FINAL
REMEDIAL ACTION WORK PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawai‘i

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

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Summary of Revisions

Final Remedial Action Work Plan
Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawai‘i

The Final Remedial Action Work Plan (RAWP) for Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014), Maui Space Surveillance Complex, Haleakalā, Hawai‘i, was finalized in January 2025 and the Health and Safety Plan (Appendix E of the RAWP) was finalized in June 2025. Subsequently, a Field Change Request (FCR) was generated with the following edits made.

FCR Number	Description	RAWP Revision Number	Revision Date	Revised Sections and/or Pages
FCR-001	Updates to reflect current project personnel	Revision 01	1/28/2025	RAWP Table 5-1; Appendix E Health and Safety Plan; SOPs (Attachment B of Appendix D Sampling and Analysis Plan)

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Appendix D Sampling and Analysis Plan
Appendix E Health and Safety Plan
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Appendix G Operations and Maintenance Plan

Acronyms and Abbreviations

%	Percent
°F	Degrees Fahrenheit
AMP	Archaeological Monitoring Plan
AOI	Area of Interest
bgs	Below Ground Surface
BMP	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Cl-	Chloride
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
cy	Cubic Yard(s)
DAF	Department of the Air Force
DLNR	Department of Land and Natural Resources
DNA	Deoxyribonucleic Acid
DRO	Diesel Range Organics
DU	Decision Unit
EAL	Environmental Action Level
EHE	Environmental Hazard Evaluation
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ERPIMS	Environmental Resources Program Information Management System
ft	Foot/Feet
GPS	Global Positioning System
GSINA	GSI North America Inc.
HDOH	State of Hawai‘i Department of Health
HEER	Hazard Evaluation and Emergency Response
HHAOS	Haleakalā High Altitude Observatory Site
HSP	Health and Safety Plan
IAW	In Accordance With
IfA	Institute for Astronomy
LT-EHMP	Long-Term Environmental Hazard Management Plan
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MI	Multi-Increment
msl	Mean Sea Level
MSSC	Maui Space Surveillance Complex
NPS	National Park Service
NRC	National Response Corporation
O&M	Operations and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
ppm	Parts Per Million
qPCR	Qualitative Polymerase Chain Reaction

RA	Remedial Action
RAM	Response Action Memorandum
RAO	Remedial Action Objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
SAP	Sampling and Analysis Plan
SCAE	Site Characterization and Alternatives Evaluation
SDWB	Safe Drinking Water Branch
sf	Square Foot/Feet
SOP	Standard Operating Procedure
TBD	To Be Determined
TCRA	Time Critical Removal Action
TGM	Technical Guidance Manual
TPH	Total Petroleum Hydrocarbons
UH	University of Hawaiʻi
UIC	Underground Injection Control
U.S.	United States
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound

Section 1 Introduction and Purpose

1.1 Introduction

This Remedial Action Work Plan (RAWP) was prepared on behalf of the United States (U.S.) Department of the Air Force (DAF), under contract number FA8903-24-C-0008 for Environmental Remediation Services to conduct a Remedial Action (RA) at the Generator Fuel Spill Site (SS014) located at the Maui Space Surveillance Complex (MSSC), Haleakalā, Hawaiʻi. The project will be conducted in accordance with (IAW) the requirements specified in the Performance Work Statement and in compliance with applicable State of Hawaiʻi Department of Health (HDOH), Department of Defense, and DAF regulations and guidance.

1.2 Purpose and Scope

A Response Action Memorandum (RAM) was prepared by the DAF to present the preferred remedial alternatives selected for the Generator Fuel Spill Site (SS014) (DAF, 2024b). The purpose of the Phase 3 RA project is to implement the remedy selected by the RAM, which includes remediation of the contaminated soil through active bioventing (in-situ soil) and ex-situ aeration (ex-situ soil), to achieve the Remedial Action Objectives (RAOs) which are to:

- Achieve cleanup of in-situ soil to below site-specific Environmental Action Levels (EALs) (restricted) (shown in Table 2 of the RAM or Table 3-2 of this RAWP) and below Tier 1 EALs (unrestricted) (shown in Table 3 of the RAM or Table 3-2 of this RAWP) for supersacked soil; and
- Minimize potential adverse impacts to the community and the environment during implementation of the RA.

Additionally, data gaps will be addressed to further define the nature and extent of contamination within the area of interest (AOI) at the Generator Fuel Spill Site (SS014) to allow for final decision-making. The main project activities include data collection and analysis (e.g., soil and soil vapor sampling), remedy development and implementation (e.g., active bioventing system and landfarm installation), active bioventing system and landfarm operations and maintenance (O&M), and development of a Long-Term Environmental Hazard Management Plan (LT-EHMP).

The RA project definable features of work and supporting activities include the following:

- Project Planning and Management;
- Public Meetings;
- Mobilization and Site Preparation;
- Bioventing Well Installation;
- Landfarm Installation, Management, and Decommissioning;
- In-Situ Soil Sampling and Analysis;
- Active Bioventing System Installation, Management, and Decommissioning;

- Soil Vapor Sampling;
- Waste Management;
- Data Management;
- Demobilization; and
- Reporting.

