact or very early post-Contact periods
Elmore and Kennedy 2001	Archaeological inventory survey	Waiʻanae Coast Emergency Access Rd, *makai* side of Farrington Hwy	No historic properties observed

Reference	Type of Study	Location	Description and Results
Ostroff and Desilets 2005	Archaeological monitoring	Water line installation on Farrington Hwy	Identified five charcoal-enriched sand deposits including BWS-5 in current project area; no cultural materials identified
Hammatt and Shideler 2006	Archaeological field check and literature review	Mākaha, Wai'anae, and Lualualei Ahupua'a, TMKs: [1] 8-4-016:008; 8-5-008:040, 041, 044; 8-5-018:019; 8-6-003:008, and 8-7-010:007	Conducted for five locations for Leeward Coast Emergency Homeless Shelter project; no historic properties identified; recommended conducting an AIS for Lualualei "Government Reservation" parcel
Jones and Hammatt 2006	Archaeological monitoring	La'ikū, Wai'olu, and Princess Kahanu Streets, Lualualei, TMKs: [1] 8-7-007:033, 042, and 043	No historic properties observed
McIntosh and Cleghorn 2006	Archaeological monitoring	'Ulehawa Beach Park, Ahupua'a of Lualualei, TMK: [1] 8-7-005:001	Identification of a single two-component site: SIHP # 50-80-07-6771 contained prehistoric component consisting of at least two human burials and historic component consisting of two recent trash pits; single radiocarbon date of AD 1300-1430 returned for a sample of charcoal recovered from beneath Burial 1
O'Leary and McDermott 2006	Archaeological inventory survey	Southwestern slopes of Pu'u Heleakalā	For a proposed Nānākuli B site materials recovery facility and landfill; identified pre-Contact rock shelter (SIHP # -6699) and WWII concrete bunker (SIHP # -6681)
Souza and Hammatt 2006	Archaeological monitoring	Fiber optic installation, Farrington Hwy	No historic properties observed
Hammermeister and McDermott 2007	Addendum to archaeological inventory survey	Southwestern slopes of Pu'u Heleakalā	For a proposed Nānākuli B site materials recovery facility and landfill; identified SIHP # -6920, circular mound interpreted as marker; site identified during cultural impact assessment site visit

Reference	Type of Study	Location	Description and Results
Tulchin and Hammatt 2007	Archaeological assessment	Mā‘ili	No historic properties observed
Tulchin et al. 2007	Archaeological assessment	Waianae Sustainable Communities Plan project, TMK: [1] 8-7-023:060	No historic properties observed
Hunkin and Hammatt 2008	Archaeological monitoring	NW corner of “Government Reservation,” NW of Mā‘ili Beach Park, TMK: [1] 8-7-010:007	No historic properties identified, no human burials observed
McElroy 2008	Archaeological monitoring	Lualualei, Wai‘anae, and Mākaha Ahupua‘a, portions of TMKs: [1] 8-7, 8-6, 8-5, 8-4, 8-3, and 8-2	No archaeological sites or deposits encountered
Tulchin and Hammatt 2008	Addendum to archaeological assessment	Leeward Homeless Shelter project, Lualualei TMK: [1] 8-7-010:007 por.	Addresses a 0.5-acre parcel; no historic properties identified
Hammatt 2009	Letter report on on-site monitoring	Lualualei Ahupua‘a, TMK: [1] 8-7-006:008	No cultural deposits observed
Altizer et al. 2010	Archaeological field inspection and literature review	Farrington Hwy intersection improvements, multiple TMKs	Three historic properties observed: SIHP # -9714 (OR&L Railroad), SIHP # -6824, and pre-Contact cultural layer
Hammatt and Shideler 2010	Archaeological literature review	Lualualei Ahupua‘a, TMK [1] 8-7-009:002	“Based on the current investigation, there has been no land disturbance in the vicinity of SIHP #50-80-06-4366 and none is anticipated in the foreseeable future. The installation of the continuous event fencing is regarded as an appropriate and sufficient measure to protect the site from inadvertent damage” (Hammatt and Shideler 2010:42).

Reference	Type of Study	Location	Description and Results
Mierzejewski and Hammatt 2014	Archaeological monitoring for Māʻili Beach Park Parking Improvements project Phase I and II (Project No. 12-P-11)	Lualualei Ahupuaʻa, TMKs: [1] 8-7-015:001 por., 003–008 por., 039 por., 8-7-028:021–023 por., and Farrington Hwy Right-of-Way	No historic properties or subsurface cultural deposits observed during archaeological monitoring
Mierzejewski et al. 2014a	Archaeological monitoring	Māʻili Beach Park Parking, Lualualei Ahupuaʻa, TMKs: [1] 8-7-015:001 por., 003–008 por., 039 por., 8-7-028:021–023 por., and Farrington Hwy Right-of-Way	No historic properties or subsurface cultural deposits observed during archaeological monitoring
Mierzejewski et al. 2014b	Archaeological monitoring	ʻUlehawa Beach Park, Lualualei Ahupuaʻa, TMK: [1] 8-7-007:001 por.	No historic properties or subsurface cultural deposits observed during archaeological monitoring

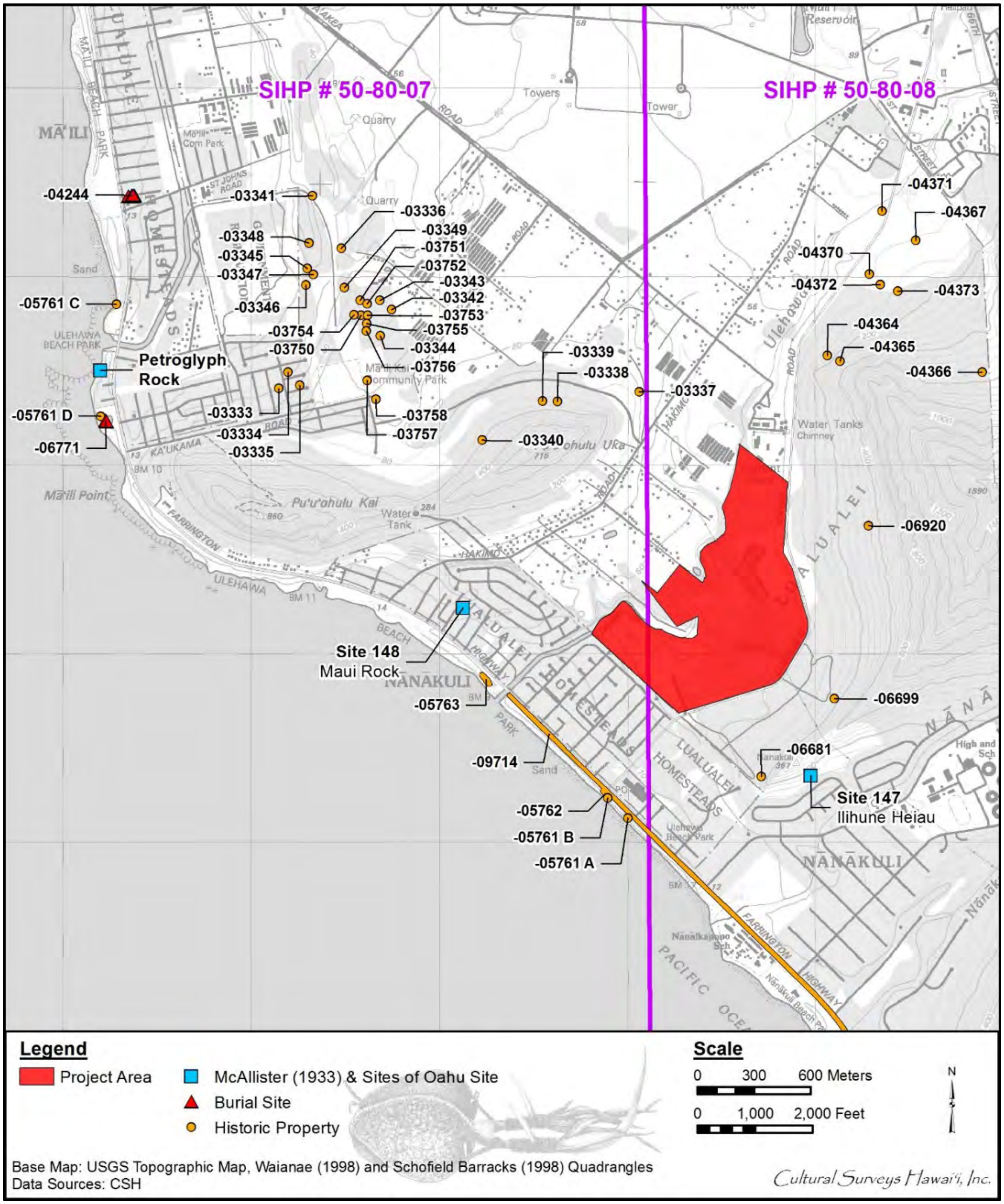

Figure 23. Previously recorded historic properties within the immediate vicinity of the project area

Table 2. Previously Recorded Historic Properties within the Immediate Vicinity of the Project Area

SIHP # 50-80-07 and 50-80-08	Nature of Site	General location	Source
50-80-07-03333	Agricultural/ranching complex (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03334	Charcoal kiln complex (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03335	Well (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03336	Reservoir complex	N central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03337	Wall (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03338	Mounds (unknown)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03339	C-Shape and wall (unknown)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03340	C-Shape (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03341	Wall (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03342	Wall (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03343	Enclosure (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03344	Platform (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03345	Wall and mound (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03346	Wall (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03347	Wall (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03348	Mounds (post-Contact)	N coastal Lualualei	Mayberry and Rosendahl 1994
50-80-07-03349	C-shape (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03750	C-shape (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03751	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994

SIHP # 50-80-07 and 50-80-08	Nature of Site	General location	Source
50-80-07-03752	Mounds (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03753	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03754	Bridge (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03755	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03756	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03757	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-03758	Mound (post-Contact)	Central Lualualei	Mayberry and Rosendahl 1994
50-80-07-04244	Burials	N coastal Lualualei	Hammatt and Shideler 1991
50-80-07-05761 A	WWII bunker (post-Contact)	Central Lualualei on coast	McDermott and Hammatt 2000
50-80-07-05761 B	WWII bunker (post-Contact)	Central Lualualei on coast	McDermott and Hammatt 2000
50-80-07-05761 C	WWII bunker (post-Contact)	N Lualualei on coast	McDermott and Hammatt 2000
50-80-07-05761 D	Concrete foundations (post-Contact)	N Lualualei on coast	McDermott and Hammatt 2000
50-80-07-148	Maui rock	Central coastal Lualualei	McAllister 1933
50-80-08-147	Ilihune Heiau	SE Lualualei	McAllister 1933
50-80-08-04364	Wall (post-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04365	Wall (post-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04366	Habitation complex (pre-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04367	Wall (pre-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04370	Historic house site (post-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04371	Wells (post-Contact)	SE side Lualualei	Hammatt et al. 1993

SIHP # 50-80-07 and 50-80-08	Nature of Site	General location	Source
50-80-08-04372	Retaining wall (post-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-08-04373	Historic incinerator (post-Contact)	SE side Lualualei	Hammatt et al. 1993
50-80-07-05762	Subsurface cultural deposit (pre-Contact)	On coast central Lualualei	McDermott and Hammatt 2000
50-80-07-05763	Subsurface cultural deposit (pre-Contact)	On coast central Lualualei	McDermott and Hammatt 2000
50-80-07-06771	Burial	On coast N Lualualei	McIntosh and Cleghorn 2006
50-80-08-06681	WWII bunker (post-Contact)	SE Lualualei	O'Leary and McDermott 2006
50-80-08-06699	Rock shelter (pre-Contact)	SE Lualualei	O'Leary and McDermott 2006
50-80-08-06920	Mound (pre-Contact)	SE Lualualei	McDermott and Hammatt 2000
50-80-12-09714	OR&L Right of Way (National Register portion) (post-Contact)	On coast length of Lualualei	Chiogioji and Hammatt 1993

Thrum identifies Kakaio Heiau in his 1906 study: "Kakaio. Puhawai. A small heiau of which nothing now remains but its sacred spring, and the sound of its drums and conchs on the nights on Kane" (Thrum 1906:47). McAllister (1933) revisited this site, provided updated information regarding Kakaio Heiau and identified it as Site 151. In 1906, Thrum lists the Nīoiʻula Heiau in Lualualei as follows: "Nioiula. Halona ridge, Lualualei. A paved and walled heiau of pookanaka class, about 50 square feet, in two sections; recently destroyed" (Thrum 1906:47). McAllister provided the following information on Heiau Nīoiʻula:

> Site 149. Nioiula heiau, Halona ridge in Lualualei, just southwest of the Forest Reserve line. A paved and walled heiau said to be of the pookanaka class. The northern portion has been almost completely destroyed, the stones having been used for a cattle pen on the McCandless property. Since cattle put into the pen sickened and died, it was seldom used and is now abandoned. The heiau probably had three inclosures [*sic*] and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures [*sic*] and terraces. This is probably the heiau on which was placed the body of the boxer killed by Kawelo and offered as a sacrifice to the gods. The temple is said to have been very ancient, belonging to the chief, Kakuihewa [sic] [McAllister 1933:110]

McAllister also provides information on a house site in Lualualei:

> Site 150. House sites or *heiaus*, middle of Lualualei at the foot of the cliffs, Pahoa. Innumerable walls and small terraces that have been house sites or possibly very old heiaus [*sic*] whose sites have long since been forgotten by the natives are located on the ends of small ridges, the sea sides of most of which are covered with rough lava rocks. These small prominences have been leveled off and some have been walled and paved with smooth stones. None of the sites are sufficiently preserved to indicate a plan, for this has been a cattle range almost since the coming of Europeans, and the cattle have scattered many a wall and terrace in grazing. [McAllister 1933:110]

Sterling and Summers (1978) note the presence of house sites and a petroglyph rock at ‘Ulehawa Beach Park, first reported by McAllister in 1933:

> Near the dried swamp, opposite light pole #152 in the public park along the beach edge, house or camping sites were found. Also a rock with petroglyphs was found which had previously been reported to the Museum. This was on a sandstone slab and was removed to the Bishop Museum. April 1954 [Sterling and Summers 1978:67]

Between McAllister's published work in 1933 and the 1970s, there is a general paucity of archaeological research on O‘ahu, but particularly the leeward side of the island. That said, an important reference was published by the Bishop Museum in 1962 titled *Sites of Oahu* (Sterling and Summers 1978). The material relied heavily upon McAllister (1933) and was republished in 1978. Related to the project area, Sterling and Summers (1978:67) note that the ‘Ulehawa Stream is "named for chief" and that Hulu, of Pu‘u‘ohulu, the hill immediately southwest of the project area, was said to be "a chief who was in love with Ma‘iliilii, one of twin sisters, but he could never tell, when he saw them, which of the two was his beloved. A *mo‘o* (supernatural lizard) changed them all into mountains so Hulu is still there watching and trying to distinguish his loved one."

As environmental legislation was passed at the state and national levels, the need for more cultural study and documentation became apparent. By the late 1980s, lawmakers were systematically pressing developers to consider historic properties when conducting ground disturbing activities. This led to an increase in documented archaeological studies, usually in support of development activities.

4.1.1 Studies Conducted in and within the Immediate Vicinity of the Current Project Area

A 1977 reconnaissance survey for the proposed Nānākuli landfill recorded no archaeological sites (Bordner 1977). The survey area included land on both sides of Lualualei Naval Road, continuing up the slope to Pu‘u Heleakalā. This inventory survey covers again the ground originally inspected by Bordner south of Lualualei Naval Road.

An archaeological reconnaissance survey of the "Naval Magazine, Lualualei (NAVMAG LLL) and Naval Communications Area Master Station Eastern Pacific Radio Transmitting Facility, Lualualei (RTF LLL)" was accomplished during the mid-1980s. The survey encompassed more than 9,000 acres, "the entire half of the large amphitheater-shaped valley, and approximately one-third of the coastal half" (Haun 1991:4). A total of 119 sites, consisting of 477 features, were identified during the survey. Indigenous Hawaiian feature types recorded include alignments, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces, and paved terraces. The features recorded relate to activities including habitation, rituals, ceremonies, agriculture, the procurement of lithic raw material, and the manufacture of stone tools. Historical and recent structures associated with cattle ranching and military use of the area were also identified. Fourteen shovel probes provided datable materials (charcoal and volcanic glass), as well as cultural materials (artifacts and midden). Radiocarbon dates range from AD 1420 to 1950. It is suggested the interior of Lualualei Valley was initially occupied on a temporary basis by people cultivating the area. This may have begun as early as the mid-1400s, continuing up to the mid- to late 1700s to early 1800s. Permanent habitation sites were occupied, and population of the valley evidently increased quite rapidly, based on the dense distribution of habitation and agricultural features (Haun 1991:vii).

During an archaeological study conducted on a 5-acre parcel near the project area, formerly a basil farm, no archaeological remains were documented (Chiogioji and Hammatt 1993). The parcel was situated between Pu‘u o Hulu and ‘Ulehawa, north of the current study area. Similarly, Akihiko Sinoto and Jeffrey Pantaleo (1994) conducted an archaeological reconnaissance survey on Lualualei Homestead lands near the project area and made no significant finds.

An archaeological inventory survey of an approximately 170-acre parcel located southeast of the Naval Magazine was conducted by CSH (Hammatt et al. 1993). The parcel is described as comprising “vacant, unused lands. It is undeveloped and contains several remnant and abandoned historic structures” (Hammatt et al. 1993:7). Eight archaeological sites were identified, including “two traditional Hawaiian sites and six historic sites related to ranching and military activities” (Hammatt et al. 1993:i). The two traditional Hawaiian sites, SIHP #s 50-80-08-4366 (a site complex) and -4367 (a wall remnant), were interpreted as being attributable to traditional Hawaiian activity, with one site (SIHP # -4366) probably representing prehistoric, recurrent habitation at the foothills of Pu‘u Heleakalā. This is primarily evidenced by the presence of a probable hearth feature within the site complex. SIHP # -4367, a remnant wall section running adjacent to an intermittent streambed, suggests an agricultural usage, possibly constructed to retain or divert water. Given the weathered condition of the structure, this site may be prehistoric (Hammatt et al. 1993:28).

The paucity of Hawaiian sites within the study parcel—in comparison to the number located within the large Naval Magazine study area, located to the north and *mauka*—suggests the parcel may represent, at most, the *makai*-most fringe of the inland settlement. The survey report concludes,

> The few traditional Hawaiian sites identified during the present study suggest that most of the project area was sparsely inhabited during prehistory and early history. This would be due primarily to the lack of fresh water resources in the vicinity. . . Although surface run-off and intermittent drainage present in the project area would allow some potential for seasonal agriculture, the attraction for settling in the wetter upland valleys would surely have been greater. [Hammatt et al. 1993:31]

Jones and Hammatt (2006) completed a monitoring report for sections of La‘ikū, Wai‘olu, and Princess Kahanu Streets for a water main installation and found no historic or prehistoric cultural materials.

CSH (O'Leary and McDermott 2006) conducted an archaeological inventory survey of 200 acres adjacent to the study area, for the proposed Nānākuli B Site Materials Recovery Facility and Landfill, Lualualei Ahupuaʻa. Two historic properties were identified,

- Approximately 300 m to the west of the project area is SIHP # 50-80-08-6699, small prehistoric basalt rock shelter.
- Approximately 500 m to the south/southeast of the project area is SIHP # -6681, World War II concrete bunker.

Hammermeister and McDermott (2007) returned to the proposed Nānākuli B Site Materials Recovery Facility and Landfill to investigate a stacked stone mound found on the project's eastern upslope boundary. The feature was excavated, interpreted as a pre-Contact marker and assigned SIHP # 50-80-08-6920.

4.2 Background Summary and Predictive Model

Based on available evidence, it appears the pre-Contact settlement pattern within Lualualei Ahupuaʻa had three basic zones: coastal, intermediate, and upland. The most resource rich zones were near the sea and in the upland mountains, where there was sufficient rainfall for agriculture and forest resources. The intervening lands between the sea and the mountains were dry scrubland. Although potentially useful for dryland agriculture in the wet winter months, there is little evidence to indicate Native Hawaiians intensively utilized this area. The settlement pattern prior to Western Contact appears to be dispersed residences concentrated at the sea and in the mountains. Based on the season and the available resources, the resident population most likely used multiple residences, perhaps one at the seaside and another *mauka* to reduce resource transport time. It is also possible, as indicated by the account provided by Pukui (in McGrath et al. 1973:10), that an informal exchange network existed whereby coastal dwellers traded marine resources for agricultural and forest resources of the inland dwellers.

The population along the Waiʻanae coast may have always been quite low. The current project area and immediate vicinity lacked water for cultivation and was proverbial for its poverty. In 1785 Vancouver noted "few inhabitants" in "the barren, rocky waste." In 1815 Whitman referred to the area as an "uncultivated plain." Oral history accounts emphasize the "crops were always poor and miserable."

By the mid-1800s the traditional Native Hawaiian lifestyle in the valley of Lualualei was in decline. The sandalwood trade, which ended ca. 1829, undoubtedly had a negative effect on the Native Hawaiian population. Lualualei began its cattle ranching period about this time. The introduction of sugar plantations brought more foreigners and the OR&L railroad, which was linked to Waiʻanae in 1895. Based on the paucity of Land Commission Awards (LCAs) claimed within the area and the early population figures, it appears the Native Hawaiian population was quite low in the latter half of the nineteenth century. Population numbers slowly increased when homesteading was instituted in the early 1900s. Military use of the land began in 1917, and World War II greatly affected the landscape of the Waiʻanae coast by placing bunkers, gun emplacements, and barbed wire along the waterfront.

Archaeological investigations within the Lualualei Valley have demonstrated a pattern of high intensity land use in only the *mauka* and *makai* portions of Lualualei Valley, with a relative gap in archaeological remains in the middle sections, as discussed above. The studies of the *mauka* portions of the valley (Haun 1991; Ogden Environmental Services 1995) have identified numerous archaeological sites and features. The identified features included “alignments, C-shapes, L-shapes, U-shapes, walls, terraces, enclosures, mounds, platforms, walled terraces and paved terraces” (Haun 1991: vii). These features relate to habitation, agriculture, rituals, ceremonies, and the procurement and manufacture of stone tools.

Evidence of pre-Contact Native Hawaiian activity has also been documented in *makai* sections of the *ahupau‘a*, immediately adjacent to the ocean. A total of seven Native Hawaiian burials were inadvertently discovered during water system improvements approximately 2 km north of the current project area (Hammatt and Shideler 1991), and two cultural layers containing charcoal deposits, pit hearths, midden, and artifacts associated with pre-Contact occupation were documented during the ‘Ulehawa Beach Park survey (McDermott and Hammatt 2000). The cultural layers were observed in the southern end of the survey area, in the vicinity of the project area.

In contrast to the abundance of traditional Hawaiian sites and features encountered in the *mauka* and *makai* portions of Lualualei Valley, the sites recorded during the studies in the central section of Lualualei Valley are relatively minimal in number and are generally of post-Contact origin. Pre-Contact Hawaiian sites in this area consist of trails, lithic scatters, and temporary habitation sites, indicating intermittent use of the central portion of Lualualei Valley. The paucity of traditional Hawaiian sites in this central area may reflect not only a less intensive use during pre-Contact times, but also the extensive disturbance of this area by historic ranching, sugar agriculture, bulldozing, quarrying and U.S. military occupation.

The project area itself currently represents a dynamic flow landscape of O‘ahu material culture. The PVT archaeo-scape has material culture value in and of itself as it holds a record of construction and demolition debris relating to the development of the island. Expectations of encountering other remnant historic or ancient traditional features and artifacts is relegated to the margins of the project area. That said, the pedestrian survey for this vertical landfill expansion project generally examines the internal features of the landfill, with increasing focus on the project area perimeter, and special attention to the ‘Ulehawa Stream riparian area.

Section 5 Results of Fieldwork

5.1 Archaeological Survey Results

On 17 September 2014, two archaeologists and two cultural researchers from CSH inspected the project area for cultural resources. The CSH team was oriented and given a site tour by PVT landfill personnel followed by a 100% pedestrian inspection of the project area. Carrying a Garmin GPS device, the entire perimeter of the project area was inspected as well as the central core of the active PVT ISWMF facility, with special attention given to the riparian zone in the western and northwestern margins of the project area (see Figure 12). The riparian zone in the western/ northwestern margin of the project area exhibits significantly less mechanized surface impact from historic bulldozing and the daily traffic of large trucks moving debris within the landfill. In fact, these western/northwestern margins of the project area are not currently in use by the PVT landfill and there is no evidence to suggest this area has been used much for the past 50 years. Two potential historic properties were identified during fieldwork, including a historic dry-stack wall, referred to here as CSH 1 (Figure 24 through Figure 27) and CSH 2, a meandering linear pile of stones associated with CSH 1 and a terrace boundary (Figure 28). Additionally, the dynamic flow of contemporary construction debris being both deposited and mined within the core of the project area was observed and recorded (Figure 29). Figure 30 is a greater than 10 m by 10 m stand of aloe plants, immediately between CSH 1 and CSH 2.

CSH 1, a historic rock wall is a substantial feature, 125.0 cm high by 80.0 cm wide and approximately 400 m long, extending beyond the project area to the northwest for several kilometers (Figure 24 through Figure 27). CSH 1 is comprised of dry-stacked coral limestone. The wall is bi-faced with in-fill and a rectilinear cross-section. Large basalt limestone boulders (up to 1.0 m by 0.8 m) are positioned with their broadest faces parallel to the wall face create regular structural pillars on both sides of the feature. One large basalt boulder is noted in the entirety of the observed portion of the feature, the remaining being basalt boulders. The wall is constructed with three to ten courses of limestone boulders stacked with their broadest faces parallel to the ground and perpendicular to the wall face. The wall is intact and in very good condition, with exceptions being found at three locations where small bulldozed roads bisect the rock wall, creating gaps in the wall with these stones pushed into piles running parallel to the roadside.

The wall identified as CSH 1 appears to be an extension of a wall shown on a 1919 map (see Figure 14) near the Mikilua settlement, approximately 1,200 m northwest of the project area. In this 1919 image, a portion of the railroad dead-ends near the Mikilua settlement. The CSH 1 wall is also identified in 1936 and 1943 topographic maps (see Figure 15 and Figure 16). Figure 15 indicates the wall was extended in the 1930s into the project area and during this same time-frame the railroad was extended to bound the entire eastern property area margin with a spur terminating approximately 300 m west of the northern portion of the project area.

From these images the wall appears to be a part of a historic cattle drive-line that also utilized the slope and terrace ridges of the ‘Ulehawa Stream to drive and corral herds of livestock. If this is the case, then it is plausible that the stand of aloe pictured in Figure 30 may be associated as planted medicine for burns for a branding activity area. Further discussion of this wall feature may be found in the following Section 5, Site Descriptions.

Figure 24. CSH 1, a historic wall in the west-central margin of the project area, view to southwest

Figure 25. CSH 1, historic wall with 100 cm tape for scale, view to south

Figure 26. CSH 1, a historic wall, view to northwest

Figure 27. CSH 1, a historic wall, red arrows indicating terminus points and a gap in the wall created by a bulldozed road with Pu‘u‘ Heleakalā in the background, view to east

Figure 28. Archaeologist assesses CSH 2, the pile of boulders along a terrace in the west-central portion of the project area, immediately to the east of the aloe stand discussed above, view to north

Figure 29. Built landfill landscape in the central portion of the project area; debris piles to the right of the dump truck are the demolished Sears, Ala Moana Center; view to northeast with Puʻu Heleakalā in the background

Figure 30. Greater than 10 by 10 m stand of upland aloe plants, possibly related to a cattle branding station, located immediately adjacent to southeast terminus of CSH 2 and in between and approximately 100 m northeast of CSH 1, view to southeast

CSH 2, the archaeological feature photographed in Figure 28 is a pile of coral limestone boulders following a portion of the first upland terrace of the ʻUlehawa Stream drainage in the project area. The pile meanders along the terrace margin and appears to have filled in with sediment on the high side of the terrace. While the pile of stones in CSH 2 is substantial (approximately 220 m long by 1.5 m wide), it appears to have been created either as a mechanized bulldozer push and/or hand-piled into a berm. It is possible the CSH 2 stones were being staged for future expansion of the CSH 1 historic wall. It is also possible the CSH 2 pile of boulders may have been created to prevent slope erosion along the upland terrace of the ʻUlehawa Stream. More likely, noting the location of CSH 2 in relation to CSH 1, it is an additional livestock containment or funneling feature related to CSH 1. If CSH 1 is indeed a historic cattle drive wall, it is plausible that CSH 2 was intended as an associated livestock drive feature designed to funnel livestock to a branding station indicated by the stand of aloe in Figure 30.

While this report does not list the contemporary construction debris accreting daily in the PVT landfill as a significant historic archaeological site (Table 3), the locale as representative of other similar types of urban landfill middens that are of some interest to archaeologists (Humes 2012; Rathje and Murphy 2001; Strasser 1999). Although not considered a historic property, the landfill site does merit archaeological reflection, especially noting that citizens of the United States currently produce more material waste than any other human population, ever. “Americans throw away about 7.1 pounds per peron per day” (Humes 2012:5), and “contemporary Americans know only a well-developed consumer culture, based on a continual influx of new products . . . discarding things is taken to be a kind of freedom; landfills and garbage disposers make disposal an area for technical experts” (Strasser 1999:16). Oʻahu currently generates approximately 1.7 million tons of waste debris annually, 30% (510,000 tons) of which is costruction/demolition debris (PVT 2014) (see Figure 29, Figure 31, and Figure 32).

The PVT ISWMF at Lualualei is the primary location for discarding historical construction debris on O‘ahu, accepting non-hazardous materials including primarily “wood, metal, plastic, concrete, asphalt, glass, masonry, roofing, rock, dirt, boulders, and siding” (PVT 2014). Thus, the dedicated construction debris archaeoscapes at the project area at Lualualei are dynamic, constantly changing features, with numerous active debris piles on top of sealed and previously buried materials. While this report does not make the case that the landfill itself should qualify as a significant historic property, in the realm of modern material culture studies and garbology (Humes 2012; Rathje and Murphy 2001), the site does present a well documented systematic accretion of an urban midden which may merit future studies.

PVT recycles up to 80% of its demolition and construction debris (PVT 2014). All materials deposited at PVT are noted and mapped as staged for transport to be processed for compaction and to be mined and removed from the PVT facility as recycled raw material resources or combusted energy. New construction debris material is brought in daily, while other materials are stockpiled, sorted, and reclaimed (see Figure 28, Figure 29). Non-hazardous material stockpiles, referred to internally at PVT at “feedstock,” can be processed at up to 900 tons/day at PVT. The location of all materials that enter the landfill are noted and recorded for potential future extraction. While the facility does not accept hazarous materials, asbestos-containing materials that have been double-wrapped in 6 mm plastic are allowed and depositied, not to be removed, at one locale within the landfill, known as the asbestos pit.

Table 3. Sites Identified within the Current Project Area

CSH Survey #	Formal Type	Function
CSH 1	Historic wall, dry-stacked, limestone boulders	Livestock drive wall
CSH 2	Historic boulder pile, bulldozer push and/or placed pile	Livestock drive funnel wall

Figure 31. Landfill debris sorting machine for recycling or reuse as combusted energy, view to west

Figure 32. CSH cultural researcher with landfill debris sorted for recycling. Pu‘u‘ohula Kai and Pu‘u‘ohula Uka, left to right in the background, view to southwest

Section 6 Summary and Interpretation

At the request of LYON, CSH has prepared this archaeological literature review and field inspection report (LRFI) for the PVT Expanded Recycling, Landfill Grading and Renewable Energy Project. The project area is located approximately 500 m inland on the west side of Lualualei Naval Road in Lualualei Ahupua‘a, central Wai‘anae District, on the west or leeward coast of O‘ahu, TMKs: [1] 8-7-009:025 and 8-7-021:026. This archaeological report and cultural impact assessment (CIA) support the project’s Environmental Impact Assessment for the PVT Expanded Recycling, Landfill Grading and Renewable Energy Project in Lualualei, O‘ahu. The reconnaissance-level fieldwork was completed on 17 September 2014 under archaeological permit numbers 14-04 and 15-03. This document provides information pertinent to the assessment of the proposed project’s impacts to cultural practices through document research and cultural consultation efforts, and in consideration of the Office of Environmental Quality Control’s *Guidelines for Assessing Cultural Impacts* (2012 edition).

Background research for the project identifies the environmental context and changes to cultural contexts over time. A significant component of the background research, in this case, is the analysis of historic maps over time. Further, 36 previous archaeological studies have been conducted in the region around the project area (see Table 1) recording 48 archaeological sites (see Figure 23). No prehistoric and two potential historic properties (CSH 1 and CSH 2) are noted in the project area. CSH 1 nor CSH 2 are affected nor impacted in any way by PVT’s proposed project plans.

CSH 1 is a dry-stacked rock wall (ca. 1936) that is part of a larger dry-stacked wall system. CSH 2 is an approximately 220-m long by 1.5-m wide meandering pile of raised reef coral limestone boulders following a portion of the first upland terrace of the ‘Ulehawa Stream drainage in the project area. The pile meanders along the terrace margin and appears to have been in-filled on the high side of the terrace. It appears to have been created either as a mechanized bulldozer push and/or hand-piled into a berm. It is possible the CSH 2 stones were being staged for future expansion of CSH 1. It is also possible the CSH 2 pile of boulders may also have been created to prevent slope erosion along the upland terrace of the ‘Ulehawa Stream. More likely, noting the location of CSH 2 in relation to CSH 1, it is an additional livestock containment or funneling feature related to CSH 1.

These two features are probably related to one another as post-1935 built features of a larger dry-stack wall complex that began on the Hon. J. Dowsett’s Mikilua Ranch in the late 1800s. The wall features represent artifacts of early O‘ahu *paniolo* (Hawaiian cowboy) lifestyle which still expresses itself in the contemporary socio-economics of the communities surrounding the project area. The twentieth century ranching wall complex, of which CSH 1 and CSH 2 are a part, was built to graze, brand, and move cattle to market via the railroad.

Recalling from Section 3.4 that the Lualualei Ranch began when William Jarrett leased approximately 17,000 acres of land from Kamehameha III in 1851 (Hawai‘i Bureau of Land Conveyances 1845-1869), an analysis was conducted regarding the historic maps and development around the project area. This analysis indicates that by 1919 the dry-stacked wall complex extends around the base of Pu‘u‘ohula Uka and Pu‘u‘ohula Kai to the railroad (see Figure 14) within a kilometer of the project area. These early built portions of the dry-stacked rock wall show up on maps as early as 1919 and include walled open spaces, a circular pen, and linear funneling features.

These features were likely built by twentieth century *paniolo* to create walled pastures for grazing, pens for holding, and funnels to move cattle to and from the railroad. It is also quite possible, then, that the historic wall features documented in this project represent extensions of earlier walls built for the original herd of longhorn cattle brought to Lualualei, Oʻahu from Hawaiʻi Island in 1809 by John Young and Kamehameha I (Kamakau 1992:268). A 1914 map of the area around the project area (see Figure 13) indicates a railroad that bends around the base of Puʻuʻohulu Uku, to the small ranching village of Mikilua as the "Wainae Co. Railroad," which appears to be associated with the earliest expression of the historic dry wall, CSH 1 and likely CSH 2.

Although the precise function of these walls remains unknown, if CSH 1 is indeed a historic cattle-drive wall, it is plausible that CSH 2 was intended as an associated livestock drive feature designed to funnel livestock to a branding station indicated by the stand of aloe in Figure 30. If the dense stand of aloe that currently grows inside the area in between CSH 1 and CSH 2 indeed represents the floral evidence of a historic branding station, then further archaeology might be below the dense grass and brush encountered by CSH in the 100-m zone between these features. The lack of other archaeological sites, especially the void of identified prehistoric cultural materials in the project area is due to the historic land use practices, especially the use of heavy machinery to maintain pasture and expand the landfill footprint.

Section 7 Effect and Mitigation Recommendations

In this report CSH documents two historic features (CSH 1 and CSH 2). No discrete cultural layers, no human nor any faunal remains, nor in situ artifact assemblage(s) were observed. In this private (non-governmental) project, subject to HAR §13-13-284-7, no historic properties will be effected. It is understood that no increase in the active footprint of the facility is anticipated. While no historic properties will be impacted by the current project proposal, pursuant to HAR §13-13-284-8 (private projects), CSH recommends that future work within the project area and particularly the portion including the ‘Ulehawa Stream area, preserve by avoidance CSH 1, a dry-stacked rock wall (ca. 1936). With the understanding that the proposed project will not extend outside the existing active landfill footprint, a determination of “no historic properties affected” is recommended, as per HAR §13-13-284-7.

Sufficient information regarding the location, extent, function, and age of the historic features documented here has been obtained during the current archaeological investigation, which is undertaken to mitigate any adverse effect caused by proposed development activities. That said, CSH recommends no further archaeological work for this project.

Section 8 Significance Assessments

Historic property significance is evaluated and assessed based on the five State of Hawaiʻi historic property significance criteria. To be considered significant, a historic property must possess integrity of location, design, setting, materials, workmanship, feeling, and/or association and meet one or more of the following broad cultural/historic significance criteria (in accordance with HAR §13-13-284-6):

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value;

d. Have yielded, or is likely to yield, information important for research on prehistory or history; or

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

Two new historic properties (CSH 1 and CSH 2) are identified within the project area. Neither of these two historic properties will be impacted by developments of the proposed project. CSH 1, a historic rock wall, is evaluated and assessed as significant under criteria "c" and "d.", however CSH 2, a pile of coral limestone boulders is determined to be insignificant.

CSH 1, a historic rock wall of dry-stacked coral limestone, 125.0 cm high by 80.0 cm wide and approximately 400 m long within the project area and appears to extend beyond the project area to the northwest for several kilometers. The wall is bi-faced with in-fill and a rectilinear cross-section. Large basalt limestone boulders (up to 1.0 m by 0.8 m) are positioned with their broadest faces parallel to the wall face create regular structural pillars on both sides of the feature. The order and regularity of this cultural feature has high artistic value and exhibits the work of a master rock mason. CSH 1 is approximately 80 years old and its current aesthetic and fairly pristine condition indicate the high quality of work of a master. Further, CSH 1 represents an artifact of Oʻahu *paniolo* (Hawaiian cowboy) lifestyle and was built to facilitate the grazing, branding, and movement of cattle to market.

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APPENDIX I - CULTURAL IMPACT ASSESSMENT

Cultural Impact Assessment for the PVT Integrated Solid Waste Management Facility – Expanded Recycling, Landfill Grading, and Renewable Energy Project
Lualualei Ahupua‘a, Wai‘anae District, O‘ahu
TMKs: [1] 8-7-009:025 and 8-7-021:026

Prepared for
LYON Associates, Inc.

Prepared by
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Management Summary

Reference	Cultural Impact Assessment for the PVT Integrated Solid Waste Management Facility (ISWMF) – Expanded Recycling, Landfill Grading and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu, TMKs: [1] 8-7-009:025 and 8-7-021:026 (Ishihara et al. 2014)
Date	May 2015
Project Number(s)	Cultural Surveys Hawaiʻi, Inc. (CSH) Job Code: LUALUALEI 22
Project Location	PVT Integrated Solid Waste Management Facility (ISWMF)
Project Description	At the request of LYON Associates, Inc. (LYON), Cultural Surveys Hawaiʻi Inc. (CSH) conducted a cultural impact assessment (CIA) for the PVT Integrated Solid Waste Management Facility (ISWMF) – Expanded Recycling, Landfill Grading, and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu, TMKs: [1] 8-7-009:025 and 8-7-021:026. The PVT Landfill property covers a total of 200 acres. On the west side of Lualualei Naval Road, approximately 153 acres are designated for waste disposal with a maximum elevation of 135 ft above sea level. The operating area covers 200-acres on the west side of Lualualei Naval Road, approximately 153-acres are designated for construction and demolition (C&D) debris disposal with a maximum elevation of 135 ft above sea level. PVT ISWMF landfill is being used as a comprehensive solid waste management facility for C&D debris and other recyclable waste products. It does not accept hazardous waste or municipal solid waste.
Project Acreage	The total project acreage is approximately 200 acres.
Project Area (PA)	The Project Area (PA) is defined as 200 acres in total. This investigation focuses on the PA location within the context of the whole *ahupuaʻa* (land division) of Lualualei.
Document Purpose	This CIA was prepared to comply with the State of Hawaiʻi's environmental review process under Hawaiʻi Revised Statutes (HRS) Chapter 343. Through document research and cultural consultation efforts, this report provides information pertinent to the assessment of the proposed project's potential impacts on cultural beliefs, practices, and resources (Office of Environmental Quality Control 2012:11). The document may also support any historic preservation review of the project under Hawaiʻi Administrative Rules (HAR) Chapter 13-284.
Results of Background Research	1. Background research for this study yielded two traditional meanings given to the name Lualualei. One meaning, "flexible wreath," is attributed to a battle formation used by Māʻilikūkahi

<table>
<tr><td></td><td>against four invading armies in the battle of Kīpapa in the early fifteenth century (Sterling and Summers 1978:68). A second meaning offered by John Papa ʻĪʻī is “beloved one spared.” This meaning relates to a story of a relative who was suspected of wearing the king’s malo (loincloth) when the proclamation of the king was given by Kulaʻinamoku, that Kalakua did not wear the kings loin cloth, sparing the family of Luluku, thus a child born in the family was named Lualualei (ʻĪʻī 1959:23).

2. The Waiʻanae district, a dry coastal area was known for its off-shore fishing, taro, gourds and sweet potato.
3. Puʻu Heleakalā, translates to “snared by the sun” (Pukui in Sterling and Summers 1978:62), is east of the project area and separates nā ahupuaʻa (land divisions) of Lualualei from that of Nānākuli. The puʻu (hill) faces where the sun sets, where the sun’s rays are broken, and is also where Hina (goddess of the moon), Māui’s mother, lived in a cave and made her kapa (barkcloth) (Sterling and Summers 1978:62). This and numerous Hawaiian traditional accounts of the demigod Māui, Hiʻiaka-i-ka-poli-o-Pele, Pele, Lohiʻau, Hōpoe, Pāʻuopalaʻā, and Wahineʻōmao, and archaeological studies as well, define Lualualei in Waiʻanae moku (district) as an important center of Hawaiian history.
4. In 1901, the Waianae Sugar Company leased 3,332 acres in Lualualei for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Amfac, Inc. purchased the plantation and closed it down in 1947.
5. Land tenure includes Mahele Awards in 1848 and Land Commission Awards in the 1850s; Hawaiian homelands designations in 1921; U.S. Navy use beginning in 1930 and 1933; and most recently in 1995, the State of Hawaiʻi and the U.S. government have been involved in the land ownership changes in Lualualei.</td></tr>
<tr><td>Results of Community Consultation</td><td>CSH attempted to contact 70 Hawaiian organizations, agencies, and community members. Of the 20 people that responded, two kamaʻāina (Native-born) and/or kūpuna (elders) participated in formal interviews for more in-depth contributions to the CIA. Consultation was received from community members as follows:
1. Jan Becket, a retired Kamehameha Schools teacher
2. Stacey Eli of Nānāikapono School
3. Eric Enos of Kaʻala Farms</td></tr>
</table>

	4. Lucy Gay, Board Member for KAHEA—The Hawaiian Alliance, member of the Concerned Elders of Waiʻanae, and Leeward Community College –Waiʻanae Satellite Campus 5. Alice Greenwood, *kupuna* (elder), long-time resident, *kamaʻāina* (native born), Waiʻanae Moku Representative for the Committee on the Preservation of Historic Sites and Cultural Properties, and member of Nani o Waiʻanae and the Concerned Elders of Waiʻanae 6. Paulette Kaʻanohi Kaleikini, cultural practitioner, State of Hawaiʻi recognized lineal descendant and resident of Nānākuli Ahupuaʻa 7. Shad Kāne, *kupuna,* cultural practitioner, Oʻahu Island Burial Council Representative, ʻEwa Moku Representative, Chair for the Committee on the Preservation of Historic Sites and Cultural Properties, and the Founder of the Kalaeloa Heritage Center and Legacy Foundation 8. Glen Kila, cultural practitioner, *kupuna,* Program Director of Marae Haʻa Koa and a Koa Mana Lineal Descendant 9. Kepā Maly, Senior Vice President of Culture and Historic Preservation at Pūlama Lānaʻi 10. Kawika McKeague, Honouliuli historian, and long-time resident of Honouliuli 11. Dolly Naiwi, President of the Nānāikapono Hawaiian Civic Club 12. Christophor Oliveira, cultural practitioner and Project Director at Marae Haʻa Koa 13. Jeff Pantaleo, Navy Region of Hawaiʻi Archaeologist 14. Environmental Justice in Waiʻanae Working Group, a collaborative effort with KAHEA, the Concerned Elders of Waiʻanae, and American Friends Service Committee
Non-Cultural Community Concerns and Recommendations	Based on information gathered from the community consultation, participants voiced the following concerns not related to the cultural context. 1. Ms. Dolly Naiwi voiced her concerns regarding the health and safety of the residents that live near and in the vicinity of the project area. She is concerned with dust flying into the neighboring residential areas and along Farrington Highway. She is also concerned with construction debris possibly seeping into the ground and contaminating areas that surround the PVT landfill. Ms. Naiwi suggested not renewing PVT's license to accept construction debris and also stated that the landfill could be utilized for other activities rather than a landfill. 2. Ms. Paulette Kaʻanohi Kaleikini does not appreciate the landfill being so close to the community and believes the vertical expansion should cease. Ms. Kaleikini is concerned with the

	increased traffic of large, heavy trucks in the area; air pollution; and the loss of agricultural lands. 3. The Environmental Justice in Waiʻanae Working Group shared various thoughts and posed several questions at a meeting. Questions included: What are the health risks with the vertical expansion in terms of dust control? If there is a vertical expansion, will dust spread and go into Ulehawa Stream? Suggestions from the Environmental Justice in Waiʻanae Working Group include sending community consultation letters and figures to residents neighboring the project area and beyond; having a health grant offered to the community and to residents of Hakimo Road; to conduct a dust study; and to install trees or liners to help mitigate dust control. 4. Mr. Eric Enos suggest air and water quality monitoring. He also proposed ground quality monitors. He suggests that a unit of waste and watershed management needs to be integrated into the school system to channel new technologies for improved future management practices.
Cultural Community Concerns and Recommendations	Based on information gathered from the community consultation, participants voiced and framed their concerns in a cultural context. 1. Mr. Glen Kila states that the *ʻōpala* (trash, rubbish) from the project will kick up dust including asbestos in the air that will injure the health and safety for residents of the Waiʻanae Coast; the additional waste will also have an adverse effect of the underground water lens in Waiʻanae and will add to the leaking pollutants that are effecting the drainage system in Lualualei, Ulehawa Canal, and coastal waters. 2. Mr. Kila adds that the height increase from the *ʻōpala* will affect his religious view plane from the following places: Puʻu Hulu Kai and Puʻu Hulu Uka to Puʻu Heleakalā; Puʻu Heleakalā to Puʻu Hulu Kai and Puʻu Hulu Uka; Makalualei to Ulehawa. 3. The proposed additional height increase will also have a negative impact to the *wahi pana* and *ʻaumakua* (family or personal gods, deified ancestors), Māui A Akalana. 4. Aunty Alice Greenwood is concerned with preserving some forest area within the PVT property for *pueo* (Hawaiian short-eared owl; *Asio flammeus sandwichensis*) and bees. She is also concerned with the *ʻalae* (mudhen; *Gallinula chlorpus sandwicensis*) bird who frequents the Ulehawa area.
Impacts and Recommendations	Based on information gathered from the cultural and historic background and community consultation detailed in this CIA report, the proposed project may potentially impact Native Hawaiian cultural beliefs and *iwi kūpuna* (ancestral remains). CSH identifies these potential impacts and makes the following recommendations.

	1. Participants expressed that the proposed vertical expansion will alter the cultural landscape of Lualualei Ahupua‘a. The project area currently lies between culturally significant sites (Pu‘u Helekalā, Hina's Cave, Pu‘u o Hulu Kai, Pu‘u o Hulu Uka, Makalualei, Ulehawa, and landforms associated with the demi-god and *mo‘olelo* of Māui). In the event that the proposed undertaking is approved and moves forward or PVT requests another vertical expansion, it is recommended that cultural experts and practitioners are consulted to reduce negative impacts on Hawaiian cultural beliefs, practices, and resources. 2. Participants expressed their concerns over dust and debris that may be carried via wind. According to one participant, the Ko‘olau Wahine wind (a strong leeward wind), will have a negative impact on the health and safety of those who reside in Lualualei. To prevent further dust and debris from effecting the surrounding neighborhoods, a higher fence line and/or windbreak trees are suggested for the short-term mitigation measures. An air quality study and consistent monitoring around the proposed project area are recommended for the long-term mitigation measures. 3. Participants also voiced concerns over pollutants effecting the underground water lens system, which could impact the health of Ulehawa Stream. On a larger scale, pollutants could also affect the drainage system in Lualualei Ahupua‘a and possibly coastal waters. Ulehawa Stream empties directly into the ocean. Pollutants could potentially effect the rich aquatic life and the livelihoods of residents on the Wai‘anae Coast. A water quality study and consistent monitoring along the stream and at the mouth of Ulehawa Stream are recommended for long-term mitigation measures. 4. The proposed project does not involve any ground disturbing activities. However, based on the community's questions and if it should arise, personnel involved in the construction activities should be informed of the possibility of inadvertent cultural finds, including human remains. Should burials (or other cultural finds) be encountered during ground disturbance or via construction activities, all work should cease immediately and the appropriate agencies should be notified pursuant to applicable law, HRS §6E.

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Section 1 Introduction

1.1 Project Background

At the request of LYON Associates, Inc. (LYON), Cultural Surveys Hawaiʻi Inc. (CSH) conducted a cultural impact assessment (CIA) for the PVT Integrated Solid Waste Management Facility (ISWMF) – Expanded Recycling, Landfill Grading, and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Oʻahu, TMKs: [1] 8-7-009:025 and 8-7-021:026. The PVT Landfill property covers a total of 200 acres. On the west side of Lualualei Naval Road, approximately 153 acres are designated for waste disposal with a maximum elevation of 135 ft above sea level. The project area is depicted in a U.S. Geological Survey (USGS) topographical quadrangle (Figure 1), tax map plats (Figure 2 and Figure 3), and an aerial image (Figure 4).

The landfill is being used as a comprehensive solid waste management facility for construction and demolition (C&D) debris and other recyclable waste products. It does not accept hazardous waste or municipal solid waste. PVT ISWMF includes:

- A C&D landfill with asbestos disposal and liquids solidification areas
- Recycling materials recovery operations

Primary operations at the facility include the following:

- Segregation of incoming loads into materials for processing, recycling, on-site usage or disposal
- Mixed waste sorting to remove and separate recyclable materials
- Processing to produce feedstock for bioconversion of organic wastes
- Production of aggregate materials including rock, gravel, and crushed asphalt
- Solidification of liquid wastes
- Reclamation of previously landfilled construction and demolition waste to minimize the potential for fire, to prevent settlement, to minimize leachate potential, and to remove voids
- Storage and marketing of recyclable materials
- Landfill disposition of residual non-recoverable waste materials, including primarily composition/asphalt roofing shingles, tile, gypsum board, lead painted concrete, and cementitious siding

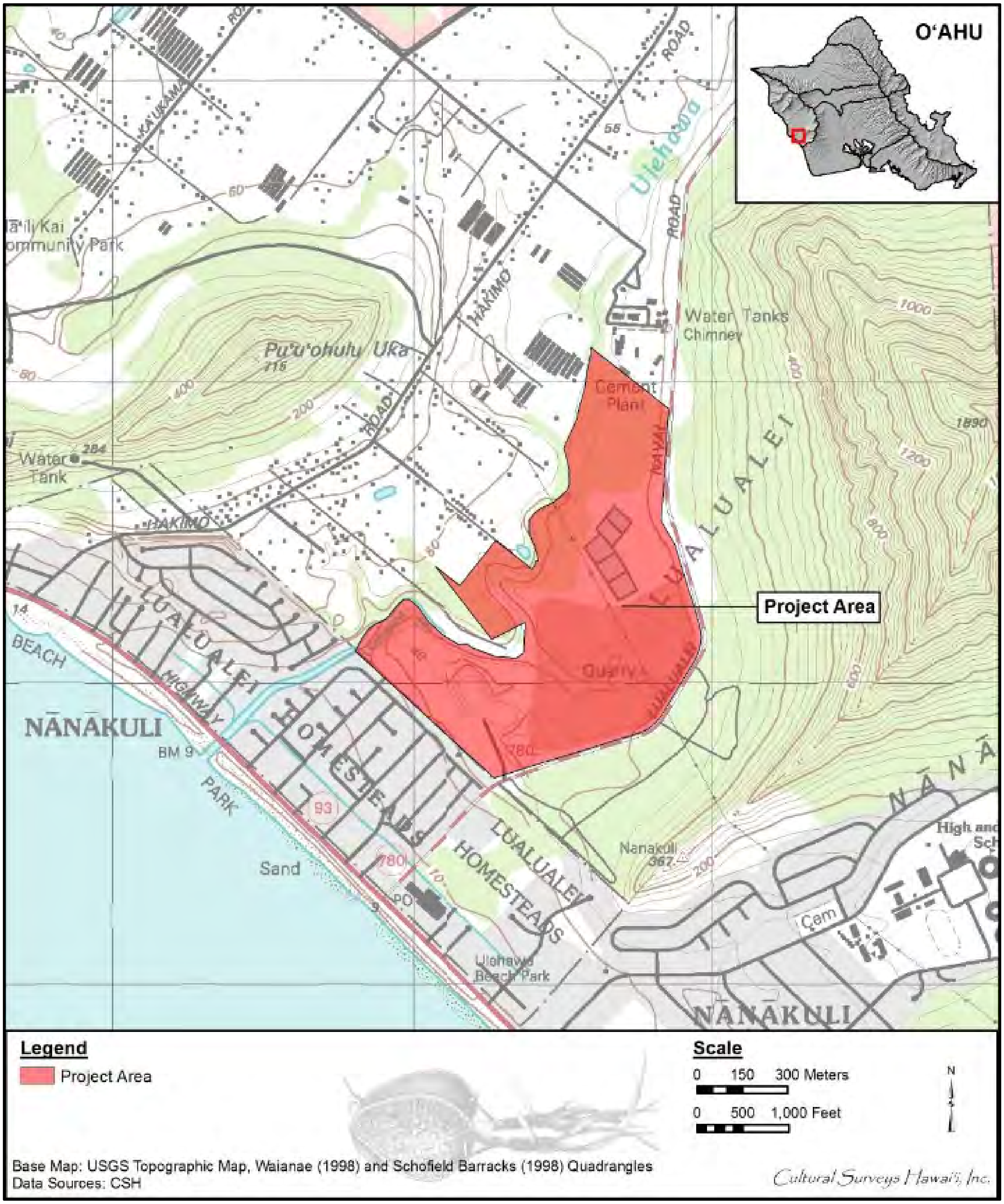

Figure 1. Portion of 1998 Schofield Barracks and 1999 Waianae USGS Topographic Quadrangles depicting project area

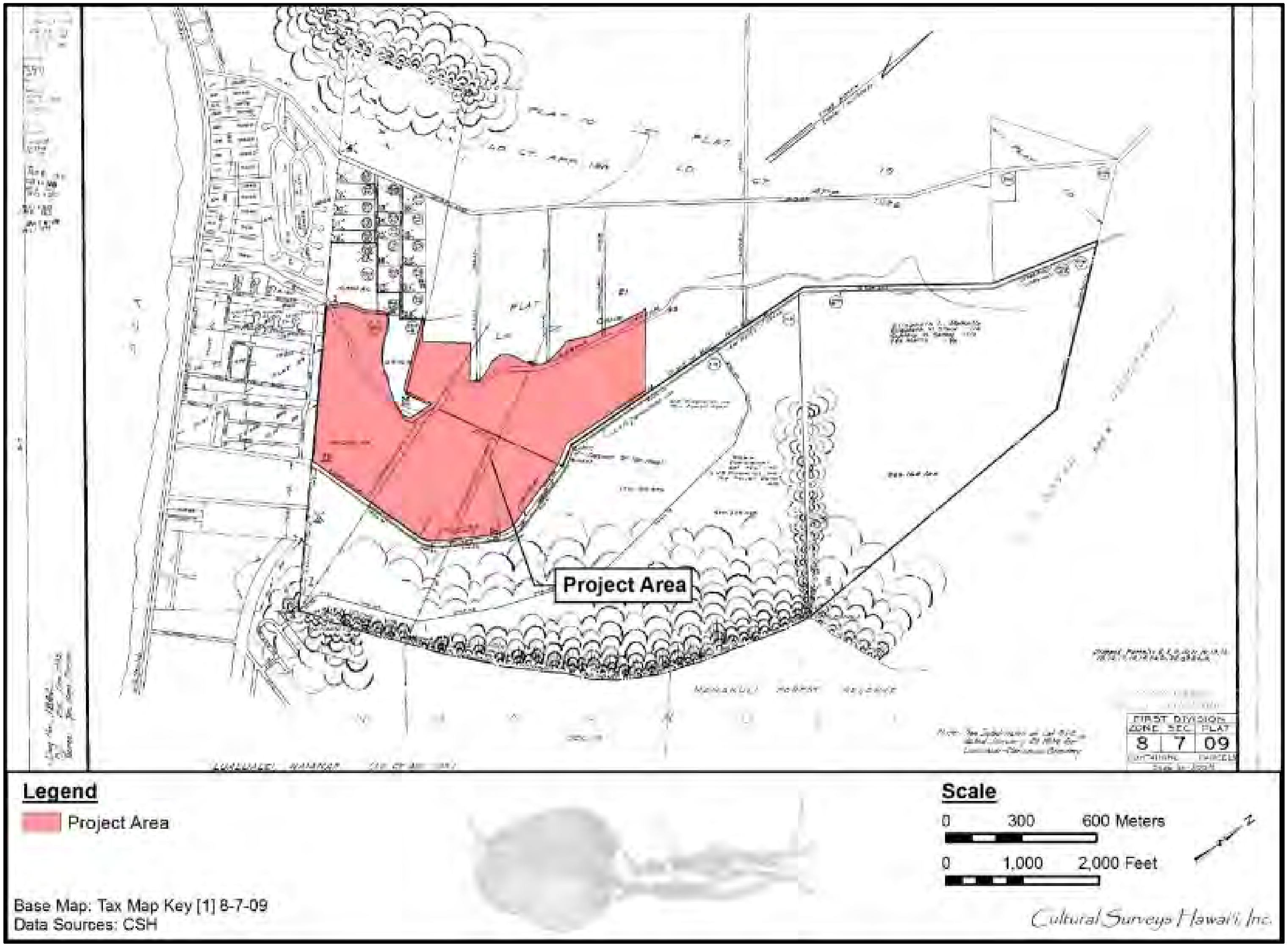

Figure 2. Tax Map Key (TMK) [1] 8-7-009 with project area (Hawai‘i TMK Service 2014)

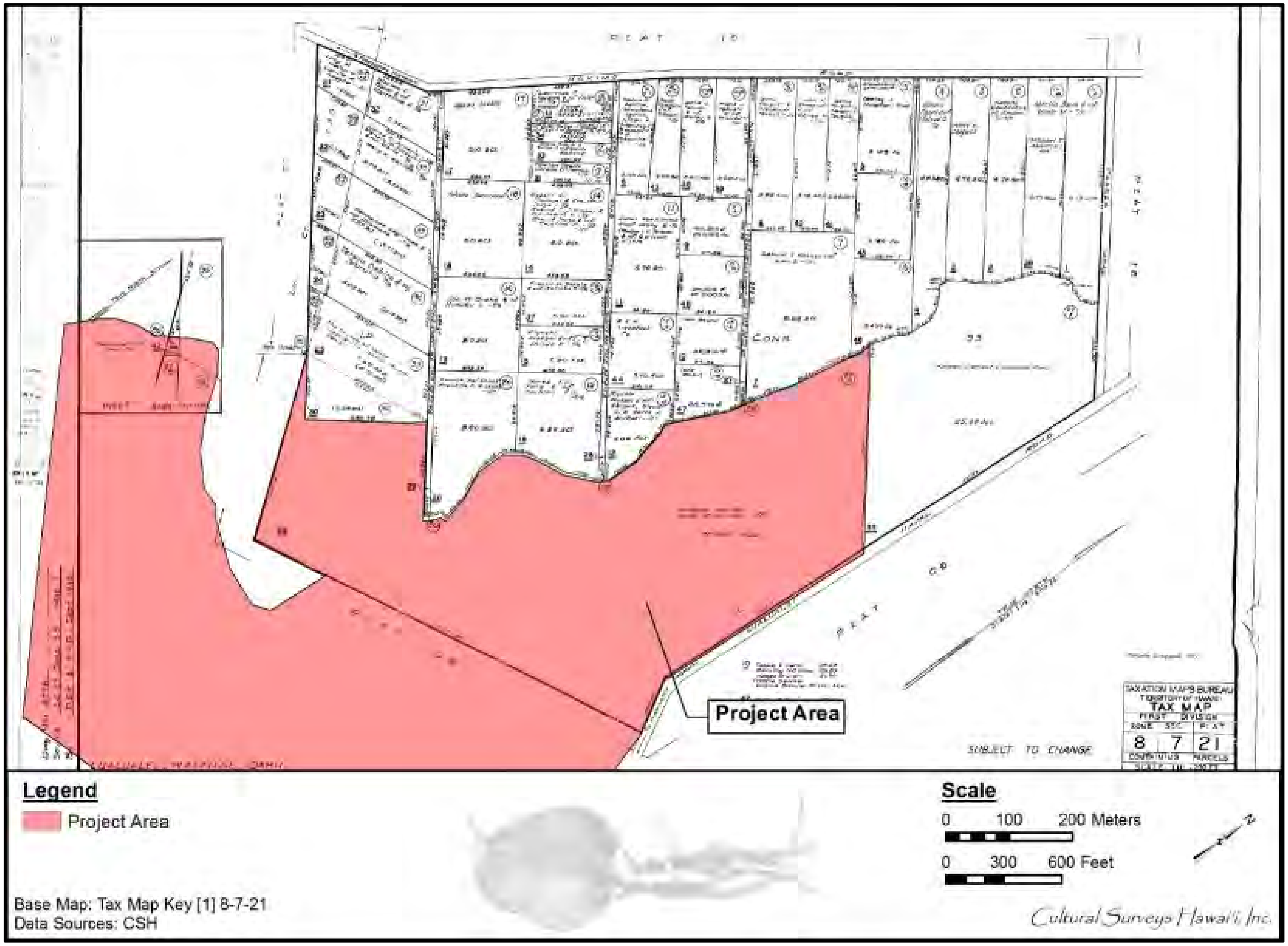

Figure 3. TMK: [1] 8-7-021 with project area

Figure 4. Aerial photograph showing the project area (Google Earth 2013)

1.2 Document Purpose

This CIA was prepared to comply with the State of Hawai‘i's environmental review process under Hawai‘i Revised Statutes (HRS) Chapter 343. Through document research and cultural consultation efforts, this report provides information pertinent to the assessment of the proposed project's potential impacts on cultural beliefs, practices, and resources (Office of Environmental Quality Control 2012:11). The document may also support any historic preservation review of the project under Hawai‘i Administrative Rules (HAR) Chapter 13-284.