This RAWP provides an outline of the primary methods proposed by GSI North America Inc. (GSINA) to complete the project. The RAWP also include the following appendices:

- Appendix A Maps - provides figures showing site location, prior investigation results, site physical profiles (soil, topography), and proposed sample design;
- Appendix B National Park Service (NPS) Commercial & Construction Vehicles (Access) Permit – provides copies of the NPS special use permits required to access the site;
- Appendix C Archaeological Monitoring Plan (AMP) (provided under separate cover) – provides procedures to account for the potential inadvertent discovery of historic cultural deposits;
- Appendix D Sampling and Analysis Plan (SAP) - provides details on types and quantities of samples to be collected, sampling design, and quality assurance/quality control procedures to ensure that the sampling design meets data quality objectives, and has been prepared IAW the HDOH Hazard Evaluation and Emergency Response (HEER) Office Technical Guidance Manual (TGM) for the Implementation of the Hawaiʻi State Contingency Plan (HDOH, 2009);
- Appendix E Health and Safety Plan (HSP) - presents the minimum requirements for health/safety that must be met by personnel, and complies with DAF, Occupational Safety and Health Administration, U.S. Environmental Protection Agency (EPA), state, and local health and safety regulations regarding the project;
- Appendix F Environmental Protection Plan (EPP) - describes the procedures and methods that will be implemented during remedial activities at the MSSC to minimize pollution and protect and conserve natural and cultural resources; and
- Appendix G O&M Plan – provides the planned O&M activities for the site.

Section 2 Background

2.1 Site Description

The Generator Fuel Spill Site (SS014) is located on Puʻu Kolekole, a promontory, at the western edge of the summit caldera of the Haleakalā volcano on the island of Maui, roughly 10,000 feet (ft) above mean sea level (msl). Site SS014 is located within the Maui County-owned 4.4-acre MSSC which is located within the 18.2-acre property of the Haleakalā High Altitude Observatory Site (HHAOS). HHAOS is managed by the University of Hawaiʻi (UH) Institute for Astronomy (IfA) on behalf of the landowner, the State of Hawaiʻi Department of Land and Natural Resources (DLNR). MSSC is a tenant on the HHAOS and leases the land from the DLNR. The AOI for this project is approximately 8,490[1] square ft (sf) in the vicinity of the MSSC generator release (Figure 1, Appendix A).

The site was formally designated for observatory use by an executive order of the Governor of Hawaiʻi in 1961 and has been managed and operated by UH to support high-quality, high-impact research, education, and space surveillance. The site is further defined by the City and County of Honolulu Real Property Tax Office as tax map key (2) 2-2-007: 008. The AOI is designated as Release Identification Number 3239 by the HDOH HEER Office.

2.1.1 Climate

The daytime temperatures at the summit fluctuate from as high as 66 degrees Fahrenheit (°F) in the summer to below 42.5 °F in the winter. The summit also experiences less rainfall compared to the windward side of Haleakalā (north of the summit), with an average annual rainfall of approximately 40.79 inches per year. Due to the low humidity levels and lack of vegetation of the summit region, evapotranspiration rates are low in this area, roughly 400 millimeters per year, with the lowest rates occurring between the months of June and October (Giambelluca, 2013). Snowfall is uncommon to infrequent, although frost conditions do occur during the winter.

2.1.2 Topography

Haleakalā is the larger of the two volcanoes on Maui, located on the eastern side of Maui and rising to 10,023 ft above msl. The summit of Haleakalā is rugged and mostly barren, consisting of lava rocks of varying sizes and pyroclastic materials. The MSSC has a flat surface, though the site's southwestern quadrant slopes downward before flattening out again (Figure 2, Appendix A). This flat area is bordered to the southeast by a rock wall made of large basalt blocks.

2.1.3 Soils/Geology

The site elevation is approximately 10,000 ft above msl, at the summit of the Haleakalā volcano. The summit region where the MSSC is located is composed mainly of postshield-stage cinders and lava eruptions of the preceding eruptive phase, termed the Kula series (Kolekole cinder cone). The substrate beneath the facility consists of about 100 ft of alkalic pyroclastic cinders originating

[1] *Does not include landfarm area(s).*

from a vent roughly 300 ft west of the MSSC. Inter-bedded ankaramite basalt lava flows are present deeper beneath the MSSC (National Response Corporation [NRC]/US Ecology, 2023).

According to the U.S. Department of Agriculture (USDA) Soil Conservation Service and the UH Agricultural Experiment Station, the site is situated on soil classified as 100 percent (%) cinder land (Figure 3, Appendix A). Cinder land refers to a ground surface with a presence of cinders, or small fragments of erupted basaltic rock that contains numerous vesicles and is typically composed of excessively drained paragravel from 0 to 60 inches (USDA, 2023). On Maui, this type of landscape is limited to the summit region of Haleakalā, above roughly 7,000 ft above msl. Vegetation is limited due to environmental conditions and a lack of mature soil.

According to soil borings performed in 2005, the underlying solid basalt layers at the site range from 5 to 21 ft below ground surface (bgs) (UH IfA, 2005). According to soil borings performed in 2023 during the Site Characterization and Alternatives Evaluation (SCAE), site soil consists of basalt ranging from gravel to fine sized particles with some larger basalt rocks. Most soil borings performed in 2023 showed basalt gravel ranging from about 0 to 55 ft bgs (DAF, 2024a).

2.1.4 Surface Water

The nearest surface water body is an intermittent stream located northwest approximately 1.9 miles downslope of the MSSC (KC Environmental Inc., 2010). No surface water features were observed within or near the AOI.

The HHAOS is built squarely on the Haleakalā's southwestern rift zone, and surface drainage at the facility is influenced by which side of Haleakalā's western rift zone water initially drains to. Water draining to the north of the rift zone is likely to continue draining in a westerly direction, while water that initially drains to the south of the rift zone will continue to drain south, with both eventually terminating in the Pacific Ocean.

Stormwater at the MSSC is generated from the surfaces encountered at the facility, including the existing buildings, roads, and parking areas. The HHAOS also has stormwater engineering features such as paved gutters, an asphalt berm, and several culverts that run into an infiltration basin located on the western portion of the facility, acting as a natural sink for the stormwater. According to the HHAOS Stormwater Management Plan (UH IfA, 2006), stormwater at the MSSC is primarily controlled via natural drainage paths due to the site's topography and the native soils can infiltrate the stormwater. Engineered drainage is not present at or near the AOI.

Based on GSINA's onsite observations and topographic maps reviewed, the topographic gradient and presumed hydraulic gradient is to the west-southwest (Figure 2, Appendix A), towards the Pacific Ocean.

2.1.5 Groundwater

Groundwater resources below the HHAOS, if present, are characterized as part of the Kamaole and Makawao systems of the Central sector and the Lualailua and Nakula systems of the Kahikinui sector (Mink and Lau, 1990)[2]. Groundwater characteristics of the Kamaole, Makawao, Lualailua, and Nakula systems are the same as those in nearby systems and sectors. Two high-level, unconfined, perched aquifers exist, one on top of the other, in dike compartments. Groundwater in both the upper and lower aquifers are identified as freshwater (containing less than 250 milligrams per liter [mg/L] of chloride [Cl-]) that have the potential for future use as drinking water, but it was not being used when the aquifer was classified. The upper aquifer is classified as being replaceable and highly vulnerable to contamination while the lower dike aquifers are classified as being irreplaceable and moderately vulnerable to contamination.

The AOI is located above the Lualailua Aquifer. Tables 2-1 and 2-2 provide information regarding the aquifers (Mink and Lau, 1990).

Table 2-1: Lualailua Upper Aquifer Classification System

Aquifer Code	**60603214**
Island Code	6 – Maui
Aquifer Sector	06 – Kahikinui
Aquifer System	03 – Lualailua
Aquifer Type, hydrogeology	2 – High Level
Aquifer Condition	1 – Unconfined
Aquifer Type, geology	4 – Perched
Status Code	**21121**
Development Stage	2 – Potential Use
Utility	1 – Drinking
Salinity (in mg/L Cl-)	1 – Fresh (less than 250)
Uniqueness	2 – Replaceable
Vulnerability to Contamination	1 – High

Table 2-2: Lualailua Lower Aquifer Classification System

Aquifer Code	**60603212**
Island Code	6 – Maui
Aquifer Sector	06 – Kahikinui
Aquifer System	03 – Lualailua
Aquifer Type, hydrogeology	2 – High Level
Aquifer Condition	1 – Unconfined
Aquifer Type, geology	2 – Dike
Status Code	**21112**
Development Stage	2 – Potential Use
Utility	1 – Drinking
Salinity (in mg/L Cl-)	1 – Fresh (less than 250)
Uniqueness	1 – Irreplaceable
Vulnerability to Contamination	2 – Moderate

[2] *Mink and Lau aquifers were drawn to mountain summits to define the general location of groundwater resources. This report was not intended to define actual aquifer boundaries and is not based on empirical data collected from the summit region*

The HDOH Safe Drinking Water Branch (SDWB) established an underground injection control (UIC) line to serve as a boundary between drinking water and non-drinking water portions of aquifers. Areas above (mountain side) the UIC line are within potential drinking water portions of the aquifer, while areas below (ocean side) the UIC are considered non-drinking water portions of the underlying aquifer. The AOI is located above the UIC line (HDOH SDWB, 2019). However, there are no drinking water wells within 11 miles of the summit (Air Force Research Laboratory, 2005).

The HDOH SDWB maintains an online database of contaminated wells throughout Hawaiʻi. GSINA's review of SDWB's database did not identify any contaminated wells within 10 miles of the site.

2.2 Cultural Land Use

Haleakalā, especially the summit (including the area on which MSSC resides), is considered sacred to the Hawaiian people and their ancestors. It is a Puʻu Honua (sacred refuge or place of peace), which both Hawaiian ancestors and modern-day Hawaiians believe is a Wao Akua, or place where gods and spirits walk. The sacred class of na poāo kāhuna (priest) used the summit area as a learning center, and in ancient times, commoners could not even walk on the summit because it belonged to the gods.