1.3 Traditional Cultural Property or Place

According to the *National Register Bulletin 38* "Guidelines for Evaluation and Documenting Traditional Cultural Properties," the National Park Service's internal cultural resource management guidelines define the word "culture" as follows:

> Cultural (is) a system of behaviors, values, ideologies, and social arrangements. These features, in addition to tools and expressive elements such as graphic arts, help humans interpret their universe as well as deal with features of their environments, natural and social.
>
> Culture is learned, transmitted in a social context, and modifiable. Synonyms for culture include "lifeways," "customs," "traditions," "social practices," and "folkways." The terms "folk culture" and "folklife" might be used to describe aspects of the system that are unwritten, learned without formal instruction, and deal with expressive elements such as dance, song, music, and graphic arts as well as storytelling. [Parker and King 1998:26]

A traditional cultural property or place (TCP) can be defined and eligible for inclusion in the National Register due to its association with cultural practices or beliefs of a living community that are rooted within that community's history and are maintained; and continue cultural identity of the community. TCPs can be difficult to recognize and vary, however, they are critical to identify and consider during planning as TCPs are eligible for inclusion to the National Register of Historic Places. The National Register includes:

- All prehistoric and historic units of the National Park System;
- National Historic Landmarks, which are properties recognized by the Secretary of the Interior as possessing national significance; and
- Properties significant in American, State, or local prehistory and history that have been nominated by State Historic Preservation Officers, Federal agencies, and others, and have been approved for listing by the National Park Service. [Parker and King 1998:i]

According to HAR §13-13-275-2 and §13-13-284-2, "traditional cultural property" is defined as,

> Any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community's history and contribute to maintaining the ethnic community's cultural identity. Traditional associations are

> those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

An agency is responsible for determining whether historic properties are present within the project area and if so, to identify and inventory the properties. If SHPD concludes that an inventory survey needs to be conducted, the survey should identify all historic properties and gather information to evaluate the properties’ significance. There are three inventory surveys: an archaeological inventory survey, an ethnographic survey, and an architectural inventory survey. Traditional cultural properties are evaluated through an ethnographic survey:

> An ethnographic survey is undertaken when the SHPD concludes that traditional cultural properties are present or are likely to be present within the project area and when the project area is known to have been used by members of the community at least fifty years ago or by preceding generations. Guidelines for this survey can be obtained from the SHPD. The survey must be directed by a qualified ethnographer who meets qualifications set forth in chapter 13-281. [HAR § 13-13-275]

CSH has taken into consideration the possibility of TCPs within the project area. According to the National Register and National Historic Landmarks on the National Register database, there are no TCPs registered within or in the vicinity of the project area.

1.4 Environmental Setting

The environmental setting draws from previous environmental and historical surveys conducted throughout the Hawaiian archipelago (Foote et al. 1972; Giambelluca 1986; Nakuina 1990; WRCC 2010) the environmental setting is divided into two sections. The natural environment begins with the two primary seasons characteristic of the area’s tropical locale and adds the annual precipitation found in the project area, then shifts to a description of the prevailing winds, focusing finally on the 1972 soil surveys conducted by the Foote et al. research team. The natural environment describes a characteristic coastal Hawaiian island setting. The second setting section concludes with a description of the built environment, emphasizing a transitional change into modernity.

1.4.1 Natural Environment

The Wai‘anae Plain is a Pleistocene reef platform overlain by alluvium from the western end of the Wai‘anae Mountain Range. This alluvium has supported commercial sugar cane cultivation for a century. The Wai‘anae Plain is distinguished for its arid qualities, with an average temperature of 74˚F.

1.4.1.1 Precipitation

Pre-Contact Hawaiians recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October and is a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho‘oilo* (winter, rainy season) continues through the end of the year from November to April and is a much cooler period when trade winds are less frequent, and widespread storms and rainfall become more common (Giambelluca et al. 1986:17). Typically the maximum rainfall occurs in January and the minimum in June; this is particularly true for the leeward areas (Giambelluca et al. 1986:17) such as where the project area is located.

The mean annual rainfall in the project area is approximately 600 mm (23.625 inches) (Giambelluca et al. 1986:138). Annual rainfall aggregates between 10-100 higher volume occurring mostly in the rainy season between November and April (Giambelluca et al. 1986: 138–150). Many rains are named and associated poetically with particular places. These names refer to the action of the rain on plants, or show the supposed effects of rain on people or their possessions (Pukui and Elbert 1986:361). Kaiāulu is the name of a temperate trade wind breeze, made famous in a *mele* (song) about Waianae, *ʻOluʻolu i ka pā a ke Kaiāulu*, cool with the touch of the Kaiāulu, and also in *Pua-kaiāulu* (Pukui and Elbert 1986:115).

1.4.1.2 Prevailing Winds

Northeasterly trade winds prevail throughout the year, although their frequency varies from 80 to 95% of the time during the summer months, when high-pressure systems tend to be located north and east of Hawaiʻi. During the winter months, the high pressure systems are located farther to the south, decreasing the occurrence of the trade winds to about 50 to 80% of the time (WRCC 2010).

Ka poʻe kahiko (the people of old) recognized characteristic differences of the predominant winds, and named each in such a way as to describe the direction, locale, or velocity. Pahelehala (*lit.* pandanus ensnarement) is the name of the wind off Waiʻanae (Pukui and Elbert 1986:299). Pukui and Elbert (1986:304) name Pakaiea as another wind at Waiʻanae. Puʻukaʻala is the name of another wind found in the *mauka* region of Mount Kaʻala (Pukui and Elbert 1986:359).

1.4.1.3 Streams and Rivers

The project area is located on the arid coast of Oʻahu. Ulehawa Stream winds down the valley floor of the *ahupuaʻa* (division of land) in a southwesterly direction, before flowing into the Pacific Ocean. Puʻu Heleakalā creates a division in the water system, where an intermittent stream pours away from the project area down the southeasterly slope of the mountain, and flows into the Nānākuli stream system.

1.4.1.4 Soil Surveys

The U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972) have been overlaid onto a Google Earth aerial image (Figure 5) with the project area outlined in black. The project area is comprised of four soil series: Mamala stony silty clay (MnC), Lualualei extremely stony clay (LPE), Pulehu very stony clay loam (PvC), and Quarry (QU).

The majority of the project area is comprised of Mamala stony silty clay loam series (MnC). Foote et al. describe this soil series:

> [Mamala stony clay] consists of shallow, well-drained soils along the coastal plains. These soils formed in alluvium deposited over coral limestone and consolidated calcareous sand. They are nearly level to moderately sloping. Elevations range from nearly sea level to 100 feet. The annual rain fall amounts to 18 to 25 inches, most of which occurs between November and April. The mean annual soil temperature is 74˚ F. Mamala stony silty clay loam, 0 to 12 percent slopes. [Foote et al. 197:93]

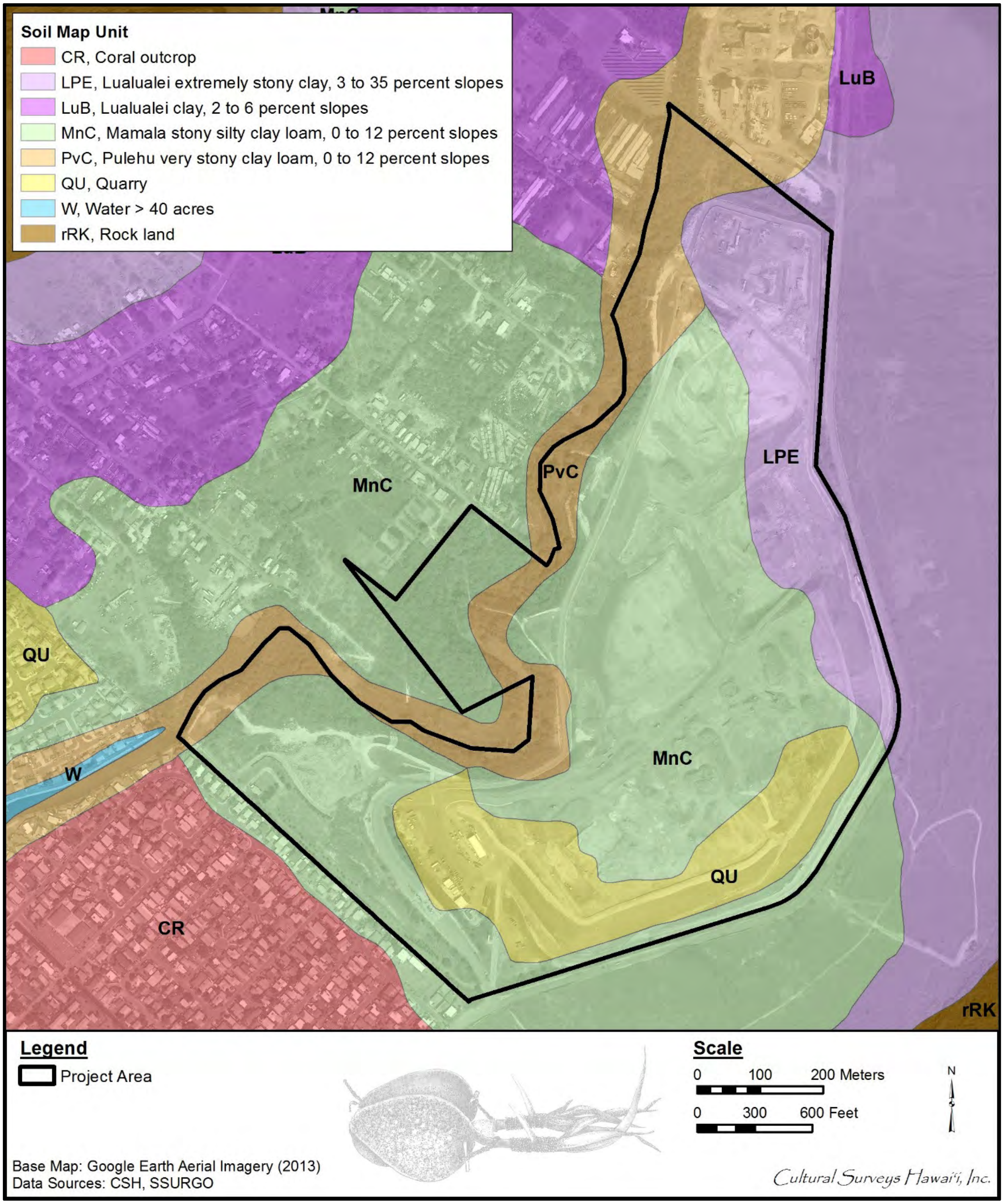

Figure 5. Google Earth Aerial Imagery (2013) showing the project area with soil overlay (Foote et al. 1972)

A second soil series found by Foote et al. is the Lualualei series (LPE):

> [Lualualei] consists of well-drained soils on the coastal plains, alluvial fans, and on talus slopes . . . Elevations range from 10 to 125 feet. In most places the annual rainfall amounts to 18 to 30 inches . . . There is prolonged dry period in summer. The mean annual soil temperature is 75˚ F. Lualualei soils are geographically associated with Honouliuli, Jaucas, and Kekaha soils. These soils are used for sugarcane, truck crops, pasture, wildlife habitat, urban development, and military installations. [Foote et al. 1972:84]

A third soil series Pulehu (PvC), surveyed by Foote et al.:

> [Pulehu very stony clay] consists of well-drained soils on alluvial fans and streams terraces and in basins . . . They developed in alluvium washed from basic igneous rock . . . The annual rainfall amounts to 10 to 35 inches. The mean annual soil temperature is 74˚ F. Pulehu soils are geographically associated with Ewa, Jaucas, Kealia, Lualualei, Waialua, and Mala soils. [Foote et al. 1972:115]

The fourth soil series in the project area is identified as Quarry (QU) by the Foote et al. surveyors. The Lualualei Quarry is discussed briefly by Stearns in a section on mineral resources of O‘ahu. The Testa Quarry in Lualualei is mentioned as having road metal and lime as its primary resources.

> Massive layers of dense basalt are quarried extensively, production varying with the rate of construction . . . Reef limestone is quarried for road metal at Kahuku, Waimea, Barbers Point, and Testa Quarry in Lualualei Valley. At the Testa Quarry the rock breaks into suitable fragments because of the numerous small cavities where shells and coral have dissolved out of a limestone that before consolidation was a limy mud. The ledge is 35 to 60 feet thick and rests upon earthy sediments. This reef was laid down during the 95-foot stand of the sea.
>
> Reef limestone is quarried near Waianae, Waipahu, and Kahuku for the manufacture of lime. Most of the lime is used for refining sugar. The chief producer is the Waianae Lime Co. Their output was 8,221 tons in 1937. The newly organized Hawaiian Gas Products Co. has a vertical kiln with a capacity of 25 tons per day. They used rock from Testa Quarry and manufactures quick lime and carbon dioxide for dry ice and the bottling industry. [Stearns 1939:71–72]

1.4.1.5 Botanical Description

In 1972, Foote et al. surveyors found the soils in the vicinity of the project area best used for sugar cane, truck crops, orchards, and pastures. The natural vegetation consisted of *kiawe* (algaroba; *Prosopis pallida*), *koa* (*Acacia koa*), *haole koa* (*Leucaena leucocephala*), bristly foxtail (*Setaria viridis*), and swollen finger grass (*Chloris barbata*) (Foote et al. 1972:93). A property survey produced additional confirmation of wild tobacco (*Nicotiana glauca*), *‘ākulikuli* (general name for succulents; *Sesuvium portulacastrum*), and aloe (*Aloe vera*) scattered throughout the project area (Figure 6 through Figure 8).

Figure 6. Photo of aloe vera within the project area (CSH 2014)

Figure 7. Photo of *kiawe* and wall found within the project area (CSH 2014)

Figure 8. Photo of *‘ākulikuli* within the project area (CSH 2014)

1.4.2 Built Environment

The project area is bound by Lualualei Naval Road, which extends from the south to the north. North of the project area is the Pine Ridge Farms, Inc. trucking, concrete and asphalt recycling and concrete production facility. West of the project area are a neighborhood and farms. The southwestern portion of the project area is bordered by Princess Kahanu Estates, a Hawaiian Homestead community. The Princess Kahanu Estates subdivision is approximately 50 m from the project area.

There has been substantial ground disturbance within the project area with evidence of past bulldozer activity. PVT Land Company Ltd. accepts construction debris, asbestos, and soil for bioremediation. The landfill is located on top of an old quarry. Non-natural objects on the landscape consist of a few scattered plywood boards nailed to trees. During a tour and field inspection of the PVT ISWMF, a stacked wall and a retaining wall on a hillside were also found.

Section 2 Methods

2.1 Archival Research

Historical documents, maps, and existing archaeological information pertaining to the project area were researched at the CSH library and other archives including the University of Hawaiʻi at Mānoa's Hamilton Library, the State Historic Preservation Division (SHPD) library, the Hawaiʻi State Archives, the State Land Survey Division, and the Bishop Museum Archives. Previous archaeological reports for the area were reviewed, as were historic maps and photographs and primary and secondary historical sources. Information on Land Commission Awards (LCAs) was accessed through Waihona ʻAina Corporation's Māhele database (Waihona ʻAina 2000) and the Office of Hawaiian Affairs (OHA) Papakilo database (Office of Hawaiian Affairs 2014) as well as a selection of CSH library references.

For cultural studies, research on traditional background centered on Hawaiian activities including religious and ceremonial knowledge and practices, traditional subsistence land use and settlement patterns, gathering practices and agricultural pursuits, Hawaiian place names, *wahi pana* (legendary places), *moʻolelo* (story), *oli* (chant), *ʻōlelo noʻeau* (Hawaiian proverbs), *mele* (songs), and more. For the Historic Background section, research focused on land transformation, development, and population changes beginning in the early post–Western Contact era to the present day.

2.2 Community Consultation

2.2.1 Sampling and Recruitment

A combination of qualitative methods including purposive, snowball, and expert (or judgment) sampling were used to identify and invite potential participants to the study. These methods are used for intensive case studies such as CIAs to recruit people who are hard to identify, or are members of elite groups (Bernard 2006:190). Our purpose is not to establish a representative or random sample. It is to "identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied . . . This approach to sampling allows the researcher deliberately to include a wide range of types of informants and also to select key informants with access to important sources of knowledge" (Mays and Pope 1995:110).

We began with purposive sampling informed by referrals from known specialists and relevant agencies. For example, we contacted the SHPD, OHA, Oʻahu Island Burial Council (OIBC), and community and cultural organizations in the Waiʻanae District for their brief response and/or review of the project and to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the study area and vicinity, cultural and lineal descendants of the study area, and other appropriate community representatives and members. Based on their in-depth knowledge and experiences, these key respondents then referred CSH to additional potential participants who were added to the pool of invited participants. This is snowball sampling, a chain referral method that entails asking a few key individuals (including agency and organization representatives) to provide their comments and referrals to other locally recognized experts or stakeholders who would be likely candidates for the study (Bernard 2006:192). CSH also employs expert or judgment sampling that involves assembling a group of people with recognized experience and expertise in a specific area (Bernard 2006:189–191). CSH maintains a database that draws on over two decades of established relationships with community consultants. These are cultural practitioners and specialists, community representatives and cultural and lineal descendants. The names of new potential contacts were also provided by colleagues at CSH and from the researchers' familiarity with people who live in or around the study area. Researchers often attend public forums (e.g., Neighborhood Board, Burial Council, and Civic Club meetings) in (or near) the study area to locate potential participants.

CSH focuses on obtaining in-depth information with a high level of validity from a targeted group of relevant stakeholders and local experts. Our qualitative methods do not aim to survey an entire population or subgroup. A depth of understanding about complex issues cannot be gained through comprehensive surveying. Our qualitative methodologies do not include quantitative (statistical) analyses, yet they are recognized as rigorous and thorough. Bernard (2006:25) describes the qualitative methods as "a kind of measurement, an integral part of the complex whole that comprises scientific research." Depending on the size and complexity of the project, CSH reports include in-depth contributions from about one-third of all participating respondents. Typically this means three to 12 interviews.

2.2.2 Informed Consent Protocol

An informed consent process was conducted as follows: 1) before beginning the interview the CSH researcher explained to the participant how the consent process works, the project purpose, the intent of the study, and how his/her information will be used; 2) the researcher gave him/her a copy of the Authorization and Release Form; 3) if the person agreed to participate by way of signing the consent form or providing oral consent, the researcher started the interview; 4) the interviewee received a copy of the Authorization and Release Form for his/her records, while the original was stored at CSH; 5) after the interview was summarized at CSH (and possibly transcribed in full), the study participant was afforded an opportunity to review the interview notes (or transcription) and summary and to make any corrections, deletions or additions to the substance of their testimony/oral history interview (accomplished either via phone, post or email or through a follow-up visit with the participant); 6) the participant received the final approved interview and any photographs taken for the study for their records. If the participant was interested in receiving a copy of the full transcript of the interview (if there is one, as not all interviews are audio-recorded and transcribed), a copy was provided. Participants were also given information on how to view the report on the OEQC website and were offered a hardcopy of the report once the report is a public document.

2.2.3 Interview Techniques

To assist in discussion of natural and cultural resources and cultural practices specific to the study area, CSH initiated semi-structured interviews (as described by Bernard 2006), asking questions from the following broad categories: gathering practices and *mauka* (toward the mountain) and *makai* (toward the ocean) resources, burials, trails, historic properties, and *wahi pana*. The interview protocol is tailored to the specific natural and cultural features of the landscape in the study area, identified through archival research and community consultation. For example, for this study fishing, *ala hele* (trails), and salt gathering were emphasized over other categories less salient to the project area. These interviews and oral histories supplement and provide depth to consultations with government agencies and community organizations that may provide brief responses, reviews and/or referrals gathered via phone, email, and occasional face-to-face commentary.

2.2.3.1 In-depth Interviews and Oral Histories

Interviews were conducted initially at a place of the study participant's choosing (usually at the participant's home or at a public meeting place) and/or—whenever feasible—during site visits to the project area. Generally, CSH's preference is to interview a participant individually or in small groups (two–four); occasionally participants are interviewed in focus groups (six–eight). Following the consent protocol outlined above, interviews may be recorded on tape and in handwritten notes, and the participant photographed. The interview typically lasts one to four hours, and records the who, what, when, and where of the interview. In addition to standard interview questions based on broad categories, the interviewee is asked to provide biographical information (e.g., connection to the study area, genealogy, professional and volunteer affiliations).

2.2.3.2 Field Interviews

Field interviews are conducted with individuals or in focus groups comprised of *kūpuna* (elders) and *kama‘āina* (native born) who have a similar experience or background (e.g., the members of an area club, elders, fishermen, *hula* [dancers]) who are physically able and interested in visiting the project area. In some cases, field visits are preceded with an off-site interview to gather basic biographical, affiliation, and other information about the participant. Initially, CSH researchers usually visit the project area to become familiar with the land and recognized (or potential) cultural places and historic properties in preparation for field interviews. All field activities are performed in a manner to minimize impact to the natural and cultural environment in the project area. Where appropriate, Hawaiian protocol may be used before going on to the study area and may include the *ho‘okupu* (offering) of *pule* (blessing) and *oli*. All participants on field visits are asked to respect the integrity of natural and cultural features of the landscape and not remove any cultural artifacts or other resources from the area.

2.2.4 Study Limitations

Cultural impact assessments are limited by the time frame and costs of the study as well as community participation. Often, researchers have little control over the time frame or budget available for a project but may have more discretion over study design and the methodologies employed to illicit public participation. Various factors may affect participation, such as the availability of contact information for community members during the recruitment process, the interest of the community in the project, and the commitment of participants through several phases of the interview process. For example, once an interview is scheduled and conducted, CSH engages the interviewee at least one more time (in person or by email or phone call) to gain their approval of the interview transcript or summary and to incorporate any changes they make. The voluntary nature of community participation in this process, combined with restraints on time and costs, often limits the number of interviews and the depth of information gathered during the interviews.

2.3 Compensation and Contributions to Community

Many individuals and communities have generously worked with CSH over the years to identify and document the rich natural and cultural resources of these Islands for cultural impact, ethno-historical and, more recently, traditional cultural places studies. CSH makes every effort to provide some form of compensation to individuals and communities who contribute to cultural studies. This is done in a variety of ways. Individual interview participants are compensated for their time in the form of a small honorarium and/or other *makana* (gift). Community organization representatives (who may not be allowed to receive a gift) are asked if they would like a donation to a Hawaiian charter school or nonprofit of their choice to be made anonymously or in the name of the individual or organization participating in the study. Contributors are provided their transcripts, interview summaries, photographs and—when possible—a copy of the CIA report; CSH is working to identify a public repository for all cultural studies that will allow easy access to current and past reports. CSH staff do volunteer work for community initiatives that serve to preserve and protect historic and cultural resources (for example on Lānaʻi and Kahoʻolawe). Generally our goal is to provide educational opportunities to students through internships and sharing our knowledge of historic preservation and cultural resources and the State and Federal laws that guide the historic preservation process, and through involvement with an ongoing working group of public and private stakeholders collaborating to improve and strengthen the HRS Chapter 343 environmental review process.

Section 3 Traditional Background Research

The PVT Landfill Expanded Recycling, Landfill Grading, and Renewable Energy project is located in the *moku* (district) of Wai‘anae, in the *ahupua‘a* (land division usually extending from the mountain to the sea) of Lualualei. This section of the report focuses on the uniquely Hawaiian way of life, connecting the pre-Contact *kama‘āina* (Native-born) to the *‘āina* (land) through a complex cosmological arrangement. A broad overview of Hawaiian history introduces key concepts and terms used throughout the report leading to the general history of the *moku* of Wai‘anae focusing on Lualualei regarding the earliest known settlement, subsistence patterns, marine and land resources, and a compilation of *wahi pana*. The report then focuses on the linguistic aspects of Hawaiian culture found in the *mo‘olelo, oli*, *‘ōlelo no‘eau*, and *mele*.

3.1 Settlement Patterns

The archaeological record suggests early Hawaiians formed settlements of hamlets along the coasts, interred the dead, ate domesticated pigs, dogs, and chickens, and began to clear tracts of forest between AD 600–1100 (Kirch 2000:293). Significant advances in radio carbon dating in the past two decades suggest that the initial settlement of Hawai‘i came from eastern Polynesia between approximately AD 1000 and 1200 (Kirch 2011:3). The early settlers of the Hawaiian archipelago would have been especially attracted to windward O‘ahu with its coral reefs, bays, and sheltered inlets for fishing, dense basalt dikes for the production of stone adzes and other tools, and amphitheater-headed valleys and broad alluvial floodplains that contained fertile soils, numerous permanently flowing streams, and abundant rainfall for the cultivation of crops (Kirch 1985:69). Archaeological excavation data indicate the settlers' descendants, like their east Polynesian ancestors, lived in pole-and-thatch dwellings, interred the dead beneath these structures, cooked in small hearths, and manufactured stone tools as well as bone and shell fishhooks, and supported themselves by cultivating inland crops, raising domesticated animals, hunting seabirds on offshore islets, fishing, and gathering shellfish (Kirch 1985:71–74).

As they adapted to local conditions, they invented distinctive Hawaiian artifacts, including two-piece fishhooks and the *lei niho palaoa* (*lei* of rock oyster shell), which, in addition to other ornaments interred with individuals, suggests a degree of social stratification among the early Hawaiians (Kirch 1985:71–74). The domiciliary use of the project area dates to the ancient *kānaka ‘ōiwi* (native people).

3.2 *Ahupua‘a* System (Land Divisions)

Prior to the unification of the Hawaiian Islands, each island was independently ruled and the land was managed by the ruling faction, the *ali‘i* (chiefly class). The inhabitants of O‘ahu divided the land as it extended from the uplands to the sea; the system is known in Hawaiian as *ahupua‘a*. Chinen describes this land division as follows:

> To a large extent, the Hawaiians made the divisions of the land along rational lines, following a mountain range, the bottom of a ravine, or the center of a stream or river. But oftentimes only the line of growth of a certain type of tree or grass marked a boundary; and sometimes only a stone determined the corner of a division. [Chinen 1959:1]

By approximately AD 1310, Māweke (a priest renowned for his knowledge of black magic and sorcery) partitioned O‘ahu into three main districts: the Kona region; the ‘Ewa, Wai‘anae, and Waialua region; and the windward Ko‘olau region (Kirch 2010:88). This division of land and resources allowed sustainable living within each *moku*.

Later, in approximately 1490 AD, the *‘aha ali‘i* (council of chiefs) chose the *ali‘i* Mā‘ilikūkahi, an *ali‘i kapu* (forbidden/sacred chief) who was born in Waialua at Kūkaniloko (sacred birth stones), to be the new *ali‘i nui* (paramount chief) (Kirch 2010:89). After Mā‘ilikūkahi's paramountship was installed at the *heiau* (ceremonial structure) of Kapukapuākea (Site 225; McAllister 1933:140) in central Waialua, Mā‘ilikūkahi instituted an explicit land division and administration structure. O‘ahu was divided further into six *moku*—Kona, ‘Ewa, Wai‘anae, Waialua, Ko‘olauloa, and Ko‘olaupoko—that were further divided into 86 *ahupua‘a* and smaller territorial units (Kirch 2010:89–90).

This land system divides districts based loosely on natural land formations. The creation of smaller divisions were cared for by *konohiki* (land manager).

3.2.1 Wai‘anae Moku

In ancient times, the *moku* of Wai‘anae was renowned for its ocean resources especially for deep sea fishing off Ka‘ena where the ocean currents meet. The meaning of Wai‘anae ("mullet water") also implies an abundance of fish hence the word *‘anae*, which is the full-grown mullet (*Mugil cephalus*) (Pukui and Elbert 1986). Handy and Handy (1972) attribute the naming of Wai‘anae to a large freshwater pond for mullet called Pueha or Puehu. Today, Wai‘anae is still considered to be one of the best fishing grounds on O‘ahu.

Wai‘anae was also known for the independent lifestyle and attitudes of its inhabitants, another trend that continues into the modern day. This independence was a factor in many of the political struggles of the pre-Contact and early historic period when the district was the scene of battles and rebellions and often the refuge of dissident and/or contentious factions. This independent spirit is often attributed to the conditioning of generations having to cope with marginal environments. In Wai‘anae, the lack of water for cultivation and consumption was precariously balanced by the productivity of the marine resources available off-shore (Handy and Handy 1972:467).

3.2.2 Lualualei Ahupua‘a

Lualualei Ahupua‘a is part of the Wai‘anae district on the leeward coast of O‘ahu. Lualualei Ahupua‘a is bordered by Wai‘anae Ahupua‘a to the west and Nānākuli Ahupua‘a to the east. Lualualei comprises approximately 15,000 acres and is the largest valley in the Wai‘anae District. There are two traditional meanings given to the name Lualualei. One meaning, "flexible wreath," is attributed to a battle formation used by Mā‘ilikūkahi against four invading armies in the battle of Kīpapa in the early fifteenth century (Sterling and Summers 1978:68). A second, and perhaps more recent, meaning offered by John Papa ‘Ī‘ī is "beloved one spared." This meaning relates to a story of a relative who was suspected of wearing the king's *malo* (loincloth). The punishment was death by fire. ‘Ī‘ī writes the following:

> The company, somewhat in the nature of prisoners, spent a night at Lualualei. There was a fish pond there on the plain and that was where the night was spent . . . After several days had passed, the proclamation from the king was given by Kula‘inamoku, that there was no death and that Kalakua did not wear the king's

> loin cloth. Thus was the family of Luluku spared a cruel death. For that reason, a child born in the family later was named Lualualei. [ʻĪʻī 1959:23]

Mary Kawena Pukui believed the first meaning, "flexible wreath" to be the more appropriate one for Lualualei (Sterling and Summers 1978:63). According to the late scholar and activist Marion Kelly, the fishpond on the plain is Puehu Fishpond which is actually located just over the border in Waiʻanae (Haun 1991:317). The fishpond no longer exists today and was probably destroyed during the sugar plantation era. Perhaps a third association to the name Lualualei is an older reference to one of the Hawaiian demigod Māui's sisters who went by the same name.

3.3 Subsistence and Settlement

The Waiʻanae district is a dry coastal area with poor soil and four streams that cross gulches and valleys before emptying into the ocean (Handy and Handy 1972:467). As previously mentioned, the Waiʻanae district was known for its off-shore fishing, especially beyond Kaʻena Point. Makaha Ahupuaʻa consists of a small valley with a large stream suitable for cultivation. In the past, the valley supported a large community of fisherman and contained *loʻi* (terraced pond fields) that began half-way up the valley floor. Rock-faced terraces surveyed by McAllister in 1933 can still be seen today.

Waiʻanae Kai Ahupuaʻa consists of poor terrain. The valley was once able to support wet taro cultivation along the main stream and its tributaries. Taro cultivation was abandoned and sugar cane was introduced to the Waiʻanae area instead. Gourds were found growing wild in the *mauka* regions, while sweet potato and coconut could be found in the lower regions (Handy and Handy 1972:468).

3.4 Coastal Lualualei

3.4.1 Ulehawa Beach Park

Ulehawa Beach Park spans from Ulehawa Stream on the south to Maʻipalaoa Stream to the north (Clark 1977:84). Pukui translates Ulehawa as "filthy penis" (Pukui et al. 1974:214–215). Pukui also states that Ulehawa was said to be the birthplace of the demigod Māui and to have been named for a chief (Pukui et al. 1974:215; Sterling and Summers 1978:64). The beach park takes its name from Ulehawa Stream, which empties into the ocean. The beach is considerably long; however, one area frequented most often is centered around a comfort station known as Aupaka. The sandy pocket of beach is between a limestone point on the east and a reef shelf on the west (Clark 1977:85). During the summer months, the area is relatively calm. However, during the winter the beach disappears. The freshwater from Ulehawa Stream has created a relatively smooth shelf compared to the surfaces of the remainder of the area. The Puʻu o Hulu Kai section of Ulehawa is rocky and no recreational swimming is possible. The area is ideal for fishing and many pole fishermen can be found in this area. A concrete marker on the point warns fishermen of the dangerous, rocky conditions. In 1935, these markers were constructed by the Honolulu Japanese Casting Club (Clark 1977:85). The original markers were printed in Japanese with the word "danger" on both sides and placed at actual spots where fishermen were lost at sea. Puʻu o Hulu was known to Japanese fishermen as *obake* or ghosts, from a feeling that the area was haunted.

3.4.2 Māʻili Beach Park

Māʻili Beach Park extends from Maʻipalaoa Stream to Māʻiliʻili Stream and is also another long stretch of shoreline. Māʻili is a contracted form of the word *māʻiliʻili* ("lots of little pebbles"). *ʻIliʻili* (pebbles) were used for many purposes such as net sinkers, percussion instruments for dances and chanting, as a filler for the construction of house and religious sites, and as jacks by children for the game of *kimo* (a game similar to jacks) (Clark 1977:85). Many residents argue about the name because no *ʻiliʻili* were in fact ever found in this area. The most popular swimming area is in front of the wide sand beach next to the mouth of Māʻiliʻili Stream. Surfers once frequented the area for a choice surf spot. However, the construction of a jetty in 1966 to improve the stream channel has affected the break (Clark 1977:86).

3.4.3 Lualualei Beach Park

The widest and most popular section of Lualualei Beach park was once known as Kalaeokakao or "the point of the goats" (Clark 1977:86-87). Numerous wild goats roamed the area during the 1800s. Goats were originally introduced by Captain Cook in 1778. Additional animals were brought to Hawaiʻi by Captain Vancouver in 1792. Originally the animals were protected by the *kapu* (taboo, prohibited). Eventually they multiplied so rapidly they began to run rampant, destroying cultivated lands, native plants, watersheds, and forest areas (Clark 1977:87). It became necessary to kill off the introduced animals, resulting in large, organized hunts.

3.5 Wahi Pana

A Hawaiian *wahi pana* translates to "legendary places". According to Landgraf (1994) *wahi pana* are also referred to as a place name, "physically and poetically describes an area while revealing its historical or legendary significance." *Wahi pana* can refer to natural geographic locations such as streams, peaks, rock formations, ridges, and offshore islands and reefs, or they can refer to Hawaiian divisions, such as *ahupuaʻa*, *ʻili* (land section), and man-made structures such as fishponds.

The earliest documented research in Lualualei Ahupuaʻa was completed by J. Gilbert McAllister (1933) during his survey of Oʻahu. Elspeth P. Sterling and Catherine C. Summers (1978) expanded McAllister's survey by collecting additional testimonies and archival sources. Below is a compilation of McAllister and Sterling and Summers' findings. The *wahi pana* of Lualualei and the study area tangibly link long-time *kamaʻāina* of the area to their past.

Puʻu Heleakalā separates the *ahupuaʻa* of Nānākuli and Lualualei. The barren *puʻu* (hill, peak) is sometimes called Haleakalā, which Pukui felt was wrong. Pukui translated the words as *hele* ("to snare"), *a* ("belonging to"), and *kalā* ("the sun") (Sterling and Summers 1978:62). Together Heleakalā means, "Snare by the sun." Pukui goes on to define Heleakalā: "This hill faces right into the setting sun and reference is made as to this place being 'where the sun's rays are broken.'" Puʻu Heleakalā is the location where Hina (moon goddess), Māui's mother, lived in a cave and made her *kapa* (clothes of any kind; bedclothes) (Sterling and Summers 1978:62). In an account published by Cordy, Poepoe notes in the Hawaiian newspaper *Kuakoa*, 11 August 1899 (translated by Sterling and Summers [1978]): "I saw the cave in which Hina [Maui's mother] made kapa cloths on the slope of a hill facing a stream [Ulehawa]" (Cordy 2002:91). Figure 9 and Figure 10 depict Hina's Cave and the view from the cave, respectively.

Figure 9. Photo of Hina’s Cave located within Pu‘u Heleakalā (CSH 2015)

Figure 10. View of Lualualei Ahupua‘a from Hina’s Cave; note Pu‘u o Hulu in the background and the PVT property middle ground bordered by Lualualei Naval Road traveling west to east (CSH 2015)

Palikea is a peak on the borders of Honouliuli, Nānākuli, and Lualualei Ahupua‘a. The *pu‘u* stands at 3,098 ft in height and literally translates to “white cliff” (Pukui et al. 1974:177).

Pōhākea Pass is located on the Wai‘anae Mountain Range (Figure 11). The peak has an elevation of 2,200 ft (Pukui et al. 1974:1985). Pōhākea serves as a passage to Honouliuli Ahupua‘a. This is also the location where Hi‘iaka saw cloud omens that her *lehua* (flower of the *‘ōhia* tree) groves had been burned by her sister Pele and her friend Hōpoe had been turned into stone. See Section 3.6.3 for an expanded version of the *mo‘olelo* of Hi‘iakaikapoliopele.

Pu‘ukaua is a peak on the Wai‘anae Mountain Range on the Lualualei and Honouliuli Ahupua‘a border. The *pu‘u* stands at 3,127 ft and literally translates to “war hill” or “fort hill” (Pukui et al. 1974:199).

Also on the Lualualei and Honouliuli Ahupua‘a border is Pu‘ukānehoa. The peak was named for the native shrubs in the area and stands at 2,728 ft (Pukui et al. 1974:198). The native shrubs and trees include all species and varieties of *Styphelia* (Cyathodes) and grow to a height of 1-2 m. They consist of narrow leaves, tiny white flowers, and red or white fruits. The leaves were used in the practice of *lā‘au lapa‘au* (Hawaiian healing medicine) for colds or headaches.

Pu‘u Hāpapa (“rock stratum”) converges at the border of the Honouliuli, Wahiawā, and Wai‘anae Districts (Sterling and Summers 1978).

Pu‘uka‘īlio is a *pu‘u* approximately 1,965 ft high in the Wai‘anae Mountain Range prior to reaching Kolekole Pass. It literally translates to “the dog hill” (Pukui et al. 1974:197).

Kolekole is a passage and road from Wai‘anae Uka (Schofield Barracks) through the Wai‘anae Range in Lualualei. A large stone at the pass has been widely thought to be a sacrificial stone, however, according to Pukui it was probably never used for that purpose (Pukui et al. 1974:116). Others say the stone represented a woman named Kolekole who guarded the pass. It has also been said that those who practiced *lua* (a type of dangerous hand-to-hand fighting in which the fighters broke bones, dislocated bones at the joints, and inflicted severe pain by pressing on nerve centers) would wait at Kolekole Pass to practice their skill on unsuspecting travelers. It was also here at Kolekole Pass that Kahekili’s army from Maui killed the last of the O‘ahu people led by Kahahana who escaped the massacre at Niuhelewai (an old part of Honolulu). An expanded reading of Kolekole Pass can be found in Section 3.6.3.

Maunakūwale is located on the Lualualei and Wai‘anae Ahupua‘a border as well and is *makai* of Kaua‘ōpu‘u. Maunakūwale literally translates to “mountain standing alone” (Pukui et al. 1974:149). It is also the most northern *pu‘u* on the Pāhe‘ehe‘e (“slippery”) Ridge. The most southern *pu‘u* on the ridgeline is Pu‘upāhe‘ehe‘e.

Pāhe‘ehe‘e is a ridge and hill (approximately 652 ft in height) that borders Lualualei and Wai‘anae Ahupua‘a. Pāhe‘ehe‘e translates to “slippery” (Pukui et al. 1974:174).

Kāne‘īlio Point is also on the Lualualei and Wai‘anae Ahupua‘a border. The point demarcates the most southern point of Pōka‘ī Bay. A *heiau* once stood at the point and was dedicated to Kū‘īlioloa, a legendary giant man-dog. The name translates to “dog Kāne” (Pukui et al. 1974:84).

Pu‘u o Hulu is a small mountain range before the Mā‘ili ‘Ili. Pu‘u o Hulu is said to be have been a chief in love with Ma‘ili‘ili‘i, one of twin sisters. The chief could never tell the two sisters

Figure 11. Photo of Lualualei and Waiʻanae Ahupuaʻa from Pōhākea Pass, n.d. (Hawaiʻi State Archives)

apart therefore both became his beloved (Sterling and Summers 1978:67). A *mo‘o* (supernatural being) changed them all into mountains. The chief sits in Lualualei as a mountain to distinguish which one is his beloved. The mountain is split into two *pu‘u*: Pu‘u o Hulu Kai and Pu‘u o Hulu Uka (Figure 12).

Mā‘ili is the name of an *‘ili* in Lualualei Ahupua‘a. The small town consists of a beach park, point, surfing area, stream, and elementary school (Pukui et al. 1974:139). The word Mā‘ili translates to "little pebbles" or "pebbly" (Pukui et al. 1974:139; Sterling and Summers 1978:67). Mā‘ili lies between two *pu‘u*: Pu‘u o Hulu and Pu‘u Mā‘ili‘ili. Mary Kawena Pukui believes the word is a contraction of "Mā‘ili li‘i li‘i" or "lots of little pebbles" (Pukui et al. 1976:139).

Ma‘ipalaoa is the name of a bridge, beach park, and street in Lualualei Ahupua‘a and is not listed in Pukui's *Place Names of Hawaii*. *Palaoa* translates to "sperm whale" or "ivory," especially whale tusks as used for the highly prized *lei palaoa*, a necklace made of a whale tooth pendant. *Ma‘i* translates as "sickness, illness, or disease." The literal translation for Ma‘ipalaoa is "sickened whale tooth." Sterling and Summers' *Sites of O‘ahu* described Ma‘ipalaoa as being named for a swamp and also a chiefess (Sterling and Summers 1978:67). In *Hawaiian Street Names*, Ma‘ipalaoa is translated as "whale genitals" (Budnick and Wise 1989:129).

3.5.1 Pōhaku

3.5.1.1 Māui Pōhaku

Site 148, a large rock said to be Māui, is located approximately 1.1 miles from the Nānākuli Station going towards Pu‘u o Hulu (Sterling and Summers 1978:64). McAllister continues,

> Northeast of the road on the property of E.P. Fogarty is a rock said to be named after the Hawaiians hero, Maui, who is said to have landed here from the south. This stone at the time was surrounded by water, and it was here that Maui reposed and sunned himself. In the bluff just northeast of the rock is a shelter which he lived, and in the vicinity was a spring where he obtained water. The large rock is now split in half and adorned with many small, oddly shaped rocks. It is said to be bad fortune to build one's house across a line drawn directly from the rock to the shore. J.J. Mathews is said to have collected detailed information in regard to this site. [McAllister 1933:110].

Figure 13 displays the Māui Pōhaku within the Garden Grove condominium complex in Lualualei Ahupua‘a. Figure 14 depicts the plaque found at the foot of the Māui Pōhaku recalling the Māui *mo‘olelo* by McAllister.

3.5.1.2 Petroglyph Pōhaku

Sterling and Summers noted a rock with petroglyphs in Lualualei Ahupua‘a. Described as being near a dried swamp and adjacent to light pole #152 in a public park near the edge of a beach, former house sites and a petroglyph rock were discovered. The *pōhaku* (rock) was reported to the Bishop Museum where it was later removed and housed (Sterling and Summers 1978:67).

Figure 12. Photo of the Wai'anae Mountain Range with Kolekole Pass in left background; Pu'u o Hulu Uka in the left foreground; downslope of Pu'u Heleakalā in right foreground, n.d. (Hawai'i State Archives)

Figure 13. Photo of the Māui Pōhaku at the Garden Grove condominium complex in Lualualei (CSH 2015)

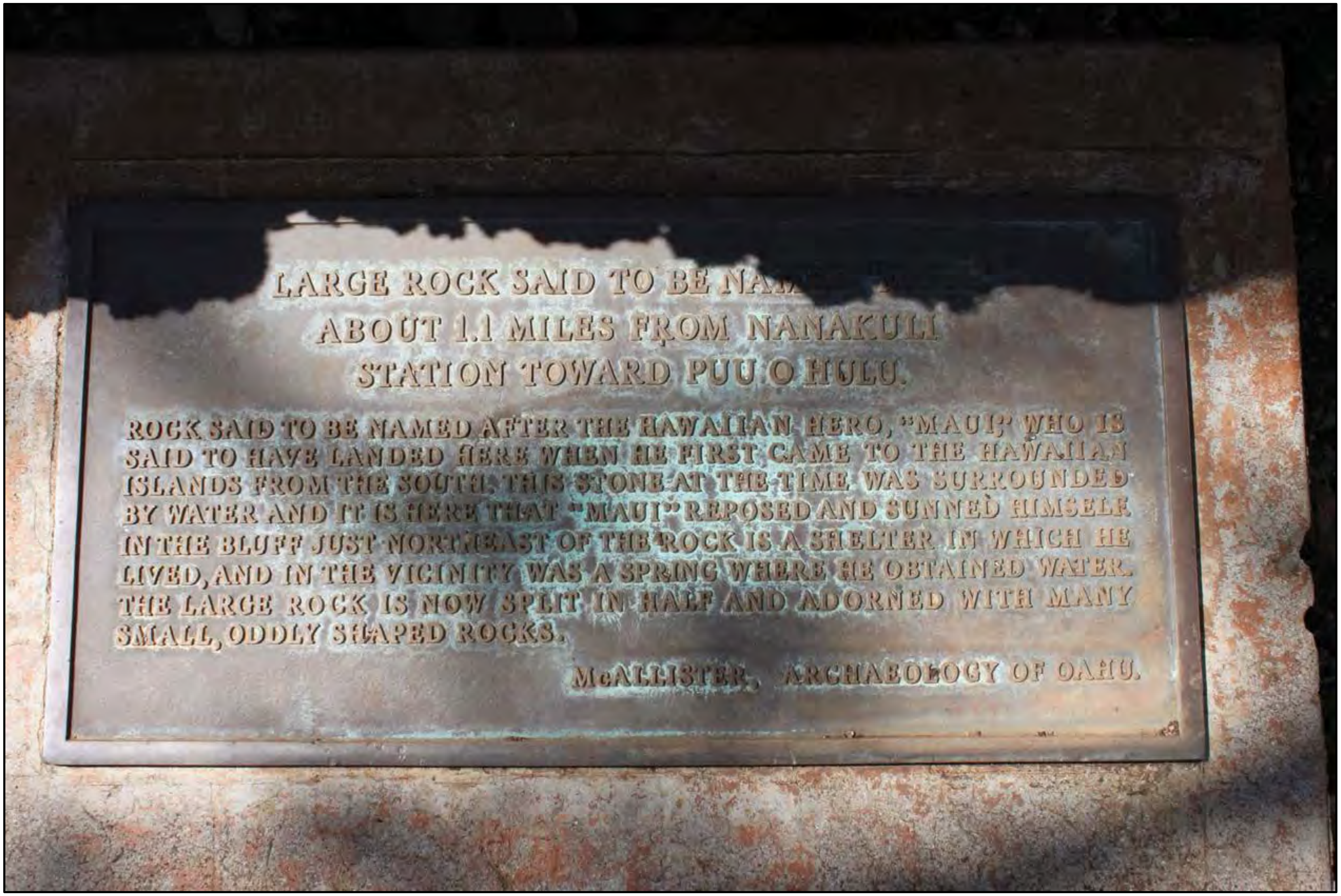

Figure 14. Photo of plaque located at the foot of the Māui Pōhaku at the Garden Grove condominium complex (CSH 2015)

3.5.2 Heiau

3.5.2.1 Nīoiʻula Heiau, Site 149

Located on Halona Ridge in Lualualei (McAllister 1933:110), Nīoiʻula Heiau sits within the Lualualei Naval Preservation. The paved and walled *heiau* was classified as *poʻokanaka* or sacrificial class. The northern portion was nearly completely destroyed and the stones were used for a cattle pen on the McCandless property. It is said that the cattle in the pen became sick and died, resulting in infrequent use followed by abandonment. McAllister continues, "The heiau probably had three inclosures [*sic*] and three platforms open to the west side, but so little remains of the northern part of the heiau that it is difficult to discern inclosures and terraces" (McAllister 1933:110). Westervelt's account of the legendary Kawelo also suggests this is the *heiau* where the body of the boxer killed by Kewalo was sacrificed as an offering to the gods. The *heiau* is said to be ancient and belonged to Kakuhihewa (Westervelt 1963:178). Figure 15 depicts the site plan of the *heiau*.

3.5.2.2 Site 150

Home sites or possible *heiau* were surveyed and noted by McAllister as Site 150 (McAllister 1933:110). These sites are located in the middle of the *ahupuaʻa* at the foot of the cliffs of Pāhoa, an *ʻili* within Lualualei. Walls and small terraces reportedly used as house sites or possibly old *heiau* are located near the foot of the ridges.

3.5.2.3 Site 151

Kakioe Heiau, Site 151, was located at Pūhāwai in Lualualei (McAllister 1933:110). It was noted as a small *heiau*, however, nothing remains except a sacred spring. It was also noted that drums could be heard on the nights of Kāne (name of the 27th night of the lunar month).

Figure 16 is a composite of *wahi pana*, sites surveyed by McAllister (1933), *loko* (pond), Land Commission Awards (LCA), *puʻu*, trails, streams, and gulches located in Lualualei Ahupuaʻa.

3.6 *Moʻolelo*

For the people of Hawaiʻi, traditional Hawaiian knowledge was preserved through a narrative dialogue known as *moʻolelo*, an oral history as real and factual as any written account of history.

> Folklore, like any living organism, passes through a series of metamorphoses. It originates in the tale of the storyteller who draws upon personal experiences, actual historic events, or imaginative reconstructions to instruct, entertain, or enthrall an audience. From this point of origin, the tale is then diffused by word of mouth through the culture until it often reaches a state of existence separate from the storyteller. At this stage the tale has become a cultural artifact that is retained in the collective memory as an explanation of mysteries, a bridge to the supernatural, or an account of the past. [Kalakaua 1990: forward]

3.6.1 Māui Genealogy

Hawaiian *moʻolelo* contain numerous traditional accounts of the demi-god Māui. Like many ancient accounts of deities, each of the Hawaiian Islands held their own versions of similar stories, and the tales of Māui are no different. The Hawaiian concept of genealogy and kinship is a crucial structure for piecing together the similarities in Hawaiian stories.