Haleakalā is an important place where traditional cultural practices have taken place for thousands of years and continue to be conducted by Hawaiian people. Examples of these cultural practices include:

- Gathering of plants:
  - Collection of ʻōhelo berries (*Vaccinum sp.*) which were traditionally offered to Pele by those who frequented the upper elevations;
  - Harvesting of the trunks and branches of the ʻaʻaliʻi (*Dodonaea viscosa*) and māmane (*Sophora chrysophylla*) for making hale (house) posts;
  - Harvesting of māmane timber for weaponry such as spears;
  - Harvesting of pōpolo (*Solanum americanum*) leaves, which were traditionally used in laʻau lapaʻau (Hawaiian medicinal practices); and
  - Collection of pūkiawe (*Syphelia tameiameiae*), lehua blossoms, māmane, and other plants and flowers for lei making (Air Force Research Laboratory and MSSC, 2010).
- Hunting of birds for food and feathers. Specifically, the ʻuaʻu (Hawaiian petrel) was well sought after because they were considered to very tasty, especially the nestlings which were reserved for the chief's consumption. In addition, the nēnē, and the extinct flightless birds *Platochen pau* and *Branta hylobadisies* were hunted (KC Environmental Inc., 2010);
- Basalt collection, which was used to craft tools;
- Training to read the stars and learning to be one with the celestial entities above;

- Honoring the Sun during the solstices and equinoxes;
- Burial;
- Birth rituals; and
- Other cultural ritual practices and ceremonies, many of which are unknown to the public as they are kept secret.

The AMP (Appendix C) and the HHAOS Management Plan (KC Environmental Inc., 2010) provide additional information related to the cultural land use at the summit and surrounding area.

2.3 Historic Land Use

The HHAOS was used by the NPS in the 1920s until the 1940s when the War Department began utilizing the site.

The MSSC has been an essential location for space surveillance and electro-optical research for over 60 years, after first being sighted as a potential observatory location in 1951. In 1961, by state executive order, the HHAOS was classified as conservation land and given to the UH to manage for the study of astronomy. The HHAOS is managed by the UH IfA on behalf of the DLNR.

UH developed plans for the MSSC which were used by the U.S. Army Corps of Engineers to begin construction in 1963, and the complex began operation in 1965 under the Air Force Systems Command. In 1980, three new domes and approximately 10,000 sf of office and laboratory spaces were constructed.

The primary use of the MSSC is to perform continuous deep space surveillance and satellite tracking, while also supporting research and development projects and collaborating with outside organizations for space-monitoring efforts.

Haleakalā is also an important place where traditional Hawaiian cultural practices historically took place (Section 2.2). Two ahu (altar or shrine) were erected within the HHAOS boundary on the west (Hinala‘anui) and east (Pā‘ele Kū Ai I Ka Moku) side of the property in 2005 and 2006, respectively.

2.4 Current/ Future Land Use

Since 1961, consistent land uses for MSSC include hosting a suite of telescopes dedicated to conducting astronomical research and advanced space surveillance. The MSSC is primarily used to perform 24/7 deep space surveillance and satellite tracking, supporting research and development projects, and collaborating with outside organizations for space-monitoring efforts. The MSSC hosts small, medium, and large-aperture tracking optics, including the largest Department of Defense optical telescope designed for tracking and imaging satellites (Space Base Delta 1, 2023).

The MSSC is likely to continue to host astronomical research and space surveillance facilities for the foreseeable future. Continued DAF use of the MSSC is contingent on renewals of leases with the Department of Land and Natural Resources and the Federal Aviation Administration in 2031 and 2027, respectively (DAF, 2024b)

Additionally, Haleakalā is currently used and will continue to be used in the future for traditional cultural practices (Section 2.2).

2.5 Investigation History

This section summarizes previous environmental investigations conducted at the site.

2.5.1 Initial Fuel Release

In response to a lightning strike on 29 January 2023, the emergency generator at MSSC leaked fuel onto the generator pad and surrounding soil. Contractor personnel working at the site discovered the leak on 30 January 2023. Approximately 700 gallons of fuel leaked onto the generator pad and flowed to the adjacent soil, impacting approximately 750 sf (6.5 ft wide by 115 ft long) in the vicinity of the generator. Site personnel reported fuel-impacted stormwater runoff flowing downslope approximately 40 ft to the southwest, impacting an estimated additional 400 sf downslope of the generator[3]. The fuel was an 80/20 mixture of low sulfur diesel and Jet A fuel oil, respectively. Notifications of the spill were made to HDOH and the EPA on 30 January 2023 (Pacific Air Forces, 2023).

2.5.2 Phase 1 Time Critical Removal Action

In March 2023, a Phase 1 Time Critical Removal Action (TCRA) was completed (NRC/US Ecology, 2023). Excavations reached a depth of 2 ft bgs, except for an area of approximately 5 ft by 5 ft, immediately north of the northeast corner of the generator pad, which extended to a depth of 3 to 4 ft bgs (Figure 4, Appendix A). Additionally, three potholes were advanced to depths up to 7 ft bgs to screen deeper soil for petroleum impacts. Field screening data via photoionization detector (PID) indicated that contaminated soil likely remained at depths at least to 7 ft bgs along the north and south sides of the generator pad, in soil beneath the generator pad, and beyond the sides of the excavations in both the upslope and downslope directions.

Excavated soil was placed into 41 supersacks, with a total estimated volume of approximately 30 cubic yards (cy). The excavated area was lined with a heavy poly sheeting IAW guidance provided by the geotechnical engineers prior to being backfilled with soil from the upgradient slope north/northeast of the generator (NRC/US Ecology, 2023). TCRA soil (supersack soil) is stored on site pending remediation.