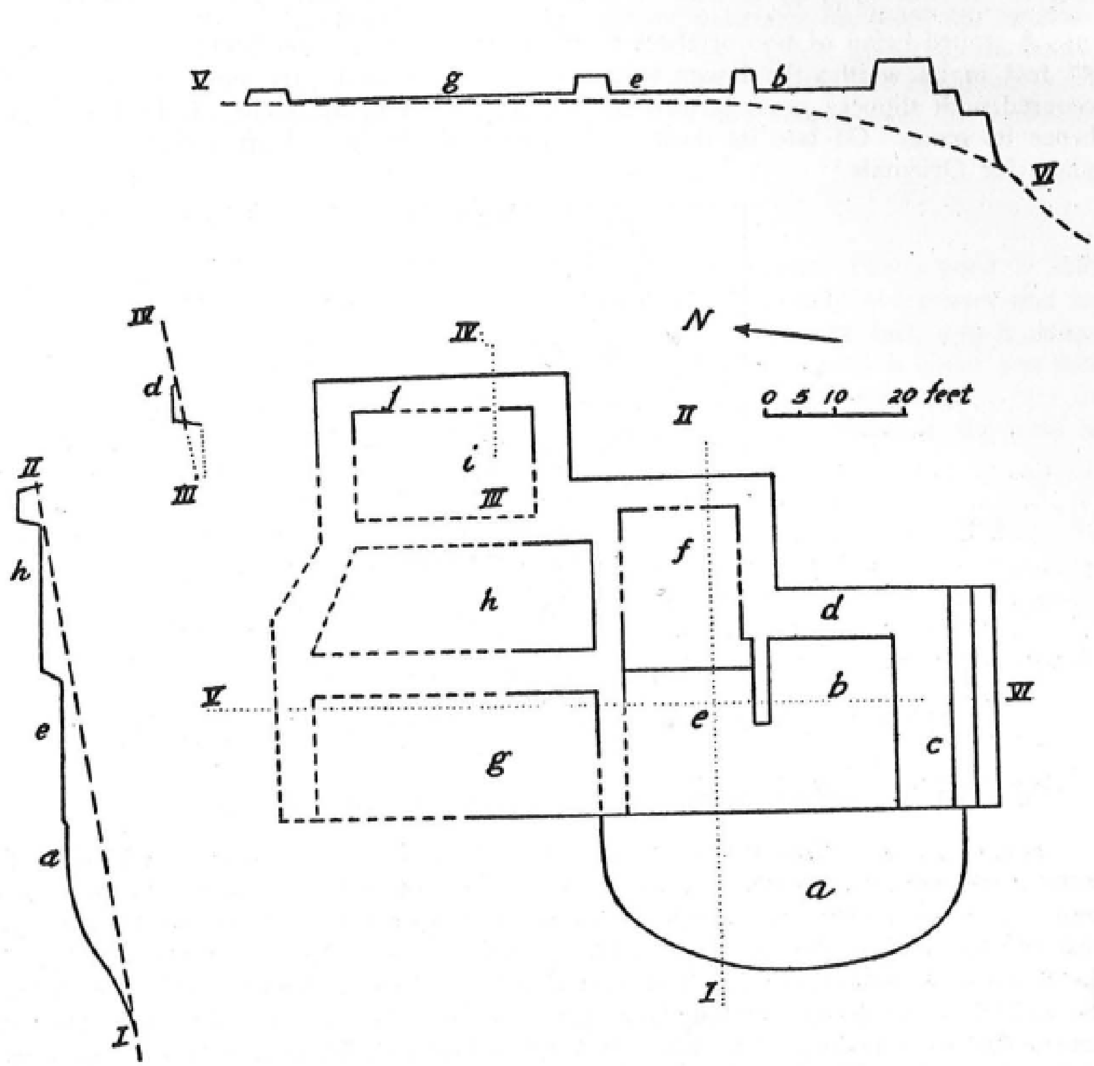

FIGURE 33.—Nioiula heiau, Halona, Lualualei, Site 149: *a*, sloping terrace of large rocks, approximately 20 feet wide, probably built up in form of steps, as slope approximates 10 feet in vertical height; *b*, probable site of house with front lanai 18 by 24 feet, paved with stones 1 foot in width; *c*, wall 4 feet high on inside, 8 feet wide, with two terraces 3 feet wide on outside where ridge that rapidly slopes into deep gully is faced by embankment of stones 14 feet high; *d*, wall 4 feet high inside and outside, 7 feet wide; *e*, open dirt-paved terrace; *f*, terrace 3 feet higher than *e*, paved with stones 1 foot in width, surrounded on three sides by walls but open toward *e*; *g*, stone-paved terrace 46 by 18 feet, probably walled originally on three sides but open to west; *h*, *i*, probably walled inclosures; *j*, wall 26 feet long, 5 feet wide, 4 feet high inside, flush with slope on the outside. Roman numerals indicate cross sections.

Figure 15. Image of Nīoiʻula Heiau from McAllister's Survey (McAllister 1933:111)

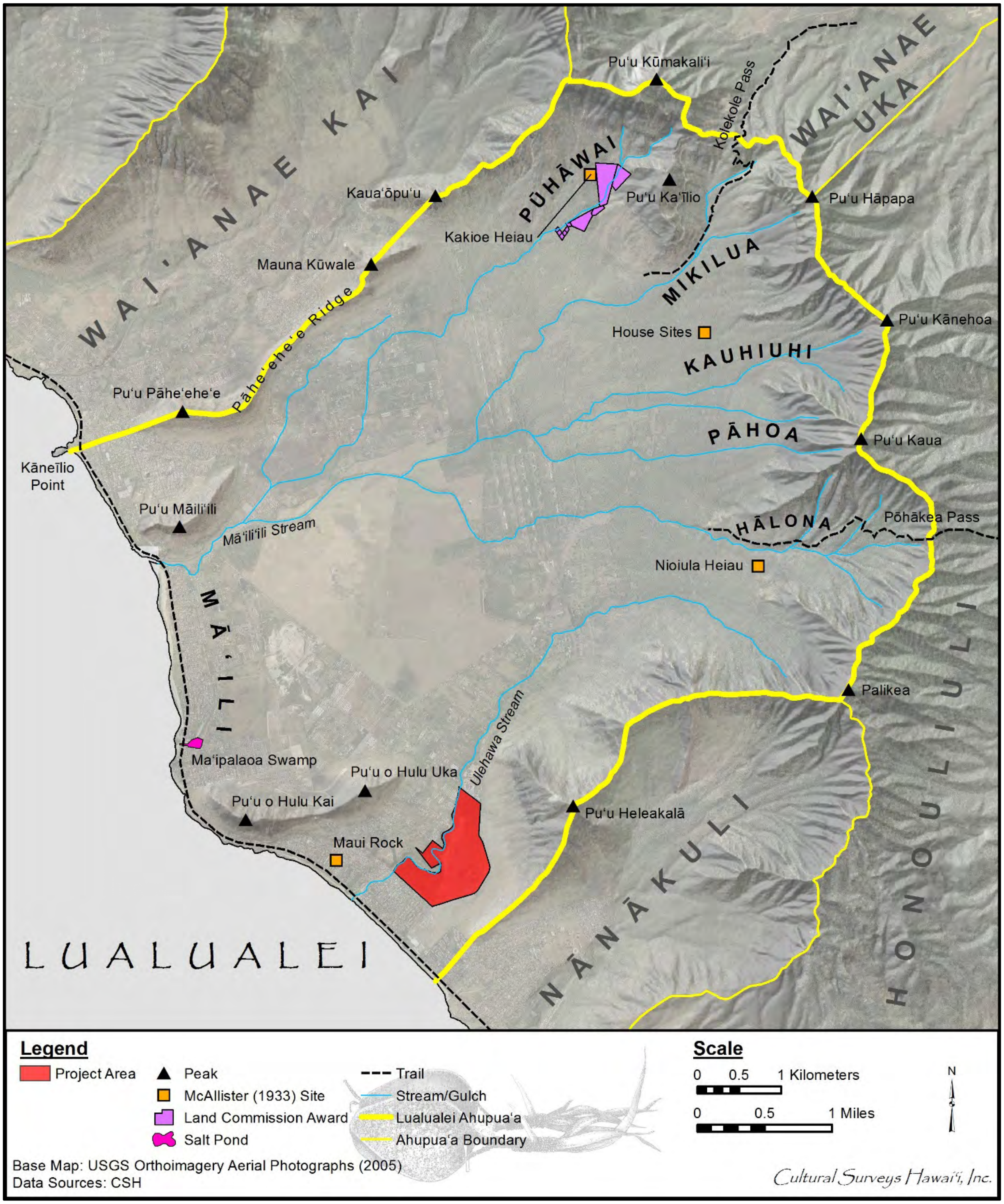

Figure 16. 2005 USGS Orthoimagery Aerial Photographs depicting *wahi pana*, McAllister Sites, LCAs, *loko*, trails, streams, and gulches

Kamakau's 1991 text, *Tales and Traditions of the People of Old*, outlines the ʻUlu genealogy as it leads down to Māui-akalana, the legendary Hawaiian trickster whose exploits are recorded in one of the oldest genealogical chants, the Kumulipo (name of Hawaiian creation chant). In the fifteenth epoch of the Kumulipo, Māui, the youngest of four sons, is born to Akalana (k = kane = male) and Hinaakeahi (w = wahine = female). In the sequence of Hawaiian genealogies, Māui is associated with the line of ʻUlu and the sons of Kiʻi (Westervelt 1910:4). Kamakau articulates the same kinship chart following seven generations of fathers that stretch back to Nanaʻie and his marriage to Kahaumokuleʻia, leading down to the marriage of Hina-kawea to the chief Akalana and their four offspring, all with the name Māui: Māui-mua, Māui-waena, Māui-kiʻikiʻi, and Māui-akalana (Kamakau 1991:135). Māui-akalana is the Māui whose stories fill legendary accounts on the island of Oʻahu. From Kamakau's reading, it's stated that there are four sons named Māui born to Hina. This is an important concept to understand as each of the four main Hawaiian Islands may have had their very own Māui, and each would have been a descendant of Hina, and each would have *wahi pana* associated with them.

Samuel Kamakau tells us that Māui's genealogy can be traced from the ʻUlu line through Nanaʻie:

> *Nanaʻie lived with Kahaumokuleʻia at Waiʻalua, and Nanaialani, a male was born;*
> *Nanaialani lived with Hina-kinau, and Waikūlani, a male, was born;*
> *Waikūlani lived with Kekauilani, and Kūheleimoana, a male, was born;*
> *Kūheleimoana lived with Mapunaiaʻaʻala, and Konohiki, a male was born;*
> *Konohiki lived with Hīkaʻululena, and Wawana, a male, was born;*
> *Wawena lived with Hina-mahuia, and Akalana, a male, was born;*
> *Akalana lived with Hina-kawea, and Māui-mua, Māui-waena, Māui-kiʻikiʻi, and Māui-akalana, all males, were born.* [Kamakau 1991:135]
>
> Ulehawa and Kaʻōlae, on the south side of Waiʻanae, Oahu, was their birthplace. There may be seen the things left by Māui-akalana and other famous things: the tapa-beating cave of Hina, the fishhook called Mānai-a-kalani, the snare for catching the sun, and the places where Māui's adzes were made and where he did his deeds. However, Māui-akalana went to Kahiki after the birth of his children in Hawaiʻi. The last of his children with Hina-a-kealoha was Hina-a-ke-kā. His children became ancestors for the oceanic islands as far as the islands called New Zealand by the haole. In the islands of the ocean, Māui performed his famous deeds, which will never be forgotten by this race. [Kamakau 1991:135]

3.6.2 Māui Learns the Secret of Fire

Hawaiian legends reveal that the Waiʻanae coast and uplands have been an important center of Hawaiian history. It is in Waiʻanae that the famous exploits of Māui-akalana (Māui) are said to have originated. According to Pukui, Ulehawa was the birthplace and origin of Māui legends (Pukui et al. 1974:215). It was here in Lualualei that Māui learned the secret of making fire for mankind:

> Maui's first feat is getting fire from the mud hens while they are roasting bananas. Hina teaches him to catch the littlest one. He finds them at Waianae on Oahu. Each time he approaches they scratch out the fire. When he finally succeeds in seizing the littlest mud hen she tries to put him off by naming first the taro stalk, then the

> ti leaf as the secret of fire. That is why these leaves have hallows today, because Maui rubbed them to try to get fire. At last the mud hen tells him that fire is in the water (wai), meaning the tree called ʻsacred waterʼ (wai-mea), and shows how to obtain it. So, Maui gets fire, but he first rubs a red streak on the mud henʼs head out of revenge for her trickery before letting the bird escape. [Beckwith 1970:229–230]

3.6.3 Hiʻiakaikapoliopele

Hiʻiaka-i-ka-poli-o-Pele ("Hiʻiaka in the bosom of Pele" also known as Hiʻiaka) is sent by her elder sister Pele, the fiery volcano goddess, to fetch Peleʼs lover Lohiʻau from Hāʻena, Kauaʻi and bring him back to Kīlauea on Hawaiʻi Island. Hiʻiaka asks Pele to take care of her friend Hōpoe while she sets forth on this journey for her sister. Hiʻiaka is joined by Pāʻūopalaʻā, an attendant to Pele and her sisters, and Wahineʻōmao, a friend she met along the way to Kauaʻi (Hoʻoulumāhiehie 2008:33-39). Upon their return from Kauaʻi with Lohiʻau, Pōhākea is the location where Hiʻiaka witnessed her sister destroy her *aikāne* (friend) Hōpoe (Hoʻoulumāhiehie 2008:98).

Hiʻiaka began climbing the mountain road up and over Pōhākea. Hiʻiaka climbed over the plain of Māʻili and turned *mauka* where she noticed the sun sparkling on the plains of Lualualei. Hiʻiaka then began to chant:

> Hot from the sun!
>
> Hot from the sun!
>
> The plain of Lualualei is heated by the sun
>
> Gnashed by the sun into bits
>
> The lower jaw of the sun has fallen
>
> O the sun, ah! In all directions
>
> The sun tended its fire to a blaze
>
> With no place of respite
>
> Where oneʼs foot can find relief
>
> Up to the top of Pōhākea
>
> Let us share our tears. [Hoʻoulumāhiehie 2008:260]

After chanting, Hiʻiaka found herself atop Pōhākea, gazing towards Hawaiʻi Island, and saw that her beloved *aikāne* Hōpoe had perished in the fires of her sister, Pele. Again, Hiʻiaka chants on Pōhākea:

> Alas my friend of the rugged mountain pass
>
> On high at Pōhākea, above Kamaoha
>
> Maunauna is a dangerous escarpment
>
> Līhuʻeʼs high plain yet to be traversed
>
> Inhaling the scent of the grasses
>
> The fragrance of kupukupu fern

Entwined by the Waikōloa breeze

By the wind called Waiʻōpua

My blossom, like a flower in my sight

Moving before my eyes, washed salty by tears

There in my sight, I weep. [Hoʻoulumāhiehie 2008: 262]

3.6.4 Kolekole Pass

The trail from the pass descends down the valley towards the ocean (Figure 17). Kolekole Pass is well known today, but Pōhākea Pass was heavily used in the past as well (Cordy 2002:95).

> In the old days people from Wahiawa side would meet those from Waianae at Kolekole and attempt to cross over. Each would challenge the other for the right to pass. The losing chief would then have to kneel before the big rock and place his head on it and be killed. His skin was then stripped from the flesh and bones (leaving it raw–Kolekole).* The spoils of the battle and the bones were then brought to the heiau in Halona (Site 149) and offered in sacrifice. Below Kolekole and beyond Kailio is a hair-pin turn known as Hupe Loa for the retainers of the vanquished chief—because of their weeping and blowing of noses.
>
> *Mrs. Pukui says 'holehole' is to strip the flesh. She believes the name Kolekole most likely came because of the battles and the wounds the warriors received, leaving their flesh raw—'Kolekole'. The idea of the chief kneeling before a rock to be killed seems to be modern. [Sterling and Summers 1978:67]

3.7 *Oli*

A variation of the *moʻolelo* of Hiʻiaka-i-ka-poli-o-Pele by Emerson places Hiʻiaka, Lohiʻau, and Wahineʻōmao in a canoe en route to Mokuleia. The party of three land in Mokuleia where Hiʻiaka parts ways and tells Lohiʻau and Wahineʻōmao that she will call for them at a designate place at a later time. Hiʻiaka pays her respects to her *kūpuna*, Pōhaku-o-Kauaʻi, then to Kaʻena (Emerson 1915:156-157). Passing through Kaʻena, the western cape of Oʻahu, she turns and passes through the slopes of the Waiʻanae Mountain Range and chants the following:

Kunihi Kaena, holo i ka malie;

Wela i ka La kea lo o ka pali;

Auamo ma ii ka La o Kilauea;

Ikiiki i ka La na Ke-awa-ula,

Ola i ka makani Kai-a-ulu Koholā-lele—

He makani ia no lalo.

Haōa ka La in a Makua;

Lili ka La i Ohiki-lolo;

Haʻa-hula leʻa ke La i ka kula,

Ka haʻa ana o ka La i Makāha;

Oī ka niho o ka La i Ku-manomano;

Ola Ka-maile i ka hunā na niho;

Moʻa wela ke kula o Waliō;

Ola Kua-iwa i ka malama po;

Ola Waianae i ka makani Kai-a-ulu, (a)

Ke hoā aku la i ka lau o ka niu.

Uwē o Kane-pu-niu (b) i ka wela o ka La;

Alaila kuʻu ka luhi ka maloʻeloʻe,

Auaua aku i ka wai i Lua-lua-lei.

Aheahe Kona, (c) Aheahe Koolau-wahine, (d)

Ahe no i ka lau o ka ilima.

Wela, wela i ka La ka pili i ka umauma,

I Puʻu-liʻiliʻi, i Kalawalawa, i Pahe-lona,

A ka piʻina i Wai-ko-ne-nē-he;

Hoʻomaha aku i Ka-moa-ula;

A ka luna i Poha-kea

Ku au, nana i kai o Hilo:

Ke hoʻomoe aʻe la i ke kehau

O aʻu hale lehua i kai o Puna,

O aʻu hale lehua i kai o Ku-kiʻi.

(a) *Kai-a-ulu*, a sea-breeze that comforted Waianae.

(b) *Kane-pu-niu*, a form of god Kane, now an uncarved bowlder [boulder]; here used in a tropical sense to mean the head. The Hawaiians, impelled by the same vein of humor as ourselves, often spoke of the human head as a coconut (pu-niu).

(c) *Kona*, here used as a local name for the sea-breeze.

(d) *Koolau-wahine*, a wind, stronger, but from the same direction as the Kona.

Translation:

Kaena's profile fleets through the calm,

With flanks ablaze in the sunlight—

A furnace-heat like Kilauea;

Ke-awa-ula swelters in heat;

Koholā-lele revives in the breeze,
That breath from the seam, Kai-a-ulu.
Fierce glows the sun of Makua;
How it quivers at Ohiki-lele—
'Tis the Sun-god's dance o'er the plain,
A riot of dance at Makaha.
The sun-tooth is sharp at Kumano;
Life comes again to Maile ridge.
When the Sun-god ensheaths his fang.
The plain Wailiō is sunburned and scorched:
Kua-iwa revives with the nightfall;
Waianae is consoled by the breeze
Kai-a-ulu and waves its coco fronds;
Kane-pu-niu's fearful of sunstroke; (e)
A truce, now, to toil and fatigue:
We plunge in the Lua-lei water
And feel the kind breeze of Kona,
The cooling breath of the goddess.
As it stirs the leaves of ilima.
The radiant heat scorches the breast
While I sidle and slip and climb
Up one steep hill then another:
Thus gain I at last Moa-ula.
The summit of Poha-kea.
There stand I and gaze oversea
To Hilo, where lie my dewy-cool
Forest preserves of lehua
That reach to the sea in Puna—
My lehus that enroof Kukiʻi.

(e) The author begs to remark that sunstroke is unknown in all Hawaii. [Emerson 1915:157-158]

3.8 *‘Ōlelo No‘eau*

Mary Kawena Pukui is known to many as a scholar and ethnologist, and one of the greatest contributors to preservation of the Hawaiian language. The following section draws from Pukui's knowledge of Hawaiian folk tales and proverbs.

The following *‘ōlelo no‘eau* (proverb) describes the famed mud hen who taught the demi-god Māui the secret of fire.

> *He ke‘u na ka ‘alae a Hina*
>
> A croaking by Hina's mudhen.
>
> A warning of trouble. The cry of a mudhen at night is a warning of distress.
>
> [Pukui 1983:77]

The following *‘ōlelo no‘eau* describes the cause and effect from the demi-god Māui looking for the secret of fire; the secret of fire was only know to the mudhen who guarded the knowledge from Māui.

> *Ua mo‘a ka mai‘a, he keiki māmā ka Hina.*
>
> The bananas are cooked, [and remember that] Hina has a swift son.
>
> Let's finish this before we are caught. This saying comes from the legend of Māui and the mudhens, for a long time he tried to catch them in order to learn the secret of making fire. One day he overheard one of them saying these words. He caught them before they could hide and forced them to yield the secret of fire.

[Pukui 1983:310]The following *‘ōlelo no‘eau* describes the particular leeward winds that blow across the channel from Kaua‘i.

> *Ola Wai‘anae i ka makani Kaiaulu.*
>
> Wai‘anae is made comfortable by the Kaiaulu breeze.
>
> Chanted by Hi‘iaka at Ka‘ena, O‘ahu, after her return from Kaua‘i.
>
> [Pukui 1986:273]

Figure 17. Photo of Kolekole Pass in right background with Pu‘uka‘īlio directly below; Maunakūwale in left foreground (CSH 2012)

Section 4 Historical Background

The following section provides a summary of the historical events that transpired in Lualualei Ahupua‘a. Focusing on geographic and temporal scales, this section then traces the exploration of the Pacific Ocean and the subsequent discovery, settlement, and expansion into the Hawaiian archipelago. The historical background illustrates the changes to Lualualei Ahupua‘a from the time of the arrival of Captain Cook in 1778, the first Western explorer to visit Hawai‘i, through to the present era.

4.1 Pre-Contact to Early Post-Contact Period

4.1.1 Western Reconnoiters

In January 1778, Captain James Cook sighted Wai‘anae from a distance, but chose to continue his journey and landed off Waimea, Kaua‘i instead. Fifteen years later, Captain George Vancouver approached the coast of Wai‘anae from Pu‘uloa and wrote in his log:

> The few inhabitants who visited us [in canoes] from the village earnestly entreated our anchoring . . . And [they] told us that, if we would stay until morning, their chief would be on board with a number of hogs and a great quantity of vegetables; but that he would not visit us then because the day was taboo poory [a kapu day]. The face of the country did not however, promise an abundant supply [of water]; the situation was exposed. [Vancouver in McGrath et al. 1973:17]

Vancouver was not impressed with what he saw of the Wai‘anae coastline, stating in his log that the entire coast was “one barren, rocky, waste nearly destitute of verdure, cultivation or inhabitants.”

Vancouver did not anchor at Wai‘anae. But had he done so, he would have been pleasantly surprised, at least by portions of the coastline. Even though the dry, arid coast presented a dismal aspect, the ocean provided an abundant supply of fish, the lowlands provided *‘uala* (*Ipomoea batatas*; sweet potato) and *niu* (*Cocos nucifera*; coconut), and the inland valley areas were planted in *kalo* (*Colocasia esculenta*; taro) and *wauke* (*Broussonetia papyrifera*; paper mulberry). The upland forest regions provided various woods needed for weapons and canoes. By the 1790s, there was probably a good variety of introduced vegetables being planted in the valley as well.

4.1.2 Sandalwood Trade

The Hawaiian Islands began exporting sandalwood to Asia shortly after 1800 and the commerce flourished until the supply dwindled in the mid-1830s. Lualualei was a region of importance in the sandalwood trade. The demands put on the *maka‘āinana* (commoner) to harvest wood for trade caused many agricultural fields to become fallow and unused.

By 1811, sandalwood merchants began actively exploiting the Hawai‘i market and huge amounts of sandalwood were shipped to China. Traditionally, Hawaiians used sandalwood for medicinal purposes and as a scent to perfume their *kapa*. Kamehameha I and a few other chiefs controlled the bulk of the sandalwood trade. Kamakau writes, “The chiefs also were ordered to send out their men to cut sandalwood. The chief immediately declared all sandalwood to be the property of the government” (Kamakau 1992:204).

The sandalwood trade greatly impacted Hawaiian culture, and the traditional lifestyle Hawaiians pursued was altered drastically. In an effort to acquire western goods, ships, guns and ammunition, the chiefs had acquired massive debts to the American merchants (ʻĪʻī 1959:155). Chiefs including Boki Kamaʻuleʻule were in debt 15,000 piculs (one picul equals 133.33 pounds) of sandalwood worth approximately $200,000 (McGrath et al. 1973:24). When Kamehameha found out how valuable the sandalwood trees were, he ordered the people not to let the felled trees fall on the young saplings, to ensure their protection for future trade (Kamakau 1992:209–210). According to Samuel Kamakau:

> The debts were met by the sale of sandalwood. The chiefs, old and young, went into the mountains with their retainers, accompanied by the king and his officials, to take charge of the cutting, and some of the commoners cut while others carried the wood to the ships at the various landings; none was allowed to remain behind. Many of them suffered for food . . . and many died and were buried there. The land was denuded of sandalwood by this means. [Kamakau 1992:252]

Kamakau comments about the plight of the common people and the general state of the land during this time:

> This rush of labor to the mountains brought about a scarcity of cultivated food throughout the whole group. The people were forced to eat herbs and tree ferns, hence the famine called Hīlaulele, Hāhāpilau, Laulele, Pualele, ʻAmaʻu, or Hāpuʻu, from the wild plants resorted to. [Kamakau 1992:204]

In 1816, Boki was made governor of Oʻahu (and chief of the Waiʻanae district) and served in that capacity until 1829, when he sailed to New Hebrides in search of sandalwood. Boki assembled a group of people to join him on his sandalwood expedition and set out with two ships to help pay off his debts. Boki was never seen again in the Hawaiian Islands and it was reported that his ship was wrecked (McGrath et al. 1973:24).

After Kamehameha's death in 1819, Liholiho allowed his chiefs to share in the trade, resulting in an unrestrained demand on the stocks of wood and upon the energies of the *makaʻāinana* who did the harvesting. Already by October 1817, a Russian visitor noted on Oʻahu, "There are now many fields left uncultivated, since the natives are obliged to be cutting sandalwood" (Barratt 1988:218).

The sandalwood era was short-lived and by 1829, the majority of the sandalwood trees had been harvested, and the bottom fell out of the trade business. It is unclear how extensive Lualaulei's sandalwood resources were; however, the effects of the sandalwood gathering, the population shifts and disruption of traditional lifestyles and subsistence patterns, would undoubtedly have affected the population of Lualualei.

4.2 Mid-Nineteenth Century to Present

4.2.1 The Māhele (1848)

The Organic Acts of 1845 and 1846 initiated the process of the Māhele—the division of Hawaiian lands—that introduced private property into Hawaiian society. In 1848, the crown and the *aliʻi* (royalty) received their land titles. *Kuleana* (property) awards to commoners for individual parcels within the *ahupuaʻa* were subsequently granted in 1850. At the time of the Māhele, the *ahupuaʻa* of Waiʻanae, which included Lualualei, was listed as Crown lands and was claimed by King Kamehameha III as his personal property (Board of Commissioners 1929:28). As such, the land was under the direct control of the King. Many of the chiefs had run up huge debts to American merchants throughout the early historic period and continuing up into the mid-1800s. A common practice at the time was to lease (or mortgage) large portions of unused land to other high chiefs and foreigners to generate income and pay off these earlier debts.

Until the passage of the Act of 3 January 1865, which made Crown Lands inalienable, Kamehameha III and his successors did as they pleased with the Crown Lands, selling, leasing, and mortgaging them at will (Chinen 1958:27).

In 1850, the Privy Council passed resolutions that affirmed the rights of the commoners or native tenants. To apply for fee-simple title to their lands, native tenants were required to file their claim with the Land Commission within the specified time period of February 1846 to 14 February 1848. The Kuleana Act of 1850 confirmed and protected the rights of native tenants. Under this act, the claimant was required to have two witnesses who could testify they knew the claimant and the boundaries of the land, knew that the claimant had lived on the land for a minimum of two years, and knew that no one had challenged the claim. The *kuleana* parcels also had to be surveyed.

Not everyone who was eligible to apply for *kuleana* lands did so and, likewise, not all claims were awarded. Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. For many reasons, out of the potential 2,500,000 acres of Crown and Government lands "less than 30,000 acres of land were awarded to the native tenants" (Chinen 1958:31).

A total of 13 land claims were made in Lualualei; however, only seven were actually awarded. Most awards were located upland in the *ʻili* of Pūhāwai, *mauka* of the current project area. From the claims, it can be determined that at least eight families were living in Pūhāwai at the time of the Māhele in 1848. Together, they cultivated a minimum of 163 *loʻi*. The numerous *loʻi* mentioned in the claims indicate the land was ideal for growing wetland taro and that this livelihood was actively pursued by the awardees. In addition, dryland crops were grown on the *kula* (plains), *wauke* (paper mulberry; *Broussonetia papyrifera*) was being cultivated, and one claimant was making salt.

Information on the occupations at Lualualei at the time of the Māhele, aside from the historical accounts of scattered coastal hamlets, is from archival records indicating there were nine taxpayers at Māʻili near the coast and 11 taxpayers at Pūhāwai in the upper valley (Cordy et al. 1998:36). Māʻili is located along the eastern edge of the *ahupuaʻa* and Pūhāwai is *mauka*. Based on these numbers, Cordy estimates a population of 90 people for coastal Lualualei and 55 people for the upper valley in 1855 (Cordy et al.1998:36). Regardless of the population estimate, the existence of 20 taxpaying adults in Lualualei indicates the area was inhabited and worked. In this case, the Māhele documents are only a partial reflection of the population and actual land use during the time. Figure 16 depicts the location of these LCAs in Lualualei Ahupuaʻa.

Table 1. LCAs in Lualualei Ahupuaʻa

LCA number	Claimant and *ʻili*	Property description (measurements omitted)	Original LCA transcription in Hawaiian
7334	Kulepe: located in Lehanoiki, Moomuku	Parcel of land 1: A narrow strip of cultivated land within Lehanoiki, Waianae Oahu. Commencing at the southern corner and moving northeast on the farmed boundary. Thence moving southwest at the boundary of Akaloa. Moving south at the boundary of Pooloa and going to the beginning of the square. Parcel of land 2: An agricultural field and house in Lehanoiki. Commencing at the western corner and moving northeast to the field boundary of the land manager. Thence moving southeast to the road, thence moving southwest of the land manager's field, thence going northwest at the bulrush (*Scirpus validus*) of Lehanoiki. Going northeast, then moving northwest, going back to the beginning square. In total 2 acres, (or) 9 23/100 links. Parcel of land 3: A narrow strip of land in Ana, Waianae. Commencing at the northeastern corner going southeast at the boundary of Paupau. Going southwest at the field boundary. Thence going northeast at the field boundary. Then continuing going northeast. Then going northeast at the boundary of Keauhee. Then going southeast at the farm to the beginning square. In total 4 acres, (or) 7 18/100 links. A. Bishop	*Apana* 1. *He mookalo iloko o Lehanoiki, Waianae Oahu. E hoomaka ma ke kihi Hema, e hele ana. Ak.* 61º *Hik.i* 1.00 *k.h. maka palena koele. Malaila aku. Ak.* 32º *Kom. i* 4.66 *k.h. ma ka palena no Akaloa. Malailaaku. Hem.* 51 1/2º *Kom. i* 1.44 *k.h. ma ka palena no Kekee. Malaila aku. Hem.* 34 1/2º *Hik.i* 4.50 *k.h. ma ka palena no Pooloa. a hiki i ka hoomaka ana. He* 5 59/100 *k.h huinaha. Apana* 2. *He kula mahiai, me ka pahale, ma Lehanoiki. E hoomaka ma ke kihi Komohana, e hele ana. Ak.* 68º *Hik. i* 3.00 *k.h. maka palena kula o Konohiki. Malaila aku. Hem.* 18º *Hik. i* 7.95 *k.h. ma ka alanui. Malailaaku. Hem.* 62º *Kom. i* 3.50 *k.h. ma kula o Kon. Malaila aku. Ak.* 20º *Kom. i* 4.00 *k.h. ma ke akaakai o Lehanoiki. Malaila aku. Ak.* 73º *Hik. i* 0.98 *k.h. Malaila aku. Ak.* 20º*Kom. i* 3.90 *k.h. a hiki i ka hoomaka ana.* 2 *Eka.* 9 23/100 *k.h. huinaha. Apana* 3. *He mooaina ilo o Ana, Waianae.E hoomaka ma ke kihi Hik. Akau, e hele ana. Hem.* 7º *Hik. i* 2.60 *k.h. maka palena no Paupau. Malaila aku. Hem.* 48º *Kom. i* 5.50 *k.h. ma ka palena kula. Malaila aku. Ak.* 6º *Hik. i* 2.92 *k.h. ma ka palena kula. Malaila aku. Ak.* 51º *Hik.i* 2.40 *k.h. Malaila aku. Ak.* 16 1/2º *Hik. i* 3.50 *k.h. ma ka palena no Keauhee. Malaila aku Hem.* 11º *Hik. i* 1.98 *k.h. Malaila aku. Hem.* 80º *Hik. i* 0.28 *k.h. ma ka palena koele, a hiki i ka hoomaka ana.* 1 *Eka*. 2.95 *k.h. huinaha. Pau loa* 4 *Eka.* 7 18/100 *k.h. huinaha. A. Bishop. Mea Ana*

LCA number	Claimant and *‘ili*	Property description (measurements omitted)	Original LCA transcription in Hawaiian
7436	Kahi: located in Puhawai	Parcel of land 1: A narrow strip of land belonging to Kalimako. In Puhawai, Waianae. Oahu. Commencing at the southern corner, moving northeast at the boundary of the land manager. Continuing northeast along the gulch. Then moving northwest at the boundary of Apiki. Continuing northwest, then going southwesterly, then going southeast at the boundary of Maui, then finishing at the beginning. In total 24 acres, (or) 2.21 links. Parcel of land 2: House platform [*Hanapili*] in Puhawai. At the house boundary of Kailianu. The three other sides are bound by the land manager. In total there are 24 acres (or) .56 links. A. Bishop	*Apana 1. He mooaina Kalimako. Puhawai. Waianae. Oahu. E hoomaka ma ke kihi He. e hele ana. A.* 81º *Hi. i* 3.50 *kh.ma ka palena i Konohiki. Malaila aku. A.* 41º *Hi. i* 2.06 *kh. ma kahawai. Malaila aku. A.* 2 Ko. i 11.79 *kh. ma ka palena no Apiki. Malaila aku*. A. 3º *Ko. i* 13.*63 kh. Malaila aku. He.* 7(?)º *Ko. i* 13.40 *kh. Malaila aku. He.* 20 ½º *Hi. i* 25.80 *kh. ma ka palena aina no Maui. a hiki i ka hoomaka ana. He.*24 *Eka.* 2.21 *kh. huinaha.* *Apana* 2. *Kahuahale. Hanapili. Puhawai. He.* 34 *½º Ko. i* 2.12 *kh. ma ka palena hale o Kailianu. He.* 50º *Hi. i* 2.95 *kh. ma kula o Konohiki. A.* 34º *Hi. i 2.12 kh. ma kula o Konohiki. A.* 50º *Ko. i* 2.95 *kh. ma kula o Konohiki. He.* 6.35 *kh. huinaha Pau loa 24 Eka.* (?).56 *kh. huinaha.* *A. Bishop. Mea Ana*
7451	Kailianu: located in Puhawai, Mookumu	Parcel of land: 1 A house lot at Keakahiki in the section of Puhawai, Waianae, Oahu. Commencing at the eastern corner and moving southwest at the boundary house lot of Kami. Thence north thence northeast thence southeast, then finishing at the beginning. In total there are 3.34 links. Parcel of land 2: A taro field of Kumukukui, in the section of Moomuku, Waianae. Commencing at the southern corner and moving northeast at the boundary of Kaina. Thence northwest. Thence southwest. Thence southeast, and finishing at the beginning. In total there are 1.91 links.	*Ap. 1. He Pahale ma Keakahiki, ili o Puhawai. Waianae. Oahu. E hoomaka ma ke kihi Hi, e hele ana. He.* 34 ½º *Ko. i* 2.12 *kh. ma ka palena pahale o Kami. Malaila aku. A* 5º1.58 *kh. Malaila aku. A.* 3(?)º *Hi. i 2.12 kh. Malaila aku. He.* 50º *Hi. i* 1.50 *kh. a hiki i ka hoomaka ana He.* 3.34 *kh. huinaha.* *Ap.* 2. *He loi o Kumukukui, ili o Moomuku. Waianae.E hoomaka ma ke kihi. He. e hele ana. A.* 68º *Hi. i* 1.20 *kh.ma ka palena no Kaina. Malaila aku. A.* 24º *Ko. i* 1.80 *kh.Malaila aku. He.* 66º *Ko.* 1.10 *kh. Malaila aku. He.* 20º *Hi. i* 1.71 *kh. a hiki i ka hoomaka ana. He.* 1.91 *kh. huinaha.* *Ap.* 3. *Mooaina Kanaikoele. ili o Moomuku. Waianae. E hoomaka ma ke kihi. A. Ko. e hele ana. He.* 31 ½ º *Ko. i* 4.80 *kh. ma ka palena aina no Hulupu.*

LCA number	Claimant and *ʻili*	Property description (measurements omitted)	Original LCA transcription in Hawaiian
		Parcel of land 3: Narrow strip of land, in the section of Moomuku, Waianae. Commencing at the northwestern corner, moving southwest at the land boundary of Hulupu. Thence southeast then northeast at the farm boundary. Thence northeast then southeast again at the land managers boundary. Thence north, then west back to the beginning quadrangle. In total there are 2 acres (or) 2.25 links. Final payment for 2 acres 7.5 links total. A. Bishop	*Malaila aku. He.* 56º *Hi.i* 1.86 *kh. Malaila aku. A.* 55º *Hi. i* 1.76 *kh. ma ka palena koele. Malaila aku. A.* 81º *Hi. i 2.24 kh. Malaila aku. He.* 5 ½ º *Hi. I* 3.85 *kh. Malaila aku. A.* (?)2º *Hi. i* 1.11 *kh. ma ka palena no Konohiki. Malaila aku. A. i* 4.00 *kh. Malaila aku. Ko. i* 3.90 *kh. a hikiika hoomaka ana. He.* 2 *Eka me* 2.25 *kh. huinaha. Pau loa.* 2 *Eka* 7 ½ *kh. huinaha.* *A. Bishop. Mea Ana*
7452	Kaahia: located in Puhawai	Parcel of land 1: A narrow strip of [*Ohia grove*]. Puhawai. Waianae, Oahu. Commencing at the western corner going southeast at the farm boundary, thence northeast thence northwest thence southwest at the land boundary of Kahi. Then going to the beginning quadrangle. One acre. Parcel of land 2: House lot at Keakapili in Puhawai. Commencing at the western corner and moving southeast at the house lot of Apiki. Thence northwest, thence southeast, then going back to the beginning quadrangle. It total there are 2 acres .80 links. A. Bishop	*Ap. 1. Mooaina, Kumuohia. Puhawai. Waianae. Oahu. E hoomaka ma ke kihi. Ko. e hele ana He. 44º Hi. i 3.60 kh.ma ka palena koele. Malaila aku. A. 35º Hi. i 6.16 kh. Malailaaku. A. 40º Ko. i 2.00 kh. Malaila aku. He. 49º Ko. i 5.70 kh. ma ka palena aina no Kahi. a hiki i ka hoomaka ana. 1 Eka me (???)4* *Ap. 2. Pahale ma Keakapili. Puhawai. E hoomaka ma ke kihi Ko. e hele ana. He. 50º Hi. i 2.00 kh.ma ka pahale o Apiki. Malaila aku. A. 30ºHi. i 2.12 kh. Malaila aku. A. 50º Ko. i 2.00 kh. Malaila aku. He. 30º Hi. i 2.12 kh.a hiki i ka hoomaka ana. He 4.24 kh. huinaha. Pau loa. 2 Eka 0.80 kh. huinaha.* *A. Bishop. Mea Ana.*
7454	Kanahele: located in Puahwai	Parcel of land 1: A narrow strip of land, in Waianae, Oahu. Commencing at the western corner, moving north then south along the land manages	*Ap. 1. Mooaina. (??) (??) Waianae. Oahu. E hoomaka ana ke kihi. Ko. e hele ana. A. 20º He. i 2.70 kh.ma ka palena o Konohiki. Malaila aku.He.44º Hi. i 3.60 kh. Malailaaku. He. 52º Ko. i 2.64 kh.*

LCA number	Claimant and *‘ili*	Property description (measurements omitted)	Original LCA transcription in Hawaiian
		boundary. Thence southeast thence southwest at the cliff boundary. Thence northwest at the boundary of Kailaa. Going back to the beginning quadrangle. In total there are 7 9/100 links. Parcel of land 2: The house lot of Keakapili located in Puhawai. Commencing at the southern corner and moving northeast at the land manager's field. Thence northwest at the fence of Kailaa. Thence southwest thence south at the house site of Kaahia, then going back to the beginning eastern quadrangle. A. Bishop	*ma ka aoao pali. Malaila aku. A. 42 ½º Ko. i 2.10 kh. ma ka palena no Kailaa. a hiki ika hoomakaana He. 7 09/100 kh. huinaha.* *Ap. 2. Pahale no Keakapili. Puhawai. E hoomaka ma ke kihi He. e hele ana A. 30º Hi. i 2.86 kh. ma kulao Konohiki. Malaila aku. A. 50º Ko. i 7.86 kh. ma ka paaina o Kailaa. Malaila aku. He. 30º Ko. i 2.86 kh. Malaila aku. He. 50º(??) (??) kh. ma ke kahuahale o Kaahia. a hiki i ka hoomaka ana. Hi. 4.42 kh. huinaha.* *A. Bishop. Mea Ana.*
7456	Kailaa: located in Puhawai	Parcel of land 1: A narrow strip of land, within Keakapili, in Puhawai, Waianae, Oahu. Commencing at the western corner and moving east at the house lot of Kailaa. Thence East at the field boundary. Thence northwest at the base of the cliff. Thence northeast, thence northwest at the gulch. Thence southwest beside the gulch, then going back to the beginning. Parcel of land 2: The home site at Keakapili. Commencing at the northern corner of the property, moving southeast at the fence of Kailaa. Thence southwest thence northwest thence north then south to the beginning quadrangle. There are 6 acres with 7.42 links total. A. Bishop	*Ap. 1. Mooaina. Keakapili. Puhawai. Waianae. Oahu. E hoomaka ma ke kihi Ko. e hele ana. Hi. 55 ½º HI. i 3.06 kh. ma ka pahale no Kailaa. Malaila aku. Hi. i 6.70 kh.ma ka palena kula. Malaila aku. A. 6º Ko. i 3.95 kh.ma kumu pali. Malaila aku. A. 4 ½º Hi. i 3.15 kh. Malaila aku. A. 13º Hi.i 3.57 kh. Malaila aku. A. 43º Ko. i 3.10 kh. a ke kahawai. Malaila aku. He. 39º Ko. i 13.55 kh. ma kahawai. a hiki i kahi.(?) hoomaka (??) (??) Eka, a he okoa na koele. Ehia mawaena.* *Ap. 2. He kahuahale ma Keakapili. E hoomaka ma ke kihi A. e hele ana. He. 55 ½º Hi. i 2.90 kh.mano paaina no Kailaa. Malaila aku. He. 53º Ko. i 2.65 kh. Malaila aku. A. 55 ½º Ko. i 2.90 kh. Malaila aku. A. 53ºA (?) 2.65 kh. He 7.42 kh. huinaha. Pau loa. 6 Eka me 7.42 kh. huinaha.* *A. Bishop. Mea Ana*

LCA number	Claimant and *‘ili*	Property description (measurements omitted)	Original LCA transcription in Hawaiian
8005	Apiki: located in Puhawai	Parcel of land 1: Commencing at the eastern corner and going southwest beside the gulch. Thence northwest thence northwest at the land boundary of Mahi. Thence southeast and going back to the beginning quadrangle. Parcel of land 2: The home at Kealahili. Commencing at the northern corner and going southwest at the boundary marker of Kahi. Thence southeast, thence south again. Thence northwest at the boundary marker of K(??)ahai, then finishing back at the beginning quadrangle. Total 7 acres. A. Bishop	*Ap. 1. E hoomaka ma ke kihi. Hi. e hele ana. He. 28º Ko. i 13.00 kh ma kahawai. Malailaaku. A. 53º Ko. i 3.62 kh. Malaila aku.A. 3º Ko. i 13.63 kh. ka palenaaina no Mahi. Malaila aku. He. 68º Hi. i 11.00 kh. a hiki i ka hoomaka ana, (????)(?) (?) me 5.82 kh. huinaha. Ap. 2. Ko Kahuahale ma Keakahili. Puhawai. E hoomaka ma ke kihi A. e hele ana. He. 34º Ko.ma (?) palena pa o Kahi. Malaila aku. He. 50º Hi. i 2.00 kh. Malailaaku. 4.34º He. i 2.12 kh. Malaila aku. A.50º Ko. 2.00 kh. ma ka palena pa o K(??)ahia, a hiki i ka hoomaka ana. He. 4.24 kh. huinaha. Pau loa 1(7) Eka. A. Bishop. Mea Ana*

4.3 Twentieth Century to Present

4.3.1 Homesteading

After the overthrow of the Hawaiian monarchy in 1893, the Crown Lands and the Government Lands were combined to become Public Lands. The Crown Lands were no longer indistinguishable and inalienable. In 1895, the Republic of Hawai’i decided to open up lands for homesteading in the hopes of attracting a “desirable class of immigrants”—Americans and those of Caucasian decent (Kuykendall and Day 1961:204). In anticipation of the Dowsett-Galbraith lease expiring in 1901, the Government intended to auction off these lands to the highest bidder.

There were two waves of homesteading on the Wai‘anae Coast (McDermott and Hammatt 2000). The first impacted Lualualei and coincided with homesteading occurring at Wai‘anae Kai. In 1902, the government ran advertisements in the local newspapers stating their intent to open up land in Lualualei for homesteads (Kelly 1991:328). Due to the lack of water, the lots were classified as second-class pastoral land rather than agricultural land. The homesteads were sold in three series between the years 1903 and 1912. In Lualualei, the first series was for *mauka* lots purchased by McCandless, who ranched most of his land until 1929, subletting use rights to the Sandwich Island Honey Company. The second and third series were for lots in the lower valley and along the coast, *mauka* of the government road. By the early 1920s, about 40 families had settled on homestead lots in Lualualei (Kelly 1991:331–332). The well-known families that obtained homestead lots at this time were Von Holt, McCandless, and Dowsett.

Despite promises by the government to supply water, there was none, and what little there was, was not enough to go around. Competition between the Waiʻanae plantation and the homesteaders for water caused friction within the community. The lack of water placed a hardship on the homesteaders. Water had to be carried in, and many lost their crops. The Waianae Sugar Company had a lease with the government to take 2.5 million gallons of water daily from government lands, but even after their lease had expired, the plantation continued to take the water. In 1924, the government made an agreement with the plantation to release 112,000 gallons of water daily for the homesteaders.

4.3.2 Sugar Industry

The sugar industry in the Hawaiian Islands first began in the 1830s. In 1863, a discouraged missionary wrote that the Waiʻanae Coast had "little prospect of the population's increasing for years to come, but the opposite, as no part of the district is suitable for an extensive sugar plantation" (McGrath et al. 1973:35). Hermann A. Widemann was a jack-of-all-trades who dabbled in politics and business (Dorrance and Morgan 2000:43).Widemann had financial backing from Hackfeld & Company as well as George N. Wilcox, a reputable sugar planter from Kauaʻi. In 1879, Widemann leased Waiʻanae Kai for 25 years (McGrath et al.1973:37). Widemann hired 20 Hawaiian workers, 15 *haole* (foreign) technicians, and 60 Chinese laborers. He also built 24 new homes in Waiʻanae to house his employees.

By 1901, the Waianae Sugar Company had obtained a five-year lease on 3,332 acres of land at Lualualei to be used for raising cane as well as for ranching (Figure 18; Commissioner of Crown Lands 1902). The small plantation was unique in the sense that it had its own 30-inch narrow gauge railroad (Dorrance and Morgan 2000:43). The plantation boasted 12 miles of railroad, three locomotives, and 350 laborers (McGrath et al. 1973:48). The Waianae Sugar Company had smooth labor relations due to its isolated location and careful attention to employees. Production increased dramatically during the plantation's early years due to the construction of several tunnels, which were used to collect mountain water. Wells were also constructed at Kamaile, the site of an early Native Hawaiian village and spring, to tap ground water for irrigation (McGrath et al. 1973:49). Prior to the construction of the tunnels and wells, sugar yielded 5.24 tons per acre (Dorrance and Morgan 2000:44). In 1930, after the construction of the tunnels and wells, sugar yield increased to 8.57 tons per acre. Five years later, the yield had increased again to 13.79 tons per acre.

By the 1940s, Waianae Sugar Company could no longer compete against foreign companies with cheaper labor. This, in addition to drought problems, labor unions, and land battles, caused the undermining of Waianae Sugar Company. In 1947, Amfac, Inc. purchased the plantation and closed it down.

4.3.3 Military

During the first half of the twentieth century, another major influence in Lualualei Ahupuaʻa was the military. In 1921, Congress designated approximately 2,000 acres in Lualualei as Hawaiian home lands. However, in 1930 and 1933 Territory of Hawaiʻi Governor Lawrence Judd signed an executive order granting 1,525 acres of land in Lualualei to the United States Navy for an ammunition depot and radio station (*Honolulu Star-Bulletin* 5 October 1998). The construction of the Naval Magazine LLL and Radio Transmission Facility (RTF) took place in Lualualei between 1930 and 1935 (Figure 19 through Figure 21; Kelly 1991:339–341). In 1986, the State of Hawaiʻi filed a lawsuit to recover land in Lualualei. However, two years later, Judge Harold Fong threw out the lawsuit stating that the statute of limitations had run out (Honolulu Star-Bulletin 5 October 1998). In 1995, President Bill Clinton signed the Hawaiian Home Lands Recovery Act, which was authored by Senator Daniel Akaka and set a dollar value on the confiscated lands in Lualualei. In 1998, the Department of Hawaiian Home Lands were awarded 894 acres of surplus federal land under the Hawaiian Home Lands Recovery Act. However, the Navy was still granted continued use of the Lualualei facilities. Today, two antennas of the Navy’s communication systems at Lualualei stand at 1,503 ft, the State of Hawai‘i’s highest structure (Figure 22).

The number of troops stationed and trained on the Wai‘anae Coast during World War II at times reached 15,000 to 20,000 (McGrath et al. 1973:136). The beaches were fortified with barbed wire and concrete bunkers—many of which are still visible today. Martial law severely curtailed the movements of the local population. In 1971, the Navy began sub-leasing some of its land for agricultural use, mainly for grazing and bee keeping. The presence of the military boosted the economy of Lualualei by providing jobs to residents over the years. The lower portions of Lualualei Valley were developed into residential lots after World War II. The project area lies outside military lands.

Figure 18. Photo of sugar cane in Lualualei Valley with flume to the right; Kolekole Pass in center background, n.d. (Hawai‘i State Archives)

Figure 19. Photo of the Lualualei Naval Base area, n.d. (Hawai‘i State Archives)

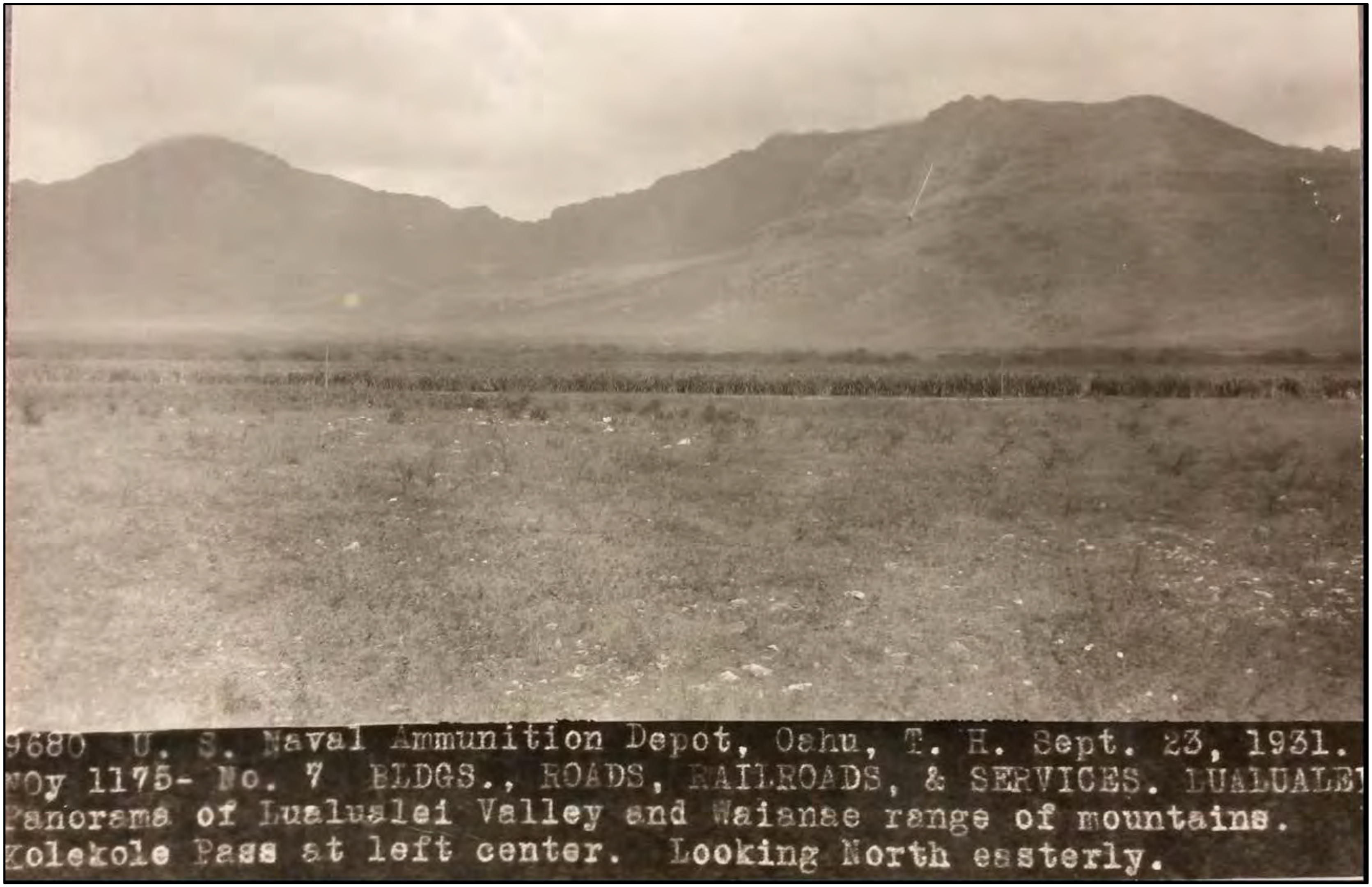

Figure 20. Photo of the Lualualei Naval Ammunition Depot taken on 23 September 1931 showing the valley and Wai'anae Mountain Range; Kolekole Pass lies in the middle background (Hawai'i State Archives)

Figure 21. Photo of the Lualualei Naval Ammunition Depot taken on 28 October 1931; Puʻu Heleakalā in the center background; government offices in the foreground (Hawaiʻi State Archives)

Figure 22. Photo of the two antennas used for the Navy's communication systems at Lualualei; the two antennas stand at 1,503 ft, the highest structures in the State of Hawai‘i (CSH 2012)

Section 5 Previous Oral History Research

This section draws from previous oral history research from the Waiʻanae Coast Culture and Arts Society titled *Ka Poʻe Kahiko o Waiʻanae* (1986) highlighting the voices of several dozen people who had deep knowledge of the culture and history of the *ahupuaʻa* of Waiʻanae and its surrounding areas. Their *moʻolelo* color the cultural and historical background with nuanced recollections and add depth to the information provided by *kūpuna* and *kamaʻāina* interviewed for this CIA (see Section 7).