[3] During a site visit discussion on 25 April 2024, personnel who observed the release indicated that no sheen was observed running downslope and that the release appeared to be limited to the immediate vicinity of the generator. Surface soil sampling of the slope will be conducted in tandem with subsurface sampling to delineate the lateral extent of the release.

2.5.3 Phase 2 Site Characterization and Alternatives Evaluation and Response Action Memorandum

In July 2023, a Phase 2 SCAE (DAF, 2024a) was completed to characterize site conditions, define the nature and extent of contamination, quantitatively estimate risks to human health and the environment, and produce alternatives for Phase 3 of the project (remediation). Sampling using exploratory single borehole decision units (DUs) were utilized to preliminarily identify contaminated spill areas (assess areas for presence/absence). Additionally, Phase 1 TCRA soil in the 41 supersacks were sampled using multi-increment (MI) sampling methods. The exploratory subsurface sampling analytical results indicated that the contaminated soil extended to a depth of approximately 20 ft bgs[4] (based on restricted HDOH EALs for restricted land use at the time [HDOH, 2017]) and the bulk of the release was located immediately adjacent and to the south of the generator (Figure 4, Appendix A). Concentrations of total petroleum hydrocarbons (TPH) diesel range organics (DRO) exceeded the restricted HDOH EALs in the MI samples collected from the supersacks, therefore, all soil excavated during the Phase 1 TCRA is considered impacted and should be addressed during the Phase 3 RA.

The Phase 2 SCAE investigation also identified additional data needs. It was determined that the horizontal boundary of contamination to the south, east, and west of the generator had not been delineated and site topography limited drill rig access in those directions. Also, delineation of the vertical boundary had not been established, though exceedances of restricted EALs appeared confined to 2 to 20[5] ft bgs. Therefore, additional modified MI sampling was recommended to be performed during the Phase 3 RA.

As part of the Phase 2 SCAE, a site-specific Environmental Hazard Evaluation (EHE) and human and ecological risk assessments were performed. Based on the findings of the EHE and risk assessments, RAOs were established for the site and presented in the RAM (DAF, 2024b).

The RAOs presented in the RAM are to be protective of human health and the environment and prevent exposure to DRO and associated contaminants of potential concerns (COPCs) (identified in Table 3-1) in the site via the ingestion, dermal contact, and inhalation of particulates exposure pathways at concentrations above EALs. The RAOs include the following:

- Achieve cleanup of in-situ soil to below site-specific EALs (shown in Table 2 of the RAM or Table 3-2 of this RAWP) and below Tier 1 EALs (shown in Table 3 of the RAM or Table 3-2 of this RAWP) for supersacked soil; and
- Minimize potential adverse impacts to the community and the environment during implementation of the RA.

Three remedial alternatives were considered and evaluated in the RAM: Alternative 1 No Action, Alternative 2 Land Use Controls and LT-EHMP, Alternative 3 Land Use Controls and LT-EHMP, Active Bioventing (in-situ soil only), and Aeration (supersacked soil only). Following a detailed analysis and comparison of the remedial alternatives, Alternative 3 was selected as the preferred

[4] Revised HDOH EALs were released in April 2024 (HDOH, 2024). Soil with contaminant concentrations exceeding the revised restricted EALs extended to a depth of at least 40 ft bgs in one screening boring. MI sampling will be conducted during the RA project to better delineate the vertical extent of contamination.
[5] 40 ft bgs based on revised EALs (HDOH, 2024).

remedy for addressing the environmental concerns at the site. The alternative was deemed the most advantageous for the site, striking a balance between immediate risk management and long-term contaminant treatment. The LT-EHMP will serve as the initial protective measure. It will include physical and administrative controls developed based on the findings of the EHE to manage the risks associated with subsurface contaminants. Active bioventing will treat subsurface contamination by accelerating microbial degradation of the fuel. Aeration of the supersack soil will allow impacted soil to remain on-site while reducing the contaminant mass (DAF, 2024b).

Section 3 Summary of the Environmental Hazard Evaluation

The EHE, prepared for the Phase 2 SCAE (DAF, 2024a), identified potential environmental hazards associated with COPC concentrations in site media through comparison with HDOH EALs. The environmental hazards identified were direct exposure, vapor intrusion, leaching, terrestrial ecotoxicity, and gross contamination. The EHE was not conducted for the supersack soil during the Phase 2 SCAE because the supersacks were tied shut, taped across their tops, and covered with tarps that were weighed down with cement blocks. These precautions prevented contact with potential receptors, water from entering/exiting the supersacks, and fugitive dust emissions.

3.1 Contaminants of Potential Concern

The EHE was performed for COPCs that were detected above or approaching the restricted HDOH Tier 1 EALs identified within the AOI for in-situ soil as listed in Table 3-1. The Phase 2 SCAE supersack soil sampling concentration ranges and their applicable unrestricted HDOH EALs are also shown in Table 3-1.

Table 3-1: Soil COPCs

COPC	Phase 2 SCAE In-Situ Soil Sampling Concentration Range (mg/kg)	Phase 2 SCAE Supersack Soil Sampling Concentration Range (mg/kg)	Restricted EAL[1] (mg/kg)	Unrestricted EAL[2] (mg/kg)
Toluene	0.00082 – 4.8	0.08	3.2	0.78
Ethylbenzene	0.00067 – 4.2	0.08	3.7	0.90
Xylenes, total	0.0011 – 33	0.08	2.1	1.4
TPH-DRO	5.3 – 12,032	650 - 777	210	180
1-Methylnaphthalene	0.019 – 5.8	0.160 - 0.267	4.2	0.89
2-Methylnaphthalene	0.032 – 8.5	0.170 - 0.247	4.1	1.9
Naphthalene	0.071 – 6.4	0.077	4.4	3.1

Notes:
[1] Restricted (commercial/industrial) EAL, Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air (respectively), sites not within 150 meters of a surface water body and where groundwater is a potential drinking water source (HDOH, 2024)
[2] Unrestricted (residential) HDOH EALs; Table A-2, Soil Action Levels, Potentially impacted groundwater IS a current or potential drinking water source; Surface water body IS located within 150 m of release site (HDOH, 2024).

3.2 Applicable Environmental Action Levels

For the RA sampling activities, the site will be evaluated based on a comparison of the analytical results to the Tier 1 EALs for unrestricted (residential) land use of sites within 150 meters of a surface water body and where groundwater is a current or potential drinking water source which are the most conservative EALs (Table A-2, Soil Action Levels, *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater*, *Volume 2*, *Appendix 1*; HDOH, 2024).

Any analytical results exceeding the unrestricted EALs will also be compared to the EALs for restricted (commercial/industrial) land use of sites not within 150 meters of a surface water body and where groundwater is a potential drinking water source (Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air [respectively], *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater, Volume 2, Appendix 1*; HDOH, 2024), which are applicable based on site conditions (Sections 2.1.3 and 2.1.4). Refer to the project SAP (Appendix D) Tables 4-2 and 4-3 for a detailed list of project analytes and associated screening levels.

Additionally, for RAO cleanup levels, since the supersacked soil is planned to be reused as unrestricted cover or fill in the vicinity of the fuel spill following remediation, Tier 1 EALs (unrestricted) are used as the cleanup levels for the supersacked soils. For in-situ soil, site-specific EALs (restricted) are used as the cleanup levels (Table 3-2).

Table 3-2: Soil Cleanup Goals

COPC	Cleanup Goal (mg/kg)[1]
In-Situ Soil	
Toluene	3.2
Ethylbenzene	3.7
Xylenes, Total	2.1
TPH-DRO	210
1-Methylnaphthalene	4.2
2-Methylnaphthalene	4.1
Naphthalene	4.4
Supersacked Soil	
TPH-DRO	180

Notes:
[1] Cleanup goals for in situ soil are restricted (commercial/industrial) HDOH EAL; Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air (respectively), greater than 150 meters from surface water; above a potential drinking water resource (HDOH, 2024). Cleanup goals for supersacked soil are unrestricted (residential) HDOH EALs; Table A-2, Soil Action Levels, Potentially impacted groundwater IS a current or potential drinking water source; Surface water body IS located within 150 m of release site (HDOH, 2024).
mg/kg - Milligrams per Kilogram

3.3 Nature and Extent of Contamination

On 29 January 2023, a fuel storage tank for an emergency generator released approximately 700 gallons of fuel onto the generator pad and surrounding soil at the summit of Haleakalā. This spill consisted of a roughly 80/20 mixture of diesel fuel and Jet A (ultra-refined kerosene and is predominantly C9-C16 hydrocarbons), respectively. Due to the elapsed time since the spill, the lighter Jet A components are expected to have largely evaporated, with the heavier diesel fuel remaining in site soil.

A Phase 1 TCRA was completed to remove contaminated soil to a depth of 2 ft bgs, except for an area of approximately 5 ft by 5 ft, immediately north of the northeast corner of the generator pad, which extended to a depth of 3 to 4 ft bgs. Field screening data at three pothole locations indicated that contaminated soil likely remained at depths at least to 7 ft bgs along the north and south sides of the generator pad, in soil beneath the generator pad, and beyond the sides of the excavations in both the upslope and downslope directions. Approximately 30 cy of excavated soil was placed into 41 supersacks. The excavated area was lined with a heavy poly sheeting prior to being backfilled with soil from the upgradient slope north/northeast of the generator (NRC/US Ecology, 2023).

A Phase 2 SCAE was completed to define the nature and extent of contamination (DAF, 2024a). Laboratory data indicated that the contaminated soil extended to a depth of approximately 20 ft bgs[6] and the bulk of the release was located immediately adjacent and to the south of the generator, based on restricted HDOH EALs. (Figure 4, Appendix A). Concentrations of TPH DRO exceeded the restricted HDOH EALs in MI soil samples collected from the supersacks (i.e., soil excavated during the Phase 1 TCRA from depths of 2 ft bgs, except for an area of approximately 5 ft by 5 ft, immediately north of the northeast corner of the generator pad, which extended to a depth of 3 to 4 ft [Figure 4, Appendix A]).

3.4 Environmental Hazards

Groundwater is not documented within several miles of the site. The State of Hawaiʻi DLNR provided information to the DAF in February 2023 that there is one well designated for agricultural use within 5 miles of the summit. According to the Integrated Natural Resource Management Plan (DAF, 2016), the nearest groundwater aquifer is located approximately 5.5 miles southeast of the installation at an altitude of about 6,300 ft. The depth to groundwater/perched groundwater at the summit is unknown. There is no perched groundwater known at the summit of Haleakalā, and the SCAE investigation did not encounter groundwater in any of the borings advanced, which reached depths of 80 ft. This lack of groundwater presence at shallow depths suggests that there is no potential for human or ecological receptors to come into contact with groundwater at the site and the direct exposure pathway is considered incomplete. Also, the drinking water exposure pathway is considered incomplete because the likelihood of leaching to groundwater is minimal. However, to further confirm this assessment, Synthetic Precipitation Leaching Procedure data will be collected during the Phase 3 RA to provide evidence supporting the conclusion that the potential for contaminants to reach and impact groundwater is minimal.