5.1 James Robinson Holt III

James Robinson Holt III shared his memories of the Waiʻanae coast in *Ka Poʻe Kahiko o Waiʻanae*. Mr. Holt's great-grandfather bought Mākaha Valley where he built a large seven-bedroom home. The family also had a home in Honolulu in Makiki. The Mākaha Valley home eventually became a weekend home for the Holts. Mr. Holt shared his memories below:

> Even the cave down Mākua—the Hawaiians used to bury their dead in the cave. They would roll the bodies in mats but some terrible people would go into the cave and pull out the mats and really desecrate the place; the bones used to be all over the place.
>
> The Hawaiians in the early days used to travel over these mountains to go to market in Waialua. They weren't in any hurry so they would spend weeks before they would come home. There were no automobiles so traveling was done by horseback and wagon. Everybody rode the horse or buggy to go to school and every place else. We used to ride to town on horseback from here and it took us twelve hours but we didn't feel it. Some of the roads has since changed. We used to go over the mountains through this valley or go through Kolekole Pass and go through Leilehua. [Waiʻanae Coast Culture and Arts Society 1986:38]

5.2 Louise Kahili Van Gieson Mathias

Louise Kahili Van Gieson Mathias was born in Honolulu on 4 April 1903. She was raised in the Kālia ʻĪli in Waikīkī. The Van Gieson *ʻohana* (family) consisted of seven children including Mrs. Mathias—six girls and one boy. Mrs. Mathias attended Kaʻahumanu School and later transferred to Royal School. She left school and worked at a kindergarten in Kalihi when she was 15 years old. When she was 22 she met her first husband, John Lincoln Kaleihulumano Naiwi. He was born across from Mākua Ranch, which was known as Hikilolo. Mr. Naiwi's family owned property in the Puʻunui and Kapālama areas. Below are Mrs. Mathias' memories of Mākua located on the Waiʻanae coast:

> John was very active in politics and he was also a deacon with the Mākua Protestant Church. The people of Waiʻanae and Mākua helped to build this church which is a branch of the Kaumakapili Church. The first building the church had in Mākua was felt to be too large, so it was later moved to Pearl City and the people held *luaus* [*lūʻau*, Hawaiian feast] to help them finance the second building of the church. A building resembling a home was built and the Reverend Poepoe and Kekuews, who were agents for the church, said that it looked too much like a house, so they added

> a tower to the plans for the building, so that when it was completed, it would look like a church. During the war years the military held maneuvers at Mākua and the church building was knocked down. The church building used to stand right next to the Mākua Cemetery. [Wai‘anae Coast Culture and Arts Society 1986:110]

Mrs. Mathias recalled her *hula* instructor:

> Mrs. Marie Huffman was my hula instructor when I was about twelve years old. She used to teach the children of the Lualualei Naval Ammunition Depot service personnel. There was a total of twelve children that took lessons, some of which came from Nānākuli, but not many. There were many *‘ūniki* [graduation exercises] in her yard. [Wai‘anae Coast Culture and Arts Society 1986:115]

Section 6 Community Consultation

Throughout the course of this assessment, an effort was made to contact and consult with Hawaiian organizations, agencies, and community members including lineal and cultural descendants. CSH initiated the outreach effort in January 2015 through letters, email, telephone calls, and in-person contact. CSH completed the community consultation in March 2015. In the majority of cases, letters along with a map, aerial photograph of the project area, and TMK maps were mailed with the following text:

> At the request of LYON Associates, Inc., Cultural Surveys Hawaiʻi Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for the PVT Integrated Solid Waste Management Facility (ISWMF) Expanding Recycling, Landfill Grading and Renewable Energy Project, Lualualei Ahupuaʻa, Waiʻanae District, Island of Oʻahu, TMK [1] 8-7-009:025 and [1] 8-7-021:026. The PVT ISWMF property covers a total of 200-acres on the west side of Lualualei Naval Road. Approximately 153-acres are designated for construction and demolition debris with a maximum elevation of 135 feet above sea level.
>
> The landfill is being used as a comprehensive solid waste management facility for construction and demolition waste and other recyclable waste products. It does not accept hazardous waste or municipal solid waste. PVT ISWMF includes: (1) a C&D landfill with asbestos disposal and liquids solidification areas; and (2) recycling and materials recovery operations.
>
> Primary operations at the landfill include:
>
> - Segregation of incoming loads into materials for processing, recycling, on-site usage or disposal.
> - Mixed waste sorting to remove and separate recyclable materials
> - Processing to produce feedstock for bioconversion of organic wastes
> - Production of aggregate materials including rock, gravel, and crushed asphalt
> - Solidification of liquid wastes
> - Reclamation of previously landfilled construction and demolition waste to minimize the potential to fire, to prevent settlement, to minimize leachate potential, and to remove voids
> - Storage and marketing of recyclable materials
> - Landfill disposition of residual non-recoverable waste materials, including primarily composition/asphalt roofing shingles, tile, gypsum board, lead painted concrete and cementitious siding
>
> The purpose of the CIA is to gather information about the project area and its surroundings through research and interviews with individuals that are knowledgeable about this area. The research and interviews assists us when

assessing potential impacts to the cultural resources, cultural practices, and beliefs identified as a result of the planned project. We are seeking your *kōkua* (assistance) and guidance regarding the following aspects of our study:

- **General history and present and past land use of the project area.**
- **Knowledge of cultural sites—for example, historic sites, archaeological sites, and burials.**
- **Knowledge of the traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kūpuna* or elders and *kamaʻāina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupuaʻa* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In most cases, two or three attempts were made to contact individuals, organizations, and agencies. Community outreach letters were sent to a total of 70 individuals or groups; 20 individuals or groups responded; and two of these *kamaʻāina* and/or *kūpuna* met with CSH for a more in-depth interview. The results of the community consultation process are presented below. The interview summaries are presented in Section 7.

Table 2. Community Consultation Table

Name	Affiliation	Notes
Ailā, William and Melva	*Kamaʻāina*, cultural practitioners	Referred to CSH by the Environmental Justice in Waiʻanae Working Group and Kepā Maly. Letter and figures sent via mail 5 March 2015; second letter and figures sent via mail 20 April 2015.
Aldeguer, Walterbea	*Kamaʻāina*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group and Glen Kila. Letter and figures sent via email 2 March 2015; second letter and figures sent via email 20 April 2015.
Arakaki, Don “Rock”	Waiʻanae Coast Rotary Club	Referred to CSH by OHA. Letter and figures sent via email 14 April 2015; second letter and figures sent via email 20 April 2015.

Name	Affiliation	Notes
Awana, Karen	Former member of the Hawaiʻi House of Representatives, District 43	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any current contact information.
Ayau, Halealoha	Hui Mālama I Nā Kūpuna o Hawaiʻi Nei	Letter and figures sent via email 3 February 2015; second letter and figure sent via email 23 February 2015; Mr. Ayau responded to CSH via email on 23 February 2015 with the following: *This is to advise you and Cultural Surveys Hawaii of the formal dissolution of Hui Malama I Na Kupuna O Hawaiʻi Nei as of January 23, 2015. Therefore, we no longer will participate in consultations pursuant to Section 106 of the NHPA or the State law. If there are any further questions, please let me know.*
Barrette, Eileen Cash	*Kamaʻāina*	Referred to CSH by SHPD; CSH was unable to find any contact information. CSH called SHPD to request for contact information on 10 April 2015; Ms. Garnet Clark would ask residents if OK to pass on contact information. CSH called SHPD to follow up on request on 16 April 2015; no answer. CSH called SHPD to follow up on request 22 April 2015; said Ms. Clark would be out for the remainder of the week. CSH emailed Ms. Clark regarding our request on 22 April 2015; no response.
Barrette, Katherine	*Kamaʻāina*	Referred to CSH by SHPD. Letter and figures sent via mail 14 April 2015.
Becket, Jan	Author, photographer, knowledgeable in cultural sites Kona Moku Representative,	Letter and figures sent via email 3 February 2015; Mr. Becket responded to CSH via email 3 February 2015 with the following:

Name	Affiliation	Notes
	Committee on the Preservation of Historic Sites and Cultural Properties	*Iʻm down for a huakaʻi! I realized that I actually know of two sites on the makai side of the project. Another one of the ridge next to Kahe Point power plant, if you want to go that far.* CSH emailed Mr. Becket 3 February 2015 requesting what sites he would like to visit; Mr. Becket responded via email on 3 February 2015 with the following: *As for the Lualualei sites, I do not have site numbers for them, but sort of remember where they are located. I can send you pics if that would help. There is a really nice complex straight downhill from Nīoiʻula, which I would love to visit of course. The complex includes the tallest upright stone I have ever seen in Hawaiʻi - about 12 feet. Unless some military types put it up for some bizarre reason. Can you get ahold of the maps done for the inventory survey about a dozen years ago?* CSH emailed Mr. Becket on 5 February 2015 with the following: *I'm having a hard time figuring out who the landowner is and getting permission for our huakaʻi. On our 1998 USGS map, it says "Lualualei Naval Transmitting Facility" but when I Google the name, it takes me to the Coast Guard. I called the Coast Guard today and they referred me to the company that maintains the transmitters and they weren't sure of the landowner either. Attempted to find out via HoLIS and that only said "United States of America." I emailed the City Council person out there--Kymberly Marcos Pine--so I'm hoping she can help me out. Hang tight—I'll figure it out (hopefully).* CSH responded to Mr. Becket via email on 18 February 2015 with the following:

Name	Affiliation	Notes
		I've been working on finding a way to get in contact with someone who can get us onto that Naval Reserve and the good news is that I finally got in touch with someone. Bad news is that he's saying the area is difficult to get into due to high security so it's looking like a no. I didn't go through US Navy Public Affairs, I actually was referred to Jeff via Tom Clements. Is there anywhere else that you'd like to huakaʻi to in Lualualei? Let me know. Safe travels.
Bradley, Stephen	Doctor, Waiʻanae Coast Comprehensive Health Center	Referred to CSH by the Environmental Justice in Waiʻanae Working Group. Letters and figures sent via mail 11 March 2015.
Brown, David	Former SHPD Branch Chief Archaeologist	Referred to CSH by the Environmental Justice in Waiʻanae Working Group and Glen Kila. Letter and figures sent via email 3 March 2015; second letter and figures sent via email 20 April 2015.
Burns, Genevive	*Kamaʻāina*	Referred to CSH by SHPD. Letter and figures sent via mail 14 April 2015; second letter and figures sent via mail 20 April 2015.
Cabinatan, Lily	*Kamaʻāina*	CSH met Ms. Cabinatan at the Environmental Justice in Waiʻanae Working Group meeting on 27 February 2015. Letter and figures sent via email 2 March 2015; second letter and figures sent via email 20 April 2015.
Cachola, Fred	*Kamaʻāina*, former educator for the Department of Education and Kamehameha Schools, former Oʻahu Island Burial Council member	Referred to CSH by Candace Fujikane and Sophie Manansala. Mr. Cachola emailed CSH on 6 March 2015 with contact information; letter and figures sent via email 9 March 2015; second letter and figures sent via email 20 April 2015.

Name	Affiliation	Notes
	Kohala Representative for Hawai‘i Island Burial Council	
Choy, Harry	Mikilua Valley Community Association	Referred to CSH by Kawika McKeague. Letters and figures sent via mail 17 February 2015.
Clements, Tom	Navy Region Public Affairs	Referred to CSH by the United States Coast Guard Base Honolulu; CSH called 6 February 2015; letters and figures sent via email 6 February 2015; Mr. Clements responded to CSH via email 9 February 2015 with the following: *Thank you for the e-mail and sorry I missed you on Friday. The two people who may best be able to help you are copied on this e-mail, and you may already know them. Victor Flint is the Joint Base Community Plans and Liaison Officer, and Jeff Pantaleo is the Navy Region Hawaii archaeologist. Victor is very connected to Lualualei and Jeff is very involved with cultural surveys.*
Cope, Aggie	Found, Wai‘anae Coast Culture and Arts	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 20 April 2015.
Crabbe, Dr. Kamana‘opono	Ka Pouhana, Office of Hawaiian Affairs	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015. A letter was received by OHA on 6 April 2015 with referrals; see Appendix B
Dodge, Dr. Fred	Retired doctor from Wai‘anae Coast Comprehensive Health Center	Referred to CSH by the Environmental Justice in Wai‘anae Working Group. Letter and figures sent via mail 11 March 2015; second letter and figures sent via mail 20 April 2015.
Eli, Stacey	Nānāikapono Elementary School	Ms. Eli called CSH on 9 February 2015 saying they received a report and was given it to review; has questions about the report and who

Name	Affiliation	Notes
		can review it; CSH returned Ms. Eli's call on 9 February 2015; left a message; CSH called Ms. Eli on 10 February 2015; Ms. Eli would find out the name of the artist who did the statue of Māui at Nānāikapono Elementary School; Ms. Eli called CSH on 24 February 2015 saying Nānāikapono has a statue of Māui but Nānākuli High School has a mural of Māui; CSH returned Ms. Eli's call on 24 February 2015; left a message.
Enos, Eric	Founder, Kaʻala Farms Cultural Practitioner	Letters and figures sent via mail 29 January. 2015; letter and figures returned on 4 February. 2015; letter and figures sent via email. 25 February 2015; Mr. Enos responded via email 25 February 2015: *Got your email. I am willing to comment. Let me know when, where, and how.* CSH responded to Mr. Enos on 2 March 2015 with the following: *E kala mai for the delay. I have read your past interview with Angela Faʻanunu. We have a couple of options:* *•I can drive to Kaʻala Farms (or your place of choice) and we can talk story all over again or use parts of your past interview. We can talk about Lualualei Ahupuaʻa and if you have any concerns about the proposed project.* *•We can talk story over the phone or via email and if you have any new additions or concerns to your previous interview done by Angela Faʻanunu, you can make those adjustments. Either way is fine with me. After our kūkā session, I will draft an interview summary. From there you can review and make any necessary edits. Once I receive your edits, I will make those changes and have you review again. Once you approve of your interview, it will be included in the cultural impact assessment report. Ideally, it would be nice to visit the farm--see the operation and get an*

Name	Affiliation	Notes
		idea of the cultural landscape. Let me know what you would prefer at your earliest convenience. I have no problem meeting you in Waiʻanae. Mr. Enos responded to CSH via email on 3 March 2015 stating that he will be off-island for the remainder of the week and next week is better; CSH responded to Mr. Enos via email on 4 March 2015 stating that CSH is available next week; Mr. Enos responded to CSH via email 4 March 2015 stating that Tuesday, 10 March 2015 at 10AM is a good time to interview; CSH responded to Mr. Enos on 4 March 2015 via email confirming Tuesday, 10 March 2015 at 10AM for an interview; interviewed Mr. Enos at Kaʻala Farms on Tuesday, 10 March 2015; CSH sent draft transcription via email 23 March 2015; CSH followed up with Mr. Enos via email 30 March 2015; Mr. Enos replied to CSH on 31 March 2015 stating that his staff was assisting him with the transcription; CSH replied to Mr. Enos on 31 March 2015 thanking him for reviewing the transcription. CSH followed up with Mr. Enos on 10 April 2015 on the status of his transcription review; Mr. Enos replied to CSH via email on 11 April 2015 stating he was still reviewing and reconstructing and to call next week; CSH replied to Mr. Enos via email on 13 April 2015 stating that we would call or email to check in; Mr. Enos emailed CSH on 20 April 2015 stating that he completed the transcript and wants to set a time to meet; CSH replied to Mr. Enos on 21 April 2015 with available dates to meet; Mr. Enos replied to CSH on 21 April 2015 with his schedule; CSH replied to Mr. Enos on 22 April 2015 stating that we are available in the afternoon or the following day to meet; Mr. Enos replied to CSH via email on 22 April 2015 with his schedule; CSH replied via email on 22 April 2015 stating 24 April

Name	Affiliation	Notes
		2015 via phone or the following week to meet up works; CSH called Mr. Enos on 24 April 2015 and left a message; Mr. Enos called CSH on 24 April 2015 and went over edits to transcription; CSH emailed Mr. Enos his edits to the transcription and a USGS map of points-of-interest covered during his interview on 27 April 2015. CSH emailed Mr. Enos his draft interview summary and site map for review on 5 May 2015; Mr. Enos responded via email on 7 May 2015 stating he will do a last review; CSH emailed Mr. Enos on 13 May 2015 to check in regarding status of interview summary review; Mr. Enos emailed CSH 13 May 2015 stating he would review that afternoon; Mr. Enos called CSH on 14 May 2015 asking to resend draft interview summary; CSH emailed draft interview summary on 14 May 2015 followed by a phone call to go over edits; CSH emailed Mr. Enos his revised interview summary on 14 May 2015.
Enos, Soloman	Native Hawaiian artist, *kamaʻāina*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; unable to contact due to time constraints.
Feliciano, Makalauna		Referred to CSH by Glen Kila; unable to contact due to time constraints.
Flint, Victor	Joint Base Community Plans and Liaison Officer	Referred to CSH by Tom Clements. Letter and figures sent via email 10 February 2015; second letter and figures sent via email 16 February 2015.
Fujikane, Candace	Board of Directors, KAHEA – The Hawaiian Alliance, Associate Professor, University of Hawaiʻi at Mānoa	Letter and figures sent via email 3 February 2015.Ms. Fujikane responded to CSH via email 3 February 2015 with the following: *Nicole, thanks so much for these maps! I forwarded it to the Concerned Elders of Waiʻanae to ask for their input.* CSH replied to Ms. Fujikane via email on 3 February 2015 thanking her for forwarding to

Name	Affiliation	Notes
		the Concerned Elders of Waiʻanae; Ms. Fujikane emailed CSH on 19 February 2015 asking if we could attend a meeting for the Environmental Justice in Waiʻanae Working Group on 27 February 2015 from 6:30-8:30 p.m. at Leeward Community College (LCC) Waiʻanae Satellite Campus to discuss the letter and see if anyone can speak of the significance of the area; CSH replied to Ms. Fujikane on 20 February 2015 via email stating that CSH will be attending the meeting for the Environmental Justice in Waiʻanae Working Group on 27 February 2015; CSH attended the meeting for the Environmental Justice Working Group in Waiʻanae on 27 February 2015; Ms. Fujikane referred Fred Cachola.
Gates, Cedric	*Kamaʻāina* and Waiʻanae Coast Neighborhood Board No. 24, Housing and Development Committee	CSH met Mr. Gates at the Environmental Justice in Waiʻanae Working Group meeting on 27 February 2015. Mr. Gates referred Glen Kila, Chris Oliveira, David Brown, the Waiʻanae Comprehensive Health Center; letter and figures sent via email 2 March 2015. Mr. Gates responded to CSH via email 2 March 2015 with the following: *Mahalo for following up. I will bring up the study at provide interested parties your contact information if that is alright with you.* *I will also provide you with an update from tomorrow's board meeting if needed.*
Gay, Lucy	Board of Directors, KAHEA –The Hawaiian Alliance, Concerned Elders of Waiʻanae,LCC – Waiʻanae Satellite Campus	Referred to CSH by Glen Kila. Letter and figures sent via email 3 February 2015; Ms. Gay responded to CSH via email 4 February 2015 with the following: *Thanks for including me. Would you kindly extend the invitation to Aunty Alice Greenwood, too?*

Name	Affiliation	Notes
		CSH attended the meeting for the Environmental Justice Working Group in Wai‘anae on 27 February 2015 hosted by Ms. Gay.
Gomes, Domingo	*Kama‘āina* and fisherman	Referred to CSH by the Environmental Justice in Wai‘anae Working Group. Letter and figures sent via mail 5 March 2015; second letter and figures sent via mail 20 April 2015.
Greenwood, Alice	Wai‘anae Moku Representative, Committee on the Preservation of Historic Sites and Cultural Properties, Nani o Wai‘anae Concerned Elders of Wai‘anae	Letters and figures sent via mail 29 January 2015; referred by Lucy Gay on 4 February 2015; Letter and figures sent via email 4 February 2015; Ms. Greenwood responded to CSH via email on 6 February 2015 with the following: *I have been busy. As for the Cultural Assessment of PVT, there are lots of stories on many of the outlining properties. However, on the night of the Akua moon [first night of fullness] the dogs in the area would make a strange barking sounds, coming from the direction of PVT, making it's way to the property I was living at 87-1107 Hakimo Rd. My girlfriend lived at 87-1641 Ulehawa Rd, she notice the barking sounds coming from the directions of PVT [it may have been from Ulehawa River] going towards my direction. (She does all her planting and activities during the phases of the moon). As my neighbors dogs were barking [that strange sounds], I looked out my window and notice a little person. I knew better but out of stupidity I yelled at it, it ran in the direction of the dry-river bed Ulehawa and slowly disappeared with every step it made. I have lived there in 1975 to 2005, my daughter seem him and so has other children in our area. Her and I have gone down to the property which is now PVT, to walk the rivers bed and have picked-up native plants in the area. There was another story in that river-bed, I can't remember, if I do I'll let*

Name	Affiliation	Notes
		you know, [its about a rock] any way I'll let you know. CSH responded to Ms. Greenwood via email 9 February 2015 thanking her for her *moʻolelo* and asked if it would be possible to meet for a talk story session; CSH sent a follow up email to Ms. Greenwood on 2 March 2015; Ms. Greenwood responded to CSH with dates of availability via email 3 March 2015; CSH responded to Ms. Greenwood via email on 3 March 2015 confirming 6 March 2015 at 10 a.m. for an interview; Ms. Greenwood replied to CSH via email 4 March 2015 that she is confirming the 6 March 2015 at 10 a.m. at Nānākuli McDonalds for an interview; interviewed Ms. Greenwood at Nānākuli McDonald's on Friday, 6 March 2015; CSH sent draft transcription via email 20 March 2015; CSH followed up via email on 25 March 2015 on the status of the transcription; CSH followed up via email on 10 April 2015 on the status of the transcription; Ms. Greenwood emailed CSH 18 April 2015 stating the she was busy; CSH replied to Ms. Greenwood via email 20 April 2015 with the following: *We're coming down the wire with wrapping up consultation for this project and I don't want to leave out your manaʻo and ʻike. If you need assistance with reviewing your transcription, let me know and we can meet again.* Ms. Greenwood replied to CSH via email on 22 April 2015 stating that she will complete by 27 April 2015 and she will call to set up a time and place to meet to review her transcription; Ms. Greenwood emailed CSH on 29 April 2015 with the following: *I am working in the area of PVT the land deeds with the Demigod Maui, the Owl's and the impact of the cultural stories that was and is still effecting the farms.*

Name	Affiliation	Notes
		CSH responded to Ms. Greenwood via email 29 April 2015 with the following: *Ok. We are approaching our draft due date, which is this Friday. Keep on working through the transcription. If you would like to sit down and kūkā about the transcription, I am available tomorrow after 10:30AM and Friday between 9:00AM to noon. After the transcription is approved, I will start on the interview summary. That will also need your review and edits. Let's touch bases daily, if can.* Ms. Greenwood responded to CSH via email 29 April 2015 requesting to meet on 1 May 2015 at 9:00 AM at Leeward Community College Waiʻanae Campus. Ms. Greenwood met with CSH on 1 May 2015 and provided edits to her transcription. CSH emailed Aunty Alice Greenwood her edited transcription on 7 May 2015. CSH emailed Aunty Alice Greenwood her draft interview summary for approval on 14 May 2015. CSH emailed Aunty Alice Greenwood on 18 May 2015 on status of draft interview summary; CSH called later to see if any edits were needed to draft interview summary; Aunty Alice Greenwood approved summary via phone.
Hale Mua A Akalana		Referred to CSH by Glen Kila; unable to contact due to time constraints.
Hawaiian Railway Society		Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 20 April 2015.

Name	Affiliation	Notes
Hew Len, Herbert	Waiʻanae Valley Homestead Association	Referred to CSH by OHA. Letter and figures sent via mail 15 April 2015; second letter and figures sent via mail 20 April 2015.
Hopfe, Hanale	*Kamaʻāina* and artist	Referred to CSH by the Environmental Justice in Waiʻanae Working Group and Glen Kila. Letter and figures sent via email 2 March 2015; second letter and figures sent via email 20 April 2015.
Hoʻohuli, Josiah "Black"	Cultural practitioner	Referred to CSH by OHA. Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 15 April 2015; fourth letter and figures sent via mail 20 April 2015.
Kaeo, George "Gigi"	*Kamaʻāina* and *kūpuna*	Referred to CSH by SHPD; CSH was unable to find any contact information. CSH called SHPD to request for contact information on 10 April 2015; Ms. Garnet Clark would ask residents if OK to pass on contact information. CSH called SHPD to follow up on request on 16 April 2015; no answer. CSH called SHPD to follow up on request 22 April 2015; said Ms. Clark would be out for the remainder of the week. CSH emailed Ms. Clark regarding our request on 22 April 2015; no response.
Kahoʻonei, Marlene	Kamaile Academy	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any contact information.
Kaleikini, Paulette Kaʻanohi	Lineal descendant, Cultural Monitor and Practitioner, resident of Waiʻanae	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; Ms. Kaleikini responded to

Name	Affiliation	Notes
		CSH via email on 1 March 2015; for an expanded response, see Section 6.1.
Kaloi, Lyle		Referred to CSH by Glen Kila; unable to contact due to time constraints.
Kamanā ʻOhana	*Kamaʻāina*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any contact information.
Kamealoha, Thomas	Kamealoha, Native Hawaiian Organization, Cultural Monitor	Letters and figures sent via mail 29 January 2015; second letter and figures sent via email 23 February 2015; third letter and figures sent via email 20 April 2015.
Kanaheli, Kamaki	Department of Hawaiian Homelands Nānākuli Homesteads, State Council of Hawaiian Homestead Associations	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 20 April 2015.
Kāne, Shad	Member, Oʻahu Island Burial Council ʻEwa Moku Representative and Chair, Committee on the Preservation of Historic Sites and Cultural Properties; Founder, Kalaeloa Heritage Center and Legacy Foundation	Letters and figures sent via mail 29 January 2015; second letter and figures sent via email 23 February 2015; third letter and figures sent via email 20 April 2015; Mr. Kāne responded to CSH via email 20 April 2015 stating he would review and respond; CSH responded to Mr. Kāne via email 21 April 2015 thanking him for his quick response and that we look forward to his *ʻike* and *manaʻo* of Lualualei; Mr. Kāne responded to CSH via email on 21 April 2015 with the following: *My biggest challenge these days it drafting lengthy consultation responses so I try to keep things brief. I am familiar with the project area although I am sure that there are Waianae people who possesses "place based generational knowledge". I am not from Waianae but familiar with previous archaeological efforts and its surviving cultural landscapes. I have a cleanup and restoration project starting next week with the Navy in Lualualei Naval Mag of Nioiula Heiau. I am familiar with Pohakea, its cultural landscape and its historic cultural relationship*

Name	Affiliation	Notes
		with Lualualei and the project area. It is important to understand as you know with respect to cultural sites there is a mauka - makai relationship in terms of a subsistence lifestyle and the gathering of resources. The project site is within that walkway. I had a meeting recently with Albert Shigemura, president of PVT Land Company, Ben Yamamoto, vice president, Stephen Joseph, general manager and Mr. Gary Omori and was also given a site tour of the project area. Historically the project area was cultural significant. However as many other areas much of that cultural landscape is no longer. Which makes areas that possess a cultural presence all the more important to protect. Much of the cultural landscape of the project had been altered as the result of past efforts to include a landfill, modern day intrusion, neglect and interest.
Keaulana, Richard “Buffalo”	*Kamaʻāina, kūpuna*, legendary waterman	Referred to CSH by SHPD; CSH was unable to find any contact information. CSH called SHPD to request for contact information on 10 April 2015; Ms. Garnet Clark would ask residents if OK to pass on contact information. CSH called SHPD to follow up on request on 16 April 2015; no answer. CSH called SHPD to follow up on request 22 April 2015; said Ms. Clark would be out for the remainder of the week. CSH emailed Ms. Clark regarding our request on 22 April 2015; no response.
Keliʻi, Mama	*Kamaʻāina* and *kupuna*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any contact information.
Kila, Glen	Program Director, Marae Haʻa Koa, Koa Mana lineal descendant	Referred to CSH by Cedric Gates.

Name	Affiliation	Notes
	of Wai‘anae, *Kama‘āina*, cultural practitioner	Letter and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 20 April 2015; fourth letter and figures sent via email 21 April 2015; Mr. Kila responded to CSH via email 26 April 2015; see his expanded response in Section 6.5.
Knight, Debra	Principal, Nānāikapono Elementary School	Letters and figures sent via mail 29 January 2015.
Ku, Tercia	Princess Kahanu Hawaiian Homestead Association	Referred to CSH by OHA. Letter and figures sent via email 14 April 2015; second letter and figures sent via email 20 April 2015.
Lalapa, Kau‘i	Forwarding contact to City Council Member Kymberly Marcos Pine	Letter and figures sent via email 5 February 2015.
Lee, Mike	‘Ewa Beach Limu Project and cultural practitioner	Referred to CSH by the Environmental Justice in Wai‘anae Working Group and Alice Greenwood; CSH was unable to find any contact information.
Lenchanko, Anthony	*Kumu hula*	Referred to CSH by Kawika McKeague. Letter and figures sent via mail 17 February 2015; second letter and figures sent via mail 20 April 2015.
Lenchanko, Thomas	*Kama‘āina,* Waha ‘Ōlelo ‘Aha Kūkaniloko	Referred to CSH by SHPD. Letter and figures sent via email 3 February 2015; second letter and figures sent via email 20 April 2015.
Mahoe, Harriet	Wai‘anae Valley Homestead Association	Referred to CSH by OHA. Letter and figures sent via mail 15 April 2015; second letter and figures via mail 20 April 2015.
Maly, Kepā	*Kama‘āina*, cultural researcher, Senior Vice President of Culture and Historic Preservation at Pūlama Lāna‘i	Referred to CSH by SHPD; letter and figures sent via email 13 April 2015; Mr. Maly responded to CSH via email on 13 April 2015 with the following:

Name	Affiliation	Notes
		Mahalo for your note and inquiry. I am sorry to say that I haven't done a lot of ethnographic or oral history work in the area, and sadly those that I interviewed in the past have passed away. Two suggestions come to mind though, as individuals who might be able to assist, at least in the area of oral history. William Aila is a long time area residents with generational ties to the district. Kalena Silva's family is also generationally tied to the land, and connected with the McCandless/Marx family, so he might have some interesting information to share. I'm sorry that I cannot be of more help. If I come across some information in our collections I'll get back to you. CSH sent Mr. Maly an email 13 April 2015 thanking him for his *manaʻo*; Mr. Maly emailed CSH 14 April 2015 with more information on Lualualei; for an expanded response see Section 6.4.
Manansala, Sophie Flores	Mikilua Valley Community Assocation	Referred to CSH by Kawika McKeague; letter and figures sent via email 23 February 2015; Ms. Manansala responded to CSH via email on 24 February 2015 with the following: *Please say Aloha to Kawika for me.* *I am sorry I do not know anything about the "knowledge of cultural sites (historic sites, archaeological sites, and/or burials), knowledge of gathering practices, referrals, and/or any other cultural concerns."* *I suggest you contact William Aila who was Dir of DLNR and who is now with DHHL for that info. Another person is Fred Cachola a former teacher at Waianae High School (he was my teacher) but he moved back to the Big Island and I don't have contact info for him. Best bet is to contact William and if he is too busy with his new deputy directorship he can give you people to contact.*

Name	Affiliation	Notes
		Good luck and if there's anything else Kawika thinks I can help with give a holler.
Magallanes, Pokiʻi	Representative, Oʻahu Island Burial Council	Referred to CSH by Glen Kila; unable to contact due to time constraints.
Maui Akalana		Referred to CSH by Glen Kila; unable to contact due to time constraints.
McKeague, Kawika	Cultural practitioner, Honouliuli historian and long-time resident	Letter and figures sent via email 3 February 2015; Mr. McKeague responded to CSH via email on 16 February 2015 with the following: *Mahalo for your email. My apologies for my delay in responding. I don't have anything personal to share but from affiliation on working on another project near Puʻu o Hulu am aware of some of the neighboring farmers' concerns. I would suggest if not already included on your list that you consider consulting with the Mikilua Valley Community Association led by Sophie Flores Manansala and Harry Choy. I also recall that Kumu Hula Anthony Lechanko took us on a tour once of Nioiʻula and Punanaʻula Heiau many years ago and recall he had many stories to share for the back of Lualulalei. I would also recommend Ms. Patty Kahanamoku Teruya who sits on the NMNB but has great community knowledge of the area.*
Momoa, Joe	*Kamaʻāina*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any contact information.
Nahoʻopiʻi, Kawika	Lualualei Hawaiian Civic Club	Referred to CSH by OHA and the Waiʻanae Hawaiian Civic Club. Letter and figures sent via mail 15 April 2015; second letter and figures sent via mail 20 April 2015; third letter and figures sent via email 22 April 2015.
Nahulu, Bunny		Referred to CSH by the Environmental Justice in Waiʻanae Working Group; CSH was unable to find any contact information.
Nahulu, Eli	Cultural practitioner	Referred to CSH by Kepā Maly.

Name	Affiliation	Notes
		Letter and figures sent via mail 15 April 2015; second letter and figures sent via mail 20 April 2015.
Naiwi, Dolly	President, Nānāikapono Hawaiian Civic Club	Reffered to CSH by OHA. Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015. Ms. Naiwi called CSH 23 March 2015 requesting for to update contact information as well as voicing concerns centered on the health and safety of residents; Ms. Naiwi states the landfill has posed health concerns with dust flying into neighboring residential areas and along Farrington Highway; also concerned if construction debris will seep underground contaminating surrounding areas; suggestions include maybe not renewing PVTs license to accept construction debris and states the land could be used for other things than a landfill for construction waste; Ms. Naiwi has attended multiple community meetings regarding the PVT Landfill and has also given testimony Ms. Naiwi can relay letter to the Cultural Committee within the Nānāikapono Hawaiian Civic Club for feedback on cultural concerns.
Oclinaria, Bella	*Kama‘āina*	Referred to CSH by the Environmental Justice in Wai‘anae Working Group. Letter and figures sent via email 2 March 2015; second letter and figures sent via email 20 April 2015.
Oliveira, Christophor	Cultural practitioner and Project Director at Marae Ha‘a Koa	Referred to CSH by Glen Kila. Letter and figures sent via email 3 February 2015; second letter and figures sent via email on 23 February 2015; third letter and figures sent via email 20 April 2015; Mr. Oliveira responded to CSH via email on 20 April 2015 with the following:

Name	Affiliation	Notes
		E kala mai for not responding to the earlier emails. I will look over the attachments and repond with my comments by friday. You may want to contact glen kila as well. CSH responded to Mr. Oliveira via email on 21 April 2015 thanking him for his quick reponse and looking forward to his *ʻike* and *manaʻo* of Lualualei; Mr. Oliveira responded to CSH via email on 25 April 2015 with the following statement: *I looked over the map and i wouldnt be able to comment on the part that is not currently filled unless i went there. The area is associated with the kumulipo, maui a akalana, hina i ke ahi, and the story of how maui slowed the sun. I believe that area above ulehawa was the settlement that stretched down to garden groves. There are some important view plans in the area associated with heleakala and puu hulu. There is also an ili wall that stretches up heleakala. They should be careful around that area. Could we (glen kila and i) visit the area that is planned to be filled.* CSH responded to Mr. Oliveira via email on 28 April 2015 stating that we have forwarded his request to visit the project area to the client and we will add his *ʻike* and *manaʻo* to the report.
Ornellas, Landis	*Kamaʻāina*	Referred to CSH by the Environmental Justice in Waiʻanae Working Group. Letter and figures sent via mail 5 March 2015; second letter and figures sent via mail 20 April 2015.
Orr, Maria	*Kamaʻāina*, cultural researcher	Referred to CSH by SHPD. Letter and figures sent via email 13 April 2015; second letter and figures sent via email 20 April 2015.

Name	Affiliation	Notes
Paik, Kaleo	Cultural monitor, *kamaʻāina*, Mālama Naʻau o Poe	Referred by Glen Kila; was unable to contact due to time constraints.
Pantaleo, Jeff	Navy Region Hawaiʻi Archaeologist	Referred to CSH by Tom Clements. Letter and figures sent via email 10 February 2015; second letter and figures sent via email 16 February 2015; Mr. Pantaleo responded to CSH via email 18 February 2015 with the following: *Based on the maps provided, the PVT Landfill project is outside Navy property (Lualualei Naval Magazine). Attached is an archaeological probability map of the magazine showing site locations. Access into this area is difficult to the high security. I have archaeological reports from this area that can be useful for your research.* See Appendix B for map.
Parker, Alvin N.	Principal, Ka Waihona o Ka Naʻauao Public Charter School	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 20 April 2015.
Perkins, Leialoha Apo	Author and publisher	Referred to CSH by the Environmental Justice in Waiʻanae Working Group. Letter and figures sent via mail 11 March 2015; second letter and figures sent via mail 20 April 2015.
Perry, Johnnie-May	Waiʻanae Coast Neighborhood Board No. 24	Referred to CSH by OHA. Letter and figures sent via email 20 April 2015.
Poepoe, Herbert	Hawaiʻi Island Burial Sites Specialist, State Historic Preservation Division	CSH emailed Mr. Poepoe on 5 March 2015 with the following: *My name is Nicole Ishihara and I work with Cultural Surveys Hawaiʻi, Inc. (CSH) in their cultural impact studies division. We're currently conducting a cultural impact assessment in Lualualei on Oʻahu. Several*

Name	Affiliation	Notes
		community members have referred Uncle Fred Cachola and recommend I get in touch with him to see if he will participate in the consultation portion of the project. Unfortunately, I only have outdated contact information for him when he resided on O‘ahu. Is there a way that you could possibly relay a contact letter to him for me? I'm not sure if you're able to pass on his contact information. Let me know either way if you can pass on his info or the letter. I appreciate it! Mālama pono. Mr. Poepoe forwarded CSHs email to Mr. Cachola on 5 March 2015.
Polk, Kiran	Chief of Staff for City Council Member Kymberly Marcos Pine	Letter and figure sent via email 5 February 2015.
Queen Lili‘uokalani Children's Center		Referred to CSH by Glen Kila; was unable to contact due to time constraints.
Rezentes, Cynthia	Nānākuli-Mā‘ili Neighborhood Board No. 36	Referred to CSH by OHA. Letter and figures sent via email 14 April 2015; second letter and figures sent via email 20 April 2015.
Savini, Kumu Leato	President, Tulipa Hawaiian Civic Club	Letter and figures sent via mail 29 January 2015; second letter and figures sent via email 23 February 2015; third letter and figures sent via email 20 April 2015.
Silva, Albert	*Kama‘āina*, *paniola* (cowboy)	Referred to CSH by SHPD. Letter and figures sent via mail 14 April 2015; second letter and figures sent via mail 20 April 2015.
Silva, Alika Poe	*Kama‘āina,* Koa Mana	Referred to CSH by SHPD. Letter and figures sent via email 3 February 2015; second letter and figures sent via email 20 April 2015.
Silva, Kalena	Professor of Hawaiian Language and Hawaiian Studies, Ka Haka ‘Ula O Ke‘elikōlani at the	Referred to CSH by Kepā Maly. Letter and figures sent via email 14 April 2015; second letter and figures sent via email 20

Name	Affiliation	Notes
	University of Hawai‘i at Hilo	April 2015; Mr. Silva responded to CSH via email on 20 April 2015 with the following: *Mahalo for your follow-up email about this cultural impact statement concerning Lualualei. Growing up as a child, I spent summers with my father's mother and some other family who lived just ma kai of the Naval Ammunition Depot. I don't recall any of my family speaking about historical, cultural, or burial sites in the area. It may be because they were originally from Wai‘anae and not the Lualualei area. So I don't have anything to offer the assessment.* CSH responded to Mr. Silva on 21 April 2015 thanking him for his quick response and his feedback.
Taylor, Vernon	*Kama‘āina*	Referred to CSH by SHPD. Letter and figures sent via mail 14 April 2015; second letter and figures sent via mail 20 April 2015.
Teruya, Patty Kahanamoku	*Kama‘āina*	Referred to CSH by Kawika McKeague. Letter and figures sent via email 23 February 2015; Ms. Teruya responded to CSH via email on 23 February 2015 with the following: *So sorry, I have been busy today but got your email when I got home. Have you also been in touch with Cynthia Rezentes? I have no problem speaking to you regarding the good work PVT Landfill Company is doing on their recycle program and other. I'm trying to see my calendar right now, and see if we can all meet.* CSH responded to Ms. Teruya on 23 February 2015 thanking her for the referral and requested her availability to set up an interview.

Name	Affiliation	Notes
Tiffany, Nettie	*Kahu* (honored attendant) for Lanikohokua	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 20 April 2015.
United States Coast Guard Base Honolulu		CSH called 6 February 2015; referred CSH to Tom Clements.
Waiʻanae Coast Comprehensive Health Center		Referred to CSH by OHA. Letter and figures sent via email 14 April 2015; second letter and figures sent via email 20 April 2015.
Wong-Kalu, Hinaleimoana	Chair, Oʻahu Island Burial Council	Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 20 April 2015.
Worthington, Mele	President, Waiʻanae Hawaiian Civic Club	Referred to CSH by OHA. Letters and figures sent via mail 29 January 2015; second letter and figures sent via mail 23 February 2015; third letter and figures sent via mail 15 April 2015; fourth letter and figures sent via mail 20 April 2015.

6.1 Office of Hawaiian Affairs

CSH contacted Dr. Kamanaʻopono Crabbe, Ka Pouhana of the Office of Hawaiian Affairs, via mail 29 January and 23 February 2015. OHA responded to CSH via letter on the 6 April 2015 with the following people and organizations (see Appendix B).

- Johnnie-May Perry, Waiʻanae Coast Neighborhood Board No. 24
- Cynthia Rezentes, Nānākuli-Māʻili Neighborhood Board No. 36
- Don “Rock” Arakaki, Waiʻanae Coast Rotary Club
- Waiʻanae Coast Comprehensive Health Center
- Tercia Lu [Ku], Princess Kahanu Hawaiian Homestead Association
- Josiah Hoʻohuli, Ahupuaʻa ʻO Nānākuli Homestead Association
- Herbert Lean [Len], Waiʻanae Kai Homestead Association
- Harriet Mahoe, Waiʻanae Valley Homestead Association
- Kawika Nahoʻopiʻi, Lualualei Hawaiian Civic Club
- Dolly Naiwi, Nānāikapono Hawaiian Civic Club
- Mele Worthington, Waiʻanae Hawaiian Civic Club

6.2 Paulette Kaʻanohi Kaleikini

CSH contacted Paulette Kaʻanohi Kaleikini, a State of Hawaiʻi recognized lineal descendant and resident of Nānākuli Ahupuaʻa, via email on 29 January and 23 February 2015. Ms. Kaleikini responded to CSH via email on 1 March 2015 with the following statement:

> I apologize for taking so long to respond. Hope it is not too late to participate.
>
> First of all, I need to say that I don't appreciate having this dump so close to the community as indicated in the map. I live on the other side of Puu Heleakala in Nanakuli and the community believes this landfill is too close for comfort so imagine how the community living in closer proximity must feel. Some of the community members have already died in this struggle to fight having this dump and other polluters (such as the military) in our immediate community. So, I truly feel that this expansion needs to stop. But if this monster will be approved by the government no matter what the community says, then I will participate in as much of the consultation as possible and look toward more active participation going forward.
>
> These are my cultural concerns:
>
> The lands of Lualualei was largely habituated by native Hawaiians. It was highly productive for their food. The ancients lived in Lualualei for many generations.
>
> Several stones that were found near the site of the Naval Radio Transmitting Facility in Lualualei when it was built were identified as those used for sharpening spears and other Hawaiian war implements. Lualualei has a number of meanings, one of which is 'flexible wreath', which is said to recall the war strategy of a chief who sent his ranks of Waianae warriors to surround the invading armies like a wreath, defeating them at the battle of Kipapa about 1410 A.D. Lualualei may have been a weapons production center for Hawaiian warriors several hundred year ago, which would make it the oldest ammunition facility in the U.S.
>
> Lualualei Valley is noted frequently in old Hawaiian literature so it makes the area particularly important.
>
> The profile of Maui, the cave of Hina, the epics of Pele, Hiiaka and Maui stretches throughout Lualualei. The Lualualei corridor was the highway for Waianae. The ancients either took Kolekole pass or Pohakea pass; the main corridors to Waianae. The ancients did not go out around Kalaeloa unless you had business out there. It was hot, dry and water was not available. Travel through Kalaeloa would be difficult.
>
> Numerous Hawaiian legends reveal Lualualei to be an important center to Hawaiian history. Ulehawa and Kaolae is the birthplace of Maui-mua, Maui-waena, Maui-kiiʻkii,and Maui-akalana. Puu Heleakala is where Hina, Maui's mother lived and made kapa cloth. The project area is associated with moolelo of the god maui. These moolelo place the project site within a cultural context; linked with the names and stories of the ahupuaʻa. The Maui pohaku is located in Lualualei.

Near the project area and the NRTF was the location of the Ulu Wauke, the wauke grove. Here is where Hina, as well as the ancients, gathered wauke to pound their kapa.

Among cultural sites recorded in Lualualei; 1) the large rock; Maui pohaku, northeast of the rock is a shelter where he lived. And in the same vicinity was a spring where Maui obtained water. the large rock is now split in half. 2) Niʻoiula heiau is very ancient, belonging to chief Kakuhihewa. 3) house sites in Lualualei at the foot of the cliffs of Puu Heleakala 4) Kakioe Heiau of which nothing remains but its sacred spring. 5) Mauna Kuwale burial cave, house sites and a petroglyph rock in Lualualei 6) in 1991, archaeological survey encompassing the project area identified 131 indigenous hawaiian historic sites, over 1000 features related to habitation, rituals, ceremonies, agriculture and stone manufacture. Datable material (charcoal and volcanic glass) and cultural material (artifacts and midden) produced radiocarbon dates ranging from 1420-1950. Occupation of Lualualei valley continued to increase rapidly in the early 1800s. 7) on the southwestern slopes of Puu Heleakala, a historic site was identified as a pre-contact rock shelter.

Completed studies reveal and document that wahi pana (sacred sites) and moolelo (cultural stories) of the project area is located within a complex network of sacred sites in Lualualei.

The significance of the native Hawaiian culture continues despite any changes in the physical landscape but the landscape is important because it reinforces and would resonate more with the culture than a highly altered landscape and would validate the ancient legends. So I am concerned that this project would not only result in increased traffic of large heavy trucks, air pollution, as well as the loss of agricultural lands but also, for me, the most important loss would be the desecration of the cultural landscape.

Aloha ʻAina,

Kaʻanohi

6.3 Environmental Justice in Waiʻanae Working Group

CSH initially contacted Candace Fujikane, Associate Professor of English at the University of Hawaiʻi at Mānoa and is part of the Board of Directors for KAHEA—The Hawaiian Alliance, on 3 February 2015 via email. Ms. Fujikane emailed CSH on 19 February 2015 asking if we could attend a meeting for the Environmental Justice in Waiʻanae Working Group on 27 February at the Leeward Community College Waiʻanae Satellite Campus discussing the community consultation letter and to scope for potential interviewees who could attest to the cultural significance of the area. CSH replied to Ms. Fujikane on 20 February 2015 via email stating that CSH would attend the meeting.

The meeting was conducted by Lucy Gay. Ms. Gay is the Director for the LCC Waiʻanae Satellite Campus, is part of the Board of Directors for KAHEA—The Hawaiian Alliance, and is also involved with the Concerned Elders of Waiʻanae. Approximately a dozen community members were at the meeting. A member of the group also approximated cultural points of interest on a 1998 USGS Topographic Map within Lualualei Ahupuaʻa (Figure 23).

Questions from the community included the following:

- What are the health risks with the vertical expansion in terms of dust control?

Cultural concerns from the community included the following:

- Ulehawa Stream: If there is a vertical expansion, will dust spread and go into the stream?
- Is there *iwi kūpuna* (ancestral bones) in the cementitious mixture being brought in from construction sites? Is there someone checking for *iwi kūpuna*?
- Ms. Lucy Gay stated that the vertical expansion at the landfill "is a pimple to the Māui story" in terms of its location between Hina's Cave and the Māui Pōhaku.

Suggestions from the community included the following:

- Sending community consultation letters and figures to residents neighboring the project area and beyond.
- Having a health grant offered to the community and to residents of Hakimo Road.
- To conduct a dust study.
- Trees or liners to help mitigate dust control.

Referrals from the community included the following:

- Mike Lee
  - CSH could not find contact information
- Cynthia Rezentes
  - CSH contacted, no response
- Walterbea Aldeguer
  - CSH contacted, no response
- Kamaki Kanaheli
  - CSH contacted, no response
- Glen Kila
  - CSH contacted, see Section 6.5
- Chris Oliveira
  - CSH contacted, see Section 6
- David Brown
  - CSH contacted, no response
- Aha Moku Advisory Committee
  - CSH interviewed Alice Greenwood, the Waiʻanae Moku Representative
- Hanale Hopfe
  - CSH contacted, no response
- Landis Ornellas
  - CSH contacted, no response
- William and Melva Aila
  - CSH contacted, no response
- Dr. Stephen Bradley at the Waiʻanae Coast Comprehensive Health Center
  - CSH contacted, no response

- Lēhua Kapaka, Librarian at Nānāikapono Elementary School
    - CSH contacted other parties at Nānāikapono Elementary School
- Mama Keliʻi
    - CSH could not find contact information
- Bunny Nahulu, OHA
    - CSH could not find contact information
- Nahoʻopiʻi ʻOhana
    - CSH could not find contact information
- Bella Oclinaria
    - CSH contacted, no response
- Domingo Gomes
    - CSH contacted, no response
- Dr. Fred Dodge
    - CSH contacted, no response
- Marlene Kahoʻonei of Kamaile Academy
    - CSH could not find contact information
- Aggie Cope
    - CSH contacted, no response
- Leialoha Apo Perkins
    - CSH contacted, no response
- Karen Awana
    - CSH could not find contact information
- Kamanā ʻOhana
    - CSH could not find contact information
- Joe Momoa
    - CSH could not find contact information
- Soloman Enos
    - CSH ran out of time for consultation process; interviewed father, Eric Enos

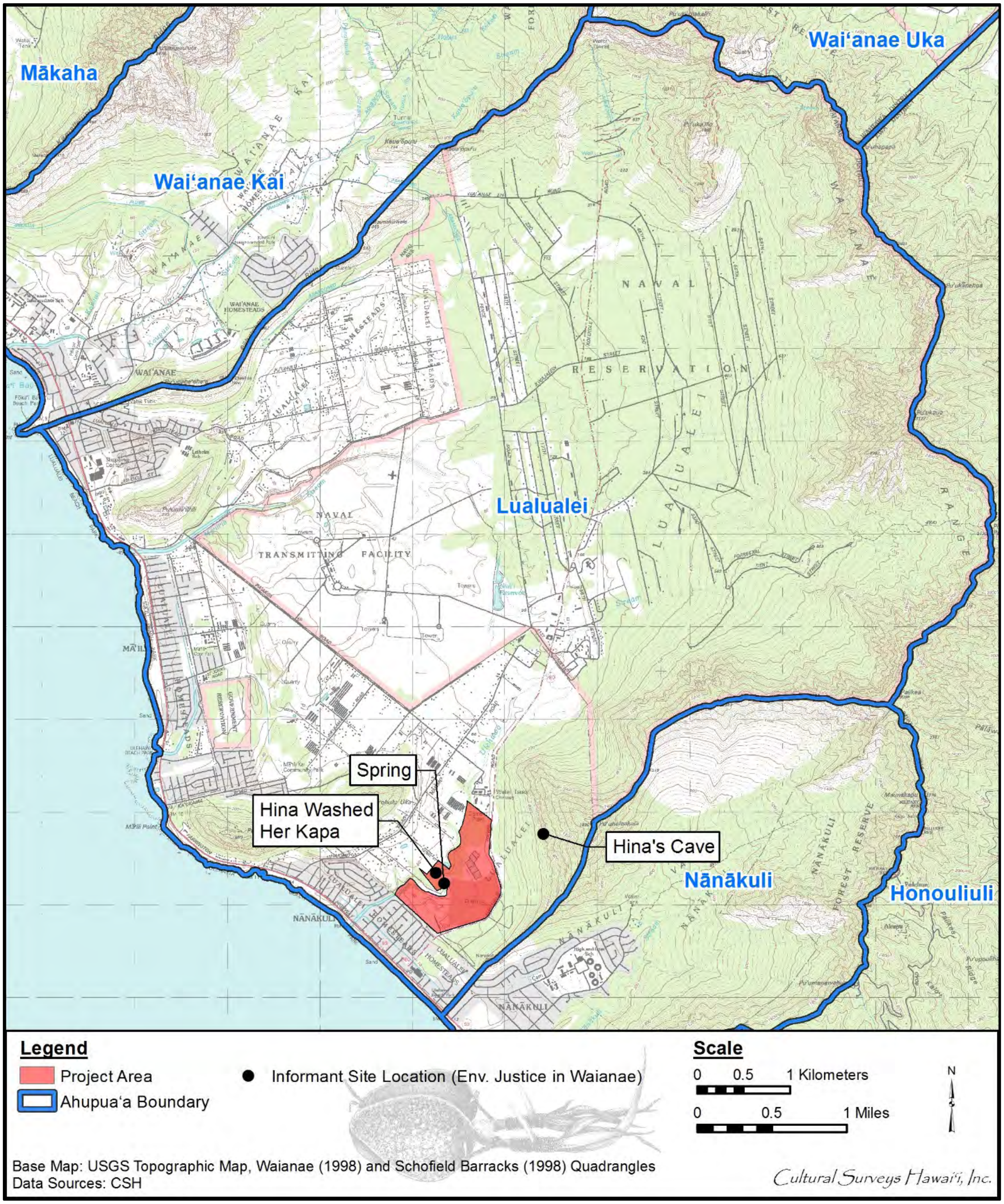

Figure 23. 1998 USGS Topographic Map with Cultural Sites Approximated by the Environmental Justice in Wai‘anae Working Group

6.4 Kepā Maly

Kepā Maly, cultural researcher and Senior Vice President of Culture and Historic Preservation at Pūlama Lānaʻi, was referred to CSH by SHPD. CSH contacted Mr. Maly via email on 13 April 2015. Mr. Maly responded to CSH via email the same day with the following:

> Mahalo for your note and inquiry. I am sorry to say that I haven't done a lot of ethnographic or oral history work in the area, and sadly those that I interviewed in the past have passed away.
>
> Two suggestions come to mind though, as individuals who might be able to assist, at least in the area of oral history.
>
> William Aila is a long time area residents with generational ties to the district.
>
> Kalena Silva's family is also generationally tied to the land, and connected with the McCandless/Marx family, so he might have some interesting information to share.
>
> I'm sorry that I cannot be of more help. If I come across some information in our collections I'll get back to you.

Mr. Maly sent CSH more background information and a referral via email on 14 April 2015:

Traditional References:	Pele & Hiiaka (mele and short descriptions of travel through the area) The account of Priest Kaopulupulu and his son Kahulupue (Puuohulu is cited in some of the accounts. Also Haleakala ridge may have some leads.
Register Maps:	2040, 2165, and 2359 provide a good records of place names and parcels.
Mahele:	It doesn't appear that any claims cited kuleana in Lualualei. One claimant, Waimalu and a group of natives asked for permission to lease a section of Lualualei (see NR 4:124). It appears to have been missed in the Buke Mahele.
RP Grants/L.C. Apps:	The maps identify a few RP Grants and later Land Court Apps. Which might offer some interesting background.
Leases:	Marin (Manini) and Jarrett (Lapaula) held leases on the land for a while, so there might be some interesting background there. A disagreement eventually led the partners to court, so even more possibilities of interesting background.

> I don't know if he's still alive, but Eli Nahulu, who was with KS for years, has ties to the area, so in addition to Aila and Silva, he might be another lead.
>
> That's about it. Hope it might be of some use.

6.5 Glen Kila

Glen Kila is the Program Director for Marae Haʻa Koa, *kamaʻāina*, cultural practitioner, and is a Koa Mana lineal descendant of Waiʻanae. Mr. Kila was referred to CSH by Cedric Gates, *kamaʻāina* and Vice-Chair and Chair of the Parks and Recreation of the Waiʻanae Coast Neighborhood Board. Mr. Kila was contacted via mail for this project on 29 January, 23 February, and 20 April 2015. Mr. contacted was then contacted for a fourth time via email on 21 April 2015. Mr. Kila responded to CSH via email on 26 April 2015 with the following statement:

> This is my input to the CIA study of the PVT project in Lualualei.
>
> - The project will have a negative impact on the health and safety of the Lualualei families by our Lualualei wind Koʻolau Wahine.
> - The reclamation of opala by the project will kick up dust including asbestos in the air that will injure the health and safety of our residents on the Waianae Coast.
> - The additional height will have a negative impact on our religious view plane of Kanenuiakea worshipers from Puʻu o Hulu Kai and Uka to Puʻu Heleakala.
> - The additional height will have a negative impact on our religious view plane of Kanenuiakea worshipers from Puʻu Heleakala to the twin mountains of Puʻu o Hulu Kai and Uka.
> - The additional height will have a negative impact on our religious view plane of Kanenuiakea worshipers from Makalualei to Ulehawa.
> - The additional height and project operations will have a negative spiritual impact to our wahipana of Maui A Akalana.
> - The additional height and project operations will have a negative spiritual impact to our worship of our aumakua Maui A Akalana.
> - The additional opala in the landfill will add to the adverse affect of our underground water lens in Waianae.
> - The additional opala in the landfill will add to the leaking pollutants that are now affecting the drainage system in Lualualei, Ulehawa canal and coastal waters. Immediate monitor and clean up the pollutants are required now.
>
> Please contact the Lualualei Queen Liliuokalani Children Center, Marae Haʻa Koa project director Christophor Oliveira, members of the Hale Mua A Akalana, residents of Lualualei and Leeward Community College for their input. They are cc'd in my report to you.
>
> Sincerely submitted,
>
> Glen Kila, Koa Mana lineal descendant of the aboriginal families of Waianae Moku

Section 7 Interviews

Kamaʻāina and *kūpuna* with knowledge of the proposed project and study area participated in semi-structured interviews from January through March 2015 for this CIA. CSH attempted to contact 47 community members and government agency and community organized representatives for this CIA report; of those, two participated in formal interviews. CSH initiated the interviews with questions from the following five broad categories: *wahi pana* and *moʻolelo*, agriculture and gathering practices, freshwater and marine resources, cultural and historic properties, and burials. Participants' biographical backgrounds, comments, and concerns about the proposed development and project area are presented below.

The authors and researchers of this report extend our deep appreciation to everyone who took time to speak and share their *manaʻo* with CSH whether in interviews or brief consultation, including contacts who opted not to contribute to the current cultural impact assessment, but nevertheless spent time explaining their position on the proposed project. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and in no way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

7.1 Alice Greenwood

CSH interviewed Alice Ululani Kaholo Greenwood on 6 March 2015 at Nānākuli McDonalds. Aunty Alice came from a large family. Her mother's first marriage was to Sylvester Zablan whom she had six children with. Her mother's second marriage was to James Kaholo whom she had four children with—three girls and one boy. Aunty Alice is the second oldest child from James Kaholo. The family was raised in Mākua near the area called Pōhaku Kulaʻilaʻi, also known as Pray for Sets or Pray for Sex. They family lived in a tent but slept in a covered wagon until their home could be built on Maiuʻu Street.

The Waiʻanae Coast was Aunty Alice's playground growing up. She recalls the Waiʻanae area having many streams and adds that her mother knew every single place to obtain fresh water from Mākua to Honolulu to fill their Model T car. Aunty Alice remembers when she was a member on the Oʻahu Island Burial Council (OIBC) and the group visited the beginning of the proposed Honolulu Rail Transit line in Kapolei, the group was in the area known as Kualakaʻi. Aunty Alice recalls the group questioning her and her knowledge of water on the usually arid plain, "Going into the place we didn't see it but as we came out, someone said, 'Alice, you were right. Did you see the stream?' It was the formation of a stream."