Stormwater is the most likely source of surface water at the site. Current and future potentially complete exposure pathways for stormwater ponding at the site were eliminated due to the Phase 1 TCRA excavation, placement of a heavy poly liner, the presence of a clean fill cap within the AOI, and the type of soil present. There are no surface water features within 150 meters of the spill location, which eliminates surface water as a potential pathway for human and/or ecological receptors.

[6] *HDOH EALs have since been updated. When compared to the revised EALs, contamination exceeding the restricted EALs was encountered to a depth of at least 40 ft bgs in one boring.*

Leaching, gross contamination, and direct exposure of soil to current and future construction/trench workers and terrestrial ecological habitats were identified as the primary potential hazards at the site.

Leaching is not anticipated to pose a significant environmental hazard at the site due to the considerable depth of groundwater beneath the AOI (based on the lack of presence of groundwater encountered during previous investigations as stated above), the plastic liner placed after excavation, and the clean fill cap. Additional data to evaluate leaching potential to deeper soil will be collected during the RA project.

Gross contamination is also not expected to pose a significant hazard except during construction activities (e.g., utility work, drilling, soil sampling) where best management practices (BMP) and control measures will be implemented to mitigate exposure risks.

Direct exposure hazards to terrestrial ecological habitats were eliminated by excavating and replacing the top several ft of impacted soil with clean fill. While exposure hazards are minimized at the surface, there remains potential for exposure to current and future construction and trench workers within the subsurface contaminated zone (2 to 40 ft bgs within the AOI). If subsurface contaminated soil is encountered or brought to the surface during excavation or sampling activities, appropriate health and safety measures will be implemented. These measures include dust suppression, containment, and waste handling protocols to prevent worker exposure to hazardous materials. A site-specific health and safety plan will be developed to include these BMPs for any project activities involving ground disturbance within the AOI. Minimal exposure to construction or trench workers may occur during remediation of TCRA-stored (supersacked) soils.

3.5 Conceptual Site Model

A summary of the AOI conceptual site model (CSM) is presented in Table 3-3 below.

Table 3-3: CSM Summary

Primary Source(s)	Primary Release Mechanism(s)	Secondary Source(s)	Potential Environmental Hazards		Hazard Present Under Site Conditions	
					Current	Future
Generator	Spill	Soil	Risk to Human Health[1]	Direct Exposure	No	Yes
				Vapor Intrusion into Buildings	No	Yes[8]
			Risk to Terrestrial Ecological Habitats[2]		No	No
			Leaching[3]		Yes	Yes
			Gross Contamination[4]		Yes	Yes
		Groundwater	Risk to Human Health[5]	Direct Exposure	No	No
				Vapor Intrusion into Buildings	No	No
			Risk to Aquatic Ecological Habitats[6]		No	No
			Gross Contamination[7]		No	No
		Soil Vapor	Vapor Emissions		Yes	Yes

Notes:
[1] Includes direct exposure to contaminated soil, vapors and dust from soil, and vapor intrusion into overlying buildings.
[2] Assumes significant terrestrial, ecological habitat is impacted by contamination with resulting toxicity to flora and fauna.
[3] Although leaching from soil to groundwater is unlikely at this site, it is not ruled out as the liner may not prevent infiltration in all impacted areas.
[4] Includes potential explosive hazards, odors, interference with construction work (e.g., soil reuse and disposal), and related concerns.
[5] Based on ingestion of contaminated groundwater, via dermal exposure, and vapors during showering and other water use.
[6] Assumes discharge of contaminated groundwater into an aquatic habitat; COPCs in groundwater screened using acute aquatic toxicity levels for sites greater than 150 meters from a surface water body.
[7] Includes potential taste and odor concerns for drinking water, presence of free product, explosive hazards, odors, sheens, interference with construction work (e.g., dewatering), and other related concerns.
[8] Potential future risk if new building is built overlying or adjacent to fuel spill site.

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Section 4 Remedial Action Tasks

To address the potential exposure to contaminated soil, RAOs were established for the site to be protective of human health and the environment and prevent exposure to DRO and associated COPCs (identified in Table 3-1) in the site via the ingestion, dermal contact, and inhalation of particulates exposure pathways at concentrations above EALs. The RAOs include the following:

- Achieve cleanup of in-situ soil to below site-specific EALs (shown in Table 2 of the RAM or Table 3-2 of this RAWP) and below Tier 1 EALs (shown in Table 3 of the RAM or Table 3-2 of this RAWP) for supersacked soil; and
- Minimize potential adverse impacts to the community and the environment during implementation of the RA (DAF, 2024b).