Aunty Alice's father worked in Honolulu during the week and returned to the Waiʻanae Coast on the weekends. It was her mother who tended to the children and their everyday needs. Aunty Alice describes her mother as being a jack of all trades. She states that her mother was their provider—she did all the fishing, gathering, and planting. Her mother would be up before dawn setting up a large *pakini* (bucket, tub) that would sit on a circle of stones as a fireplace to wash clothes:

Boiling yesterday's clothing for a family of seven, pounding, washing, raising, and hanging each piece of clothing like a puzzle—small, medium, large. In the meantime, cooking breakfast, sometimes preparing *palawa* (pancakes), stew, or fish—steamed, fried, dry, or raw—just to name a few.

Aunty Alice recalls having a garden with edible plants such as *pōpolo* (the black nightshade; *Solanum nigrum*), papaya, chili pepper, *'ōlena* (turmeric; *Curcuma domestica*), *laukahi* (broad-leafed plantain; *Plantago major*), *laukī* (*Cassia leschen-aultiana*), *kupukupu* (sword fern; *Nephrolepis exaltata*), *pakai* (Spleen amaranth; *Amaratihus dubius*), and *kalo*. The majority of food was gathered from Mākua prior to the closing of the valley for the Makua Military Reservation. She remembers mango, *liliko'i* (passion fruit; *Passiflora edulis*), sugar cane, *pōpolo*, *'ōlena*, *laukahi*, *laukī*, *kupukupu*, *kalo*, guava, and other plants being gathered from Mākua Valley. For snacks the children would eat mountain apples, figs, papaya, bananas, tamarind, guava, mangoes, *liliko'i*, and stalks of sugar cane. Aunty Alice shares her memory of an ancient oval shaped *lo'i* being on the crest of Mauna Ko'iahi. All plants were either for consumption or for medicinal use.

When Aunty Alice looks out to the ocean, she always thinks of her mother and can still see her slender silhouette gathering food and shells along the shoreline. *Pipipi* (general name for small mollusks), *'opihi* (limpets), *leho* (cowry shell), *'ōlepe* (bivalve including mussels or oysters), *wana* (sea urchin; *Diadema paucispinum* and *Echinothrix diadema*), *'ina* (small sea urchin; *Echnometra spp.*), *hā'uke'uke* (edible variety of sea urchin; *Colobocentrotus atratus*), *'a'ama* (black edible crab; *Grapsus grapsus tenuicrustatus*), *'alamihi* (common black crab; *Metopograpsus thukuhar*), *kūhonu* (edible spotted-back crab; *Portunus sanguinolentus*), *limu kohu* (*Asparagopsis taxiformis*), *'aki'aki* (seashore rush grass; *Sporobolus virginicus*), *manauea* (small red seaweed; *Gracilaria coronopifolia*), *'ele'ele* (*Enteromorpha prolifera*), *waewae'iole*, *kala* (*Sargassum echinocarpum*), and *līpoa* (*Dictyopteris plagiogramma*) were found in the tide pools or along the shoreline. While the children were swimming, Aunty Alice's mother would watch them and either clean fish or wash dishes in the tide pools. She remembers her mother would always carry a large stick with her. Aunty Alice could never figure out why her mother carried a stick with her everywhere. It wasn't until 2005 when Aunty Alice became homeless that she would understand why. One day while she was cleaning fish, an eel stole the fish. Aunty Alice learned that the stick was used for security. Another thing her mother would do was use an *'umeke* (bowl), fill it with salt water, and leave it in the sun. Eventually the water would evaporate leaving the salt behind, which would be used for their food.

Aunty Alice credits her mother for her cultural knowledge. She describes her mother as being culturally knowledgeable. Her mother's sister Daisy was married to Simplicio Dela Cruz who constructed cesspools from Mākahā to 'Ewa and some in Wahiawā. Mr. Dela Cruz relied on her mother when *iwi* (bones) or cultural sites were found. Aunty Alice adds, "Culturally they depended on my mom….I was very young—the look on her face when the men would come and get my mom—I knew there were concerns."

Growing up, her mother would take the children to the beach to pick shells and other beachcombing finds. Aunty Alice describes the beach being hilly and full of shells with coral varying in size, color, and shape. She recalls seeing *leho*, *pūpū'alā* (cone shell; *Conus sp.*), and coral that looked like *bonsai* (Japanese art form using miniature trees)—plates and platter shapes—in vivid colors of pink, yellow, orange, light brown, and pure white. Her mother never allowed the children to touch the corals. She adds that when she was growing up the water was so clean unlike today.

Aunty Alice describes the landscape of Mākua:

> The history of the area as told by my mom—Mākua mountain is known as Mount Koʻiahi. Further in the valley, that was called Mākua and then Kahanahāiki. As a little girl, we had three streams we used to play in: Koʻiahi, Mākua, and Kahanahāiki. When the railroad track was built, the explosives blew out part of Kaneana Cave or what is known today as Mākua Cave, which is part of a lava tube. As a little girl, I remember going into Kaneana Cave, it felt awesome and homely. I was able to see the water inside the cave.

She continues to share that there once was a passageway in the cave that led to ʻŌhikilolo and confirms that her mother had swam it.

The *moʻolelo* of Nanaue—the shark-man of Mākua—would allegedly eat people. Another *moʻolelo* that Aunty Alice shares is one of a handsome *manō* (shark) and a beautiful *moʻo* whose union produced a shark child who became the guardian of the sea and of Pōhaku Kulaʻilaʻi. The shark child would occasionally journey into Kaneana Cave. When Aunty Alice's mother would venture into the ocean, it would never bother her. If her mother caught any fish, she would always take what she needed and threw back the rest—an offering and also for conservation. Others who did not know the *moʻolelo* or were not *maʻa* (accustomed, familiar) to the area would often be scared:

> When my husband James Hatchie would go diving with Akule Joe and his gang, some of the boys seen a giant shark. They panicked and jumped into the boat. James stayed in the water, the shark never bothered him and in fact, he said he felt safe from other sharks.

Her mother's cultural knowledge, survival skills, and intuitive demeanor stems from Kauhai-liukua, Aunty Alice's great-great grandmother. Kauhai-liukua was a *kumu hula* (*hula* teacher) for King Kalākaua and Queen Liliʻuokalani. She was responsible for reinstating the *hula*. During the Overthrow of the Hawaiian Kingdom, Queen Liliʻuokalani gave Kauhai-liukua land in Olowalu, Maui. Queen Liliʻuokalani instructed Kauhai-liukua to continue teaching *hula* and to become a *kahu*. Aunty Alice believes that her great-great grandmother is responsible for passing on spiritual gifts to the *ʻohana*, especially to her children and grandchildren. Aunty Alice shares that her gift is that during certain time frames, she has the ability to see things regardless of physical obstacles:

> I worked at Nānāikapono School. One night as I was passing the school from Farrington Highway, I happened to look at the music room. I could actually see inside the classroom and seen four boys. My mistake is when I seen the police cars, I told my friend about the four boys in the band room. She told the office and I had to explain what I had seen. I had to convince the police officer I was not there, but what I seen while sitting in my car on the way home.

She also shares how her granddaughter, Kekai, has this special gift as well:

> One of the neighbors has a dog that is a hunter. One of their dogs got loose and as my daughter was watching from her bay window, she knew it was too late to help

> her daughter. The child’s name is Kekai. Kekai turned to look back and as she turned, the dog was approaching with an open mouth. Kekai told the dog, “GO HOME!” My daughter, Lanikay, said, “The dog was in the air and flipped right around and headed home crying.” Another time as they were taking her husband to work one morning, Kekai was getting louder as she was talking. Lanikay asked Kekai, “What’s wrong with you?” And Kekai states, “I’m not talking to you! I’m talking to Tūtū [grandma]!” She looked to see and the seat was empty. Kekai was just five years old.

She continues to discuss these spiritual events that circulate around her *‘ohana* including that her sisters are unable to stay at her great-great grandmother’s home in Olowalu, Maui:

> In Lahaina where my great-grandmother’s land is till today in the 1980s my cousins were trying to Quiet Title the land. I attended the court processing as a pro sé [advocating on one’s own behalf before a court]. I won the court case not knowing my sisters had to sign their portion off as heirship. One of my sisters would have bites on her arms and legs when she goes to the property and the other would have headaches—her middle name is after our great-grandmother. It is a special name. The story of my family is there were three other mothers who heard the name and gave their child the name. One died when they were an infant. Another had disabilities. The three hearing what happened to those children changed their names.

In 1975, Aunty Alice applied for Hawaiian Home Lands. Not knowing her genealogy, she traveled to Lahaina, Maui hoping for some insight from her maternal side of the family. For three days no one shared any information with Aunty Alice. The last evening in Maui, Aunty Alice decided to stay with her daughter who lives at her great-grandmother’s home in Olowalu:

> That night in my dreams, something hit me on the shoulder and said “*PULE* [pray]!” When I opened my eyes, all I could see was an *akualele* (fireball). It was doing a back and forward movement. All I could said was, “*‘Ae*, *‘ae* [yes, yes]” to its movements. The next morning I told my daughter, “My plane back to Honolulu leaves in two hours.” On the drive to the airport, for some reason I found myself at the Family History Center in Kahalui. I asked the attendant if they had information on the Kahai or Opunui ‘Ohana of Lahaina and she gave me three reels. As I looked at the time I knew I didn’t have enough time and told her, “Maybe next time.” As I was walking out, I noticed a bunch of folders high on the shelf. I asked her what was in the folders and she said, “Nothing, it’s all empty.” I reached up to look at one of the folders and as I opened the folder, I was shocked to find three pages of descendants of Chief Hoolue. The heirs of Chief Hoolue led to my great-grandmother and to my grandmother, Alice Ululani Kahai.

Aunty Alice truly believes that all of these events and challenges that she has faced in her life are a part of the gift that she was given by her ancestors. In 1999, Aunty Alice was injured on the job while working at Nānāikapono School. Between 1999 and 2005, she was given a letter by the Department of Education (DOE) warning of possible identity theft. The State of Hawai‘i challenged First Insurance and used some employee records as evidence. Unfortunately, all records used in a court of law becomes public records. One of those records was Aunty Alice’s. In 2000, she became a foster mom to help her husband's family. The following year her husband passed away. In 2005, her landlord found out he had cancer. To help with his medical expenses, her landlord sold the property. As a resident of that property for 35 years, she paid only $599 a month for rent. With the rising costs of rent, Aunty Alice had no choice but to live at Māʻili Beach Park where she also raised her foster son. In 2006, the DOE could not place Aunty Alice in a permanent position due to her injury and was totally laid off. It was her homeless stint that also played a pivotal role:

> The police was arresting and giving tickets to many of the homeless campers. [Through] communications with some of the homeless campers, I found out many concerns (when the police fall short of meeting their quota of tickets, they would ticket the homeless and they were being charged for destroying bathrooms or trashing the parks.) When I finally got a ticket, (*The Advertiser* had a front page story of her receiving a ticket) [Figure 24], the campers told me, "Just pay the fine and they will leave you alone." I went to LCC Waiʻanae to study the law of my ticket and homelessness. When I went to court and my name was called, I plead "Not Guilty." The prosecuting attorney was shocked and said, "What do you mean?" I said, "I am in a public beach park," at the time, the law did not say I needed a camping permit. She tried to plea bargain by saying, "You admit to trespassing on private property and pay $25.00, I'll let you go." I replied, "I am in a public beach park and if the judge agrees with you, he is also breaking the law." In the Constitution of the State of Hawaiʻi, Article 10 and on the badge of the police officer is the Splinter Paddle Law insignia. By Kamehameha the Great, "Men, women, and children may lay at the roadside without any harm." The judge declared me "not guilty" and I walked out.
>
> I remembered my mom always told me, "Just because everybody looks good in black doesn't mean you do." If there's a problem…solve it. If the doors are locked, climb through the toilet bowl. There's a way to solve it.

An area of interest for Aunty Alice is environmental issues. She is hoping Hawaiʻi legislation will pass a bill to establish an Environmental Court, which ensures that all will live in a safe and healthful environment. For example, while she was homeless she saw a woman picking something up on the beach. When she asked what it was, the woman replied it was Hawaiian Jade. Every morning Aunty Alice would search for Hawaiian Jade on the reef and would find some every once in a while. The same woman taught her how to string them together to make necklaces. She ended making two necklaces out of Hawaiian Jade. One necklace was for Kaulana Park, coordinator of the homeless programs appointed by former Governor Linda Lingle, and the second necklace was for William Aila, Waiʻanae resident and former Waiʻanae Harbor Master. Mr. Aila brought it to Aunty Alice's attention that this was not Hawaiian Jade but rocket boosters. "I brought the matter to the Waiʻanae Neighborhood Board who jumped the military. That's how the cleanup of Māʻili Beach Park and Ordnance Reef came about," said Aunty Alice.

She was once involved with Nani ʻO Waiʻanae, a non-profit group that is affiliated with Keep America Beautiful, she was a secretary for the organization. The project to clean-up Māʻili cost the organization $45,000. Clean up efforts included gas, truck hauling, and light refreshments.

Figure 24. Photo of Aunty Alice Greenwood with her son, Makali‘i Hatchie being ticketed by authorities (courtesy of *The Honolulu Advertister*)

It took four days, 30 tons of tires, and collection of municipal waste (mattresses, furniture, etc.) to complete the job. The majority of the clean-up stemmed from Paʻakea Road, just north of the project area. The military was also called upon to help clean the area.

> And you talk about the stream [Ulehawa]! A lot of the stream was filled with tires, mattresses, all of that—so when we have these floods…
>
> People illegally dumping. The problem that's happening to our streams especially that affects Ulehawa is people—you know the canal where PVT is at? You see how people throw their bag of rubbish and everything in the canal? That's Ulehawa. It connects to Ulehawa. And you know what? Our ancient knew about that place, they call it "Dirty Penis."
>
> All I know is that if we wanna change it, we better do something about it.

Regardless if Ulehawa Stream is polluted, it still holds cultural significance. Aunty Alice believes that Ulehawa Stream was once the location where native people may have congregated. She adds that the husband of Pat Bacon, *hānai* (foster child) daughter of Hawaiian historian Mary Kawena Pukui, photographed the Lualualei area extensively:

> Yeah, look into the Bacon Collection and you'll find a lot of collections of this area and it shows where certain…when you have the…how the stream….how the farmers…certain farmers in that whole area and it's right by PVT area and everything and how wide that stream used to be. How wide that river used to be. And they used to…for them to get across, they had to go on the boat. She has all those photos.

Some *moʻolelo* about the demi-god Māui is centered on Ulehawa Stream. Aunty Alice shares the *moʻolelo* about Māui attempting to bring the Hawaiian Islands together. Many people think that Kaʻena Point is where Māui attempted to bring the islands together, but Aunty Alice believes that if you were to go straight out from Ulehawa and into the ocean, you can see all the islands.

> Yeah. So you know, I keep telling people you gotta look at the area. Because Pōhākea Pass, I remember Hiʻiaka saying you could see Big Island. You now? And what was happening…what Pele was doing. You know what I mean? Telling the story and everything. So if you think of that, you go out there in the ocean.
>
> To go to Ulehawa and bring the islands together. Where everybody says, "No, it's at Kaʻena…No, it's on the island of Maui."
>
> The view of it is different.
>
> And Oʻahu centralizes everything. A lot of it.

Another coincidence that baffles Aunty Alice is that she found a copy of the deed from Māui and the property is bounded by Ulehawa Stream:

> Demigod Māui documented: Land Deed 1848, Number 1313 Kuapuu. Had three sections: Puniaikane, Makamai, ʻIli of Uluhawa (a river, known today as Ulehawa River).

She shares a *moʻolelo* about the *pueo* (Hawaiian short-eared owl) of Lualualei, specifically near Hina's Cave and the Ulehawa Stream area. The *pueo* is an *ʻaumakua* (family or personal gods) that protects people (Figure 25). In ancient times when a predator or stranger came to attack one of the villagers, an owl would give a hoot that would signal the rest of the owls in the area. The owls would then fly down and attack the predator or stranger. Another *moʻolelo* about owls is that of Kahalaopuna, a beauty who make a promise to Kauhi who is from a powerful *ʻohana* from Koʻolau:

> Mischievous persons pretend they had enjoyed Kahalopuna's favor. Kauhi believed them and with jealousy determines that she must die. He leads her to the uplands of Pōhākea where he ends her life. Kahalaopuna's *ʻaumakua* is the owl. The owl flies to the top of a tree and tells the story of Kahalaopuna. Passerby finds that she is still warm and restores her back to life.

Aunty Alice recalls people once gathering near the Ulehawa Stream area. Fish would be gathered during the rainy season. Fish would come up the stream from the ocean and spawn. However, today the stream is dry in certain areas and polluted. The streambed is also covered in concrete making it difficult to travel upstream and spawn. During the dry season, *ʻuhaloa* (small, down American weed; *Walterhia indica var. americana*) and *ʻōlena* would be gathered along Ulehawa Stream. *ʻUhaloa* would be used for sore throat while the *ʻōlena* would be used for spiritual practices:

> The *ʻōlena* can tell you your future if you know how to do it.
>
> You get the root but you have to take off the stem and then you put it in fresh water. Put salt. Hawaiian salt. And then the *ʻōlena*…that's our ocean…the *ʻōlena* will represent your land. And then the stalk of…not the stalk but the leaf, brand new leaf of a ti.
>
> The shoot. That represents the heaven. And what you do is turn around and in your mind you vision something.

The surrounding neighborhood also had its share of supernatural activities described by Aunty Alice:

> One day my girlfriend called to tell me to listen to the way the dogs are barking. She lives on Ulehawa Road. The barking came from the PVT area by the river. It is a very strange bark and seems to go in the direction of where I live. One night when I heard my neighbors hunting dogs barking, I noticed it was a strange sound. I looked out my window and noticed someone small teasing the dogs. I tiptoed to the living room to call my husband. When he came with me he noticed it too. I yelled, "HEY! What you doing?!"" It turned in my direction, all I seen was a faceless person with a helmet running towards the river (Ulehawa) slowly disappearing.
>
> The Green Onion Farm on Hakimo Road next to the bridge. I was asked by the owner if I could do a blessing. I told him, "There are *kahus* that he can call, why not one of them?" He said he has and that "nothing has worked." When I walked into his house I felt something strange by one of the bedrooms. After I did the blessing his wife told me their story. This is seen [the apparition] by her and her mother-in-law. Her mother-in-law will not come to the house and they are [husband and wife] [concerned] because she is getting older.

Figure 25. Photo of *pueo* in right opening; photo was taken adjacent to Hina’s Cave in Lualualei Ahupua‘a (CSH 2015)

> When the children was little, a native boy would play with them in the house. I stared at one of their children. He was on his computer and looked like he was in high school. [The wife] said, "Yes, she still sees the child." This happens on certain nights.

The project area is also adjacent to Kaolae ‘Ili. From February to May 2010, *pōhaku* and some *poi* pounders were taken from Kaolae for the construction of stone walls in the affluent subdivision known as Royal Summit in Kalauao Ahupua‘a (between Waimalu and ‘Aiea Ahupua‘a; Figure 26). Pearl Tavares who owns a piggery nearby told Aunty Alice that she could hear the rocks rolling down the mountainside. When Aunty Alice went to Kaolae to investigate, she noticed the rocks had replenished themselves. In the same area, a trucking company had the business offices blessed when a woman came walking down from the rocks and kept saying, "Where is my water?" as she walked towards the gate and slowly vanished. Aunty Alice suspects the woman was either talking about Ulehawa or the numerous streams that once existed in the area. She also points out that a plane crash occurred in 1955 (Figure 27):

> We was living there. My mom lived right across. Was living at Wong's place. Tavares. Oshiro. All of these farmers…all of these farmers came to help them. But it was too late, we couldn't help them. Tried to pull bodies out and everything.
>
> This one right here.
>
> Heleakalā. Yeah, yeah, Heleakalā.

On certain evenings from Kaolae if you stand on a *pā* (rock wall), you can see "an aura" over the Wai‘anae Mountain Range on certain nights. The "aura" comes from Wahiawā, the birth place of the *ali‘i*.

Kaolae ‘Ili was considered special and Aunty Alice states that there was "something about that property." It was once considered prime food land. The late Governor John A. Burns's wife had a disability. Mrs. Burns wrote to Mr. Oshiro, a farmer of Lualualei, "Your vegetables are very, very healing." Mānoa lettuce and watermelons grew beautifully in this area, which was later dubbed ‘Āinalani by the late Mr. Araki, who was also a farmer of the area. Aunty Alice points out that the former farming area is also known as Nānākuli B.

Prior to the construction of the Lualualei Transmitting Facility, the area once belonged to Hawaiian Homelands. A large part of the area was once covered in *wauke* and *heiau*. Pūhāwai ‘Ili was once covered in at least 750 *lo‘i*. Unfortunately when the military and Henry J. Kaiser began to develop the valley, a lot of the cultural sites including *heiau* were destroyed.

Aunty Alice states that owls still live in the forest area within the PVT property that's adjacent to Ulehawa Stream. Her main concern is to try and preserve the small bit of forest area within the PVT property for the *pueo* and bees. She is also concerned for the *‘alae* (Hawaiian gallinule; *Gallinula chloropus sandwicensis*) bird who frequents the Ulehawa area.

Figure 26. Photo of a *pōhaku* found at Kaolae that was taken for the construction of rock walls or *ahu*; Aunty Alice points out this particular *pōhaku* has a face with identions for eyes and a mouth (courtesy of Aunty Alice Greenwood 2015)

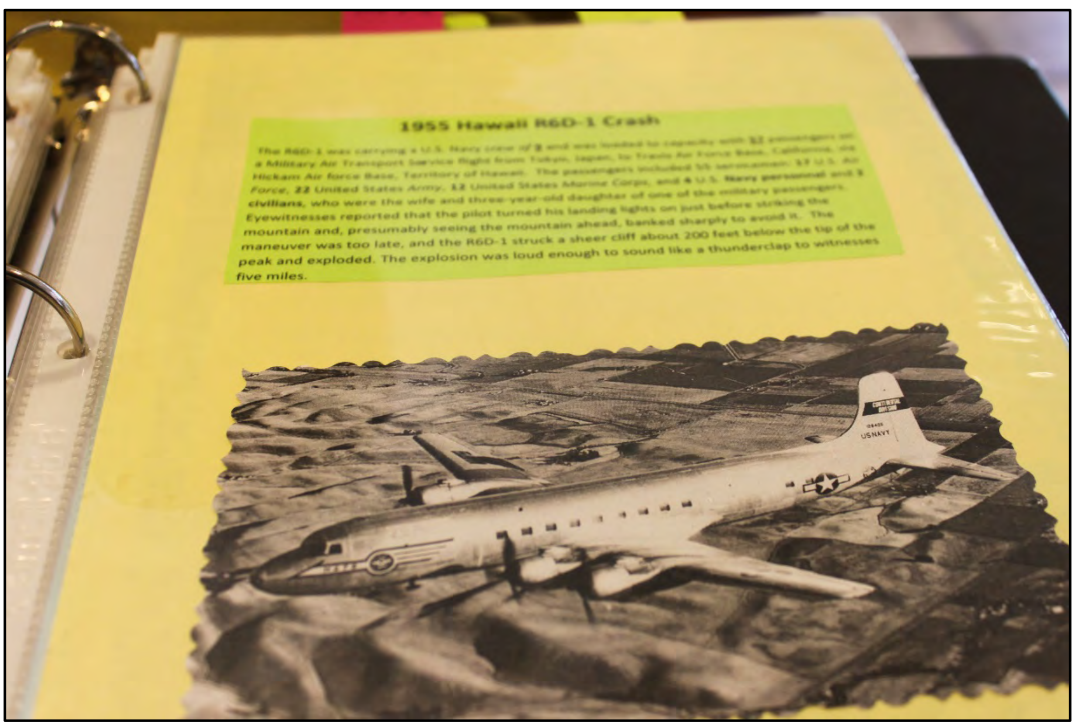

Figure 27. Photo and article of the 1955 plane crash on Heleakalā (courtesy of Aunty Alice Greenwood 2015)

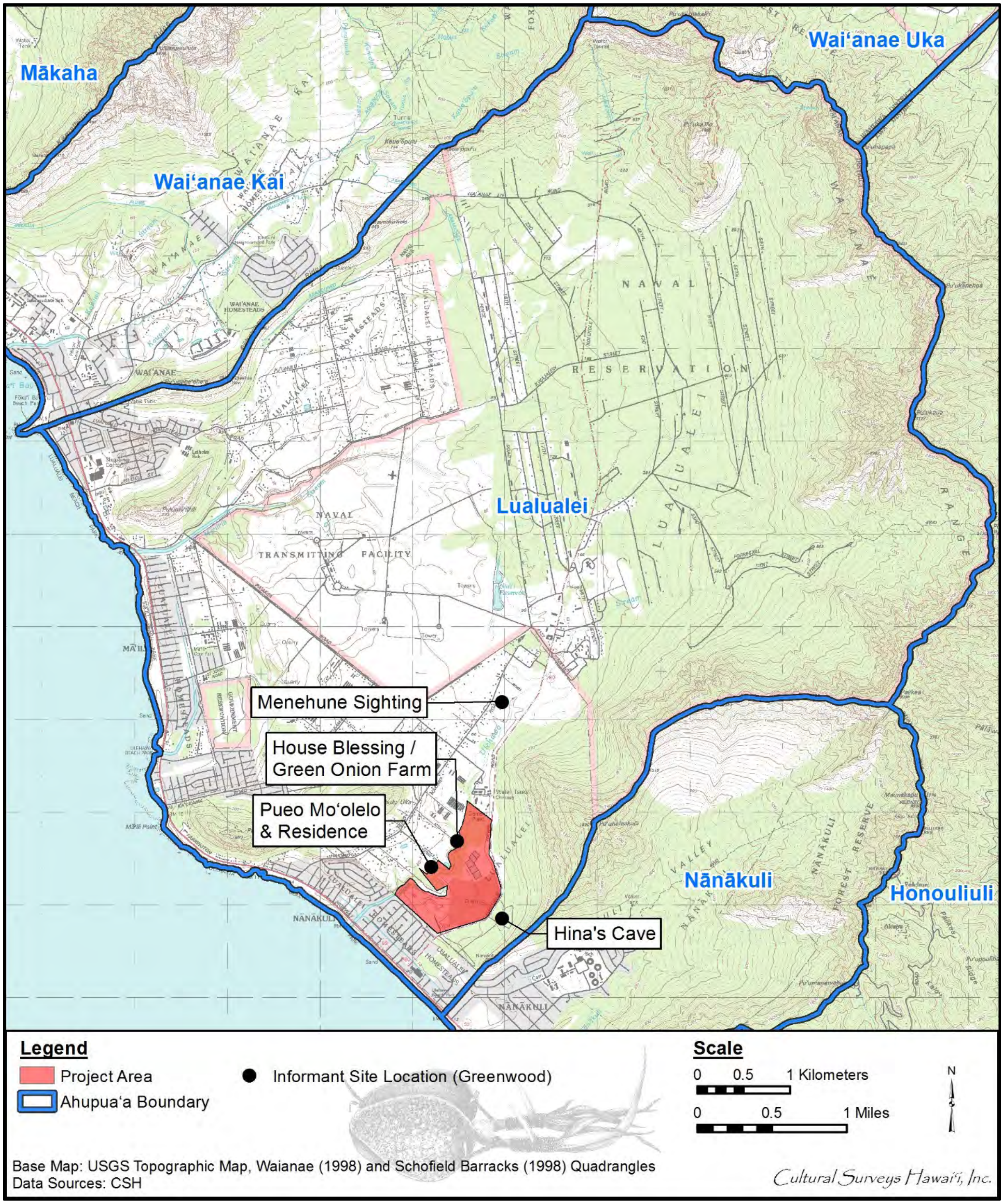

Figure 28. 1998 USGS Topographic Map, Waianae and Schofield Barracks Quadrangles depicting approximate locations of sites and points of interests from Aunty Alice Greenwood

7.2 Eric Enos

CSH previously interviewed Eric Enos, co-founder and Executive Director of Kaʻala Farms in Waiʻanae, on 8 November 2013 and for the current project on 10 March 2015. Mr. Enos has spent the majority of his life in Mākaha since his parents moved from Kalihi when he was a child. He has family connections to the Kalaeloa area, which is located in Honouliuli Ahupuaʻa. His great-grand uncle on his mother's side was a fishermen and caretaker of the place now known as Barber's Point Lighthouse. "His house was where the *lūʻau* grounds [Germaine's Luau] right now is located and we used to go there and fish when we were small. This was before the Campbell Industrial Park was built," said Mr. Enos. His paternal side of the *ʻohana* is from Kauaʻi and maternal side of the *ʻohana* Kaʻū on Hawaiʻi Island.

Kaʻala Farms is located in Waiʻanae Ahupuaʻa below Mount Kaʻala and the Waiʻanae Kai Forest Reserve. The 98-acre cultural learning center is dedicated to perpetuating Native Hawaiian culture and connecting communities to the *ʻāina*. The farm consists of many pre-Contact *loʻi* as well as an area designated for dryland taro cultivation (Figure 29 and Figure 30). Currently, over 15 varieties of *kalo* are being grown at Kaʻala Farms including *moi*, *ʻeleʻele*, and *piko*. A variety of other plants are being bred including *ʻulu* (breadfruit; *Artocarpus altilis*), *ʻuala*, *ʻōlena*, and tapioca. Kaʻala Farm has acquired the old Waiʻanae Ranch property of over 1,500 acres, which includes Punanaula Heiau, adjacent to the spring and abandoned *loʻi* terraces.

An educator and long-time land rights for Native Hawaiians activist since the 1970s, Mr. Enos shares his experiences from earlier years:

> We were involved in a lot of the cultural issues of Hawaiians uprooted from the land and their culture. I got involved [not in the actual demonstrations] way back with the Kalama Valley land struggles, Kamehameha Schools, to Chinatown, then with the Hawaiian Renaissance, Kahoʻolawe, then Hilo Airport and sovereignty issues that go way back to when nobody knew what the word sovereignty meant. So we [Kaʻala Farms] have a long tradition and then we were the ones in court for the Kalaeloa Deep Draft Harbor. We petitioned with Legal Aid and challenged the Deep Draft Harbor. It was Snug Harbor before they dug it out to create the new harbor. We went to court, first with Legal Aid then with Native Hawaiian Legal Corporation. Our concern was the potential impact of development on the fishing grounds because the Kalaeloa area is probably one of the richest fishing grounds on Oʻahu. Puʻuloa, or Pearl Harbor, was a fishery prior to being a military base. People don't realize it but if you look at that whole area in front of Kalaeloa, there's a huge coral system out there—a flat fringing reef with huge coral heads.

Mr. Enos described being involved in court cases against major development projects along the coast that threatened the ability of Native Hawaiians to practice their traditional subsistence livelihoods dependent on fishing and gathering. He shared the following:

Figure 29. Photo of dryland *kalo* area with *kiawe* (Algaroba; *Prosopia pallida*) at Ka‘ala Farm facing Kaua‘ōpu‘u (CSH 2015)

Figure 30. Photo of *lo‘i* area at Ka‘ala Farm with *‘auwai* (ditch, canal) (CSH 2015)

> We also went to court regarding the Ko‘olina West Beach Resort and our concern was the potential loss of traditional *limu* and fishing grounds and the impact on gathering food. That's what sustained families—the gathering of *limu*, salt, and fish. At the time, people were still practicing those traditions and that place was where the families would go. This was about the 1970s, around the time of the Renaissance. Everything was happening. Kaho‘olawe was happening. We saw that being able to feed yourself and eating healthy food, was how we were going to survive. We saw these projects as providing jobs but they're short-term jobs. Construction jobs.

When the job has been completed, Mr. Enos explains, "Now you no more place for fish. Your land will get so valuable, you're not going to afford it. You're gonna get pushed, pushed, pushed, and on O‘ahu, everyone got pushed to Wai‘anae." Prior to urbanization, Mr. Enos recalls Maunalua (widely known as Hawai‘i Kai) to Pearl City were once all farmlands. Today, Wai‘anae and the North Shore are the areas farthest from the impacts of urbanization. With the loss of natural resources, Mr. Enos is concerned about the loss of traditional food.

> That's why we got into the water rights in Ka‘ala so it went to the Land Board. We said, keep your urban areas this way, but at the same time, we need to preserve our culture. We need to preserve our *ahupua‘a*. We need to preserve our water and ocean resources. It was a landmark case in terms of restoring water rights.

Mr. Enos emphasizes that the lands of Wai‘anae were very important because of salt and *limu*. "If you look at the spice trade, spices made European nations. Our spices were *‘inamona* (relish made of the cooked kernel of the candlenut mashed with salt), *limu*, and salt and then we had deep sea fisheries," he explains. He states that Waikīkī did not have this combination of aquatic resources, but rather Kā‘ena. Referencing the *mo‘olelo* of Māui, the demi-god, pulling up the islands and explaining that the story was not just about pulling the islands out of the ocean but also acknowledging the deep sea—where fish such as *‘ahi* (Hawaiian tune fish; *Thunnus albacares*) and *aku* (bonito, skipjack; *Katsuwonus pelamis*) thrive—both valuable aquatic resources for the livelihood of Native Hawaiians.

Līhu‘e, the area now known as Schofield Barracks Military Reservation, is important due to its historical significance. It was once the birthing place of the *ali‘i* of O‘ahu Island:

> If you keep going straight on this road, that would have brought you to Līhu‘e which is now known as Schofield. Līhu‘e was the base for O‘ahu, not Waikīkī. Līhu‘e is where the Kūkaniloko was, the birthing stones of the O‘ahu chiefs. When the wars came and the mixing of dynasties happened, the Maui chiefs took control. People think this goes back 200 years but it goes back a lot longer. The site of Līhu‘e was strategic because Pu‘uloa, if you look down from Schofield, you see Pu‘uloa [in Honouliuli]. That was rich lands and had many salt fishponds. All that was *wai* [water], *wai*, *wai*, *wai*. Waiau, Waimalu. They were all watered lands. Rich. But at Līhu‘e, you're in a position that overlooks the resources of ‘Ewa, Waialua, Wai‘anae and that's why its Kamehameha lands now because that's where Princess Ruth gave the lands to Pauahi. So if you go to North Shore now, Kamehameha Schools owns all that land. That's where the *ali‘i* lands were.

From the uplands of Līhuʻe, *aliʻi* could command salt, deep sea fish, and other fish such as *ʻōpelu* (mackerel scad; *Decapterus pinnulatus*) and *akule* (big-eyed scad; *Trachurops crumenophthalmus*). "This place had a lot of value because you have water and sun, you have *limu* and salt, and you have fisheries," says Mr. Enos. Accordingly, Waiʻanae got its name from the *ʻanae* or mullet that would travel out of Puʻuloa and follow the current around the island. "The *ʻanae* used to be plentiful at one time and they would come out of Puʻuloa hatchery and travel around and the *ʻanae* grew huge. But you don't see it now because it's lost," Mr. Enos reminisces. He points out that from Kahe Point and the rest of the coastline consisted of fisheries. "That area would be just fishing and it would have had *koʻa* [fishing shrine] along the shoreline path."

Waimānalo is located in Honouliuli Ahupuaʻa and is used as a point of reference in accessing the north and west sides of Oʻahu. Waimānalo is located just north of the Honokai Hale-Koʻolina area. "When you go past Waimānalo to the springs there, that's when you went up *mauka* and had access to the uplands," explains Mr. Enos. He continues,

> The rich uplands were up here up at Pālehua, further south [of the project area] from both sides. If you go up above Nānākuli, that's where you have Mauna Kapu. That's where all the communication towers are. That's important, there's a series of trails that lead to Mauna Kapu and Pālehua. One of those trails goes right to Līhuʻe but Mauna Kapu, it's the unrestricted point on the *kāpae ʻāina* [archipelago] of the islands that gives you Kauaʻi and all the peaks of the other islands if you look this way. So if you look this way, you can see Kauaʻi on a good day and the other way, you can see all the way to Hawaiʻi Island. Right there is where Hiʻiaka rested in her journeys. Right where she stopped, that's Mauna Kapu. So when she stopped at Pōhākea Pass, that's where she saw Pele, her groves of *lehua* in Puna burning, and her companion Hopoe in lava so that place is significant. That's right in Lualualei, Puʻukaua. Pālehua is part of the Kahe area and connects to here.

Mr. Enos also shares is knowledge of trails such as Kolekole Pass and Pōhākea Pass, trails that are part of a historic system on Oʻahu:

> The trails came through the coast. Everything is coastal. The inland trails are only in Lualualei, Kolekole and the other one, the military call it 'Gun Site'—Pōhākea Pass. Hiʻiaka rested at Pōhākea and climbed up Mauna Kapu. That was all Honouliuli area and that's where the Honouliuli Preserve was under the Nature Conservancy. In the Waiʻanaes, that's where you could access some of your *maile* [*Alyxia olivaeformis*]. All in there was where they had the native forests and there are still remnants of it. The only other place would be at Kaʻala and Pahole, down the coast. So Honouliuli, then after that you hit Kaʻala then you go up to Pahole above Mākua and then you drop down into Kāʻena. That walking path would have gone all the way from here, along the Waiʻanaes. It's a rich trail, then you have the upper valley trails that cross over all these lands but I've never seen anything in this place [Kahe Point] other than fishing *koʻa*.

Regarding *koʻa*, Mr. Enos explained that these structures were also shrines made of coral. *Koʻa* were built to align with mountain peaks and acted as transects for indicating fishing grounds. Many *koʻa* were associated with *ʻōpelu* and *akule* fisheries. Mr. Enos described *ʻōpelu* fishing in detail below:

> We revived the hoop-net fisheries from Miloliʻi from Uncle Eddie Kaʻananā and Uncle Walter Paulo. We were trying to revive the Kona fishing canoe and in the process, we started to feed the *koʻa*. The other one to feed the *koʻa* was Barney Gomes Now, it's Domingo, the son of Barney who feeds the *koʻa* the traditional way. *ʻŌpelu koʻa* is like in Miloliʻi [South Point, Hawaiʻi]. When the *ʻōpelu* comes in to spawn, it's like salmon. You go in there, you feed them, and then you harvest them. They spawn, just like how the salmon comes upstream. They go to spawn but then after that they die [salmon]. *ʻŌpelu* season goes into the end of summer and goes into a few months then after that, they're hard to find. This is the kind of *ʻōpelu* that's pelagic—deep sea. They go out to deep sea and then they come back in so there are these rhythms and cycles. The *mana ʻōpelu* taro comes from *ʻōpelu* fishing. It's a variety of taro that was fed to the fish so it's a form of animal husbandry.

Mr. Enos also discussed the *wahi pana* in the vicinity of the project area. To the east of the project area on the mountainside of Puʻu Heleakalā is Hina's Cave. Mr. Enos informed CSH that the cave is more of a rock shelter. He also mentioned that the area below Hina's Cave consists of smaller sites including possible habitation features and *ahu* (altar). A trail may have once existed to access Hina's Cave, however, today there is no trail and the hike requires some rough scrambling and boulder hopping. The view plane from Hina's Cave is striking and expansive as it overlooks the entire *ahupuaʻa* of Lualualei including portions of Waiʻanae Kai and Mākaha. Mr. Enos classified Hina's Cave as a natural *wahi pana* and the view from the cave is a vantage point to see other *wahi pana* of the area including all sites pertaining to Māui, the demigod. Mr. Enos referenced the chant, *Hālau Waiʻanae*, which mentions the significant *wahi pana* of the Waiʻanae coast.

A big concern for Mr. Enos is the water source, Pūhāwai, a spring located just below Kolekole Pass. According to a 1998 USGS Topographic Map, a water tunnel is located west of Pūhāwai, directly between the spring and Kaʻala Farms. The Navy's source for water is via the water tunnel. In June 2012, a large wildfire broke out in Waiʻanae and Lualualei Valleys scorching approximately 1,000 acres. The burn began in the back of Lualualei Valley on the Naval Reservation before it crossed over the ridge and onto the Kaʻala Farm property destroying the *hale* (house, building) that was used as an outside classroom (Figure 31). The majority of *loʻi* can be found on the western portion of the farm rather than the eastern portion where the burn occurred. Mr. Enos points out that wet areas prevent fires and to fight fires, better water management of the wetlands needs to be implemented. He stated, "We're creating these wetland systems as corridors as a fire prevention." The water source for Kaʻala Farms is from Kaʻala, the highest peak on Oʻahu measuring at 4,020 feet (Figure 32). As stated earlier, the majority of *loʻi* can be found on the western portion of the farm, which is closest to Mount Kaʻala. However, Mr. Enos pointed out that Kaʻala and Pūhāwai share the same dike system and pull water at the same elevation.

Mr. Enos has no major concerns regarding the project, however, he discussed his position on recycling waste and shared how to better manage our waste:

> Ok, well my position on recycling waste is that we all generate a lot of waste. And we have to be responsible for our waste. I mean, my question is how much waste—and I know it's being trucked in from all over—but I think philosophically we need

> to take look at waste as a by-product of growth—our growth—and things that we take for granted so we have to be responsible for all of our waste whether it be sewage, whether it be our trash, whether it be construction waste. You know, how much of it is ours? Secondly, I think the waste will continue, that's the nature of our growth and if everything stops that's one thing. But, so how do we find the most efficient way to convert that waste into products that could be recycled and reused and I think that has to be the future because we will continue to generate waste. And I think—waste can be, if it's done correctly, it can be a beneficial by-product if it's done correctly. If it's done correctly. So how do you do that? What is the technology today? What is the technology tomorrow? Are there more efficient, environmentally friendly ways to get rid of our waste or convert our waste into value products? So, that is the future of humanity. We cannot escape our waste. Unless we crawl into a cave, it's not gonna happen. So as long as we want to live in our houses, as long as we want our electricity, and as long as we want clean water—we have to be responsible for the other end of that pipe. So how to do it correctly and how to convert it into an economic benefit. However, as long as we stay in very strict environmental and cultural issues are addressed. And good monitoring of it.

Mr. Enos suggested air and water quality monitoring. He also questioned the possibility of ground quality monitors. Another question Mr. Enos posed is, "How can you manage [waste] when you don't know [how to]?" He believes that a unit of waste management needs to be integrated into the school system to channel new technologies for improved future management practices. The proposed supporting science curriculum would include waste and watershed management.

He posed several other questions including:

> No matter how much high you go, you can't, you can't disguise it. You can't ignore it. So what is the future of that mound? What happens to landfills after they're *pau* [finished]? Do they get green turf? Are they replanted? A lot of times they do that. You know? What's the future of that? What's it going to look like in the next….or is it going to go up another 100 feet there? So the question is, where do we and how do we…and how do we expand it? Those are the unanswered questions.

Figure 33 is a composite of sites in Wai‘anae and Lualualei Ahupua‘a that Mr. Enos pointed out during the interview.

Figure 31. Photo of *loʻi* and *ʻauwai* with *hale* in background; the *hale* is still under construction after the fire in 2012 (CSH 2015)

e

Figure 32. Photo of Mount Kaʻala in background (CSH 2015)

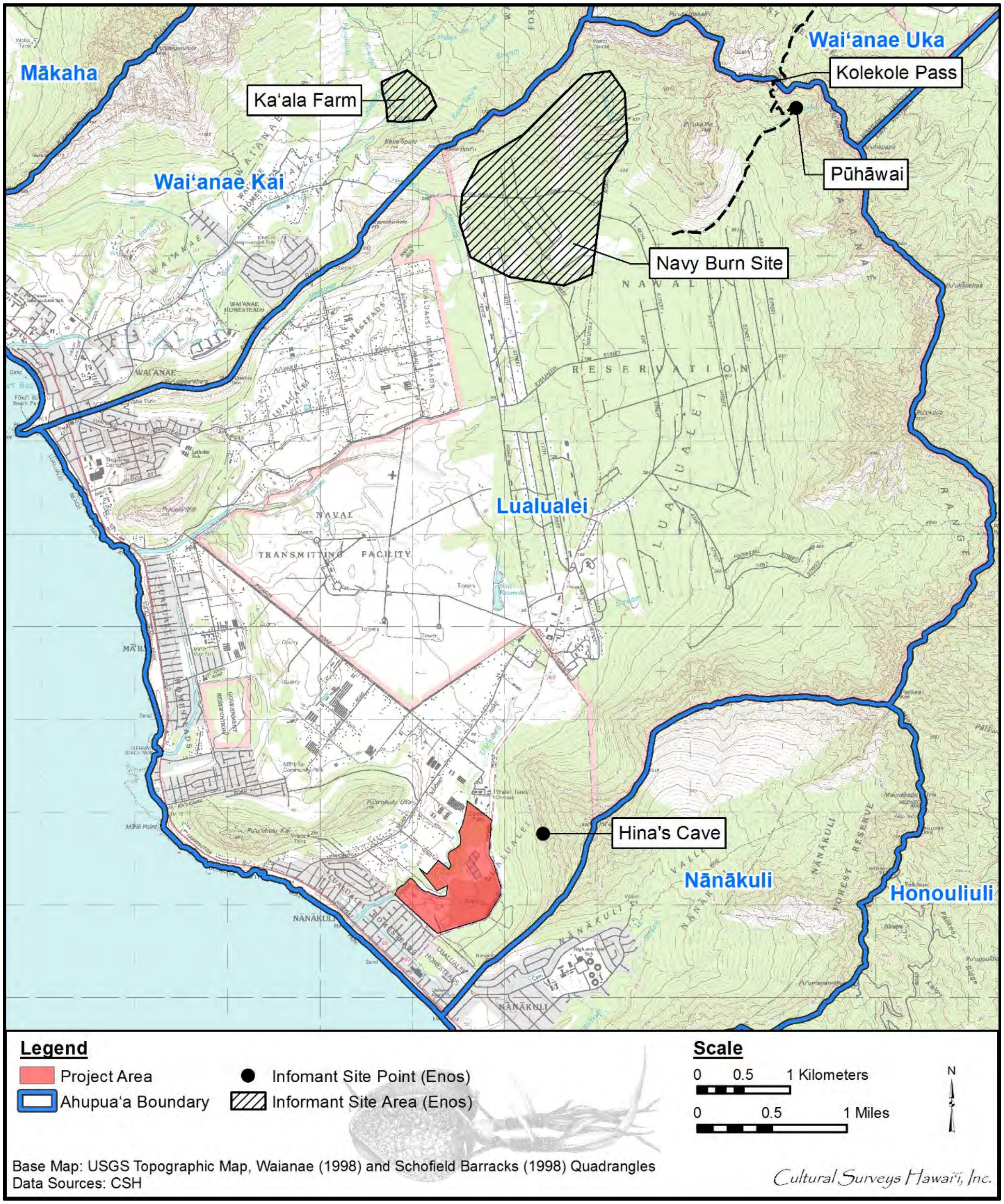

Figure 33. 1998 USGS Topographic Map, Waianae and Schoefield Barracks Quadrangles, depicting approximate location of sites pointed out by Eric Enos of Kaʻala Farms

Section 8 Cultural Landscape

Discussion of specific aspects of traditional Hawaiian culture as they may relate to the project area are presented below. This section integrates information from Sections 3–7 in examining cultural resources and practices identified within or in proximity to the project area in the broader context of the encompassing Lualualei landscape. Excerpts from interview sessions from past and present cultural studies are incorporated throughout this section where applicable.

8.1 Hawaiian Habitation

The Waiʻanae district is a dry, coastal area with poor soil and four streams. The Waiʻanae district was known for its excellent off-shore fisheries. In contrast, cultivation was not the easiest. Mākaha Ahupuaʻa is a small valley with a large stream suitable for cultivation. The *ahupuaʻa* could support its large community of fishermen and consisted of *loʻi kalo* that began half-way up the valley floor. Waiʻanae Kai Ahupuaʻa consists of poor terrain. The valley was once able to support wet-taro cultivation along the main stream and its tributaries. However, taro cultivation was abandoned to support the sugar cane industry. Gourds could be found growing wild in the *mauka* regions while sweet potato and coconut could be found in the lower regions of the valley (Handy and Handy 1972:467–468).

Kamaʻāina of the Waiʻane Coast, Alice Ululani Kaholo Greenwood, recalls the abundance of agriculture and aquaculture of Mākua, Waiʻanae, and Lualualei. Aunty Alice and her *ʻohana* once had a garden near Pōhaku Kulaʻilaʻi filled with *pōpolo*, papaya, chili pepper, *ʻōlena*, *laukahi*, *laukī*, *kupukupu*, *pakai*, and *kalo*. The majority of their food came from Mākua Valley prior to its closing for the Makua Military Reservation. She remembers gathering mango, *lilikoʻi*, sugar cane, *pōpolo, ʻōlena*, *laukahi*, *kupukupu*, *kalo*, and guava. She also recalls an oval shaped *loʻi* on the crest of Mauna Koʻiahi. *Pipipi*, *ʻopihi*, *leho*, *ʻōlepe*, *wana*, *hāʻukeʻuke*, *ʻaʻama*, *ʻalamihi*, *kūhonu*, *limu kohu*, *ʻakiʻaki*, *manauea*, *ʻeleʻele*, *waewaeʻiole*, *kala*, and *līpoa* were found in the tide pools or along the shoreline. Aunty Alice recalls people once gathered near the mouth of Ulehawa Stream. Fish would spawn here during the rainy season. Today, the stream is polluted and dry. Parts of the streambed are also covered in concrete making it difficult for fish to travel upstream and spawn. During the drier season, *ʻuhaloa* and *ʻōlena* could be found along Ulehawa Stream. *ʻUhaloa* was used for sore throat while *ʻōlena* was used for spiritual practices.

Co-founder and Executive Director of Kaʻala Farms, Eric Enos, emphasized the importance of Waiʻanae in reference to abundance of salt, *limu*, and access to deep sea fisheries that offered *ʻahi* and *aku*. In addition, other fish such as *ʻōpelu*, *ʻanae*, and *akule* were plentiful. Considering the land in Waiʻanae and Lualualei appear to be arid, Mr. Enos acknowledges a couple of water ways in the *ahupuaʻa*. Pūhāwai is a spring located just below Kolekole Pass. A spring adjacent to Punanaula Heiau near Mount Kaʻala once fed *loʻi* that is now abandoned. Mount Kaʻala is also the highest peak on Oʻahu. Mr. Enos pointed out that Kaʻala and Pūhāwai share the same dike system and pull water at the same elevation.

State of Hawaiʻi recognized lineal descendant and resident of Nānākuli, Paulette Kaʻanohi Kaleikini, stated the lands of Lualualei Ahupuaʻa were occupied by Native Hawaiians for generations and it was a highly productive area for food. She pointed out that Lualualei Valley is frequently mentioned in older Hawaiian literature making the area particularly significant.

Kolekole and Pōhākea Pass were both accessed by ancient Hawaiians. These were the main corridors to Waiʻanae Moku. Coastal trails, such as the Kalaeloa trail, were rarely used unless there was business to be done out there. Traversing the Kalaeloa trail was difficult as it was hot, dry, and no water was available on the wayside.

Ms. Kaleikini shared that a 1991 "archaeological survey encompassing the project area identified 131 indigenous Hawaiian historic sites." She also stated that over 1,000 features related to habitation, rituals, ceremonies, agriculture, and stone manufacture with datable (charcoal and volcanic glass) and cultural (artifacts and midden) material were found. Materials were radio carbon dated yielding dates ranging from AD 1420-1950, supporting her argument In addition, on the southwestern slopes of Puʻu Helekalā, a historic site was identified as a pre-Contact rock shelter. Ms. Kaleikini knows of an *ulu wauke* or *wauke* grove that is near the project area and the Navy Radio Transmitter Facility. This grove is where the goddess and mother of the demi-god Māui, as well as ancient occupants once gathered *wauke* to make *kapa*.

8.2 *Wahi Pana* and *Moʻolelo*

Various mountain peaks surround Lualualei Ahupuaʻa including Puʻu Heleakalā, the *puʻu* that separates Nānākuli from Lualualei. Pukui defines Heleakalā as "where the sun is snared." The translation is fitting as the mountain peak faces the sunset. It is also the location where Hina, the moon goddess and demigod Māui's mother, once lived in a cave and made *kapa* (Sterling and Summer 1978:62). Pōhākea Pass is also an important *wahi pana*. The pass serves as a passage to Honouliuli Ahupuaʻa and is the location where Hiʻiaka witnessed her friend Hōpoe turned into stone by her sister, Pele, the goddess of fire. A second passageway, Kolekole Pass, offers access to Waiʻanae Uka. Today the area is comprised of the Schofield Barracks Military Reservation. A large stone at the pass was once thought to be a sacrificial stone. Others say the stone was a female *kiaʻi* (guard, watchman) named Kolekole who guarded the pass. It was an area where *lua* fighters practiced their skills on unsuspecting travelers. It was also where Kahekili's army from Maui killed the last of the Oʻahu warriors led by Kahahana who had escaped the massacre at Niuhelewai. Kepā Maly, cultural researcher and Senior Vice President of Culture and Historic Preservation at Pūlama Lānaʻi, adds that the priest Kaopulupulu and his son Kahulupue have ties to Puʻu o Hulu.

Two *pōhaku* of importance can be found in Lualualei as well, a large rock said to be Māui (McAllister Site 148) and a petroglyph stone. Site 148 can be found in the vicinity of Puʻu o Hulu. During McAllister's survey in 1933, the stone was surrounded by water and said to have been the location where Māui the demigod sunned himself. Northeast of the rock was a shelter where he supposedly lived and a spring where he obtained water. The second site is of a petroglyph rock, which was located near a dried swamp in a public park at the edge of a beach. Former house sites and the petroglyph rock were discovered here. The petroglyph rock was reported to Bishop Museum that later removed and stored the *pōhaku*.

Three *heiau* can be found within Lualualei. Site 149, Nīoiʻula Heiau, is located on Halona Ridge. Today, the *heiau* is within the Lualualei Naval Preservation. The *heiau* is walled and paved and classified as *poʻokanaka,* or sacrificial. The northern portion of the *heiau* was almost completely destroyed and the stones were later used to build a cattle pen on the McCandless property. Cattle that lived in the pen became sick and died, resulting in infrequent use and eventual abandonment. Site 150 consists of home sites or a possible *heiau* surveyed by McAllister. These sites are in the middle of the *ahupuaʻa*. Kakioe Heiau (Site 151) is located in Pūhāwai. Kakioe was noted as a small *heiau*. The site is completely destroyed and only a small spring existed during the time of the survey. It was also noted that drums could be heard on the night of Kāne.

A number of participants shared their knowledge of cultural sites and *wahi pana* within Lualualei Ahupuaʻa and the broader cultural landscape of Waiʻanae Moku. Although unable to visit cultural sites due to military restrictions, Jan Becket shared his knowledge of two sites *makai* of the project area, Nīoiʻula Heiau, and a complex consisting of a 12-ft upright stone, one of the largest that Mr. Becket has ever seen in Hawaiʻi. Navy Region Hawaiʻi Archaeologist Jeff Pantaleo provided CSH with archaeological probability maps (Appendix B) of sites located within the Lualualei Naval Magazine. Due to high security, CSH was unable to secure access into Lualualei Naval Magazine. According to the map provided by Mr. Pantaleo, a majority of the Lualualei Naval Magazine is known to have sites and/or has a medium to high potential of sites. Cultural practitioner and Honouliuli Ahupuaʻa historian, Kawika McKeague, shared with CSH that he previously toured Nīoiʻula and Punanaula Heiau with Kumu Anthony Lenchanko who also shared *moʻolelo* of these sites and the back of Lualualei Valley. Shad Kāne, member of the Oʻahu Island Burial Council and ʻEwa Moku Representative and Chair for the Committee on the Preservation of Historic Sites and Cultural Properties, is also familiar with Nīoiʻula Heiau and will begin a cleanup and restoration project in conjunction with the Navy. Mr. Kāne stressed the importance of *mauka-makai* relationships "in terms of a subsistence lifestyle and the gathering of resources." He speaks of Pōhākea Pass in particular. The location of the pass is within the walkway of the project area. The pass is was used traditionally and historically.

Ms. Kaleikini shared her knowledge of over a dozen *wahi pana* in Lualualei including the Māui Pōhaku: a large rock shelter northeast of the Māui Pōhaku is where the demi-god Māui resided; a spring where Māui once obtained water is also in the vicinity of the *pōhaku* and his rock shelter; Nīoiʻula Heiau, which belonged to the *aliʻi* Kākuhihewa; house sites in Lualualei Ahupuaʻa that can be found below Puʻu Heleakalā; Kakioe Heiau, which has since been destroyed with the exception of a sacred spring; the Mauna Kūwale burial cave; and house sites and a petroglyph rock in Lualualei. Several *pōhaku* found near the Naval Radio Transmitting Facility were identified as sharpening stones for war implements. Ms. Kaleikini related that Lualualei has numerous meanings, one of which is "flexible wreath." This meaning resonates with the war strategy of a chief who sent his Waiʻanae warriors to surround invading armies like a wreath, which led to a defeat in Kīpapa in AD 1410. Ms. Kaleikini shared that Lualualei may have also been a weapons production center for Hawaiian warriors hundreds of years ago making it "the oldest ammunition facility in the U.S."

Numerous *moʻolelo* attest to Lualualei Ahupuaʻa being an important place in Hawaiian history. Ms. Kaleikini shared that Ulehawa and Kāʻolae is the birth place of Māui-mua, Māui-waena, Māui-kiʻikiʻi, and Māui-akalana. A portion of Ulehawa Stream is within the project area and Kāʻolae ʻIli is adjacent to the project area. Hina, mother of Māui, once resided in a cave on Puʻu Heleakalā where she made *kapa*. In addition, a profile of Māui can be seen on the mountain range. A segment of the epic tale of Pele and Hiʻiaka also takes place in Lualualei Ahupuaʻa. Ms. Kaleikini stated that in previous studies, documented *wahi pana*, and *moʻolelo* reveal that "the project area is located within a complex network of sacred sites in Lualualei." CSH also reached out to Nānāikapono School, which houses a statue of Māui. Ms. Stacey Eli of Nānāikapono School also stated that Nānākuli High School has a mural of Māui. Both pieces of art depict the importance and significance of the *moʻolelo* of Māui to Waiʻanae Moku.

Christophor Oliveira, Project Director of Marae Haʻa Koa and cultural practitioner, shared that the project area is associated with Māui, Hina, and the Kumulipo (Hawaiian creation chant). Mr. Oliveira believes that the area above Ulehawa Stream was the settlement that stretched into the current location of the Garden Grove condominium complex. Mr. Oliveira and Glen Kila, Program Director of Marae Haʻa Koa, stressed the importance of view planes and how the proposed height will impact cultural practitioners and Kānenuiakea worshippers who utitlize Puʻu o Hulu Kai, Puʻu o Hulu Uka, Puʻu Heleakalā, Makalualei, Ulehawa, and Māui A Akalana for spiritual purposes. Mr. Oliveira adds that an *ʻili* wall stretches to Heleakalā.

Aunty Alice Greenwood described the cultural landscape of the Waiʻanae Coast. Mākua mountain is known as Mount Koʻiahi. The valley itself was called Mākua and Kahanahāiki. As a little girl she recalled playing in the streams in that area: Koʻiahi, Mākua, and Kahanahāiki. When the railroad was built, part of Kaneana Cave was blown out. Many know the cave as Mākua Cave, but historically it's called Kaneana Cave. The cave is part of a lava tube that connects to ʻŌhikilolo. Aunty Alice confirmed that her mother swam in the lava tube from Kaneana Cave to ʻŌhikilolo. The *moʻolelo* of Nanaue—the shark-man of Mākua—would allegedly eat people. It is said that the *manō* met a beautiful *moʻo* and the two produced a shark child who eventually became the guardian of the seas and of Pōhāku Kulaʻilaʻi. It is said that the shark child would occasionally journey into Kaneana Cave. A large shark frequented the Mākua area as well. Aunty Alice also shared that if one were to travel straight out into the ocean from Ulehawa Stream, you can see the Hawaiian Islands. The story is related to Māui, the demigod, who attempted to bring the islands together. Many believe that he attempted to bring the islands together from Kaʻena, but Aunty Alice believes it's from Ulehawa. She also shared a *moʻolelo* of the owls of the area. In ancient times when a strangers attacked the villagers of the area, an owl would give a hoot to signal the others. The owls would then fly down and attack the predator or stranger. In relation to the owls of the area, Kahalopuna was a beauty who made a promise to Kauhi, a man from a powerful Koʻolau *ʻohana*. Outsiders convinced Kauhi that Kahalaopuna was not true to him. Kauhi believed these rumors and in a jealous rage determined that Kahalaopuna must die. They walked to the uplads of Pōhākea where he kills Kahalaopuna. As Kahalaopuna's *ʻaumakua*, an owl flies to the top of a tree and tells what has happened to Kahalaopuna. Her body was still warm and she was restored back to life. Aunty Alice shared personal *moʻolelo* of the area including conducting a blessing on a home that would also see an apparition of a young boy and a *menehune* sighting. Adjacent to the current project area is Kaolae ʻIli. From February to May 2010, rocks and artifacts (such as *poi* pounders) were taken from Kaolae for the construction of stone walls. Neighboring businesses could hear the rocks tumbling down the mountainside in the evenings. In the same area, a trucking business had shared that a woman came walking down from the rocks on the mountainside and kept asking, "Where is my water?" as she walked towards the front gate of the businesss before vanishing.

Mr. Eric Enos stated that Kaʻala Farms recently acquired the old Waiʻane Ranch property, which includes Punanaula Heiau with an adjacent spring and abandoned *loʻi*. He also pointed out several important sites including Līhuʻe, currently known as Schofield Barracks Military Reservation, which was once the birthing place of the *aliʻi* called Kūkaniloko. Līhuʻe was a strategic point in terms of its commanding views. From Līhuʻe you could see Puʻuloa and its many fishponds; the watered lands of Waiau and Waimalu; and most importantly, you overlooked the *moku* of ʻEwa, Waialua, and Waiʻanae. Mauna Kapu and Pālehua were also important areas in terms of viewing other islands such as Kauaʻi. In addition, Mr. Enos points out that Pōhākea Pass was where Hiʻiaka stopped and could see her sister Pele destroy her groves of *lehua* and friend Hopoe. A network of trails access these places from the Honouliuli uplands to Kāʻena. Mr. Enos shared that *koʻa* or fishing shrines can also be found atop the ridges. Mr. Enos still knows people who feed the *koʻa* in a traditional way such as Barney Gomes, the son of the late Domingo Gomes. Mr. Enos also spoke of Hina's Cave, which described as a natural *wahi pana*. The view of the cave is a vantage point as it overlooks other *wahi pana* of the area including all sites pertaining to Māui.

8.3 The Māhele

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, which divided the Hawaiian lands and introduced the concept of private property into Hawaiian society. In 1848, the *aliʻi* received their land titles. The *ahupuaʻa* of Waiʻanae, which included Lualualei, was listed as Crown lands and was claimed by King Kamehameha III (Board of Commissioners 1929:28). Many of the chiefs became indebted to American merchants. A common practice was to lease or mortgage large, unused tracts of land to other high chiefs and foreigners to generate income and pay off debts. The Kuleana Act of 1850 enabled and protected *makaʻāinana* land claims. The claimant was required to have two witnesses testify they knew the claimant and the boundaries of their land; the claimant needed to be living on the land for a minimum of two years; and no one else could challenge the claim. *Kuleana* parcels also needed to be surveyed. Not everyone was eligible to apply for *kuleana* lands. Out of the 2,500,000 acres of Crown and Government lands, only 30,000 acres of *kuleana* land were awarded (Chinen 1958:31). A total of 12 land claims were made in Lualualei Ahupuaʻa, however, only six were awarded in the *ʻili* of Pūhāwai, *mauka* of the project area. According to Land Commission documentation, at least eight families were living in the *ʻili* of Pūhāwai. A minimum of 163 *loʻi*, *wauke* cultivation, and salt making were exercised in Pūhāwai proving that the lands on the Waiʻanae coast had the ability to be fertile.

8.4 Sugar Industry

In 1901, the Waianae Sugar Company obtained a five-year lease on 3,322 acres of land in Lualualei to be used for raising cane and ranching (Commissioner of Crown Lands 1902). The small plantation possessed its own 30-inch narrow gauge railroad (Dorrance and Morgan 2000:43). The plantation boasted of 12 miles of railroad, three locomotives, and 350 laborers (McGrath et al. 1973:48). Because the plantation was small, the company had smooth labor relations. Production increased dramatically over the years due to the construction of several tunnels, which were used to collect mountain water. Additional wells were drilled in Kamaile, the site of an early Native Hawaiian village and spring. By the 1940s, Waianae Sugar Company could no longer compete against foreign companies with cheaper labor. With additional wells drilled, the company still could not keep up with the demand for water. In addition, labor unions and land battles caused the Waianae Sugar Company to crumble. In 1947, Amfac, Inc. purchased the plantation and closed it down.

8.5 Military

In 1921, Congress designated approximately 2,000 acres in Lualualei as Hawaiian homelands. In 1930 and 1933, Territory of Hawaiʻi Governor Lawrence Judd signed an executive order granting 1,525 acres of land in Lualualei to the United States Navy for an ammunition depot and radio station. The construction of the Naval Magazine LLL and Radio Transmission Facility took place from 1930 to 1935. In 1986, the State of Hawaiʻi filed a lawsuit to recover the lands in

Lualualei. Two years later the case was thrown out stating the statute of limitations had run out. In 1995, President Bill Clinton signed the Hawaiian Home Lands Recovery Act, which was authored by Senator Daniel Akaka and set a dollar value on the lands confiscated in Lualualei. In 1998, the Department of Hawaiian Home Lands was awarded 894 acres of surplus federal land under the Hawaiian Home Lands Recovery Act. The Navy was granted continued use of the Lualualei facilities. Today, two antennas of the Navy’s communication systems are still present and stand at 1,503 ft—the State of Hawai‘i’s highest structure.

Aunty Alice Greenwood shared that prior to the construction of the Lualualei Transmitting Facility, the area once belonged to Hawaiian Homelands. A large part of the area was covered in *wauke* and *heiau*. Pūhāwai ‘Ili once consisted of 750 *lo‘i*. When the military and Henry J. Kaiser began to develop Lualualei Valley, many of the cultural sites including some *heiau* were destroyed.

Mr. Enos recalled a large wildfire breaking out in Wai‘anae and Lualualei Valleys in June 2012. The massive wildfire scorched approximately 1,000 acres. The burn began in the back of Lualualei Valley within the Naval Reservation property before crossing over the ridge and onto the Ka‘ala Farm property destroying the *hale* that was used as an outside classroom and some of the farm land. The *lo‘i* were ideal as a fire prevention corridor.

Section 9 Summary and Recommendations

CSH undertook this CIA at the request of LYON. The research broadly covered the entire *ahupuaʻa* of Lualualei, including the 200-acre project area.

9.1 Results of Background Research

Background research for this study yielded the following results, presented in approximate chronological order:

1. Background research for this study yielded two traditional meanings given to the name Lualualei. One meaning, "flexible wreath," is attributed to a battle formation used by Māʻilikūkahi against four invading armies in the battle of Kīpapa in the early fifteenth century (Sterling and Summers 1978:68). A second meaning offered by John Papa ʻĪʻī is "beloved one spared." This meaning relates to a story of a relative who was suspected of wearing the king's *malo* (loincloth) when the proclamation of the king was given by Kulaʻinamoku, that Kalakua did not wear the kings loin cloth, sparing the family of Luluku, thus a child born in the family was named Lualualei (ʻĪʻī 1959:23).

2. The Waiʻanae district, a dry coastal area was known for its off-shore fishing, taro, gourds and sweet potato.
3. Puʻu Heleakalā, translates to "snared by the sun" (Pukui in Sterling and Summers 1978:62), is east of the project area and separates *nā ahupuaʻa* (land divisions) of Lualualei from that of Nānākuli. The *puʻu* (hill) faces where the sun sets, where the sun's rays are broken, and is also where Hina (goddess of the moon), Māui's mother, lived in a cave and made her *kapa* (barkcloth) (Sterling and Summers 1978:62). This and numerous Hawaiian traditional accounts of the demigod Māui, Hiʻiaka-i-ka-poli-o-Pele, Pele, Lohiʻau, Hōpoe, Pāʻuopalaʻā, and Wahineʻōmao, and archaeological studies as well, define Lualualei in Waiʻanae *moku* (district) as an important center of Hawaiian history.
4. In 1901, the Waianae Sugar Company leased 3,332 acres in Lualualei for raising cane as well as for ranching (Commissioner of Crown Lands 1902). Amfac, Inc. purchased the plantation and closed it down in 1947.
5. Land tenure includes Mahele Awards in 1848 and Land Commission Awards in the 1850s, Hawaiian homelands designations in 1921, U.S. Navy use beginning in 1930 and 1933 and most recently the State of Hawaiʻi, the U.S. government In 1995 have been involved in the land ownership changes in Lualualei.

9.2 Results of Community Consultations

CSH attempted to contact Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants in order to identify individuals with cultural expertise and/or knowledge of the project area and vicinity. Community outreach letters were sent to a total of 70 individuals or groups; 20 responded and two of these *kamaʻāina* and/or *kūpuna* met with CSH for more in-depth interview. Consultation was received from community members as follows:

1. Jan Becket, a retired Kamehameha Schools teacher

2. Stacey Eli of Nānāikapono School
3. Eric Enos of Kaʻala Farms
4. Lucy Gay, Board Member for KAHEA—The Hawaiian Alliance, member of the Concerned Elders of Waiʻanae, and Leeward Community College –Waiʻanae Satellite Campus
5. Alice Greenwood, *kupuna* (elder), long-time resident, *kamaʻāina* (native born), Waiʻanae Moku Representative for the Committee on the Preservation of Historic Sites and Cultural Properties, and member of Nani o Waiʻanae and the Concerned Elders of Waiʻanae
6. Paulette Kaʻanohi Kaleikini, cultural practitioner, State of Hawaiʻi recognized lineal descendant and resident of Nānākuli Ahupuaʻa
7. Shad Kāne, *kupuna,* cultural practitioner, Oʻahu Island Burial Council Representative, ʻEwa Moku Representative, Chair for the Committee on the Preservation of Historic Sites and Cultural Properties, and the Founder of the Kalaeloa Heritage Center and Legacy Foundation
8. Glen Kila, cultural practitioner, *kupuna,* Program Director of Marae Haʻa Koa and a Koa Mana Lineal Descendant
9. Kepā Maly, Senior Vice President of Culture and Historic Preservation at Pūlama Lānaʻi
10. Kawika McKeague, Honouliuli historian, and long-time resident of Honouliuli
11. Dolly Naiwi, President of the Nānāikapono Hawaiian Civic Club
12. Christophor Oliveira, cultural practitioner and Project Director at Marae Haʻa Koa
13. Jeff Pantaleo, Navy Region of Hawaiʻi Archaeologist
14. Environmental Justice in Waiʻanae Working Group, a collaborative effort with KAHEA, the Concerned Elders of Waiʻanae, and American Friends Service Committee

9.3 Non-Cultural Community Concerns and Recommendations

Based on information gathered from the community consultation, participants voiced the following concerns not related to the cultural context.

1. Ms. Dolly Naiwi voiced her concerns regarding the health and safety of the residents who live near and in the vicinity of the project area. She is concerned with dust flying into the neighboring residential areas and along Farrington Highway. She is also concerned with construction debris possibly seeping into the ground and contaminating areas that surround the PVT landfill. Ms. Naiwi suggested not renewing PVTs license to accept construction debris and also stated that the landfill could be utilized for other activities rather than a landfill.
2. Ms. Paulette Kaʻanohi Kaleikini does not appreciate the landfill being so close to the community and believes the vertical expansion should cease. Ms. Kaleikini is concerned with the increased traffic of large, heavy trucks in the area; air pollution; and the loss of agricultural lands.
3. The Environmental Justice in Waiʻanae Working Group shared various thoughts and posed several questions at a meeting: What are the health risks with the vertical expansion in terms of dust control? If there is a vertical expansion, will dust spread and go into Ulehawa Stream? Suggestions from the Environmental Justice in Waiʻanae Working Group include sending community consultation letters and figures to residents neighboring the project area

and beyond; having a health grant offered to the community and to residents of Hakimo Road; to conduct a dust study; and to install trees or liners to help mitigate dust control.
4. Mr. Eric Enos suggests air and water quality monitoring. He also proposed ground quality monitors. He suggests that a unit of waste and watershed management needs to be integrated into the school system to channel new technologies for improved future management practices.

9.4 Cultural Community Concerns and Recommendations

Based on information gathered from the community consultation, participants voiced and framed their concerns in a cultural context.

1. Mr. Glen Kila states that the *ʻōpala* (trash, rubbish) from the project will kick up dust including asbestos in the air that will injure the health and safety for residents of the Waiʻanae Coast; the additional waste will also have an adverse effect of the underground water lens in Waiʻanae and will add to the leaking pollutants that are effecting the drainage system in Lualualei, Ulehawa Canal, and coastal waters.
2. Mr. Kila adds that the height increase from the *ʻōpala* will affect his religious view plane from the following places: Puʻu Hulu Kai and Puʻu Hulu Uka to Puʻu Heleakalā; Puʻu Heleakalā to Puʻu Hulu Kai and Puʻu Hulu Uka; Makalualei to Ulehawa.
3. The proposed additional height increase will also have a negative impact to the wahi pana and *ʻaumakua* (family or personal gods, deified ancestors), Māui A Akalana.
4. Aunty Alice Greenwood is concerned with preserving some forest area within the PVT property for *pueo* and bees. She is also concerned with the *ʻalae* bird who frequents the Ulehawa area.

9.5 Impacts and Recommendations

Based on the information gathered for the cultural and historic background and community consultation detailed in this CIA report, the proposed project may potentially impact Native Hawaiian cultural beliefs and *iwi kūpuna*. CSH identifies these potential impacts and makes the following recommendations.

1. Participants expressed that the proposed vertical expansion will alter the cultural landscape of Lualualei Ahupuaʻa. The project area currently lies between culturally significant sites (Puʻu Helekalā, Hina's Cave, Puʻu o Hulu Kai, Puʻu o Hulu Uka, Makalualei, Ulehawa, and landforms associated with the demi-god and *moʻolelo* of Māui). In the event that the proposed undertaking is approved and moves forward or PVT requests another vertical expansion, it is recommended that cultural experts and practitioners are consulted to reduce negative impacts on Hawaiian cultural beliefs, practices, and resources.
2. Participants expressed their concerns over dust and debris that may be carried via wind. According to one participant, the Koʻolau Wahine wind (a strong leeward wind), will have a negative impact on the health and safety of those who reside in Lualualei. To prevent further dust and debris from effecting the surrounding neighborhoods, a higher fence line and/or windbreak trees are suggested for the short-term mitigation measures. An air quality study and consistent monitoring around the proposed project area are recommended for the long-term mitigation measures.

3. Participants also voiced concerns over pollutants effecting the underground water lens system, which could impact the health of Ulehawa Stream. On a larger scale, pollutants could also affect the drainage system in Lualualei Ahupuaʻa and possibly coastal waters. Ulehawa Stream empties directly into the ocean. Pollutants could potentially effect the rich aquatic life and the livelihoods of residents on the Waiʻanae Coast. A water quality study and consistent monitoring along the stream and at the mouth of Ulehawa Stream are recommended for long-term mitigation measures.
4. The proposed project does not involve any ground disturbing activities. However, based on the community's questions and if it should arise, personnel involved in the construction activities should be informed of the possibility of inadvertent cultural finds, including human remains. Should burials (or other cultural finds) be encountered during ground disturbance or via construction activities, all work should cease immediately and the appropriate agencies should be notified pursuant to applicable law, HRS §6E.

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n.d. Photo of Lualualei and Waiʻanae Ahupuaʻa from Pōhākea Pass. Hawaiʻi State Archives, Honolulu.

n.d. Photo of the Waiʻanae Mountain Range with Kolekole Pass in left background; Puʻu o Hulu Uka in the left foreground; downslope of Puʻu Heleakalā in right foreground. Hawaiʻi State Archives, Honolulu.

n.d. Photo of sugarcane in Lualualei Valley with flume to the right; Kolekole Pass in center background. Hawaiʻi State Archives, Honolulu.

n.d. Photo of Lualualei Naval Base area. Hawaiʻi State Archives, Honolulu.

1931 Photo of Lualualei Naval Ammunition Depot taken on 23 September 1931 showing the valley and Waiʻanae Mountain Range; Kolekole Pass lies in the middle background. Hawaiʻi State Archives, Honolulu.

1931 Photo of Lualualei Naval Ammunition Depot taken on 28 October 1931; Puʻu Heleakalā in the center background; government offices in the foreground. Hawaiʻi State Archives, Honolulu.

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Appendix A Authorization Form

Cultural Surveys Hawai‘i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawai‘i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: LUALUALEI 22 nishihara@culturalsurveys.com mliborio@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawai‘i (CSH) appreciates the generosity of the *kūpuna* and *kama‘āina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the proposed PVT Integrated Solid Waste Management Facility (ISWMF) Expanded Recycling, Landfill Grading, and Renewable Energy Project, Lualualei Ahupua‘a, Wai‘anae District, O‘ahu Island, TMK [1] 8-7-009:025 and [1] 8-7-021:026.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. The interview will not be tape-recorded without your knowledge and explicit permission.
2. If recorded, you will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
3. If recorded, you will be given a copy of the interview notes for your records.
4. You will be given a copy of this release form for your records.
5. You will be given any photographs taken of you during the interview.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.
3. If a photograph is taken during the interview, you consent to the photograph being included in any report/s or publication/s generated by this cultural study.

I, ______________________________, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

____
(Signature)

____
(Date)

Appendix B Letter from OHA

PHONE (808) 594-1888 FAX (808) 594-1938

STATE OF HAWAI‘I
OFFICE OF HAWAIIAN AFFAIRS
560 N. NIMITZ HWY., SUITE 200
HONOLULU, HAWAI‘I 96817

HRD15/7336B

March 24, 2015

Ms. Nicole Ishihara
CSH Cultural Researcher
Cultural Surveys Hawai‘i
P.O. Box 1114
Kailua, Hawai‘i 96734

Re: Consultation for a Cultural Impact Assessment (CIA) for the PVT Integrated Solid Waste Management Facility (ISWMF) Expanded Recycling, Landfill Grading, and Renewable Energy Project
Lualualei Ahupua‘a, Wai‘anae Moku, O‘ahu
TMK: (1) 8-7- 009:025, (1) 8-7-021:026

Aloha Ms. Ishihara:

The Office of Hawaiian Affairs (OHA) is in receipt of your letter of January 30th[1] requesting consultation for a cultural impact assessment (CIA) for the PVT Integrated Solid Waste Management Facility (ISWMF) Expanded Recycling, Landfill Grading, and Renewable Energy Project.

Regarding your request for the history of the area, cultural sites, traditional gathering practices, and referrals of kūpuna, OHA suggests that you contact the following organizations:

- Ms. Johnnie-Mae L. Perry, Wai‘anae Coast Neighborhood Board No. 24 (waianaenb24@yahoo.com);
- Ms. Cynthia Rezentes, Nānākuli-Mā‘ili Neighborhood Board No. 36 (497-1432);

[1] The letter was erroneously dated January 30, 2014 by its author.

Ms. Nicole Ishihara
March 24, 2015
Page 2

- Mr. Don "Rock" Arakaki, Waiʻanae Coast Rotary Club (255-8669);
- Waiʻanae Coast Comprehensive Health Center (697-3300);
- Ms. Tercia Lu, Princess Kahanu Hawaiian Homestead Association (668-2115);
- Mr. Josiah Hoohuli, Ahupuaʻa ʻO Nānākuli Homestead Association (668-9669);
- Mr. Herbert Lean, Waiʻanae Kai Homestead Association (696-6138);
- Ms. Harriet Mahoe, Waiʻanae Valley Homestead Association (696-9800);
- Mr. Kawika Nahoʻopiʻi, Lualualei Hawaiian Civic Club, (696-1003);
- Ms. Dolly Naiwi, Nānāikapono Hawaiian Civic Club; and
- Ms. Mele Worthington, Waiʻanae Hawaiian Civic Club (347-6549)

Mahalo for the opportunity to comment. Should you have any questions, please contact Jerry B. Norris at 594-0227 or by email at jerryn@oha.org.

ʻO wau iho nō me ka ʻoiaʻiʻo,

Kamanaʻopono Crabbe

Kamanaʻopono M. Crabbe, Ph.D.
Ka Pouhana, Chief Executive Officer

KC:jbn

Appendix C Map of Sites at Lualualei Naval Magazine

4.3 Non-Military Context of NAVMAG PH Lualualei

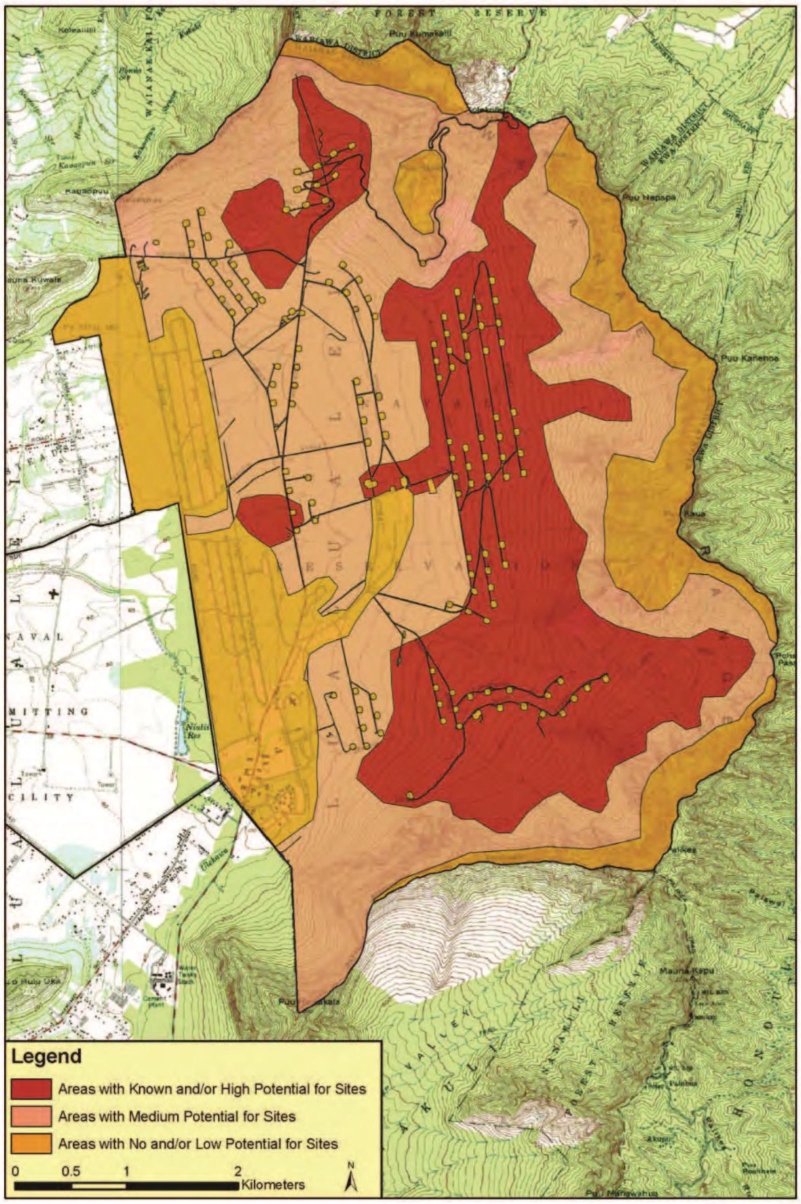

Figure 7
NAVMAG Lualualei Archaeological Site Management Areas

4 - 35

Appendix D Alice Greenwood Transcription

LUALUALEI 22 – Cultural Impact Assessment for the PVT ISWMF

Interview with Alice Greenwood on 6 March 2015 at Nānākuli McDonalds

AG: Alice Greenwood

CSH: Cultural Surveys Hawai‘i, Inc.

AG: I thought there was a height limit, that it couldn’t go higher than Hakimo Road, it was said 15 or 20 years ago, now how much higher will it go? I guess the more people we have the more trash we have. PVT always tries to do good for the community but I have a concern with the dust mitigation.

CSH: Ok.

AG: That was the cap. And now they gonna extend, they gonna go higher.

CSH: So the max is, I think, 135? Yeah? Yeah.

AG: Yeah, that’s my only concern because what you gonna do with the dust mitigation? The best thing I can tell PVT is to really work with the community next to them that, that, you know—I can see why they concerned because all the dust is going to their neighborhood.

CSH: Ok. So, can you tell me a little about yourself? State your name and where you’re from?

AG: My name is Alice Ululani Kaholo. My mother had over all 10 children all born at home. She was first married to Sylvester Zablan and then to James Kaholo. She had 4 children with James Kaholo. Three girls and one boy. I’m the second oldest. We were raised in Mākua, in the area called “Pōhaku Kula‘ia‘i” aka “Pray for Set/Sex,” we lived in a tent but slept in a covered wagon until our house could be built on Maiu‘u Street.

CSH: Cool! Basically, this was your playground?

AG: Yeah.

CSH: The Wai‘anae Coast.

AG: My mother raised her children on the shores of “Pōhaku Kula‘ia‘i” while my father worked in town. When we visited him, I remember we had a Model T, it seemed our car always needed water. My mom knew all the streams and fresh water as we traveled from Mākua to town. I used to ride in the hatchback.

CSH: So it’s fresh water?

AG: A few years ago, I was a member of the burial council [O‘ahu Island Burial Council, OIBC], when we went on a field trip to Kapolei, the start of the rail system. As we enter the area, I remember this was one of the places we got fresh water (Kualaka‘i). Going into the place we didn’t see it but as we came out, someone said, “Alice, you were right, did you see the stream?” It was the formation of a stream. It had to be fresh water for the car.

Mom’s one and only sister Daisy was married to Simplicio Dela Cruz who constructed the cesspools from Mākahā to ‘Ewa and some was done in Wahiawā. Culturally they depended on my mom especially when they found iwi or cultural sites. I was very young—the look on her face when the men would come and get my mom—I knew there were concerns. However, she was very knowledgeable and respectful when it comes to cultural concerns.

Mom loved planting, fishing, picking up limu and I also remember walking along the sand which is not flat like today, but hills, to pick-up shells of all sizes, unusual shapes, colors and it just covered the seashore. There were cowries (leho), cones (pupu‘ala), and corals that looked like bonsai trees—plates and platter shapes—some so large and colors of pink, yellow, orange, light brown, and pure white. In respect, she never allowed any of us to touch the corals. The sea water was so different from today, so clean. Using an ‘umeke (bowl) she would put sea water into it and leave it in the sun. We had sea salt for our food.

Mom also had a garden and grew pōpolo, papaya, chili pepper, ‘ōlena, laukahi, laukī, kupukupu ferns, pakai, and kalo. She got most of the plants from inside the valley. It was for medical and edible use. There were many other types of plants.

CSH: Papaloa is what? What is that? The morning glory plant? A plant?

AG: No. Papaloa is the reef. Long reef.

CSH: Ahhh. Cool.

AG: We were raised near Mākua Cave, Kaneana Cave. It was once our playground area. The history of the area as told by my mom—Mākua mountain is known as Mauna Ko‘iahi. Further in the valley, that was called Mākua and then Kahanahāiki. As a little girl, we had three streams we used to play in: Ko‘iahi, Mākua, and Kahanahāiki. When the railroad track was built, the explosives blew out part of Kaneana Cave or what is known today as Mākua Cave, which is part of a lava tube. As a little girl, I remember going into Kaneana Cave, it felt awesome and homely. I was able to see the sea water inside the cave.

CSH: So Mākua Cave, what everybody thinks is Mākua Cave….you could swim in there and you’d end up at ‘Ōhikilolo?

AG: Later in years, mom was camping at Mākua. I asked her about the shark that lived in the cave and had eaten some people so they blasted the entrance so no one could go in. As she told: There is no shark that live there. I swam in there and came out on the side of ‘Ōhikilolo. Remember it’s a matter of knowing what you are doing, don’t get bold and try to do more than you should do. Majority of the time, it was new visitors that go inside, swim, and never came back. And then they blame the place or the shark!

Mom was up before dawn, a big “pakini” that sits on a circle of stones as a fire place. Boiling yesterday’s clothing for a family of seven, pounding, washing, raising, and hanging each piece of clothing like a puzzle—small, medium, large. In the meantime, cooking breakfast, sometimes preparing palawa (pancakes), stew, or fish—steamed, fried, dry, or raw—just to name a few. For snacks we had mountain apples, figs, papaya, banana, tamarind, guava, mangoes, lilikoi, or stalks of sugar cane. She was a super mom who done everything. Dad only came home on the weekends, but was too busy working on our house.

CSH: So she would gather in Mākua before it was closed by the military?

AG: Yeah.

CSH: What kind of stuff would she gather in Mākua?

AG: From the valley we had mango, lilikoi, stalks of sugar cane, pōpolo, ʻōlena, laukahi, lauaki, kupukupu ferns, kalo, and guava. I'm sure many other plants. There was an ancient kalo pond on the crest of Mauna Koʻiahi—it was oval shape.

CSH: What kind of ocean resources would she gather?

AG: Many times when I look at the ocean I remember mom. I can see her tall, slender outline gather pipipi, ʻopihi, leho, ʻōlepe, wana, ʻina, hāʻukeʻuke. From the tide pools: crabs, ʻaʻama, ʻalamihi, kūhonu, limu kohu, ʻakiʻaki, manauea, ʻeleʻele, waewaeʻiole, kala, līpoa. While we were swimming, mom would watch us while cleaning the fish or washing dishes in the tide pools. She always carried a large stick. I didn't realize why she did that until I became homeless in 2005 and while cleaning fish, an eel took the fish I was cleaning.

There was also a story of Nanaue, the shark-man of Mākua, and how he would eat people. And another story of two lovers—one a beautiful moʻo and the other a handsome mano (k). Their union produced a child who is the guardian of the sea and of Pōhaku Kulaʻilaʻi and has been known to journey into the cave of Kaneana. Mom said when she goes out into the ocean, it never bothers her.

When my husband James Hatchie would go diving with Akule Joe and his gang, some of the boys seen a giant shark. They panicked and jumped into the boat. James stayed in the water, the shark never bothered him and in fact, he said he felt safe from other sharks.

CSH: That's cool.

AG: Yeah.

CSH: Did she have to offer him something? Like the first catch?

AG: She did all the time. She only fishes for what she needs and then she'd give back the rest.

CSH: Where did she learn that all from? Her parents?

AG: Mom's grandmother was a kumu hula for King Kalākaua and Queen Liliʻuokalani. She was one of those who brought back the hula. Days before the Overthrow, Queen Liliʻuokalani gave mom's grandmother land on Maui at Oluwalu and told her to teach the hula and become a kahu. My great-grandfather was a Royal Guard during King Kalākaua and Queen Liliʻuokalani. His name is William Kahai (Opunui). The law of 1860 states if your father and mother is married, the child will carry the father's name. If not, the child will carry the mother's name.

CSH: And what was….

AG: Mom's grandmother's children were born with a special gift. Including her great grandchildren.

I worked at Nānāikapono School. One night as I was passing the school from Farrington Highway, I happened to look at the music room. I could actually see inside the classroom and seen four boys. My mistake is when I seen the police cars, I told my friend about the four boys in the band room. She told the office and I had to explain what I had seen. I had to convince the police officer I was not there, but what I seen while sitting in my car on the way home.

In 1975, I applied for Hawaiian Homes. I didn’t know any of my ancestors. I went to Lahaina, Maui thinking that my mother’s family would help me. For three days no one would share. The last night I decided to sleep at my great-grandmother’s house. My daughter lives there. That night in my dreams, something hit me on the shoulder and said “PULE!” When I opened my eyes, all I could see was an akualele (fireball). It was doing a back and forward movement. All I could say was, “‘Ae, ‘ae” to its movements. The next morning I told my daughter, “My plane back to Honolulu leaves in two hours.” On the drive to the airport, for some reason I found myself at the Family History Center in Kahalui. I asked the attendant if they had information on the Kahai or the Opunui ‘ohana of Lahaina and she gave me three reels. As I looked at the time I knew I didn’t have enough time and told her, “Maybe next time.” As I was walking out, I noticed a bunch of folders high on the shelf. I asked her what was in the folders and she said, “Nothing, it’s all empty.” I reached up to look at one of the folders and as I opened the folder, I was shocked to find three pages of the descendants of Chief Hoolue. The heirs of Chief Hoolue led to my great-grandmother and to my grandmother, Alice Ululani Kahai.

In Lahaina where my great-grandmother’s land is till today in the 1980s my cousins were trying to Quiet Title the land. I attended the court processing as a pro sé. I won the court case not knowing my sisters had to sign their portion off as heirship. One of my sisters would have bites on her arms and legs when she goes to the property and the other would have headaches—her middle name is after our great-grandmother. It is a special name. The story of my family is there were three other mothers who heard her name and gave their child the name. One died when they were an infant. Another had disabilities. The three hearing what happened to those children changed their names.

CSH: And your great-grandma is the one who was Queen…

AG: Queen Lili‘uokalani.

CSH: What was her name?

AG: Kauhai-liukua.

CSH: I’m sorry…

AG: Kauhai-liukua.

CSH: Cause they never ask permission.

AG: One of my grandchildren has that special gift. One of the neighbors has a dog that is a hunter. One of their dogs got loose and as my daughter was watching from her bay window, she knew it was too late to help her daughter. The child’s name is Kekai. Kekai turned to look back and as she turned, the dog was approaching with an open mouth. Kekai told the dog, “GO HOME!” My daughter, Lanikay, said, “The dog was in the air and flipped right around and headed home crying.” Another time as they were taking her husband to work one morning, Kekai was getting louder as she was talking. Lanikay asked Kekai, “What’s wrong with you?” And Kekai states, “I’m not talking to you! I’m talking to Tūtū!” She looked to see and the seat was empty. Kekai was just five years old.

CSH: Could she see her?

AG: Yeah.

CSH: Wow.

AG: We all have senses. There are people who can sense impending weather changes, there are others with spiritual sense or supernatural senses. We all do! Some is more sensitive than others, but we all have them. Most of the time we are controlled by the power of TV, radio, and comments like “You nuts, crazy, stupid” which takes the sensitivity of our moral senses.

CSH: Have you always lived on this side your entire life?

AG: No, five years I went to Missouri.

CSH: Wow. Ok. When was that?

AG: I was first married to Jimmy Joe Rimer and moved to Poplar Bluff, Missouri. When we moved to St. Louis, Missouri, I got into a punch-out confrontation with my sister-in-law and her husband because they come from an affluent and wealthy family. I was told to go back to Hawaii and do the legal work on equal grounds. I learned a lot and visited over 20 states. I was there for five years. I even attended GED classes in Missouri.

CSH: Yeah.

AG: And I really don’t regret it. I was homeless for nine months.

CSH: I remember that on the EJ tour, you were saying that.

AG: I worked at Nānāikapono Elementary School for 12 years. A student playfully jumped on my back and twisted my neck in 1999. Today I have a herniated nucleus pulposus disc which is also compressing my heart area. During these years from 1999 to 2005 we were given a letter from the Department of Education warning of identity theft. The State of Hawai‘i challenged First Insurance and took some of the employees records as evidence. In the courts, all records becomes public records including social security—one of those was mine. Also, I made a loan with CitiBank who sold my contact information to another bank and then it went to a bank in Florida. I paid off the loan in 2000. In 2012, Florida Bank called and I told them what had happened and sent them the report I received from the state [of Hawai‘i] and CitiBank. Finally it got settled in 2013 with that contact.

CSH: Oh my God.

AG: In 2006, I was told Department of Education had no position for me because of my injury and I was laid off. It was a resident of 87-1107 Hakimo Road for 35 years.

In 2000, to help my late husband’s family I became a foster mom. My husband died in 2001. In 2005, my landlord finds out he has cancer and he didn’t know what to do. I told him to go ahead and sell the place—he would need all the money he could get. I found out the new owner had other plans for the place.

CSH: So where did you live when you became homeless?

AG: I had a 5-year old son and $599 a month [rent]. I had no other choice but to live at Mā‘ili Beach Park. I was homeless in June 2005. I set up my little pop tent on the sands of Mā‘ili Beach. Because of my injury, I got up crying because of my back. It was those homeless around me that moved me from a pop tent to a one-man tent to a two-man tent to a three-man tent. If I stayed any longer, I know I would have had an upstairs, downstairs tent. The homeless took very good care of my son and I. Cooking, showing me ways to make life a little easier and protecting my son and I.

One day I saw a woman picking up a small propeller and asked her what it was. She said it was Hawaiian Jade and it was very rare. So every morning I would search for them on the reef. I found them every once in a while. In the meantime, I became very popular in the news for becoming homeless. The same woman showed me how to make a necklace [with the Hawaiian Jade] so I made one for Kaulana Park (who was coordinator of the homeless programs appointed by Governor Linda Lingle) and William Aila (Waiʻanae Harbor Master) who later told me they were rocket boosters. I brought the matter to the Waiʻanae Neighborhood Board who jumped the military. That's how the cleanup of Māʻili Beach Park and Ordinance Reef came about.

CSH: Oh. I didn't even know about that!

AG: The police was arresting and giving tickets to many of the homeless campers. [Through] communications with some of the homeless campers, I found out many concerns (when the police fall short of meeting their quota of tickets, they would ticket the homeless and they were being charged for destroying bathrooms or trashing the parks). When I finally got a ticket, (The Advertiser had a front page story of her receiving a ticket), the campers told me, "Just pay the fine and they will leave you alone." I went to LCC Waiʻanae to study the law of my ticket and homelessness. When I went to court and my name was called, I plead "not guilty." The prosecuting attorney was shocked and said, "What do you mean?" I said, "I am in a public beach park," at the time, the law did not say I needed a camping permit. She tried to plea bargain by saying, "You admit to trespassing on private property and pay $25.00, I'll let you go." I replied, "I am in a public beach park and if the judge agrees with you he is also breaking the law." In the Constitution of the State of Hawaiʻi, Article 10 and on the badge of the police officer is the Splinter Paddle Law insignia. By Kamehameha the Great, "Men, women, and children may lay at the roadside without any harm." The judge declared me "not guilty" and I walked out.

CSH: Wow.

AG: And that's because of…see. Even though you got a ticket. You gotta study your ticket! All of these things, I feel like are a part of what the gift that I was given.

CSH: Yeah.

AG: I remembered my mom always told me, "Just because everybody looks good in black doesn't mean you do." If there's a problem…solve it. If the doors are locked, climb through the toilet bowl. There's a way to solve it. What was happening to the homeless, shouldn't be. We are a rich nation. We paid the bank's bills with the fall of the stock markets.

Just recently with the cutback of the military, my concerns based on homeless, "Is it called downsizing or DUMBsizing?" What is our legislature doing about this? What about our people on the islands? How does it impact them? Are we talking about people becoming homeless?

CSH: Yeah.

AG: You know what I mean? Psychologically [inaudible]. And that's what it's doing right now. Look across the street with [inaudible]. Our children don't know. They see the hands, but they see the numbers across the street and its $130. This one, you're on the crosswalk, the person is on the crosswalk. The problem I had with that, it happened to me. Like I said, everything always happens to me. Now I look at it as a gift. What I had done was I went to this organization because I thought I was crazy. I went to this organization and they told me, "No, it's a gift. You gotta learn how to manage and live with your gift." So anyway what had happened was in Māʻili, we came to one stop because people was walking across the car and stop. And then blocks later there's a crosswalk so we were all braking. You know how you taking off? So the guy in the front of me was going a little faster. One of the pedestrians on the side wanted to…see his friends walk across so he jumped into the crosswalk. The car when brake fast. I was able to brake fast…in enough time. I had my three great-grandchildren in back of me. When I looked in the mirror, a giant bus—tour bus—I was fortunate because on my Waiʻanae side bound lane, the bus never had no car so he when—went to the side. The guy in the crosswalk was laughing. But he didn't laugh anymore when he seen the bus coming towards him.

CSH: Oh my god.

AG: The bus was able to stop but what scared me was that bus would have wiped me all out because he was right on my side. So, the [inaudible] you putting a panic when you see people on the side they gonna brake. What about the trucks? What about the busses? You know what I mean?

CSH: Yeah.

AG: I'm also concerned about the ticketing of people. The new pedestrian law. Why is it so expensive? $130.00. That's food or rent money. And we talk about people becoming homeless.

I have participated in legislative concerns to do with environmental issues. One of them is Environmental Court. We are confined to our state codes and statutes. There are existing laws that ensure that all people live in a safe and healthful environment. I was once involved with Nani ʻO Waiʻanae, a non-profit and affiliated with Keep American Beautiful. I was the secretary for Nani ʻO Waiʻanae. The project for the Māʻili cleanup cost us $45,000. This included gas, trucks usage, and light refreshments. It took us four days, 30 tons of tires, collection of municipal waste (mattresses, furniture, etc.). In order for Nani ʻO Waiʻanae to get the grant monies, I was told we needed to write a resolution, which was requested by the State Board of Health. They received it half an hour before the deadline. That's where our funding came from with a little extra income.

CSH: Oh ok. I heard Aunty Lucy was talking about that last week Friday. So the $45,000 was rubbish?

AG: Rubbish!

CSH: In tonnage?

AG: All in Lualualei. All in….

CSH: The Nānākuli B side?

AG: No, no, no. All in Paʻakea.

CSH: Palikea?

AG: No Paʻakea. Paʻakea Road. Paʻakea, Māʻili. All of that whole thing. We had to call in the military to come in. And you talk about the stream! A lot of the stream was all filled with tires, mattresses, all of that—so when we have these floods…

CSH: Ulehawa?

AG: Ulehawa. All of…that's part of that whole area.

CSH: And that's coming from PVT?

AG: It's coming from people.

CSH: Just people illegally dumping?

AG: People illegally dumping. The problem that's happening to our streams especially that affects Ulehawa is people—you know the canal where PVT is at? You see how people throw their bag of rubbish and everything in the canal? That's Ulehawa. It connects to Ulehawa. And you know what? Our ancient knew about that place, they call it "Dirty Penis."

CSH: Right? That's what it means.

AG: So guess what we doing?

CSH: Yeah, making it dirtier!

[AG and CSH laughing]

CSH: Why do they call it that? Is there a moʻolelo behind that? Or…

AG: All I know is that….

CSH: It lives up to its name?!

[AG laughing]

AG: All I know is that if we wanna change it, we better do something about it.

CSH: Clean. Maybe make it clean?

[AG laughing]

CSH: Alright. So can you tell me about….generally about Lualualei? Do you have any memories here or can you share the history of Lualualei?

AG: Mom moved to Hakimo Road in 1960 at Wong's Place and lived in a Quonset hut. Every day she had the most beautiful view of TMK 87009002—ʻĀinalani. On occasions we would visit the site. She would tell me stories about the area. Today it's known as Tropic Land LLC. She mentioned the demigod Māui, ancient sites, and the haunting of places. Her stories encouraged me to seek understanding of what was happening personally to me. I researched on land deeds, genealogy, cultural moʻolelo, not only from books but personally chatting with people from the area. Also from Papa Albert Like (the only State certified genealogist and historian for the State of Hawaiʻi), Edith McKenzie, and many others.

The Green Onion Farm on Hakimo Road next to the bridge. I was asked by the owner if I could do a blessing. I told him, "There are kahus that he can call, why not one of them?" He said he has and that "nothing has worked." When I walked into his house I felt something strange by one of the bedrooms. After I did the blessing his wife told me their story. This is seen by her and her mother-in-law. Her mother-in-law will not come to the house and they are [husband and wife] because she is getting older. When the children was little, a native boy would play with them in the house. I stared at one of their children. He was on his computer and looked like he was in high school. [The wife] said, "Yes, she still sees the child." This happens on certain nights.

CSH: A real….

AG: A real, native boy.

CSH: Ok.

AG: But nobody can see him but her. And her mother.

CSH: The girl?

AG: The wahine. The wahine, his wife, only her and her mother can see the native boy. Why they had called me in is because the mother is old and they need to take care of her and the mother refused to come in the house because of the native boy.

CSH: Wow.

AG: Another area is where they have the party’s next to Pineridge LLC. The stories told by one of Mr. Saiki’s daughters was they would hear sounds of an infant crying on full moon nights. One night she seen a shadow of a woman.

CSH: Uh hm.

AG: And so I told them, “What do you mean?” And they said, “You gotta come.” And so I was invited one night to go and what I seen was a vision. A woman. And so everybody said they told me, “Is it a baby? Or is it a bird?” And I turned around around and said, “[inaudible].” I looked at her and said, “It’s a baby.” But the thing is, the baby is lost. So this woman is looking for her child and so they told me, “Why don’t you help her find um!” I said, “It’s not as simple as that!”

[AG and CSH laughing]

CSH: Did you have to bless that?

AG: So I had to bless that. [Inaudible] on this area too, my mother had done the blessing for that. For this area. I believe that, that Ulehawa Stream is where a lot of the native people may have congregated. You would know who have a lot of stories on that stream? Ummm….I met her daughter. No, her granddaughter. I can’t remember her name or anything. Bacon.

CSH: Pat?

AG: Her husband was a photographer…had done photography. He has a lot of the pictures of this area.

CSH: Ok.

AG: It’s at Bishop Museum.

CSH: The Bacon Collection.

AG: Yeah, look into the Bacon Collection and you’ll find a lot of collections of this area and it shows where certain…when you have the…how the stream….how the farmers….certain farmers in that whole area and it’s right by PVT area and everything and how wide that stream used to be. How wide that river used to be. And they used to…for them to get across, they had to go on the boat. She has all those photos.

CSH: So how come it’s….non-existent in some areas and narrower….

AG: Cause the farmers….

CSH: So the farmers filled it?

AG: The farmers filled it in. I was one of those that turned in the farmers.

CSH: What year is this? The 70s?

AG: This was in the 40s, 50s, 60s.

CSH: What kind of farmers are up there? Just…all kine? I know I smell chicken [laughing].

AG: Piggeries. Chickens. You get tropical fruits that's Mr. Nakata. You had one, I forgot what…Jellings? Forget. He lives all the way inside area. He did those plants, you know, for the hotels? The big, beautiful plants.

CSH: Oh yeah.

AG: All came from him. And then there's that the Tavares' pig farm. Lopez's pig farm. Then we had one trucking company and I got rid of them!

CSH: What trucking company?

AG: Kawelo. But majority was all piggery.

CSH: So do you of know of any moʻolelo of the area? We talked about Māui earlier.

AG: Moʻolelo of Kahalaopuna. The parents of Kahalaopuna are twins—a brother and a sister—Ka-au-kane ("the rain of the mountain ridge") and Ka-hau-kani ("the hau tree and the kona winds"). They were the children of Aikanaka and Na-lehua-akaaka, names of a projecting spur of the ridge back of Mānoa and the red lehua bushes that grow upon it. Kahalaopuna is one of beauty and promises Kauhi who is a powerful family of Koolau. Mischievous persons pretend they had enjoyed Kahalaopuna's favor. Kauhi believed them and with jealousy determines that she must die. He leads her to the uplands of Pōhākea where he ends her life. Kahalaopuna's ʻaumakua is the owl. The owl flies to the top of a tree and tells the story of Kahalaopuna. Passersby finds that she is still warm and restores her back to life.

In the book Ka Poʻe Kahiko o Waiʻanae, Gregory Kalahikiola Naliielua (page 127) at age 10 he wanted to go hiking for mokihana flowers and took nine other friends with him. The youngest being 7-years old. They got carried away when they saw a cool river and went swimming. They were having so much fun that night was beginning to fall upon them. He prayed to the ʻaumakua and a pueo came to their rescue. He listened to the sound of the pueo's flapping wings and gathered the children. The group followed the sound of the pueo's sound until they came to an open plain where their parents were waiting.

I know about Māui and…the Māui one gets me because I found the deed yeah. For…

CSH: The age?

AG: The deed.

CSH: OH! Where did you find that?

AG: The Bureau. And over here has this….it's all written this way. This one says Hakulei. And over here says Ulehawa.

Demigod Māui documented: Land Deed 1848, Number 3131 Kuapuu. Had three sections: Puniaikane, Makamai, ʻIli of Uluhawa (a river, known today as Ulehawa River). Samuel Manaikalani Kamakau, October 29, 1815 – September 5, 1876—a Hawaiian historian and scholar was born in Mokule‘a. Waialua States: At Ulehawa and Kaolae on the south side of Wai‘anae was their birth place. Sites of O‘ahu, pages 64 & 65, the birth place of Māui.

CSH: They spell it different. Uluhawa.

AG: Yeah, Uluhawa.

CSH: ULU-HAWA, not ULE-HAWA.

AG: Maybe they should turn it back to Ulu?

[AG and CSH laughing]

AG: And then Kaeolae.

CSH: Oh, that’s the ‘ili?

AG: Yeah.

CSH: Kaeolae ‘Ili.

AG: I think they changed it because of the story and then we got Māui and then Samuel Kamakau put [inaudible]. They made a mistake! And then this is the Lualualei Valley. Lualualei Valley got its name only through King Kamehameha III otherwise this is the true name of the valley….this is how you spell it [inaudible].

CSH: King…..

AG: Kauikeaouli, Kamehameha III Land Deed, naming the valley of Lualualei as his own and personal property.

CSH: So going back to the Māui mo‘olelo….

AG: Uh huh.

CSH: Can you retell it because there’s so many different ones that’s why, having to do with him snaring the sun and the kapa and all that.

AG: You know….did you see the silhouette of Māui?

CSH: When I was on the EJ tour? Where he’s rising above the pu‘u?

AG: No.

CSH: Nope, then I never seen um!

AG: When the sun goes down or when it comes up—you go by where the preschool, Kamehameha Preschool….

CSH: In Mā‘ili?

AG: No, Hakimo.

CSH: Ok.

AG: You go over there and you see the silhouette. It’s a big giant mountain that goes across.

CSH: Do you wanna mark it? I got two different maps. I have this one and this one that’s like an aerial and a USGS map.

AG: No. Cannot. We gotta go over there and I gotta show you myself. You know of course about the rock over there in Garden Grove?

CSH: I’ve heard….the one makai?

AG: I’ve heard of it, I’ve never seen it.

AG: Really?

CSH: Never seen it.

AG: Well, when you go over there, you going see the rock and everything and it’s true. During the summertime it comes wider. One of the teachers told me, “Oh, it’s because of…” what you call the heat. Then you got all the little rocks.

CSH: OH! Like it gives birth?

AG: Yeah, like it gives birth. Then you go down to the ocean side and the view of the mountain and everything, you go down to the ocean side when my kids used to go swimming over there, and we used to see tiny little sharks.

CSH: Baby ones?

AG: Tiny ones all swimming in the ocean.

CSH: Oh cool!

AG: And it’s all during a certain time frame.

CSH: Wow.

AG: It’s really something.

CSH: Is there a significance between the sharks and Māui?

AG: There’s no tales about Māui and the sharks.

CSH: Yeah.

AG: There is Māui that’s trying to bring the islands together.

CSH: Right.

AG: The reason why Ulehawa, where Ulehawa Stream is at, you go right into that Ulehawa [inaudible]. From there you can see, from that point, you can see the different islands. You can view the certain islands. So if you look at where they’re at to bring the islands as one—you know that’s true. It had to happen in that area. A lot of people say it’s at Ka‘ena Point but you cannot see the view of the demigod trying to bring the islands together. At Ulehawa out here straight out you can.

CSH: Straight out?

AG: Yeah. So you know, I keep telling people you gotta look at the area. Because Pohakea Pass, I remember Hi‘iaka saying you could see Big Island. You know? And what was happening…what Pele was doing. You know what I mean? Telling the story and everything. So if you think of that, you go out there in the ocean.

CSH: Uh hm.

AG: To go to Ulehawa and bring the islands together. Where everybody says, “No, it’s at Ka‘ena Point…No, it’s on the island of Maui.”

CSH: Yeah.

AG: The view of it is different.

CSH: Yeah.

AG: And O‘ahu centralizes everything. A lot of it.

CSH: Wow. Cool.

AG: And at that Ulehawa Stream. The only thing I didn’t care for, prior before PVT took over, [inaudible] they the one doing the port-a-potty, the outhouses.

CSH: Ok, so prior to PVT it was a lua….kinda….

AG: Yeah, the lua. They the one who contaminate the whole thing.

CSH: They contaminated it? How did they do that? With the chemicals.

AG: With all the [inaudible] and everything. They dumped it.

CSH: Well how come….did they get cited for that?

AG: Nooooo because they look at [inaudible]. It’s just like Kamaki Kanahele the [inaudible] the worse person for all of that and turn around and doing things for our community.

CSH: But isn’t he the DHHL [Department of Hawaiian Home Lands] person for Nānākuli?

AG: Yeah he’s supposed to be the….yeah. Like I said, these are the very ones that are doing things wrong for our community and they look at [inaudible] as the same source. In fact, when they when turn around and make her one of the commissioners for [inaudible], I was the one who brought it up and her husband [inaudible].

CSH: Oh.

AG: Today, I think Tropic Land….PVT has a little bit of that property, yeah? I’m concerned about is….I know they going put one solar farm there. You heard the mo‘olelo about the owls?

CSH: No. For Lualualei?

AG: Yeah.

CSH: No.

AG: In our areas we have a lot of owls. Lots of them. You know where PVT owns the property across? The space and all that….area they have.

CSH: Nānākuli B too?

AG: Nānākuli B. Mom points to the direction of Hina’s Cave for the mo‘olelo of the pueo. The pueo is said to be an ‘aumakua that protects people. In ancient times when a predator comes to attack one of the villagers, an owl would give a hoot sound then all the owls would fly from the sky. Those who know the signal would come to the aid, if not owls would fly to attack.

CSH: That's kind of trippy you say that because we went out to PVT and we walked the whole area and the side that's…closer to Waiʻanae, up Ulehawa—where there's no development—there's no puʻu of ʻōpala….

AG: On our side? The forest side.

CSH: Yeah, the forest side. There was an owl and it came down low. I never seen it come down low. And it just kinda flew across and I thought that was kind of neat. But it was a brown one.

AG: That area that PVT owns, is from the stream area…..

CSH: That's exactly where it was. It was kind of like the dried up stream area of Ulehawa and then it goes down.

AG: When you go over there, you gonna have a good feeling.

CSH: I did. I did.

AG: Yeah, it's something about that place is really….ummm…cause what had happened, my girlfriend and I….see, when we was, when PVT was building up and everything she lived at Ulehawa Road. So she invited me over there one time and so I went. And what had happened was, you heard the story about the snake? We found a snake.

CSH: What?! A real one?!

AG: A real, live snake.

CSH: Where?!

AG: It was on Ulehawa Road where she lived at. At the end of Ulehawa Road is the property that PVT owns, you go downside PVT. Anyway, it was brought in by those big trucks, weeds, whatever you see.

CSH: Yeah, yeah, yeah.

AG: That's where it was. What had happened was it went into her one of her sister's cages for the chickens, it bit the chicken but could not come back out.

CSH: Oh my god.

[AG laughing]

AG: So now she says, "Now I'm looking for my little crocodile."

CSH: That's kind of scary. It has a good feeling until you get to that point where, I don't know where the stream starts because I know it comes from the mountain, but that's where I could see…

AG: It is, it is. That little inundation is part of that stream.

CSH: That kind of marshy area? I can tell because the type of grass that's there.

AG: Yup.

CSH: I know its marsh cause it's kind of solid but mostly because of the plants.

AG: And also, you have native plants there.

CSH: I seen the ‘ākulikuli on the side of the stream. It’s so sad because when you reach the stream, you see all the trash being dumped there and you know that the Wai‘anae coast has the majority of Hawaiians…

AG: And you know that the pig farm is doing all this….you know the pig farm at Ulehawa, that’s where all the crap goes.

CSH: Ugh. Yeah, has plenty trash. Like crates and shopping carts and clothes and diapers. That’s the only sad part.

AG: And being Nani ‘O Wai‘anae we go over there and clean it up. Prior before all of that, like I said this was 20 years ago I used to go over there and I used to feel so comfortable. It was beautiful!

CSH: Yeah.

AG: I don’t know. I told my girlfriend I feel like I’m at home. I’m in a village.

CSH: Well, you from this side! This is like your home, you know?

AG: But that over there had a special feeling.

CSH: Yeah.

AG: Like I said, my only concern is to try and preserve some of the forest of that area—the trees—because we do have the owls still there. And now we’re causing them to become homeless.

As for PVT when a company is trying ways to protect and better its neighborhood, community, and island of their responsibilities on contaminated materials. Thank you! I ask, “It’s not only the iwi, but the protection of our cultural sites (Hina’s Cave), the keepers of our stories and spirits, should be protected as well.” Don’t forget the pueo—the guardians of our people—and bees—guardians of our plants. Set a little forest aside for them.

CSH: Within the PVT property?

AG: Yeah.

CSH: Do you know of people gathering in the PVT area or in the Nānākuli B area?

AG: No, before used to but not now.

CSH: Oh, people used to?

AG: Uh huh.

CSH: What did they used to gather there?

AG: I remember in that area we used to…you know during the rainy season and all that?

CSH: Uh hm.

AG: Because the stream…see what I liked about Ulehawa Stream is that…and with PVT…that whole stream…never had the concrete. Don’t have the concrete. Where the…the main part by the road….

CSH: Oh yeah, yeah. Ok.

AG: But the fish would come up the stream. The fish that we had would love to spawn in the area but now they don’t do it because like I said, dry and covered with all kinds of crap.

CSH: What would you guys….did you gather from the stream?

AG: The fish. And during the non-rainy….I mean…non-….

CSH: Dry season.

AG: The ‘uhaloa.

CSH: What would you use that for? La‘au?

AG: That’s for the sore throat.

CSH: Is there in the area now?

AG: Yeah, still get.

CSH: And the ‘ōlena would be used for….

AG: The ‘ōlena can tell you your future if you know how to do it.

CSH: Really? Wow.

AG: You get the root but you have to take off the stem and then you put it in fresh water. Put salt. Hawaiian salt. And then the ‘ōlena….that’s our ocean…the ‘ōlena will represent your land. And then the stalk of….not the stalk but the leave, brand new leaf of a ti [inaudible].

CSH: Oh yeah, the shoot.

AG: The shoot. That represents the heaven. And what you do is turn around and in your mind you vision something. Like one of mine was, William Aila. I remember he was supposed to go to jail. Remember the iwi taken from Bishop Museum?

CSH: Forbes Cave.

AG: Yeah. The Forbes Cave one. Anyways, he was supposed to go jail. And I didn’t want him to go. So I did that. I did that. I prayed for him for forgiveness. And then I remember pule-ing and then take the water and [making motions] one, two, three, four, five, six, seven, eight and then then you ask. You ask for you know….to help them. And then when I called William he said, “Aunty, I don’t want to go to jail,” and I said, “No William, you’re not.” And what happened was this worked for me and his woman taught me that. She lives in Wahiawā. She umm….she used three visions on me. The first one was, she says, “Oh, this military ship is gray.” No, the first one was…. “You were [inaudible] by someone in white horse, they were all dressed in white. And they were at the palace. [Inaudible].” Oh okay. What am I doing? She says, “No this is your future, Alice.” And then the next time she says, “Oh, I see this giant ship. And it’s military.” And I went, “HUH?” And she said, “Don’t worry. Your genealogy is going to help you.” So I look at her and go, “Yeah right!” Anyways, what had happened was when I became homeless and I went to…I remember I went to Kaiulu. I stayed over there. I formed an organization and in forming that organization I got to know the World Order. The palace shut down, three busloads with homeless people—men, children, ladies. Go to the palace…the bottom…all the way [inaudible]. Today, there’s a picture of us in that museum of our hula….I taught these people the hula and…well, I didn’t teach them, it’s part of this organization that I’m part of. And this woman was crazy. She’s going to be our kumu, she did a top job. But has the picture. And if you go to Kaiulu you going see that picture of us at the palace. Another one…I became the cultural monitor over at Schofield. And that’s because of my genealogy. What happened was, when they came to our [inaudible] they had three attorneys.

Everything we wanted they threw it out. So I went to OHA and I went to [inaudible] I don't know what her name is. She came in as our attorney. So we had two attorneys—one from OHA and one from this preservation area. And everything we wanted came back [inaudible]. And it was proven through my genealogy.

CSH: Wow.

AG: Then I was thinking, "Nah, it's just a coincidence." But there was a third one. And the third one was talking about me being homeless. And it was all these visions that she told me about and she said, "Don't worry about it. You need to go through with all of these things to realize that it's all a gift."

CSH: Yeah.

AG: So, that's what the ʻōlena does.

CSH: Wow. Is this lady still alive? Or she when make already?

AG: No, she died. I was the one she taught before she died.

CSH: Wow.

AG: I was wondering why me of all persons. She said, no. What it was because she was born and raised in Wahiawā, Kūkaniloko—she was—they used to do….she said, "Oh I had my babies and we used to clean the whole thing…" she told me stories about Kūkaniloko and how you clean it and some of the old history of the [inaudible]. And then I got to meet Tom Lenchanko. And what had happened was. The healing stone, she told me about the healing stone. So she was telling me that you gotta help the healing stone. So I looked at her and said, "I don't know anything about the healing stone." I didn't even know nothing about Kūkaniloko. Well, I'll tell you one thing. I when study the history of the healing stone not through the paper but through the elders of the area.

CSH: So you never look at the palapala you just when talk to everybody.

AG: I went talk to all the people. The only reason why I was able to talk to the older people was, what happened was Daughters of Hawaiʻi had given it to the people from India.

CSH: Ok.

AG: Yeah. They were the ones that were…they were putting this milk and everything on top of this, yeah? So anyway, when I went over there and I started to touched it and everything and was like "Why are you doing that? Why are you doing these things?" And this elderly person came up and said, "Oh, this is where the thing stay at?!" She was in her 70s. So [inaudible] big sitting stone. "When I was a baby I had club feet and today I no more club feet."

CSH: So what did her parents do?

AG: Went to go and pray with….she said, "Ok, I talk to a Japanese, Korean, one Filipino, Hawaiian, and a there were several other ones." Ok, what had happened they said or how I gathered the whole story—originally the stones come from Kauaʻi—the wizards come from Kauaʻi. They have healing stones. They have Kūkaniloko on their side. So they were inquisitive about our Kūkaniloko. So anyways, they flew over. There's two of them. Flew over. But they didn't estimate the time frame. They can only fly during night time. When the sun came up, they turned around and they turned into a giant stone and fell short of Kūkaniloko Stream over there. Galbert and his men were cleaning up the area. And then Galbert when he sleep, he dreamt that the stones had talked to him to take them to Kūkaniloko. So he spoke to his foremen because they're Hawaiian and told them to take them to Kūkaniloko. Just short of its destination. So all of his men and him got together and the astonishing part of this is that none of them got hurt even though the stone rolled over them. They became more [inaudible]. When the ailment, you know when the [inaudible] the work and all that, it cleared them all up. It's like a ripple effect. Right through the whole neighborhood. And they finally got it to Kūkaniloko and they became so popular that Daughters of Hawai‘i when turn around and said they don't belong there and they needed to be moved so they moved them over to the graveyard.

CSH: Right. Yeah, yeah.

AG: So they're at the graveyard. They moved them over there. But what happened was it went back to Kūkaniloko [inaudible]. So they took um back again and one of the Japanese ladies said, "Supposed to have two stones but I see three." Cause it fell off the truck. The Japanese lady said, "It didn't fall off the truck. I know, I was there and I seen it!" "So what happened?" "It jumped off the truck and broke into three!"

CSH: Wow.

AG: Man, woman, and child. I looked at her and she said, "Yeah, it jumped off the truck. I saw it. I was little."

CSH: The one who had the club foot?

AG: Yeah. And so I looked at her and went….and this Korean woman [inaudible]. You know, I [inaudible] and they told me their story. As I was talking to her, I [inaudible]. He's a drug baby.

CSH: The boy, right?

AG: He has seizures and all these things. Anyways, he was four years old and what had happened was we had all this fires over here and [inaudible] so I took him all the way to Kūkaniloko and as I was talking to this Korean woman who's cussing me out and saying "You stupid!" "What you doing to this thing?" I said, "No, no, it's not us. The guys from India, you see this whole thing it's part of their [inaudible] and part of everything else." And then I went and turn around and I saw my son climbing on the man like he was hugging him and everything. So I turn around and said, "What you doing on that thing? Get off of that!" And she said, "Leave that baby alone." And I said, "Yeah, but he's on that." And she said, "It'll never hurt him. It will never, ever hurt him. Leave baby alone!" "Oh, OK." And I look at him and he's riding down the slope of the [inaudible] and going. I look at him and said, "[inaudible]"

[CSH laughing]

AG: And then I see him by the child and he comes running to us. And he says, "Mom, Mom!" "What's wrong?" "He's Filipino like me!" And said, "Huh?!" He's Filipino. He was only four years old. I was looking at him and he said, "What? He Filipino like me."

CSH: Yeah.

AG: My son never had an asthma attack after that.

CSH: Ever after that? So he's fine now. So he's fine now after the healing stone?

AG: Yeah. The healing stone’s name is Keanianilaukalani. Everybody got a different name but it’s Keanianilaukalani. I was told that by the Chinese [inaudible]. Everybody calls the healing stones but it’s called Keanianilaukalani.

CSH: What’s the translation of that?

AG: I don’t know [laughing].

CSH: Gotta look into that. I will look into that. I’ll ask my co-worker.

AG: I’m going all over the place.

CSH: No, that’s fine.

[Someone sees AG and greets her]

CSH: Hi! So what is your connection to Wahiawā then? You genealogy?

AG: Mine is through John Papa ‘Ī‘ī. Part of the [inaudible] family. That’s the genealogy that I had found when I was searching for my genealogy…..

CSH: At the Mormon Church!

AG: Yes!

CSH: On Kaua‘i?

AG: On Maui.

CSH: Oh yeah! That’s right because he went to school there, yeah? That’s right.

AG: So it’s like a round table. Bring me right back here again.

CSH: Yeah! Very cool!

AG: Yeah.

CSH: Ok. Back to this ahupua‘a.

[AG and CSH laughing]

AG: Yeah, that’s my concerns.

CSH: Ok.

AG: Try and keep the little forest for the…

CSH: That’s the only one you have?

AG: I told you about the mo‘olelo, right? About the owl?

CSH: Yes.

AG: There’s one more. I can’t remember right now. There was one more. I forgot again, but…

CSH: You can always email it to me when it comes to you. Could be at 11 at night and I will just include it with your full summary.

AG: So anyway that’s some of those things that I remember right now.

CSH: Do you have any other concerns about the PVT besides leaving some of the forest?

AG: The only thing that I’m worried about is that they have a little bit forest for our bees and our owls and our native birds. Oh and another one that I’m concerned about is the ‘alae bird.

CSH: ‘Alae bird?

AG: Yeah, that’s one the demi-god gave the reason about the fire.

CSH: I gotta look into that.

AG: The ‘alae bird. And he has a red spot in the middle. You know why? That bird has been spotted….

CSH: At PVT?

AG: By Ulehawa Stream. By the canal area.

CSH: At Ulehawa….

AG: Oh, here it is [looking in her binder].

CSH: Is it black and white and it has a long tail?

AG: Yeah, it looks like a swan. In fact what had happened was, it went into Mā‘ili Stream. We had a little issue on that too.

CSH: Wait, what is this?

AG: That’s the pōhaku over at the birthplace at the birthplace of the demigod Māui.

CSH: It has eyes and a nose!

AG: February to May 2010, rocks were taken from this place for stone walls [to be constructed] at the homes at Royal Summit [subdivision in Aiea] and for the WalMart ahu [in town]. Pearl Tavares whose piggery is located near this area told me she could hear the rocks rolling down [the mountainside]. When I went to look at the place, I noticed the rocks replaced the rocks that were taken away.

When a trucking company had the place blessed, a woman came walking down from the rocks and kept saying, “Where is my water?” As she slowly vanished walking out of the gate.

On the site, there is a little pa (rock wall). Sites of O‘ahu, page 65 in Wahiawā, the birth place of the ali‘i—certain nights one can see an aura if one stands on the pa looking towards Wahiawā.

CSH: [Reading] Rocks were taken at KaoLae for stone walls….OH.

AG: Yeah, that’s for these. Even had poi pounders.

CSH: I have my camera. Is it OK if I take pictures of your pictures?

AG: Yeah.

CSH: That’s OK?

AG: This is supposed to be the birthplace of the demi-god Māui.

CSH: So you were starting to talk about the fish in Ulehawa Stream that you used to gather. What kind of fish was it?

AG: Was….[thinking]….I'd like to say the ʻōʻio but I don't know if the ʻōʻio was coming in from this one or from….everybody was telling me "No Way" and I said, "Yes, it is." Kamaile. Kamaile. You know where Kamaile Stream, the Board of Water Supply is at? There's…if you look where Waiʻanae High School, you know the stream that goes out.

CSH: Oh yeah. The canal?

AG: Yeah, the canal. Over there had nothing but salt water. That whole area. And used to have ʻōʻio. Not at PVT, PVT was different. I forgot which one was it. You know we used to have a moʻolelo about the akule and everything else.

CSH: That's OK, when it comes to your mind, you let me know.

AG: Yeah, I let you know.

CSH: What about out here? People used to fish out here too?

AG: Oh yeah, had plenty. All kinds of fishes and everything. During certain times, like when the hala blossoms—the hala trees—then you know out there has ʻākulikuli. There! Look the bird!

CSH: Oh it's dark!

AG: That's at Māʻili Stream. It's head is the red.

CSH: I'm going to take a picture.

AG: This is a small picture of it.

CSH: I can always find another picture but this is part of your book so….where is this at?

AG: This whole place. This whole book is from all over this place.

CSH: Look at the pōhaku.

AG: You know, when they took a lot of this….if you check with Tavares…what her name…Pearl Tavares. One day she turned around and [inaudible] and told me, "Aunty, the stones are replacing itself." And I went, "Huh?" And she said at night we can hear the stones go boom-boom-boom, boom-boom-boom-boom.

CSH: And this is in the Nānākuli B side?

AG: Yeah, the Nānākuli B. When they did the blessing….all this belongs to Tropic Land. When they did the blessing and everything, according to one of the truck drivers wives, I forget what her name. She had a woman in black and she was walking down the rocks. And then she kept telling everybody, "What did you do with my water? Where's my water?" And then she walked out the gate and disappeared. Everybody was just shocked to see her. She was just like in black and telling everybody "What did you do with my water?"

CSH: Water?

AG: Yeah. Remember there used to be all streams. Like Ulehawa Stream. And that's the place…see the mountain over here?

CSH: Yes.

AG: Had a crash 1955. We was living there. My mom lived right across. Was living at Wong’s place. Tavares. Oshiro. All of these farmers…all of these farmers came to help them. But it was too late, we couldn’t help them. Tried to pull the bodies out and everything.

CSH: And they crashed on a pu‘u?

AG: This one right here.

CSH: Is that Heleakalā?

AG: Heleakalā. Yeah, yeah, Helekalā. You know that land? This is how it looks today.

CSH: Right.

AG: This is how it looks….it was prime food land.

CSH: Wow!

AG: And you know Governor Burns? His wife had a disability. She wrote to Mr. Oshiro, “Your vegetables are very, very healing.” And because like, I remember one of the men was in a wheelchair today and I was talking story about the place and he said, “Aunty, there’s something about that property.”

CSH: The Nānākuli B side?

AG: Yeah. Get something about that property. And the beautiful part of the whole thing is that we were putting like a [inaudible] but once upon a [inaudible].

CSH: Yeah I know. And when you think Wai‘anae, “No more water out here, so dry, you know!”

AG: You know Mānoa lettuce? Grows beautifully here!

CSH: Mānoa lettuce growing in Wai‘anae?!

[AG and CSH laughing]

AG: Look at the watermelons!

CSH: Oh yeah, that looks good.

AG: This was Mr. Araki—he just passed away. And he was saying, they call it, ‘Āinalani. That man, the demi-god, the demi-god was born there and they called him ‘Āinalani. Beautiful saying for that. Now I lost track about what we was talking about!

[AG and CSH laughing]

AG: I’m always losing track!

CSH: No, I have lots of information already. So really…that’s your only concern about PVT?

AG: Just make sure that our birds…and then the courtesy to the neighbors…neighboring residence. The residences on all sides even the owls.

CSH: Yeah. Do you have any referrals or anyone else that I should talk to?

AG: Oh, you gonna talk to Eric Enos, yeah?

CSH: Uh hmm.

AG: Let’s see….my girlfriend doesn’t live there anymore but she live Big Island now.

CSH: Oh, but what she grew up over here?

AG: We were the ones who used to walk the whole stream area.

CSH: If she’s open to…I can send her a letter if she wants. But April 1st is when I need to get everything in. But it’s OK too even if it’s pending, it’s OK. I can drop her stuff in later to the final report. But if she has lots of memories over here and can attest to the landscape of Lualualei, then I can always send her a letter too.

AG: Ok. Let me try and get a hold of her.

CSH: Yeah, let her know and if she’s comfortable sharing that then I can send her a letter.

AG: Like I said, all our older guys are dying off like Mr. Nakata….they all in their 80s-90s.

CSH: He used to be a farmer?

AG: In fact, Mr. Nakata still has the tropical gardens over there.

CSH: Yeah, anyone. If they want to talk to me….

AG: Mr. Oshiro was the one that turned around and said, “You cannot eat concrete.” No, you cannot eat golf balls. You know they trying to save their….but anyways, the property at Tropic Lands—what happened was they went into bankruptcy. I went into the care of shelters, homeless. And the attorney lost his business and everything. You remember the story that three things that happened?

CSH: Yeah.

AG: And the attorney had lost his business and that attorney was a good friend of Mr….[inaudible]. All part of that business. Well anyway, he invited me he wanted to [inaudible] and I said, “No, not for sale.” And then he lost his business and now Tropic Land now has something about the bankruptcy.

CSH: What about the military being over there? What was there before the military came in?

AG: That was Hawaiian Homes and that was all the natives that owned properties. One was Kaopua and all these guys. But that was all wauke valley.

CSH: Wauke?

AG: Wauke. Nothing but wauke valley. That whole area where the military all has—that was all wauke valley. And then the other half, Puhawai half, was all nothing but kalo farms. There was over 750. That was just my small count. Could be more.

CSH: 750 plus lo‘i.

AG: Yeah, lo‘i.

CSH: Wow.

AG: Yeah, wauke valley had a lot of—too bad because they destroyed a lot of the sites, the cultural sites.

CSH: The military?

AG: Yeah and when Kaiser when put up there portions and everything.

CSH: What kind of sites was there?

AG: A lot of cultural….lot of….

CSH: Like heiau?

AG: Heiau. Yup. I remember my mother telling me stories about that place.

CSH: Was there burials in the back?

AG: No.

CSH: What about up here in the front? Was there burials up here too?

AG: I don't know. To me it's scattered all over. Majority is sand, yeah? That's when they found all the iwi in Waikīkī. And that's why they have that ahu over there in front of the zoo. Majority of the iwi comes from over here. Māʻili.

CSH: For real?!

AG: Yeah.

CSH: I never knew that! That's so strange that they would put it in Waikīkī.

AG: No, because Waikīkī was all marsh land and they took a lot of the sands and [inaudible] turn around and shake everything around. Like our farmers. And now Mr. Kaneshiro no care for me because the stream. [Inaudible] what you call that? It connects to Ulehawa. Ulehawa goes this way but there's another portion that comes this way. Anyways, he was the one he put more dirt. And then [inaudible] but now you look at Hakimo….[inaudible] Road get nothing but water during rainy season because they all when put more dirt on their land.

CSH: Wow. Flood zone.

AG: That's what it is. Used to have that one over Ulehawa Stream---Ulehawa Road. Over there used to be a flood zone too! But because I fought the system now they have a drainage system. Better not [inaudible] anymore!

CSH: [Laughing] Ok, so I have the map here. Do you want to mark where you know of sites? You can even mark Hina's Cave or where you used to gather stuff. That's an aerial. I kind of feel like this is easier to see what's what because it has all these call outs over here. You can mark where you used to gather stuff or….

AG: OK, this is Princess Kahanu. Right?

CSH: Yep.

AG: And over here is….

CSH: So this red is the PVT. And this would be Nānākuli B on this side.

AG: Yeah. All on this side. I know over here is the [inaudible] because it used to be part of the Graceland. Over here. It wasn't part of theirs but they went turn around and put all the contamination here. Ulehawa right there. That stream over here. And then….no and the portion…

CSH: Do you want to use that pen or this pen? Whatever's easiest for you.

AG: Where’s Ulehawa? Ulehawa Road is here?

CSH: You know, I’m not sure.

AG: I’m looking for Ulehawa Road cause this area is where…

CSH: You can mark it roughly where it’s at.

AG: This is the area I’m concerned with. Because over here is where we, my girlfriend and I would do that walk like I said with the plants and everything. And had the owls on the trees. And then you go down to this other road. See. Right in this area….remember I told you the house I did the blessing? This is that area.

CSH: Ok. Is that the one with….the….

AG: The one with the native boy…..

CSH: Yeah.

AG: Remember the one I mentioned the barking of the dogs?

CSH: Yes.

AG: One day my girlfriend called to tell me to listen to the way the dogs are barking. She lives on Ulehawa Road. The barking came from the PVT area by the river. It is a very strange bark and seems to go in my direction where I live. One night when I heard my neighbors hunting dogs barking, I noticed it was a strange sound. I looked out my window and noticed someone small teasing the dogs. I tiptoed to the living room to call my husband. When he came with me he noticed it too. I yelled, “HEY! What you doing?!” It turned in my direction, all I seen was a faceless person with a helmet running towards the river (Ulehawa) slowly disappearing.

AG: Yeah, so I lived this area. And that’s where I see the Menehune. The small…

CSH: Do you think that has anything to do with the blessing that you did too? Or was it a boy?

AG: No.

CSH: Or two totally separate things?

AG: No. Two separate things. The boy was a native boy. I still see a native boy.

CSH: He was wearing a malo and….

AG: Yeah, a malo and everything. The Menehune was different. He has a cap. When he turned there was no face that I could see.

CSH: Yeah.

AG: You know. All I could see was two eyes like. But it was short. And then the way he ran, it was a human being the way he was running.

CSH: Was he by a stream?

AG: It was antagonizing the dog [laughing].

CSH: Ohhh wow.

AG: Yeah.

CSH: So he was playing?

AG: Yeah, like I said the dog wasn't barking and it was antagonizing and going [making faces], I told my husband to look and I went, "HEY!" Turned around, looked at me, and ran off. And I believe he was still there because in 2009 to 2012, we was fighting the…the….Tropic Land issue. In 2012, Mike Lee [inaudible] Tropic Land, "Let's go…" where Nānākuli B is at…right in this area. This is Nānākuli B, right?

CSH: Yeah, I think this side over here.

AG: Over here yeah? We went here where the cave is at…where Hina's Cave is at. We was over here, I heard the barking of the dogs which was midnight night. And I told Mike and Lucy [Gay], "Wait. There's the barking of the dogs." And they look at me and said, "What's wrong with you?" Listen to the way the dog is barking. They couldn't for some reason, they couldn't, they said, "Yeah sure it's a regular bark." I said, "No, a different type of bark."

CSH: Yeah, is kind of like when they hear sirens and it's a howl…high pitch, like that?

AG: Yeah.

CSH: You can tell it's a different than a regular bark.

AG: A different bark…you know, like something spooky.

CSH: Like [makes howling noise].

AG: Yeah, like that! Mike when turned around and said, "Yeah, that is strange." I said stop, don't move because it's coming our way. So it started from where PVT is at and it's coming our way. And what had happened was…there was another thing, an incident that happened right at the same time frame. When I looked at the where Schofield is at. And I should've just shut up at that time because like I said, it was right at that time frame. I looked at the mountain and was, "OH they maneuvering again!" So we got sidetracked by that. So Lucy and Mike looked and said, "Strange yeah the light?" And I said, "Yeah." And then later I said, "Oh what happened to the barking of the dogs?" And for some reason it just ended. Another strange thing that happened was, when we looked up at the mountain it looked like a fire torches coming down the mountain.

CSH: In all of these, you can see it. And this is a no moon night? Like never had moon?

AG: Never had moon. We should go in the area during that time frames!

CSH: TOTALLY!

[AG laughing]

CSH: No, it sounds interesting. I think I would go. I would have to go with somebody like you and Lucy, who knows. I not maʻa to this area.

AG: We took a group of kids. And they enjoyed it.

CSH: I would go! As long as it doesn't come home with me.

AG: [Looking at pictures in her binder] Yeah, there's my son!

CSH: Oh, he's so big now! I remember when he was littler.

AG: Yeah, now he's tall and skinny!

CSH: [Looking at pictures in her binder] There’s Mike.

AG: They studying the heavens with the flashlight. He can actually point to every single star and knows it. And this is the one we went down to the beach. Right down here. You know where Ulehawa Stream is at?

CSH: Uh hm.

AG: Right….by the drain in that area. [Inaudible] Beach in the area. What is was is that he was telling me, you can tell when there’s fresh water and it meets the ocean. He was telling us…

CSH: Mike?

AG: Yeah. There’s a way of telling when the fresh water meets the ocean….and what it is, is that….I didn’t believe him until we went down to the stream area by the papa. When we went there, was rocky….

AG: Aloha!

CSH: Hi!

[AG talking to passerby]

AG: Anyway, what had happened was…those rocks…all of sudden he said, “Don’t worry, it’s gonna go down.” Sure enough it went down. As soon as we walked out onto the papa. And he said, “You can tell when there’s fresh water meets salt water because the limu is different. Becomes slippery.”

CSH: Oh!

AG: So what had happened was, some of the kids saw um and said, “OH LOOK! Over here is all like, slipper limu, yeah?” So that means get fresh water meeting salt water. So he turned around said, “Yeah.” Now the papa is below. So anyways, I went over there and went to check it out. What we did was dug the sand but it was filling up. So I looked at it and the water is way down there and we over here and it keeps filling up. So one of the kids turned around and go taste um, “It is fresh water!” I was like, “You kidding! You gonna get sick from that!”

CSH: Yeah, Ulehawa? Oh my gosh.

AG: But he said, no, it’s fresh water. Not from Ulehawa. It’s fresh water. I said, you kidding. You lolo I would never taste the water.

CSH: But the limu, people pick it over there too?

AG: No, it’s like a slime type of limu.

CSH: Ok, ok.

AG: And that’s how you can tell when you have salt and fresh water mixing.

CSH: Cool.

AG: And that’s what had happened in this picture. And all of us went.

CSH: Yeah.

AG: And this is the one of the stars.

CSH: Yeah, when you guys do another…let me know.

AG: [inaudible]

CSH: Is that the one with the [inaudible]? I don’t remember, I remember we talked about it briefly.

AG: Just last week we had a talk story with some of the kūpunas from Aaron Mahi. The guy didn’t know I had a picture of the stone. I was telling them about the crying…demi-god Māui and the property and everything. And he turned around and said, “Oh, you know talking about the [inaudible] and you go over there and it’s like a spooky place. Has like [inaudible].” So I turned around and showed him the picture and “That’s the [inaudible]. You should see the [inaudible].” And then when we heard the story of the kukui hele po, our natives never traveled much during the daytime because of the sun. So during the evening they make the kukui and then turns into the candle thing. Burns for 15 minutes and then they’d put it on this. It’s a windbreak!

CSH: Oh.

AG: So this stone is a windbreak. 99.99% of the time our wind comes from the mountain.

CSH: Pohakea Pass, that’s right.

AG: And then only 1% of the time we have the wind coming in from the east. But that wind is different and that’s called the kumuma‘oma‘o. So anyways, that’s the story of that. We talk!

CSH: Oh no….

AG: I getting carried away with my da kine stories and mo‘olelo.

[CSH introduces herself to passerby from earlier]

CSH: What else do you have in here? Can I take a picture of this one?

AG: Oh yeah.

CSH: This is so sad that this one is not at WalMart.

[AG talking to passerby from earlier]

Appendix E Eric Enos Transcription

Interview with Eric Enos at Kaʻala Farms on Tuesday, March 10, 2015

EE: Eric Enos

CSH: Cultural Surveys Hawaiʻi

Duration of Recorded Interview: 30:34

CSH: Go ahead.

EE: Ok, well my position on recycling waste is that we all generate a lot of waste. And we have to be responsible for our waste. I mean, my question is how much waste—and I know it's being trucked in from all over—but I think philosophically we need to take look at waste as a by-product of growth—our growth—and things that we take for granted so we have to be responsible for all of our waste whether it be sewage, whether it be our trash, whether it be construction waste. You know, how much of it is ours? Secondly, I think the waste will continue, that's the nature of our growth and if everything stops that's one thing. But, so how do we find the most efficient way to convert that waste into products that could be recycled and reused and I think that has to be the future because we will continue to generate waste. And I think—waste can be, if it's done correctly, it can be a beneficial by-product if it's done correctly. If it's done correctly. So how do you do that? What is the technology today? What is the technology tomorrow? Are there more efficient, environmentally friendly ways to get rid of our waste or convert our waste into value products? So, that is the future of humanity. We cannot escape our waste. Unless we crawl into a cave, it's not gonna happen. So as long as we want to live in our houses, as long as we want our electricity, and as long as we want clean water—we have to be responsible for the other end of that pipe. So how to do it correctly and how to convert it into an economic—convert it into an economic benefit. As long as we stay in very strict environmental and cultural issues are addressed. And good monitoring of it. I need the science of it, you know? There is the emotional side of it which is always there, but what's the science? I think one of the things that we had even required with Hawaiian Electric was the air quality monitoring and the ocean monitoring. And they—their power plant, you know. And good monitoring—good air and water quality and independent and make sure that we stay on top of it and we just don't—and it's just not something and that it gets incorporated into the educational curriculum in the local schools. I think all of our waste things needs to have a unit that is taught in our school system cause how can you manage when you don't know? And that has to be part of the science. And supporting a science curriculum that looks like waste, that's part of reading, writing, watershed. The watershed has to be part of the—I think—some kind of partnership necessary for us to manage collectively and the watershed kind of thing.

CSH: Do feel think this project or does affect the air quality and the ocean from where it's at or the expansion….

EE: I don't know if….what are the ground quality monitors? What are the air quality monitors? There's gonna be some dust, that's the question, but we gotta ask ourselves….I don't know. I don't live there of course, so the concerns of the people that live there the trucks going pass so that's a valid concern. So….but you know that's all the concerns that they going have to weigh into it. That's always been the case, so….how do you mitigate? And prevent winds. It's like we have a sewage plant down here in Wai'anae. When the wind comes here…you know, let's get rid of the sewage plant, OK? Well, how do we get rid of our sewage.

[CSH laughs]

EE: I mean, we're dumping it right out in here. That's something that we have to live with and put resources into making it better. Unless we stop putting our waste into fresh water and have it going into the ocean. I mean, there are a lot of concerns. What are we doing about it and how could we be channeling it into the technologies of the future for better management practices?

CSH: Do you feel that the vertical expansion will or the recycling facility will affect any cultural resources or wahi pana in the area?

EE: Well, I think the view plane of that area is not…it's not a critical view plane. Well, are you sure that it's just going to go up and not….I don't have a…I mean, it's just like Kahe Landfill in there. If it's already there. No matter how much high you go, you can't, you can't disguise it. You can't ignore it. So what is the future of that mound? What happens to landfills after they're pau? Do they get green turf? Are they replanted? A lot of times they do that. You know? What's the future of that? What's it going to look like in the next….or is it going to go up another 100 feet there? So the question is, where do we and how do we…and how do we expand it? So those are real good questions.

CSH: Uh hm.

EE: But for now, I don't have…I don't….I'm not necessarily. I mean, any change in the landscape is going to affect us. At this time, I really don't know.

CSH: Yeah.

EE: It's not something that you're…very few view plane goes this way. And I've been to Hina's Cave, you know? So you're looking down. Get the elevation of the Hina's Cave area. We took pictures up there when we hiked up there too. So I just…maintain the integrity of that other than that, I can't think of that. But I don't have any….

CSH: Did you see anything or find anything in the cave?

EE: Well, we weren't poking around. We just went to visit it. I just wanted to….I mean, I don't know. I don't see a lot of habitation features but then I wasn't…you know we found a few sites going up. But was small.

CSH: What kind of sites?

EE: They were just…you know, looked like ahu.

CSH: Oh.

EE: But that was just the rough scrambling of the dry creek up there. And I took pictures from there. But the view plane from there is what's striking. And it's not necessarily a cave so much. Have you ever been there?

CSH: No, but I'm planning on being there next week though.

EE: Oh yeah?

CSH: Yeah.

EE: It’s a pike because you’re scrambling, ah?

CSH: Really hilly?

EE: Well, there’s no more trail.

CSH: Oh!

EE: You kinda gotta jump on rocks going up.

CSH: Yeah, yeah.

EE: Whatever might have been a trail. Who knows?

CSH: Uh huh.

EE: But, I think those are, those are natural wahi pana. Not necessarily….because the view plane from there is where you can see the wahi pana, yeah? You can see Lualualei. So…and Maui. All of Maui. So, I assume…I don’t know where it is.

[Looking at maps]

EE: I would assume…that it’s somewhere in here.

CSH: Where the cloud is?

EE: I would assume. Just say, but I don’t know. Looks like the shadow, yeah? Because it was one of the deepest gorges, yeah? Could be at the tip of the cloud.

CSH: Yeah. OK.

EE: So the view plane….goes like [motioning]. So this is your view plane.

CSH: Wow.

EE: You can see, yeah? You going have really….and you can go back to chants of Lualualei right out of the…. Hālau Wai‘anae, is the chant. Hālau Wai‘anae nani i ka lā and it mentions the significant wahi panas. Aside from that, I mean, you know, the view plane you have a little something that comes up from below you. I’m not [thinking], I’m not in any….I don’t have any strong opinions.

CSH: Uh hm.

EE: Because I’m not….impacted, I think there are other areas where….I mean, we’ve fought some environmental battles, yeah? So Deep Draft Harbor, West Beach, and those are fishing grounds…water quality. So this to me is a minor issue, but not on that same scale because of the destruction of those other wahi pana and the area is already….you know….

CSH: Yeah, yeah.

EE: I think is something that we have to live with. And question is…how do we convert that into positive wealth?

CSH: Yeah, that’s good.

EE: That’s my recommendation. I don’t know, I think….All Lucy [Gay] them are protesting the industrial park, the expansion, the development…all those kine concerns.

CSH: Yeah.

EE: Those are all concerns. I’m more like…neutral right now because I have to take it case by case by case.

CSH: Right.

EE: You know, I have to weigh all the…and I don’t have all the facts and information because the surrounding area issues are the bigger concerns and of bigger collective impact.

CSH: Yeah.

EE: What is the….the surrounding area is the big issues.

CSH: Yeah.

EE: What are the….my assumption is the ones that live in here because of the winds when they come in.

CSH: Right, right, right.

EE: So that would be a concern so air quality monitors trying to get in place. Use of the road. Well, you know….they’ve been using that road for a long time. From the quarry and on, you know? So this isn’t like it’s new?

CSH: Yeah.

EE: So this is a heavily used industrial area from the past so it’s not like we’re talking about something new—we’re adding to this here. So you know, what’s done is done already. And I’m not….I’m not sure.

CSH: Ok.

EE: I would not—I don’t have major concerns right now.

CSH: Can you share any mo‘olelo that’s specific to Lualualei? I know you had mentioned the chant. And then you had kind of mentioned Māui.

EE: All we have are some of the chants and the Māui stories. And what’s important for me is access to Kolekole, into Lualualei, and Puhawai, which is my biggest concern—the water source at Puhawai. So ummm….

CSH: Where is Puhawai? The location….you want to….

[Reviewing maps]

EE: I think, I think….somewhere in here.

CSH: Should I just mark it with a circle?

EE: Yeah.

CSH: And then Kolekole is…..is it this one?

EE: That squiggly line.

CSH: This?

EE: Yeah, yeah, yeah. And then the pass is…where is the pass? Shoot, I'm looking for where the pass is. But yeah, I'm not sure if this is….but maybe you can….

CSH: This looks like a trail here. This red line here.

EE: Yeah, should be able to track it. You should be able to track Puhawai on the…and where the water tunnel is.

CSH: Oh, there's a water tunnel?

EE: Yup. That's where the Navy is getting their water. And Puhawai is….and then the water system. So my concern is the loʻi system.

CSH: All the loʻi is on….between?

EE: Yup, you see right here. I'm not sure. You see, that's why I need to….I'm really….this map is a little hard.

CSH: Yeah, I wish we zoomed in a little.

EE: This is the burn here, so this is us over here.

CSH: Right here?

EE: Uh hm.

CSH: Ok.

EE: Ok, see this is the burn. Where the Navy burned and then it crossed over. That's where the burn came right over the ridge, right over here.

CSH: Why did they do that?

EE: The maintenance people started a fire about 2 ½ years ago and the Navy started in here burned one day. Lost control. Came over the ridge and then burned our hale and then burned everything else. So that was Navy kuleana.

CSH: Did they take care of that?

EE: No, never did.

CSH: So this is roughly the area where came into this area where it burned?

EE: Some of the ridge here. And then here. And the ridge right here is where this fire totally came around cause this area never, never burned in my history. It's always burned on this side of the valley but you see the wet areas prevent the fires from coming this way, yeah? But because the fire started in the Lualualei—started right over that ridge. You see that ridge up there? That's the drop! Right at the base here, right inside here is Puhawai. Is the spring. Gotta be equivalent to our loʻi system up here. That spring that come out of there. I'm not sure if it's a tunnel or a….but it's pulling from the same collective water source, but the base is downsized now. You know, all the ammunition has been taken out. Pretty much, the tunnel still comes next door but it's not an active base.

CSH: So your water source for your loʻi comes from Puhawai as well?

EE: No. Puhawai is Lualualei. Kaʻala is here. So our system follows…..if you go up here all our loʻi is on this side. From the top then to this….how you say….. the dike rock in this system. This dike rock. But Lualualei has the same dike rock and Puhawai pulls from that same height of moisture. And we’re asking the Navy to put that lo‘i back in, originally here and use that as a way to prevent it from future fires. We’re trying to fight fires with better water management of the wetlands. We’re creating these wetland systems as corridors as a fire prevention.

CSH: As a breaker.

EE: Wet areas.

CSH: Kolekole…..And then Hina’s Cave is roughly…..

EE: We think. Yeah.

CSH: Is there any other wahi pana…and then the lo‘i was somewhere between these two?

EE: I’m not sure.

CSH: Hard to say….

EE: The Navy has some archaeological surveys and there’s a record of it. Survey maps…..I know we’ve done because this is Nioula, the heiau, here. Which is equivalent to Punanaula here our heiau here.

CSH: Oh, where is that? Is it nearby?

EE: The ridge over here. So we’re caretaking that heiau…..

[EE and CSH walk towards lo‘i to see Punanaula Heiau from another vantage point on the Ka‘ala Learning Center property 19:08 to 30:17]

CSH: Alright, well thank you. I’m willing to take a little tour if that’s OK?

APPENDIX J - SOCIO-ECONOMIC IMPACT ASSESSMENT

SOCIO-ECONOMIC IMPACT ASSESSMENT

PVT LAND COMPANY INTEGRATED SOLID WASTE MANAGEMENT FACILITY

Final – May 4, 2015

Prepared for: PVT LAND COMPANY, LTD.
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PVT INTEGRATED SOLID WASTE MANAGEMENT FACILITY
Final – May 4, 2015

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LIST OF ACRONYMS

C&D	Construction and demolition
CBAC	Community Based Advisory Groups
CUP	Conditional Use Permit
DAGS	Hawaii Department of Accounting and General Services
DCS	Department of Community Services
DDC	Department of Design and Construction
DLNR	Department of Land and Natural Resources
DOA	Hawaii Department of Agriculture
DOE	Hawaii Department of Education
DPR	Department of Parks and Recreation
EIS	Environmental Impact Statement
ENV	Department of Environmental Services
GDP	Gross Domestic Product
HDBEDT	Hawaii Department of Business, Economic Development, and Tourism
HDOH	Hawaii Department of Health
HDOT	Hawaii Department of Transportation
DTS	Department of Transportation Services
HEC	Hawaiian Electric Company
LYON	Lyon Associates, Inc.
NAVMAG	Naval Magazine
NRTF	Naval Radio Transmitting Facility
PPC	Pedersen Planning Consultants
PVT	PVT Land Company
PVT ISWMF	PVT Integrated Solid Waste Management Facility
ROH	Revised Ordinances of Oahu
UH	University of Hawaii

CHAPTER ONE
INTRODUCTION

1.1 PURPOSE AND SCOPE

This socio-economic impact assessment was prepared to support the PVT Integrated Solid Waste Management Facility (ISWMF) Expanded Recycling, Landfill Grading, and Renewable Energy Project (Proposed Action) Environmental Impact Statement (EIS). The assessment provides insights on potential consequences of PVT ISWMF's Proposed Action in Nanakuli, Oahu, Hawaii. The socio-economic impact assessment is based upon:

1) an evaluation of selected demographic and economic information that was available for Honolulu County and Oahu's Leeward Coast in the first quarter of 2015;
2) an evaluation of existing land uses and relationships within about 0.5 mile of the PVT ISWMF site;
3) the application of an economic input-output model to assess economic impacts of the PVT ISWMF operation on Oahu's economy;
4) a review of a Nanakuli Dust Study, dated December 20, 2011, that was prepared for the Hawaii Department of Health by Tetra Tech EM, to a) identify potential sources of dust that may affect the Nanakuli community and surrounding areas, and b) recommend feasible alternatives for reducing dust;
5) interviews of 12 community leaders in February 2015, performed to gain a sense of community attitudes, insights, concerns and recommendations regarding the PVT ISWMF.

1.2 PROPOSED ACTION

PVT Land Company, Ltd. (PVT) operates an Integrated Solid Waste Management Facility (ISWMF) at Nanakuli, Oahu, Hawaii. This facility is the only construction and demolition (C&D) debris facility on the Island of Oahu. PVT desires to expand recycling operations, modify existing height contours, and install additional renewable energy facilities.

The Proposed Action would expand recycling and materials recovery operations, increase site elevations up to 255 feet above mean sea level within the *mauka* portion of its existing site, and install renewable energy to provide power to PVT's ongoing recycling operations. Implementation of the proposed project will enable PVT to process approximately 900 tons of feedstock per day which could supply roughly 12,000 homes with electrical energy. The proposed grading along the *mauka* portions of the ISWMF would provide 4,500,000 cubic yards of additional landfill capacity over the remaining life of the landfill, as well as area necessary to support expanded recycling and material recovery. PVT would also install a gasification unit or photovoltaic cells to energize its recycling operations (LYON, 2014).

1.3 CONSULTATION PROCESS

Various representatives of PVT ISWMF provided substantial insights regarding the scope of its solid waste management and related recycling operations, disclosed confidential financial information necessary for the economic impact analysis, supplied contact information for a number of community leaders and other residents from the Waianae Coast, and provided valuable insights to various community issues.

In its preparation of this socio-economic impact assessment, Pedersen Planning Consultants (PPC) also interviewed a number of long-term residents and persons who have lived and/or worked along the Waianae Coast for two or more decades. The insights gained from these individuals are presented in Chapter Five.

Lyon Associates, Inc. (LYON) which prepared the overall environmental impact statement, shared considerable background information relevant to the socio-economic impact assessment. In addition, the firm prepared the illustrations presented in this report.

CHAPTER TWO
POPULATION AND DEMOGRAPHICS

2.1 POPULATION OF THE WAIANAE COAST

2.1.1 April 2010 Resident Population

The most recent decennial census of the U.S. Census Bureau, which was conducted in April 2010, enumerated a resident population of 48,519 persons in the Island of Oahu's Waianae zip code tabulation area. This geographical area generally includes the Waianae Coast communities of Nanakuli, Maili, Waianae, Makaha, and Makaha Valley. The same geographical area is also sometimes referred to as the Waianae District (Figure 2-1).

More specific data for the Waianae Coast indicates that 53 percent of the resident population of the Waianae zip code tabulation area resides in Waianae and Nanakuli (U.S. Census, Census 2010); the remaining population is distributed in the communities of Maili, Makaha and the Makaha Valley (Table 2-1). The difference between the total resident population for the Waianae zip code area (48,519 persons) and the cumulative population of the five census of designated places (44,950 persons) reflects the fact that the five census of designated places do not encompass all residential areas along the Waianae Coast.

TABLE 2-1
POPULATION DISTRIBUTION IN WAIANAE COAST COMMUNITIES
APRIL 2010

Census Designated Place	*Resident Population (persons)*
Waianae	13,177
Nanakuli	12,666
Maili	9,488
Makaha	8,278
Makaha Valley	1,341
TOTAL	**44,950**

Source: U.S. Census Bureau, Census 2010

Note: The total resident population of 44,950 in the five census of designated places does not reflect total number of persons whom resided in the 96792 zip code tabulation area (Waianae Coast) in April 2010.

2.2 AGE CHARACTERISTICS

The age distribution of the resident population of the Waianae Coast provides some insight into one of the demographic characteristics of those persons who reside or travel near the PVT ISWMF. Available age distribution data for April 2010 indicates the following:

Feet
0 1,500 3,000
0 250 500
Meters

Figure 2-1
Project Location
Vicinity of PVT ISWMF
February 2015

- Children and young adults, ranging between birth and 19 years of age, comprised almost 35 percent of the resident population.
- Young adults, between 20 and 24 years of age, represented about seven percent of the resident population. The lower proportion of persons in this age group is not surprising as young adults often migrate away from their original place of residence in search of new jobs, educational opportunities, or travel.
- The primary working age population, which primarily includes persons between 25 and 54 years of age, comprised almost 39 percent of the resident population.
- Adults nearing or in their retirement years (55 years of age and older) accounted for about 19 percent of the resident population.

2.3 FAMILY AND HOUSEHOLD CHARACTERISTICS

The April 2010 Census counted 11,746 households in the Waianae Coast, i.e., Waianae zip code tabulation area 96792. These households included a combination of both family and non-family households. The average household was inhabited by almost four residents (U.S. Census Bureau, Census 2010).

2.3.1 Family Households

Family households comprised 79 percent of all households along the Waianae Coast. The average family included 4.37 persons. About 49 percent of the family households represented traditional husband-wife families. Forty-three percent of these households included children under 18 years of age.

Female households with no husband present represented almost 21 percent of all household in the Waianae Coast. Forty-eight percent of these households included children under 18 years of age.

Male households with no wife present accounted for almost 10 percent of all households. Forty-three percent of these households included children under 18 years of age.

2.3.2 Non-Family Households

In April 2010, the U.S. Census Bureau documented 2,426 non-family households that represented almost 21 percent of all households along the Waianae Coast. About 73 percent of these households included a single householder who lived alone. Approximately 24 percent of all non-family households included a householder that was, at least, 65 years of age (U.S. Census Bureau, 2010 Census).

2.4 ETHNIC BACKGROUND

The people of the Waianae Coast comprise a unique mixture of ethnic groups (Table 2-2). Descendants of Native Hawaiians, who originally settled the Waianae Coast, as well as other Pacific Islanders, dominate the resident population. Other residents are of Asian descendent, Caucasians from North American, European, and Latino descent, American Indians, and Alaska Native Americans. While the majority of Waianae residents are part of one ethnic group, a sizeable proportion of residents are affiliated with two or more ethnic groups.

TABLE 2-2
ETHNIC GROUPS OF THE WAIANAE COAST
APRIL 2010

Ethnic Group	*Number of Residents*	*Proportion of Resident Population (percent)*
Native Hawaiian or Other Pacific Islander	**14,484**	**29.9**
Native Hawaiian	10,603	21.9
Samoan	1,984	04.1
Other Pacific Islander	1,814	03.7
Guamanian or Chamorro	83	0.2
Asian	**6,783**	**14.0**
Filipino	4,183	08.6
Japanese	1,170	02.4
Other Asian	901	01.9
Chinese	347	0.7
Korean	107	0.2
Vietnamese	58	0.1
Asian Indian	17	<0.1
Caucasian	**5,423**	**11.2**
African American	**608**	**01.3**
American Indian & Alaska Native	**120**	**0.2**
Other	**336**	**0.7**
ALL RESIDENTS IN ONE ETHNIC GROUP	**27,754**	**57.2**
ALL RESIDENTS IN TWO OR MORE ETHNIC GROUPS	**20, 765**	**42.8**
ALL RESIDENTS	**48,519**	**100.0**

2.5 POTENTIAL IMPACTS OF THE PROPOSED ACTION ON POPULATION AND DEMOGRAPHIC CHARACTERISTICS

The Proposed Action is not expected to generate any impacts that would modify population trends or other demographic characteristics of the resident population of the Waianae Coast. The Proposed Action would not, for example, generate any significant increase or decline in the number of residents that move in and out of the Waianae Coast.

Future growth of the Waianae Coast population is expected. However, this growth will likely be generated from planned residential development projects.

Other considerations related to the resident population are discussed in other sections of the main environmental impact statement prepared by LYON. These considerations include analyses of scenic views and public health.

CHAPTER THREE
LAND USE CHARACTERISTICS

3.1 GENERAL

Land uses along the Waianae Coast occur in 10 *ahupuaa* that were established by early Hawaiians who originally settled the west coast of Oahu. These *ahupuaa*, which are generally defined by geographical features such as mountain ridges and streams, include: Nanakuli, Lualualei, Waianae, Makaha, Keaau, Ohikilolo, Koiahi, Makua, Kahanahaiki, and Keawaula (Figure 3-1).

> *During the 19th century ranching era and the early 20th century sugar plantation era in Waianae, the principal ahupuaa in terms of economic activity and population were Lualualei, Waianae, Makaha, and Makua. Archaeological research and oral histories indicate that all of the nine ahupuaa were settled by the early Hawaiians. Today, the four major populated ahupuaa include Nanakuli, Lualualei, Waianae, and Makaha* (Townscape, Inc., 2012).

In 2015, steeper mountain slopes along the west side of the Waianae Range generally remain undeveloped. Downslope of steeper slopes, the Waianae Coast contains a combination of land uses that include agriculture, residential, commercial, industrial, as well as community and public facilities.

3.2 HOUSING

Residential land uses are the predominant land use along the Waianae Coast. As stated earlier, most residents of the Waianae Coast live in homes located in Nanakuli, Lualualei, Waianae, and Makaha. Residential subdivisions are primarily situated *mauka* of shoreline beach parks and Farrington Highway. Rural residential areas, where homes and some agricultural activity occur on the same parcel, are more prevalent on the middle to upper slopes of Nanakuli, Lualualei, Waianae and Makaha.

3.2.1 Occupancy

The U.S. Census Bureau documented 13,376 housing units in the Waianae Coast during the April 2010 Census. Almost 88 percent of these housing units were occupied.

The remaining housing units were vacant. Roughly one-third of the vacant homes were for rent. The rental vacancy rate was 11.3 percent. Just over three percent were homes used on a seasonal or recreational basis.

3.2.2 Housing Tenure

Homeowners resided in approximately 59 percent of all occupied housing units along the Waianae Coast. The remaining 41 percent of occupied housing units (4,842 housing units) were occupied by persons renting these properties (U.S. Census Bureau, 2010 Census).

Date Saved: 3/12/2015 4:44:07 PM Document Path: G:\JOBS\14.074 PVT Landfill Vertical Expansion\FIGURES\PVT Existing Land Use Maps\Fig. 2-2 -Ahupuaa of the Waianae Coast.mxd

Feet
0 5,000 10,000
0 1,000 2,000
Meters

Figure 3-1
Ahupua'a of the Waianae Coast
Vicinity of PVT ISWMF
February 2015

LYON
N W E S

3.2.3 Housing in the Vicinity of the PVT Integrated Solid Waste Management Facility

Rural residential dwellings and some related agricultural operations are located along the southeast and northwest sides of Hakimo Road. A number of vacant and undeveloped land parcels were observed during a window survey of this area in February 2015 (Figures 3-2A and 3-2B).

More densely populated residential subdivisions are situated immediately *makai* and southwest of PVT ISWMF.

- Roughly 470 single family homes were observed between Ulehawa Stream and Lualualei Naval Access Road in February 2015. This residential neighborhood extends from roughly 1,760 feet from the *makai* side of the integrated solid waste management facility to Farrington Highway.
- Another 270 single family homes were located in neighboring Princess Kahanu Estates (Department of Hawaiian Home Lands, 2009), which is situated on the northwest side of Ulehawa Stream. No vacant lots were observed in Princess Kahanu Estates.
- Hawaii Housing Authority's Nanakuli Homes, which contain 35 single family housing units, are situated between Princess Kahanu Estates and Farrington Highway.
- The Garden Groves condominium complex at the Hakimo/Farrington Highway intersection contains 46 residential units.

South of the PVT ISWMF is the Kahe Kai condominium complex that contains approximately 156 housing units. This complex is between 800 and 2,500 feet from the southeast corner of the integrated solid waste management facility. The Nanaikeola Senior Apartment complex, comprising 78 rental housing units, is situated *makai* of the Kahe Kai condominium complex.

3.3 COMMERCIAL

Commercial land uses along the Waianae Coast are largely adjacent to the *mauka* side of Farrington Highway. The primary commercial retail area is the Waianae Mall which is situated in the heart of Waianae Town. Other smaller shopping centers are scattered along the Highway and provide some concentrated locations of commercial activity. Commercial land uses are primarily associated with retail trade, food and drinking establishments, professional and technical services, finance, banking, insurance and real estate agencies, and other small business establishments.

In the vicinity of the PVT ISWMF, most commercial activity in Nanakuli is concentrated in three smaller shopping centers.

- Nakatani Shopping Center, which is situated about 0.28 mile from the ISWMF, includes Sack N Save, O'Reilly Auto Parts, a Tesoro Gas Station, and other commercial enterprises. MacDonald's and other commercial facilities are situated on the Maili side of the Lualualei Naval Access Road/Farrington Highway intersection.

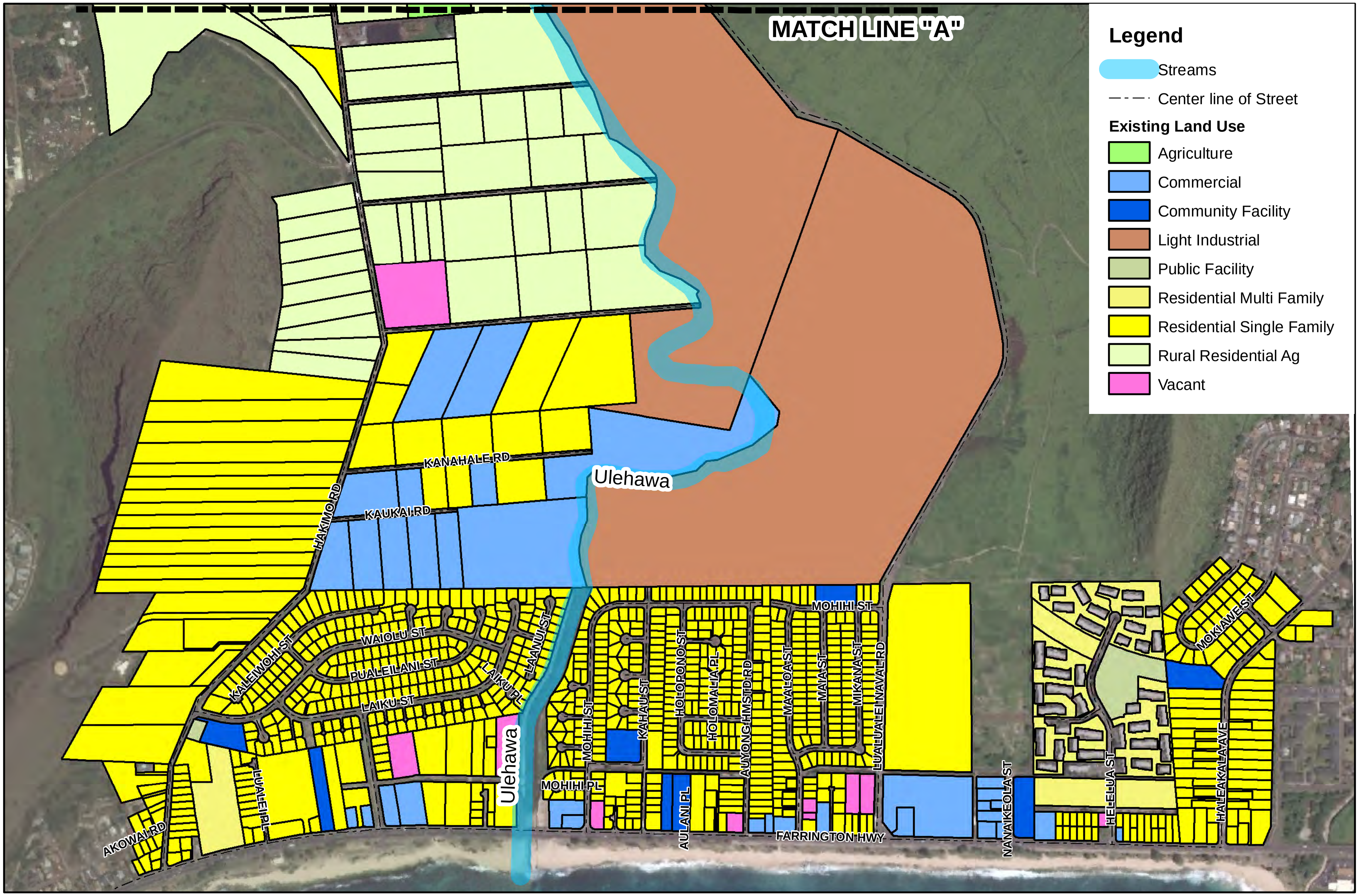

Figure 3-2A
Existing Land Use
Vicinity of PVT ISWMF
February 2015

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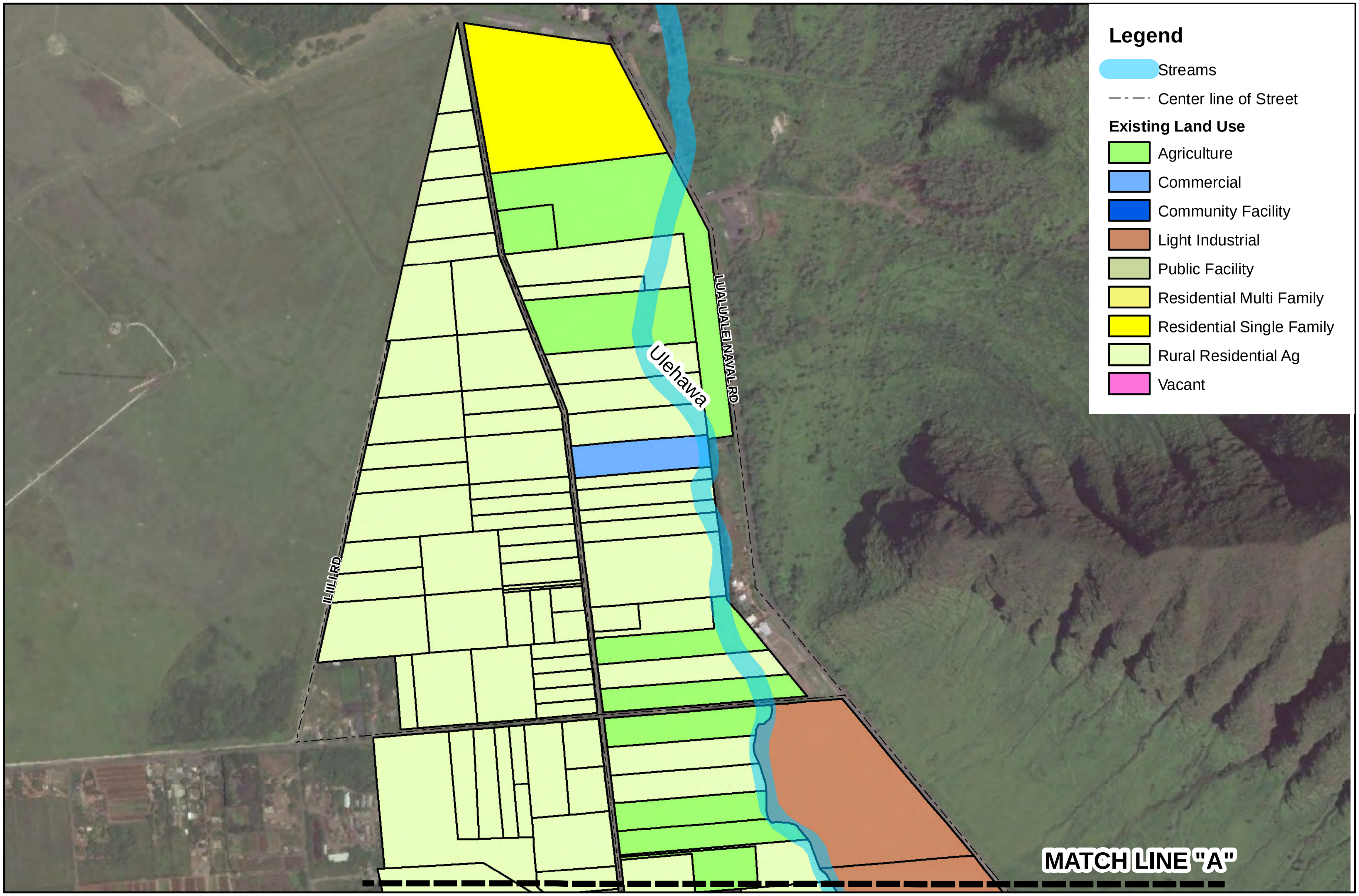

Figure 3-2B
Existing Land Use
Vicinity of PVT ISWMF
February 2015

LYON

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Service Layer Credits:

- A second area of concentrated commercial facilities is found in Pacific Shopping Mall. This commercial facility is located along the *mauka* side of Farrington Highway on the Ewa side of the Queen Liliuokalani Children's Center.
- A smaller shopping center is situated near the intersection of Mohihi Street and Farrington Highway. This shopping center is approximately 0.35 mile southwest of PVT Land Company's landfill and recycling facility.

Other one-to-two story commercial buildings in Nanakuli are intermittently scattered along the *mauka* side of Farrington Highway between Hakimo Road and Haleakala Avenue.

3.4 INDUSTRIAL FACILITIES

West Oahu Aggregate is a quarry and recycling operation that is situated on the north side of PVT ISWMF (Photo 3A).

Photo 3A: West Oahu Aggregate *Source: PPC, 2015*

3.5 COMMUNITY FACILITIES

Community facilities represent privately owned facilities that are generally available for public use. Several community facilities are located within 0.5 mile of the PVT ISWMF. These include:

- Early childhood education facilities operated by Queen Liliuokalani Children's Center which is located near the Kahau Street/ Farrington Highway intersection, and Kamehameha Preschool in the Princess Kahanu Subdivision.
- Private elementary education at Ka Waihona Public Charter School.
- Medical services provided by Kaiser Permanente Clinic Nanaikeola.
- Various churches and religious organizations such as the Samoan Church of Hawaii LMS, Nanakuli Baptist Church, Love Beyond Reason Ministry, and Nanakuli Door of Faith Mission Church.
- Youth programs such as NFL YET Hawaii Nanakuli Clubhouse for the youth of Nanakuli, as well as the Boys and Girls Club Teen Center, located adjacent to Nanaikapono Elementary School.

3.6 PUBLIC FACILITIES

Large portions of land along the Waianae Coast are used for military purposes. The Navy's facilities in Lualualei Valley consist of the 7,498-acre Naval Magazine (NAVMAG) Pearl Harbor, formerly known as Naval Magazine Lualualei, and the 1,729-acre Naval Radio Transmitting Facility (NRTF) Lualualei. The NAVMAG is used for the storage of ordinance for all U.S. military branches in Hawaii. The NRTF is used for high and low frequency radio signal transmissions (City and County of Honolulu, Department of Planning and Permitting, 2012).

Two military residential areas are located on the east and west sides of Lualualei and include:

- Military housing for NRTF Lualualei personnel is situated on the western side of Lualualei, about one mile north of Maili. This area provides 11 housing units; and
- Military housing supporting NAVMAG is on the east side of the valley and has 14 duplex and 29 single family dwellings (Global Security.org, 2011).

Other public facilities in the vicinity of PVT ISWMF, managed and operated by the State of Hawaii and the City and County of Honolulu, include:

- the State Department of Education's Nanakuli Intermediate and High School complex located approximately 0.6 mile east of the PVT ISWMF on Haleakala Avenue;
- the State Department of Education's Nanaikapono Elementary School complex, located 0.6 miles southeast of the PVT ISWMF;
- the Honolulu Board of Water Supply support facilities located on Hakimo Road immediately adjacent to the west side of Princess Kahanu Subdivision;
- the City and County of Honolulu Fire Station 28 located on Nanakuli Avenue near Mano Street; and,
- Ulehawa Beach Park and Nanakuli Beach Park, which are situated *makai* of Farrington Highway.

3.7 ZONING AND SETBACK REQUIREMENTS

Under the zoning regulations of the City and County of Honolulu, the PVT ISWMF is located with an AG-2 agricultural zoning district. Section 21-3.50-4, Article 3 of Chapter 21 of the Revised Ordinances of Honolulu (ROH) requires a conditional use permit (CUP) from the City and County of Honolulu to operate a *"waste disposal and processing"* operation.

The existing CUP for the PVT ISWMF requires that PVT also continues to have authorization from the HDOH via a current solid waste permit. The current solid waste permit that was authorized by the HDOH in May 5, 2011 includes the following setback provisions:

- C&D disposal shall not occur with a buffer area of 750 feet from the *makai* property line. Provisions for dust, litter, and nuisance controls shall include the installation and maintenance of a dust screen and green belt along the *makai* boundary.
- Landfill mining for recycling shall not occur with 1,320 feet from the residences. (Excavation for fire control or other emergency purposes is allowed.)

Photo 3B: Riparian buffer at narrowest point

Source: Eric Guinther, 2014.

Ulehawa Stream borders the western boundary of PVT's ISWMF. The stream and riparian vegetation provide a natural buffer (Photos 3B and 3C) between the adjoining rural residential area that is located along the east and west sides of Hakimo Road. This buffer extends from roughly 50 to 200 meters west of the solid waste management boundary (Guinther, 2015).

Photo 3C: View from top of landfill looking S-SW. Riparian buffer at widest point

Source: Eric Guinther, 2014

3.8 PLANNED LAND USES

The following industrial, residential and public infrastructure projects are planned within a 0.5 mile radius of the PVT ISWMF:

- Pineridge Farms, Inc. has proposed several uses for its property, which is adjacent to the PVT ISWMF. They applied for a State of Hawaii DOH permit to run a composting facility on its Pineridge Farms site, using the patented Bedminster process. Pineridge Farms also proposed plans to demolish the cement plant, and convert those parts of the 25-acre property not needed for their own operations into an industrial park. These proposed projects have not been successful, to date.
- The undeveloped lots surrounding Nanaikapono Elementary School are planned as the future Nanakuli Village Center. The Nanakuli Village Center is envisioned as a multi-purpose village center that will host retail, commercial and business activities, as well as residential and cultural spaces. Key features of the village will include the Agnes Cope Learning Center, the International Surfing Hall of Fame Museum, a 48-unit affordable rental housing complex, and the Nanakuli Commercial Center (Planning Solutions, 2014).

Table 3-1 identifies public and private projects planned for the Waianae Coast, based upon readily available information.

TABLE 3-1 (1st of 3 Pages)
PLANNED PROJECTS FOR THE WAIANAE COAST

Project No.	*Project Name and Description*	*Agency*	*Distance from PVT (miles)*
1	**Leeward Coast Benefits Program -** $1.5 million community improvement package that will benefit Leeward residents and community service providers by providing funding for parks improvements and human services grants.	DCS, DPR, CBAC	0.4

TABLE 3-1 (2nd of 3 pages) PLANNED PROJECTS FOR THE WAIANAE COAST			
Project No.	***Project Name and Description***	***Agency***	***Distance from PVT (Miles)***
2	**Restoration and Expansion of Leeward Bus Routes** - $5 million for the restoration and expansion of bus service, including the expansion of bus routes serving Leeward Coast.	DTS	0.4
3	**Makaha Community Park** - $430,000 to plan, design and construct comfort station improvements.	DDC	7.5
4	**Puu O Hulu (Maili Kai) Community Park** - $240,000 to construct Master Plan park improvements, including a comfort station, parking lot and landscaping in addition to $505,000 appropriated in 2014 for design and construction.	DDC	2.4
5	**Waianae District Park Expansion** - $621,000 to plan, design construct recreation facility improvements in addition to $400,000 to design new roof for gym and arts and crafts studio.	DDC	5.4
6	**Waianae Fire Station** - $60,000 to design interior renovations.	DDC	4.8
7	**Waianae Police Substation Replacement** - $1.29 million to continue construction, inspection & procurement of equipment for a replacement police station in addition to $650,000 appropriated last year.	DDC	4.4
8	**Oahu Bikeways -** $9.5 million for land acquisition, design and construction for a multi-use path from the vicinity of Waipio Point Access Road to Lualualei Naval Access Road.	HDOT	0.4
9	**Replacement of Maipalaoa Bridge** - $2.5 million allocated in FY 2015 for the replacement of the Maipalaoa Bridge near Ulehawa Beach Park.	HDOT	0.6
10	**Replacement of Makaha Bridges No. 3 and No. 3A** – $10 million to replace two existing wooden bridges along Farrington Highway near Makaha Surfing Beach. Constructed in 1937, both bridges classified by HDOT as deficient and require replacement.	HDOT	7.5
11	**Waianae Elementary School -** $5 million allocated in FY14 budget for plans, design and construction of a new administration building, including ground and site improvements.	DOE	4.5
12	**Waianae High School -** $2 million allocated in FY14 budget for plans, designs and construction for various projects, including $500,000 for plans and design to connect two existing Searider Productions Media buildings, and $1.5 million for plans, design and construction to replace existing wooden bleachers with aluminum bleachers.	DOE	5.5
13	**Makaha Elementary School -** $1.5 million allocated in FY14 budget for design and construction of ADA access and improvements for Buildings A and B, including ground and site improvements and equipment.	DOE	6.9
14	**Nanakuli Public Library** – $15.5 million to construct a new public library to serve the Nanakuli and Maili communities.	DAGS/ DOE	0.3
15	**Waianae Coast Campus, Leeward Community College (LCC)** – FEA approved February 2014 for acquisition and renovations to the former Tycom Building in Maili to convert the space into the LCC Waianae Coast Campus.	UH	2.7

TABLE 3-1 (3rd of 3 pages)
PLANNED PROJECTS FOR THE WAIANAE COAST

Project No.	*Project Name and Description*	*Agency*	*Distance from PVT (Miles)*
16	**Waianae Agricultural Park-** $600,000 for design and construction for miscellaneous improvements for the 150 acres subdivided into 17 lots.	DOA	4.4
17	**DHHL Waianae Residential Homesteads** - 320 Proposed Residential Homesteads on 75 Acres.	DHHL	4.4
18	**DHHL Waianae Agricultural Homesteads** - 140 Proposed Agriculture homesteads on 100 Acres.	DHHL	4.5
19	**Kamehameha School Learning Center (Ka Pua) in Maili** – FEA approved February 2013 to construct educational, recreation-al and cultural facilities in Maili. The project may also include infrastructure improvements related to roadway, traffic, water, wastewater, utilities and drainage.	DHHL	2.2
20	**DHHL Nanakuli Residential Homesteads -** 1,835 Proposed Homesteads on 320 Acres. New homesteads are proposed as infill within the existing homestead community and new subdivisions are proposed adjacent to existing Nanakuli Homesteads.	DHHL	0.8
21	**Nanakuli Village Center**- The Nanakuli Homestead Community Association, in partnership with several for profit businesses and non-profit organizations, has proposed the development of the 10 acre Nanakuli Village Center, which will include both Commercial and Community Use components.	DHHL	0.8
22	**Waianae Coast Comprehensive Health Center (WCCHC) Main Campus Facilities** - $17 million for demolition of the existing primary health care/specialty clinic, pharmacy and emergency department, and construction of three structures on the existing building footprints: a two-story Adult Medicine and Pharmacy Building; a two-story Emergency Department and a one-story Utility/Generator Building.	Private	3.4
23	**Kahe Photovoltaic Facility Project –** DEA to install an 11.5 MW (AC) photovoltaic facility including interconnections with the existing substation at the Kahe Generating Station and the island-wide electrical grid.	HEC	2.7

Notes: Department of Community Services (DCS); Department of Parks and Recreation (DPR); Community Based Advisory Groups (CBAC); Department of Environmental Services (ENV); Department of Transportation Services (DTS); Department of Design and Construction (DDC); Hawaii Department of Transportation (HDOT); Hawaii Department of Education (DOE); Hawaii Department of Accounting and General Services (DAGS); University of Hawaii (UH); Hawaii Department of Agriculture (DOA).

Sources: City and County of Honolulu Councilmember Pine, 2014; Hawaii State Senator Shimabukuro, 2014; City and County of Honolulu, 2014; Hawaii Department of Transportation, 2014; Gerald Park Urban Planner et al., 2010 and 2011; R.M. Towill Corporation, 2011; Wilson Okamoto Corporation, 2014; Planning Solutions, 2014; PBR Hawaii, 2014; and Lyon Associates, 2015.

3.9 POTENTIAL IMPACTS OF THE PROPOSED ACTION ON LAND USE

3.9.1 Future Changes in Land Use

The Proposed Action is not expected to encourage or discourage any changes in land uses along the Waianae Coast. Anticipated changes in land use will occur with the development of those projects planned by various public agencies. For example, within one mile of PVT ISWMF, additional residential and commercial development is expected with the eventual construction of the planned Nanakuli Center and Nanakuli Residential Homesteads projects (Table 3-1).

3.9.2 Adequacy of Setbacks

Based upon observations made by Pedersen Planning Consultants in February 2015, these setback requirements have been adhered to at the PVT ISWMF. A dust screen is installed along the *makai* boundary; a green belt with plantings has also been established within the setback area. The setback area, as well as other parts of the ISWMF, are being effectively maintained by PVT per the requirements of its Solid Waste Permit. The boundary of the ISWM will not change with the Proposed Action.

The existing setback requirements appear to provide reasonable protection to adjacent residential neighborhoods, agricultural areas, commercial facilities, community facilities, and public facilities that are situated *makai* and west of the solid waste management facility. They are considered reasonable because, as stated earlier, PVT has made, and continue to make, cooperative efforts to monitor and control emissions of fugitive dust, reduce dust generated from heavy truck traffic, and install plantings in selected areas of the solid waste management facility.

3.9.3 Residential Area on Ewa Side of Lualualei Naval Access Road

A smaller residential area is situated on the Ewa (southeast) side of Lualualei Naval Access Road between Farrington Highway and the entrance to the ISWMF. This area contains about 20 single family homes. Its adjacency to Lualualei Naval Access suggests that some residents in this area, particularly those living adjacent to the road right-of-way, may be impacted by noise and dust from future truck traffic along Lualualei Naval Access Road. These potential impacts will be further discussed in the Environmental Impact Statement.

CHAPTER FOUR
ECONOMIC TRENDS

4.1 ISLAND OF OAHU

The Island of Oahu's economy is primarily fueled by economic activities associated with tourism and the operation of federal, state and county government.

Tourism related investments and income are primarily derived from the development, operation, and visitor expenditures associated with accommodations, food and beverage services, and retail trade. However, the economic impact of tourism is far reaching as support services provided by other industries generate additional employment and income in the local Oahu economy.

Government operations employed roughly 21 percent of all non-agricultural wage and salary jobs on Oahu in the second quarter of 2014. Federal, state and county governmental agencies also rely upon a wide range of services that are provided by various industries comprising Oahu's overall economy.

Both the private and public sectors of Oahu's economy were significantly impacted by the national recession that extended between December 2007 and June 2009. A national reduction in discretionary household expenditures, which occurred nationally during this period, contributed to a reduction in the volume of visitor arrivals to Hawaii between the second quarter of 2008 and the second quarter of 2009. Visitor arrivals to Hawaii subsequently began a gradual increase, but did not rise to pre-recession levels until 2012. The temporary downturn in visitor arrivals during and immediately following the national recession impacted revenues and employment levels associated with visitor accommodations, food services and retail trade. These and other industries in Oahu's economy have and continue to rebound as visitor arrivals in 2013 and 2014 climbed near and over 2.0 million visitors per quarter.

4.2 EMPLOYMENT

4.2.1 Civilian Labor Force

The civilian labor force includes all residents who are 16 years of age and older and not working in military service.

The civilian labor force in the City and County of Honolulu included roughly 465,900 persons in third quarter of 2014. The size of the civilian labor force expanded by about 2.5 percent from the third quarter of 2013 (Hawaii Department of Business Economic Development and Tourism (DBEDT), 2014).

Despite some recent growth in the size of the civilian labor force on Oahu, Hawaii's overall labor participation rate has steadily dropped from roughly 67 percent in 2003 to 60.6 percent in 2013 (Hawaii Department of Labor and Industrial Relations, Research and Statistics Office, 2014). This trend suggests that Hawaii's workforce continues to feel the effects of the national recession, e.g., under employment, which occurred between December 2007 and June 2009.

4.2.2 Unemployment

The number of unemployed persons in Oahu's civilian labor force fell from 19,800 persons in the third quarter of 2013 to 18,700 persons in the third quarter of 2014. This reflects a drop in the unemployment rate from 4.4 percent in 2013 to 4.0 percent in 2014 (Hawaii DBEDT, 2014).

4.2.3 Source of Employment

The primary sources of employment for Oahu's labor force are evident through a review of recent employment levels for various North American Industry Classification System (NAICS) industry classifications for the Honolulu County economy. Quarterly census of employment and wage data that are compiled and published by the U.S. Department of Labor, Bureau of Labor Statistics. Available *covered employment* information for Honolulu County generally identifies the number of jobs held by Oahu residents within or outside of Honolulu County. If a resident holds multiple jobs, each job is accounted for separately. Job counts for the Quarterly Census of Employment and Wages document workers covered by State unemployment insurance laws and Federal workers covered by the Unemployment Compensation for Federal Employees program. However, members of the armed forces, the self-employed, proprietors, domestic workers, unpaid family workers, and railroad workers covered by the railroad unemployment insurance system are excluded from the quarterly job counts.

A review of average annual covered employment data from 2006 through the second quarter of 2014 indicates that the primary sources of employment on the Island of Oahu include government operations and three industries in the private sector (Table 4-1):

- Federal, State and City and County of Honolulu governmental agencies;
- Accommodation and food services;
- Health care and social assistance; and,
- Retail trade.

Governmental operations provided an average of approximately 97,395 jobs during the second quarter of 2014. Public agencies of the Federal, State and County government represented roughly 21 percent of all jobs within the employed workforce during the same period. Government employment generally declined following the end of the national recession in June 2009 through 2013. But, expansion of the State government workforce in 2013 increased the size of the overall government workforce in 2014 beyond pre-recession levels.

There were roughly 62,024 jobs associated with accommodation and food services during the second quarter of 2014. This workforce included almost 14 percent of all jobs of the employed labor force. Employment in accommodation and food services was significantly impacted between 2008 through 2011 as a result of sagging visitor arrivals during and following the national recession. However, employment levels rose in 2012 through the second quarter of 2014 in response to an upswing in visitor arrivals.

TABLE 4-1
[1]AVERAGE ANNUAL COVERED EMPLOYMENT
HONOLULU COUNTY, HAWAII
2006 THROUGH 2Q 2014

Industry	NAICS Code	2006	2007	2008	2009	2010	2011	2012	2013	2014 1Q	2014 2Q
PRIVATE SECTOR TOTAL	**10-All**	**356,435**	**357,498**	**352,831**	**337,191**	**334,823**	**340,228**	**347,996**	**357,083**	**356,746**	**358,408**
Agriculture, Forestry, Fishing & Hunting	11	2,322	1,669	1,625	1,684	1,768	1,801	1,812	1,899	1,979	1,828
Mining, Quarrying, and Oil & Gas Extraction	21	241	261	262	266	266	263	231	193	188	188
Utilities	22	1,800	1,848	1,895	1,985	2,027	2,164	2,339	2,517	2,538	2,533
Construction	23	24,433	26,193	25,756	22,247	21,063	21,492	21,866	22,813	22,670	22,823
Manufacturing	31-33	11,745	11,824	11,713	10,853	10,388	10,630	10,695	10,843	10,753	10,802
Wholesale Trade	42	14,346	14,722	15,025	14,330	14,163	14,004	14,108	14,155	13,958	13,908
Retail Trade	44-45	47,212	46,581	46,458	44,850	44,692	45,665	47,293	47,771	47,380	46,535
Transportation and Warehousing	48-49	22,748	22,743	20,091	17,822	17,515	17,581	18,136	18,872	19,371	19,370
Information	51	8,899	8,777	8,262	7,384	8,089	6,978	6,925	7,320	6,862	6,839
Finance and Insurance	52	14,370	14,295	14,140	13,657	13,051	12,783	12,832	12,599	12,388	12,391
Real Estate and Rental and Leasing	53	8,566	8,601	8,486	7,580	7,459	7,464	7,514	7,635	7,663	7,746
Professional and Technical Services	54	20,707	20,817	21,212	20,959	20,574	20,683	20,777	20,670	20,769	20,773
Management of Companies and Enterprises	55	6,630	6,713	6,551	6,205	5,935	6,211	6,771	7,510	7,655	7,624
Administrative and Waste Services	56	36,025	32,744	32,530	30,772	31,194	33,307	34,348	35,674	36,718	37,176
Educational Services	61	10,648	11,012	11,317	11,289	11,333	11,399	11,664	11,472	10,832	11,402
Health Care and Social Assistance	62	44,098	45,346	45,869	46,194	46,631	47,426	47,914	49,459	49,414	50,063
Arts, Entertainment, and Recreation	71	6,452	6,759	6,433	5,984	6,008	6,157	6,752	7,093	6,767	7,022
Accommodation and Food Services	72	56,077	57,397	56,088	54,585	54,040	55,483	57,213	59,297	59,610	60,024
Other Services, except Public Administration	81	19,117	19,199	19,120	18,543	18,627	18,738	18,807	19,293	19,231	19,361
Unclassified	99	[2]N/A	N/A	0	N/A	1	1	1	N/A	N/A	N/A
PUBLIC SECTOR TOTAL		**93,137**	**93,740**	**95,430**	**96,106**	**95,492**	**95,567**	**95,456**	**94,781**	**95,453**	**97,395**
Federal Government	10-All	29,254	29,120	29,439	30,549	31,785	32,003	32,017	31,022	30,635	30,373
State Government	10-All	52,347	52,813	53,908	53,504	51,547	51,546	51,427	51,668	52,819	54,962
Local Government	10-All	11,536	11,807	12,083	12,053	12,160	12,018	12,012	12,091	11,999	12,060
[1]TOTAL COVERED EMPLOYMENT		**449,572**	**451,238**	**448,262**	**443,298**	**430,314**	**435,795**	**443,451**	**451,864**	**452,199**	**455,803**

Source: U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2015.

Notes: [1] Totals may not match due to rounding; "Covered employment" for Honolulu County generally identifies the number of jobs held by Oahu residents within or outside of Honolulu County. If a resident holds multiple jobs, each job is accounted for separately. Job counts for the Quarterly Census of Employment and Wages document workers covered by State unemployment insurance laws and Federal workers covered by the Unemployment Compensation for Federal Employees program. 2) N/A: Information was not available

Health care and social assistance services in the private sector included about 50,063 jobs during the second quarter of 2014. This workforce, which supports the medical and social needs of the resident population, comprised about 11 percent of all jobs in Honolulu County's employed workforce. In contrast to industries associated with leisure and hospitality, employment associated with health care and social assistance experienced sustained growth from 2006 through the second quarter of 2014.

Jobs associated with retail trade included approximately 46,535 jobs in the second quarter of 2014. These jobs represented about 10 percent of all jobs of the employed labor force. Employment in retail trade were clearly impacted by the past national recession as the level of jobs fell sharply in 2009 with the decline in visitor arrivals. But, similar to accommodation and food services, the number of jobs rose slightly in 2011 and surpassed pre-recession levels in 2012 and 2013. A mild reduction in retail jobs was evident during the first two quarters of 2014.

4.2.4 Construction

Oahu's construction industry provided an average of 22,823 jobs during the second quarter of 2014. This workforce comprised five percent of all jobs held by the employed labor force during this period. While construction activities are not a primary source of employment for the employed workforce, the activities of this industry are especially relevant to this socio-economic impact assessment since the PVT ISWMF receives and processes construction and demolition materials generated by the construction industry. It is the only facility on the Island of Oahu that is authorized by the Hawaii State Department of Health (HDOH) for the management of construction and demolition materials.

Construction was a major source of job growth in Hawaii and the Island of Oahu during much of the past decade. In 2007, this workforce included 26,193 jobs. But, *covere*d employment in this industry fell beginning in 2008 in response to national changes in construction lending requirements and private home financing, which influenced investments in residential and commercial development. This trend was evidenced, in part, by a 28 percent reduction in the number of private residential building permits issued in 2008 and a subsequent 47 percent decline in 2009 (Hawaii DBEDT, 2014). Since 2010, *covered employment* in the construction industry has increased somewhat, but remains below workforce levels prior to the national recession that began in December 2007.

In the third quarter of 2014, there were signs of optimism as the value of private building authorizations increased. But, the increase in the value of private construction was countered by a decline in the value of governmental construction contracts *(*Hawaii DBEDT, 2014).

In the short to medium term, there are various factors that point to a resurgence in construction activity on Oahu. The Honolulu Rapid Transportation Rail project and continuing Kakaako area development represent two significant public and private investments that will generate substantive construction employment on Oahu (Hawaii DBEDT, 2014). Various residential development projects between Aiea and Waikiki will also contribute to an upsurge in construction activity. The potential growth in construction activity on Oahu is significant enough that some construction industry leaders have expressed concerns about the availability of a construction workforce to completed planned construction projects (Shimogawa, 2014).

While covered employment in Oahu's construction industry represented about five percent of total covered employment in Honolulu County during the second quarter of 2014, it is important to recognize that the construction industry generates a significant ripple effect on other industries in Oahu's economy. The Hawaii Department of Business and Economic Development and Tourism estimates that one million dollars in construction spending creates about 10 jobs in Hawaii (Hawaii DBEDT, 2014).

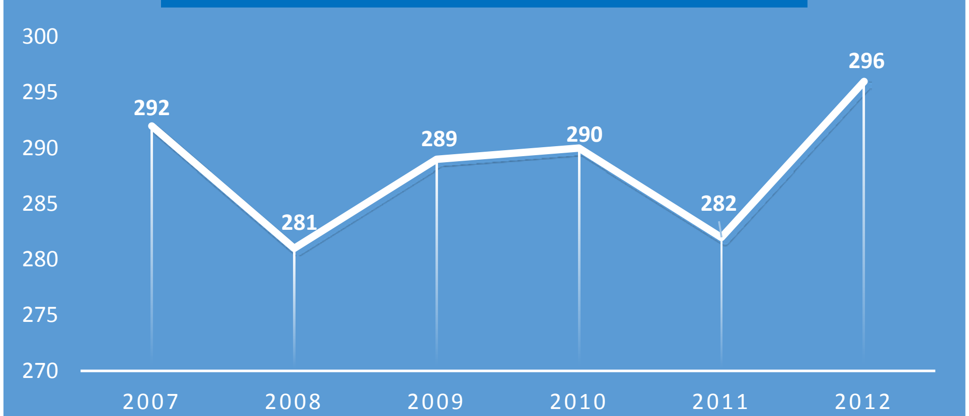
4.3 BUSINESS ESTABLISHMENTS ALONG THE WAIANAE COAST

Available data related to business patterns within the 96792 zip code tabulation area provide some insights regarding the type and extent of business activity that operate along the Waianae Coast. However, this information does not include data for sole proprietorships having no employees. While this data lags the time period of other more recent economic data for the Island of Oahu, it is helpful to gain a general understanding of the economic environment that operates near the PVT ISWMF.

4.3.1 Growth in Business Establishments

The number of business establishments (businesses with one or more employees) operating along the Waianae Coast between 2007 and 2012 ranged from 281 businesses in 2008 to 296 businesses in 2012 (Figure 4-1). A short-term drop in the growth of business establishments occurred in 2008. Subsequently, the number of businesses rose slightly in 2009 and 2010, fell again in 2011, but rebounded quickly to 296 businesses in the following year. This trend suggests that the recent national recession may have contributed, in part, to the temporary or permanent closure of roughly three percent of the business establishments within the 96792 zip code tabulation area in 2008 and 2011. But, overall, the number of businesses grew just over one percent between 2007 and 2012 (Source: U.S. Census Bureau, 2015).

FIGURE 4-1
NUMBER OF BUSINESS ESTABLISHMENTS
1Q 2007 THROUGH 1Q 2012



4.3.2 Type and Size of Businesses

A wide range of businesses characterized the economy of the Waianae Coast in 2012. The primary types of industries included health care and social assistance, retail trade, other services (except public administration), construction, and accommodation and food services.

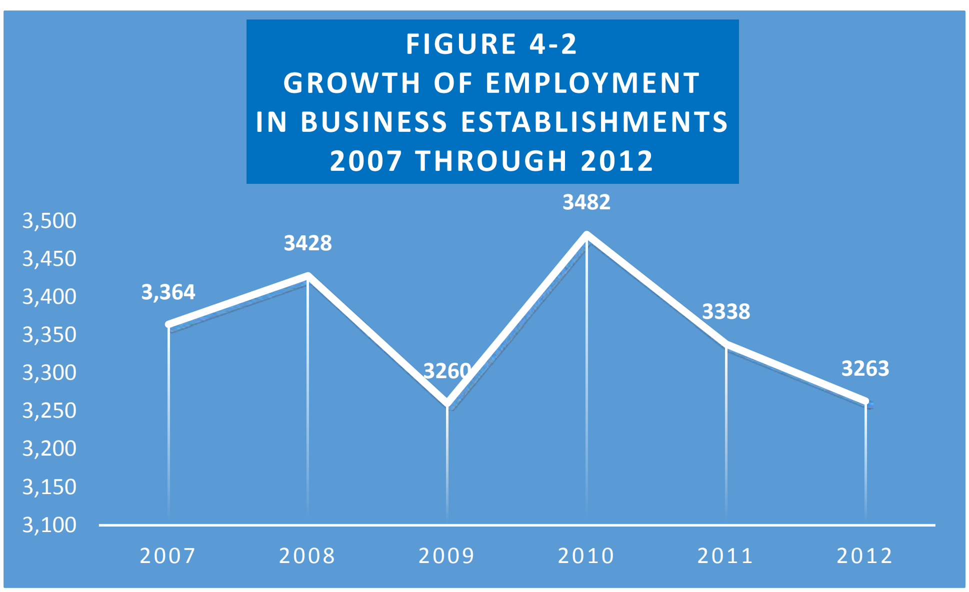
Fifty-three percent of these businesses employed one to four persons. Almost 19 percent of the businesses had five to nine employees. Another 16 percent of the businesses employed 10 to 19 persons. Nine percent of the businesses were operated by 20 to 49 persons; PVT represented one of these businesses. The remaining three percent of businesses, which employed from 50 to 999 employees, included only eight businesses.

The largest employer, Waianae Coast Comprehensive Health Center, employed a workforce that ranged between 500 and 999 employees. Two additional businesses, which were associated with retail trade and health care and social assistance, were operated by 100 to 249 employees.

4.3.3 Employment

Between 2007 and 2012, there was considerable variability in overall employment levels associated with business establishments along the Waianae Coast. A three percent decline in employment occurred during this period.

Just prior to the national recession, there were 3,364 paid employees working in the Waianae Coast economy during the first quarter of 2007 (Figure 4-2). As the national recession progressed, employment actually rose to 3,428 employees in 2008, but then slid down to 3,260 employees in 2009. But employment levels rebounded to 3,482 employees in 2010, fell back to 3,338 employees in 2011 and declined further to 3,263 paid employees in 2012 (U. S. Census Bureau, 2015).



4.4 POTENTIAL IMPACTS OF PROPOSED ACTION ON OAHU ECONOMY

4.4.1 General

The economic value of the ISWMF operations was calculated through the application of the IMPLAN model and the most recent available economic data that was obtained from IMPLAN Group LLC which is based in Huntersville, North Carolina. The IMPLAN model is an interactive computer-based modeling system that, in part, enables the calculation of economic impacts that are generated from changes in business expenditures or the expansion/contraction of local business activities. For the purposes of this assessment, the IMPLAN model, software package, and related data base were used to calculate the direct, indirect and induced effects of PVT ISWMF expenditures in the Honolulu County economy. The economic contribution of ISWMF operations was made for both 2013 and 2016 to enable a comparison of the economic impacts prior to and following implementation of the Proposed Action.

- *Direct effects* represented actual and estimated employee compensation and other expenditures of PVT in the Honolulu County economy in 2013 and 2016, as well as the economic value of services and products generated from the operation of its ISWMF.
- *Indirect effects* represent the impact of PVT purchasing goods and services from other local industries in the Honolulu County economy.
- *Induced effects* reflect changes in local spending that were generated from income changes in the directly and indirectly affected industry sectors in 2013 (Mulkey and Hodges, 2012).

Relevant economic data, e.g., regional purchase coefficients, for Honolulu County that was necessary to apply the model for this analysis were obtained from IMPLAN Group LLC for calendar year 2013. This data set represented the most recent economic data that was available for Honolulu County.

Pedersen Planning Consultants received other relevant information required for the application of the IMPLAN model from PVT. This information included a summary of annual gross revenue, total direct labor costs, as well as the size of the PVT ISWMF workforce. Other direct expenditures made by PVT in the Honolulu County economy, which are associated with equipment, purchases of equipment and supplies, the use of professional and technical services, and donations to various community organizations, were also disclosed to provide a better understanding of PVT's contribution to the Oahu economy.

4.4.2 Economic Contribution of ISWMF in 2013

4.4.2.1 Direct Impact

The direct impact of PVT ISWMF operations was derived from its employment of 37 full-time and 10 temporary personnel in 2013, expenditures for equipment, services and supplies, donations, as well as revenues generated from the operation of the integrated solid waste management facility. Its annual revenues and other direct expenditures are not disclosed to respect the confidentiality of this information.

A sizeable amount direct expenditures were made along the Waianae Coast. Most of the PVT ISWMF workforce resides along the Waianae Coast. PVT also donated a combination of funds, personnel labor, and equipment to support student scholarships, community organizations and events, community development and improvement projects, recreational sport teams, and other community activities.

4.4.2.2 Indirect Impact

The indirect effects of PVT ISWMF expenditures for equipment, professional and technical services, supplies, and donations in 2013 supported approximately 40 additional full and part-time jobs in the Honolulu County economy. Indirect employment generated almost $2.2 million in indirect labor income for employees and proprietors.

4.4.2.3 Induced Impact

Consumer spending in 2013 that was generated from income changes in each of the directly and indirectly affected industries that supported PVT's operations generated about 50 additional full and part-time jobs in the Honolulu County economy. These jobs provided an additional $2.5 million in induced labor income.

4.4.2.4 Cumulative Economic Impact

Combined direct, indirect and induced employment derived from PVT ISWMF operations in 2013 generated about 132 full and part-time jobs in the Honolulu County economy. Almost $6.2 million of labor income was generated from this employment.

Value added is a measure of the contribution to Gross Domestic Product (GDP) that is made by an individual business, industry or economic sector. It represents the difference between an industry's or business establishment's total output (gross receipts or sales) and the cost of its intermediate inputs (goods and services purchased from other industries). In 2013, PVT Land Company contributed over $10.1 million to Oahu's Gross Domestic Product through the operation of its ISWMF.

4.4.3 Economic Contribution of ISWMF in 2016

4.4.3.1 Direct Impact

The direct impact of PVT ISWMF operations would be derived from PVT's continued employment of 50 full-time and 20 temporary personnel in 2016, direct expenditures to support ISWMF operations, donations, as well as increased revenues generated from the operation of the integrated solid waste management facility. Labor costs are expected to increase considerably from 2013 levels.

4.4.3.2 Indirect Impact

The indirect effects of PVT ISWMF expenditures for equipment, professional and technical services, supplies, and donations is expected to generate approximately 50 additional full and part-time jobs in the Honolulu County economy. Indirect employment is anticipated to generate roughly $2.7 million in indirect labor income for employees and proprietors. The anticipated indirect economic impact in 2016 compares to PVT Land Company's 2013 contribution of 40 full and part-time personnel and almost $2.2 million in indirect labor income.

4.4.3.3 Induced Impact

The anticipated induced impact of an expanded ISWMF would reflect consumer spending that would be generated from income changes in each of the directly and indirectly affected industries in 2016. The induced impact would represent the generation of about 68 full and part-time jobs and almost $3.4 million of induced labor income. This impact compares to the Company's generation of about 50 additional full and part-time jobs in the Honolulu County economy and $2.5 million in induced labor income in 2013.

4.4.3.4 Cumulative Economic Impact

It is anticipated that combined direct, indirect and induced employment derived from PVT ISWMF operations in 2016 would generate about 178 full and part-time jobs in the Honolulu County Company and almost $9.0 million in labor income. This compares to an estimated economic contribution of about 132 full and part-time jobs and almost $6.2 million of labor income in 2013.

Through the operation of its integrated solid waste management facility, it is expected that PVT's contribution to Oahu's Gross Domestic Product (GDP) would increase from approximately $10.1 million of nominal GDP in 2013 to roughly $12.3 million of real GDP in 2016. Consequently, the proposed integrated solid waste management project would make a substantive contribution to the Honolulu County economy.

Aside from these economic consequences, it is also important to recognize that the conversion of construction and demolition material into reusable feedstock enables the potential formation of other new businesses in Oahu's private sector. New business enterprises, e.g. PelatronQ, will likely continue to be formed in response to the opportunity to produce additional sources of renewable energy that can help support Oahu's electrical energy demands.

CHAPTER FIVE
COMMUNITY INSIGHTS

5.1 GENERAL

The evaluation of community attitudes toward the PVT ISWMF Proposed Action examined the insights, concerns, and recommendations of Oahu residents whom live and/or work in the Waianae Coast area. This analysis was made through:

- a review of community responses to a 2011 dust survey by the Hawaii Department of Health (HDOH);
- interviews of nine residents by Tetra Tech and HDOH on August 29 and 30, 2011;
- interviews of various community leaders and other residents from the Waianae Coast in February 2015 that sought to determine what benefits and/or undesirable impacts they anticipated from the Proposed Action, as well as any actions that PVT Land Company should take if the Proposed Action is implemented.

The 2011 dust survey and interviews of nine residents by Tetra Tech and HDOH represent selected portions of a larger Nanakuli Dust Study that was prepared by Tetra Tech for HDOH. The Nanakuli Dust Study evaluated potential dust sources that may have affected the Nanakuli community and surrounding areas in 2011, and recommended feasible and realistic alternatives for reducing dust emissions. Tetra Tech completed a comprehensive review of available air quality data and performed other fieldwork and research-oriented tasks to: identify and evaluate the level of dust in the area; evaluate potential health concerns related to dust; and, compare dust concentrations with other areas on Oahu.

Site visits and reconnaissance were completed by Tetra Tech to observe and document on-site conditions that may lead to the formation and transport of dust. A questionnaire and homeowner interviews were conducted so that residents had the opportunity to express their concerns, ask questions, and discuss this issue (Tetra Tech EM Inc., 2011).

Some of the recommendations made by Tetra Tech pertained to PVT ISWMF operations. PVT subsequently implemented all recommendations related to their operations including:

- Prohibiting vehicles from driving on dirt shoulders;
- Paving of unpaved roads;
- Applying water to exposed areas on a routine basis, which results in dust reduction; and
- Vegetation or applying ground cover on unused slopes of the landfill area.

5.2 DEPARTMENT OF HEALTH DUST SURVEY

The Hawaii Department of Health mailed out a dust survey to 1,100 Nanakuli area residents in July 2011. The survey comprised nine questions which sought to better understand dust conditions reported by the community during a September 2, 2010 public hearing for an earlier solid waste permit renewal application by PVT. A transcript of public testimony received during the September 2, 2010 public hearing can be accessed via http://health.hawaii.gov/shwb/files/2013/06/PVTsignedhearingtranscipt.pdf (Flint, 2010). One hundred and fifty-seven surveys were undelivered by the U.S. Post Office. Seventy-two completed surveys were received by the Department of Health.

Survey responses indicated the following:

- 78 percent of respondents lived on their properties for more than 10 years.
- 44 percent of respondents described their situation as a lot of dust, while 40 percent describe it as a greater than average amount of dust.
- 53 percent of respondents reported that the amount of dust has increased over time.
- 44 percent of respondents reported that the dust is from the *mauka* side, while 46 percent of the respondents reported it was the same all over.
- 38 percent of the respondents indicated that the dust was the same at all times of day, while 31 percent were not sure.
- 53 percent of respondents reported that dust was worst with trade winds, while 36 percent were not sure.60 percent of respondents reported that dust can be seen blowing onto their property in Nanakuli, and 38 percent identified a source of dust.
- 30 of the respondents were interested in a visit to PVT ISWMF.
- 35 respondents requested updates (Tetra Tech, 2011).

5.3 INTERVIEWS OF NINE RESIDENTS BY TETRA TECH AND HAWAII DEPARTMENT OF HEALTH

Representatives of the Hawaii Department of Health and Tetra Tech interviewed nine residents in a residential neighborhood of Nanakuli on August 29 and 30, 2011. Each of the residents resided in a residential neighborhood that is located within an area bounded by Hakimo Street, Lualualei Road, Farrington Highway, and the southwest boundary of the PVT ISWMF (Tetra Tech, 2011).

The interviewers posed several generalized questions to each of the homeowners, such as:

- Has the dust problem gotten worse, better, or remained unchanged over the past 10 (or so) years?
- Where is the dust coming from?
- Is dust worse at certain times of day?
- Is dust worse at certain times of the year?
- Do you have any other concerns or questions?

Those interviewed reported that dust appears to be worse during business hours, and that dust emissions have generally become worse over the past several years. Dust appears to be coming from the general direction of the PVT ISWMF, and can be seen coming from trucks entering and exiting the site. Those interviewed also reported that trucks traveling to and from the PVT ISWMF along Lualualei Road are a source of dust. Residents wanted to know if the dust was harmful. Several residents indicated that they knew someone who is sick and were concerned whether the dust was affecting their health (Tetra Tech, 2011).

5.4 FEBRUARY 2015 INTERVIEWS

5.4.1 General

In January 2015, PVT provided LYON with a list of 39 names that included elected officials, community leaders, and representatives of local businesses. All of the persons interviewed reside and/or work along the Waianae Coast. PVT selected these persons on the belief that they could provide insights regarding community concerns and attitudes regarding the proposed project to its integrated solid waste management facility. In February 2015, a representative of LYON attempted to contact each person on the original interview list and schedule convenient times for a person-to-person interview with a representative of Pedersen Planning Consultants.

Pedersen Planning Consultants subsequently attempted to contact all remaining persons on the interview list who had previously not been contacted or scheduled for an interview. Most of the persons on the interview list could not be contacted or were unavailable due to other commitments; in some cases, other residents declined to be interviewed. Based upon the recommendations of two persons interviewed, Pedersen Planning Consultants added two additional community leaders to the interview list.

Photo 5A: PPC staff conducting interview at WCCHC *Source: PPC, 2015*

Several interviews were conducted at the Waianae Coast Comprehensive Health Center (WCCHC) dining room between February 16 through 25, 2015 (Photo 5 A). Some interviews were conducted at different locations at the request of the person being interviewed. With the exception of one requested telephone interview, all interviewees received a copy of non-technical project description of the Proposed Action and a related project location map.

Jim or Sandy Pedersen of Pedersen Planning Consultants conducted interviews of the following persons:

- Melvin Kauila Clark, Member, Waianae Coast Comprehensive Health Center Board;
- Bruce Desoto, Makaha Canoe Club;
- Victor Flint, Community Planning and Liaison Officer, Joint Base Pearl Harbor-Hickam Facility Board;
- Lucy Gay, Leeward Community College, Waianae;
- Alice Greenwood, Concerned Elders of Waianae, Nani O Waianae;
- Richard Landford, Nanakuli-Maili Neighborhood Board Transportation Committee, Hawaiian Civic Club;

- Sophie Flores Manansala, Member, Nanakuli-Maili Neighborhood Board Transportation Committee, Mikilua Valley Community Association, and Mikilua One, LLC;
- Kekoa McClellan, President and CEO, PelatronQ, Maili resident;
- Georgette Stevens, Grace Pacific, Malama Learning Center, West Oahu Economic Development Association; Alignment 96792 Waianae Coast Crime Prevention;
- Cynthia Rezentes, Nanakuli-Maili Neighborhood Board;
- Senator Maile Shimabukuro, Hawaii State Senate, 21st District; and,
- Representative Andria Tupola, Hawaii State House of Representatives, 43rd District.

The interviews sought to determine what benefits and/or undesirable impacts each person envisioned for the Proposed Action. The interviews also asked each person what recommendations they might have concerning how proposed improvements to the ISWMF operation should be carried out, or what precautions should be taken, if the Proposed Action is implemented.

5.4.2 Insights Conveyed During Interviews

It was evident from the interviews of various community leaders and other residents of the Waianae Coast that those interviewed support the concept of recycling C&D materials and the approach used by PVT to accomplish that objective. Most leaders were appreciative of the benefits associated with company employment, donations to local schools, and the contribution of other resources toward various community development projects. Those interviewed also expressed confidence in PVT's responsiveness toward any community concerns related to ISWMF operations.

A few of the persons interviewed were convinced that the present ISWMF and future Proposed Action will impact groundwater resources and the nearshore waters. Some persons also expressed belief that dust from PVT ISWMF operations are linked to past resident reports of respiratory illness and asthma. However, several persons indicated an improvement in dust conditions.

Community leaders and other residents also recommended various actions that they believe will reduce the potential impact of the Proposed Action. These recommendations generally included recommended operational measures, landscaping improvements, and community education. A more specific summary of the insights and recommended actions received from those interviewed is presented in Table 5-1.

TABLE 5-1 (1st of 2 Pages)
SUMMARY OF COMMENTS AND RECOMMENDED ACTIONS CONVEYED DURING INTERVIEWS
FEBRUARY 16-25, 2015

ITEM NO.	*COMMENTS CONVEYED*
PERCEIVED BENEFITS	
1	Some residents are pleased with pro-active approach to processing and recycling of construction and demolition materials.
2	Steve Joseph and other PVT representatives are easy to work with and respond to our community.
3	Recycling represents a long-term benefit for Oahu. Construction and demolition wastes become a resource. The availability of this resource opens door to formation of new industries.
4	Recycling efforts associated with the solid waste management facility lowers our dependence upon fossil fuels.
5	PVT provides safe place to dump construction and demolition wastes; otherwise, illegal dumping will be overwhelming.
6	PVT provides employment, including jobs for local residents from the Waianae Coast.
7	PVT has been a good caretaker of what they receive/process at the landfill; they do their best to accommodate the community and are eco-friendly.
8	PVT supports our community and donates back.
9	PVT has improved its community relations quite a bit, especially during the last 15 years.
10	Have confidence that PVT will work with our community if our concerns are voiced/revealed.
11	Dust from the landfill was the biggest complaint in the past; but that wasn't PVT's fault. But dust problem was partially resolved with coordinated efforts of Nani O Waianae, PVT, and U.S. Navy to landscape PVT landfill entry and related plans to landscape along other portions of Lualualei Naval Access Road. But, this landscaping expansion project needs a jump-start.
12	The source of fugitive dust is from multiple sources. The community perceives that there is only one.
PERCEIVED ADVERSE IMPACTS	
13	Construction and demolition wastes contain toxins that are leaching into the ground water and nearshore waters.
14	Although PVT has installed five protective layers below the berm they created; this will eventually deteriorate. What steps are in place to prevent the deterioration, or replace the layers when the time comes?
15	Fugitive dust from PVT operations are linked to resident reports of respiratory illness and asthma.
16	Residents of Waianae Coast believe that the PVT landfill will continue to generate dust and it will only get worse.
17	The people of the Waianae Coast believe they are the dumping ground for Oahu. The presence of the PVT integrated solid waste management facility validates their perception and defines their negative social status.
18	Increased landfill height will impact our views of the mountains.
19	We don't want more truck traffic in our community.
20	Heavy truck traffic brings added particulate matter from diesel engines.

TABLE 5-1 (2nd of 2 Pages)
SUMMARY OF COMMENTS AND RECOMMENDED ACTIONS CONVEYED DURING INTERVIEWS
FEBRUARY 16-25, 2015

ITEM N0.	*RECOMMENDED ACTIONS CONVEYED*
A	Seal construction and demolition materials going into the landfill so that wastes do not leach into soils, ground water and nearshore waters.
B	Form a citizen advisory committee that would guide future actions of the HDOH and PVT Land Company.
C	Require PVT to contribute funds to residents whose health, e.g., respiratory illness and allergies, has been affected by the landfill.
D	Plant more trees that will help absorb dust and toxins, as well as detox local soils. Consult University of Hawaii (UH) Department of Tropical Agriculture concerning the type of
E	Re-seed coral reefs and fish habitat in nearshore waters. Consult HDLNR concerning how to do it. Have youth from Waianae Coast monitor future changes in coral communities and marine habitat.
F	Provide buffers along both sides of Ulehawa Stream with natural vegetation and trees to preserve and promote cultural and natural resources.
G	Plant a greenbelt that is, at least, 1,000 feet wide to help capture fugitive dust and improve the view of the landfill.
H	Road improvements need to be a priority to mitigate fugitive dust, provide better transportation commutes, and make our neighborhoods safer.
I	Cover/grass exposed areas of the landfill as soon as possible.
J	Take steps to minimize the transport of dust beyond areas already affected.
K	Take precautions to ensure the stability of landfill and recycling areas.
L	Continue watering of exposed landfill areas to suppress fugitive dust emissions.
M	Monitor wind direction and speed, as well as dust emissions at different locations.
N	Beautify the north side of Lualualei Naval Access Road with plantings.
O	Re-visit the maximum wind speed criteria that guide the temporary shutdown of existing operation during higher wind conditions.
P	Promote incentives that encourage building contractors to begin recycling process at construction sites, e.g., segregation of wastes.
Q	Transport Waianae Coast residents to the solid waste management facility via bus for monthly tour and lunch.
R	Carry out more public relations to identify improvements to the solid waste management facility.
S	Be creative in engaging local residents. Begin educating residents of Waianae Coast at very young age. • For example, PVT should sponsor a project where young people collect construction and demolition wastes. Wastes are hauled to the landfill. Children would observe how construction and demolition wastes are recycled and converted into a useful product. • PVT should establish an internship program for young people where they could earn and learn about selected aspects of waste management and recycling operations.
T	Market zero waste: End the disposal and landfilling of virtually anything.
U	PVT Land Company needs to be more pro-active in educating people about what they're doing. PVT needs to be more specific about how they mitigate fugitive dust, deal with hazardous wastes, etc.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

1. The Proposed Action is not expected to generate any significant impacts upon the resident population and related demographic characteristics of the Waianae Coast. Future increases in resident population along the Waianae Coast will likely occur when planned residential development projects are realized.

2. The Proposed Action is not expected to encourage any changes in land uses along the Waianae Coast. Anticipated changes in land use will be those projects planned by various public agencies.

3. Existing setbacks required by the Department of Health provide reasonable protection to adjacent residential neighborhoods, agricultural areas, commercial facilities, community facilities, and public facilities that are situated *makai* and west of the solid waste management facility.

4. The Proposed Action will generate substantive direct, indirect and induced economic benefits to the Oahu economy.

    - The combined direct, indirect and induced employment derived from PVT ISWMF operations in 2016 would generate about 178 full and part-time jobs in the Honolulu County Company and almost $9.0 million in labor income. This compares to an estimated economic contribution of about 132 full and part-time jobs and almost $6.0 million of labor income in 2013.

    - PVT's contribution to Oahu's Gross Domestic Product (GDP) would increase from approximately $10.1 million of nominal GDP in 2013 to roughly $12.3 million of real GDP in 2016 through the operation of the PVT facility.

5. The conversion of C&D material into reusable feedstock enables the potential formation of other new businesses in Oahu's private sector. New business enterprises, e.g. PelatronQ, will likely continue to be formed in response to the opportunity to produce additional sources of renewable energy that can help support Oahu's electrical energy demands.

6. Community leaders and residents interviewed in February 2015 appreciate the benefits associated with PVT's ISWMF that generally include local job opportunities, donations to local schools and other organizations, and the contribution of resources towards various community development projects. But, some leaders remain convinced that the ISWMF is adversely impacting groundwater resources and nearshore waters.

6.2 RECOMMENDATIONS

1. Since no significant adverse impacts upon the resident population, land uses, and Oahu's economy are anticipated, no mitigative measures are recommended.

2. Continue to provide opportunities to better educate the community about the scope and purpose of ISWMF operations.

3. Evaluate actions recommended by community leaders and residents interviewed in February 2015 (Table 5-1) and implement those determined to be effective and feasible.

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