Potential exposure to the COPCs within the site is limited by controlled access to the facility and the location of the remaining contamination in the subsurface. In addition, clean surface fill placed over remaining contamination following the TCRA represents a de facto exposure barrier to the remaining soil. The large vertical and horizontal distances from the release area to potential groundwater sources coupled with the relatively small volume of fuel spilled precludes the possibility that the release could migrate to groundwater and affect a water supply. Therefore, groundwater RAOs are not considered for this release (DAF, 2024b).

Refer to Section 5.5 of the SAP (Appendix D) for details on the RA decision rules.

A RAM (DAF, 2024b) presented the preferred remedial alternative for the site which would address the site’s current conditions, both the in-situ and excavated contaminated soil, and safeguard against potential future risks as described in the section below.

4.1 Description of the Selected Remedial Alternative

The preferred remedy for the site is land use controls, LT-EHMP, active bioventing, and aeration. The preferred remedy will address the site’s current conditions, both the in-situ and excavated contaminated soil, and safeguard against potential future risks.

Land use controls will be physical and administrative mechanisms (e.g., clean fill cap, plastic liner, dig permits) developed based on the findings of the EHE to manage risks associated with subsurface contaminants. The LT-EHMP is required for managing contamination in place and will provide pre-planned measures for protecting human and ecological receptors from exposure and periodic inspections to ensure the land use controls remain effective. Active bioventing will treat subsurface contamination by accelerating microbial degradation of the fuel. Aeration of the supersack soil will allow impacted soil to remain on site while reducing the contaminant mass.

4.2 Project Goal

The primary goal is to implement the remedy selected by the RAM as described in Section 4.1, which includes remediation of the contaminated soil through active bioventing (in-situ soil) and ex-situ aeration (ex-situ soil), to achieve the RAOs. Additionally, the RA activities to be performed at Site SS014 during Phase 3 will address data gaps to further define the nature and extent of contamination within the AOI to allow for final decision-making.

4.3 Remedial Approach

The selected remedy (i.e., land use controls, LT-EHMP, active bioventing, and aeration) is deemed the most advantageous for the site, striking a balance between immediate risk management, long-term treatment, and addressing community and cultural concerns. This integrated strategy synergizes the protective measures of a LT-EHMP and associated land use controls with the active remediation capabilities of active bioventing for in-situ soil and aeration for previously excavated (supersacked) soil. The rationale for this preferred alternative is predicated on its comprehensive ability to provide both immediate and long-term protection to human health and the environment.

Section 5 Description of Project Activities

The project tasks for the RA scope of work are summarized in the sections below. Refer to the SAP (Appendix D) for details regarding sampling and characterization activities. Also refer to the O&M Plan (Appendix G) for details on O&M of the active bioventing system.

During field activities, personnel will strictly adhere to the HSP (Appendix E). Field personnel will consist of a Field Manager, Site Safety and Health Officer, and field technicians. Additionally, a qualified archaeological monitor will be present during all ground disturbing activities (e.g., bioventing well installation, soil sampling) associated with the project. If an archaeological site or burial site is inadvertently discovered, all work in the immediate area shall cease and the area will be protected. Both the installation Base Civil Engineer and the installation Cultural Resource Manager will be notified of the find by the onsite archaeologist. If a cultural artifact is identified, it will be inspected by the archaeological monitor and handled IAW the AMP (Appendix C). The installation Cultural Resource Manager will make any notifications to the required agencies as necessary. Refer to the AMP for details on archaeological monitoring procedures. Additionally, the DAF will provide a cultural advisor/monitor who will be on site during the Phase 3 RA field activities and will inspect all soil samples prior to removal from the summit.

Also, although not anticipated, if any rare, threatened, or endangered species are identified within RA work areas, they will be immediately reported to the DAF. Refer to the EPP for additional details (Appendix F).

5.1 Project Planning and Management

GSINA is the prime contractor for the project and will be responsible for the overall performance of the RA field activities, project reporting, and communicating with the DAF. This section provides general information on personnel, communication and reporting, and deliverables. The project schedule is provided in Section 6 and reporting is discussed in Section 5.12.

The GSINA management team will consist of competent personnel experienced in environmental remediation services. Key project personnel include the Project Manager, Corporate Quality Manager, Corporate Health and Safety Manager, Project Chemist, Field Manager, and Site Safety and Health Officer. Refer to Table 5-1 for key project personnel contact information and Figure 5-1 for the project organizational chart.

The success of the project depends on proactive and open communication among the key project personnel. Such communication ensures a mutual understanding of the intent of the project. Project meetings will be coordinated to discuss planning and scheduling, review/discuss project deliverables, and present field data and information, as necessary. Meeting attendees will vary based on the agenda items for discussion.

In addition to this RAWP, planning documents prepared for the project include an AMP (Appendix C), SAP (Appendix D), HSP (Appendix E), EPP (Appendix F), and O&M Plan

(Appendix G), as described in Section 1.2. Also, a detailed project schedule (Gantt chart) and monthly project status reports will be provided.

GSINA will be responsible for permits and licenses that are applicable for conducting work at the site. The DAF will be responsible for notifications to local, state and federal agencies. Based on initial review, the following notifications and permits may be required:

- Public and Private/Facility Specific Utility Locate (GSINA will require the DAF and/ or Facility Representative assistance);
- Notifications to HDOH and the Community; and
- NPS Special Use Permit (Commercial & Construction Vehicle Access) (Appendix B).

Table 5-1: Project Personnel and Contact Information

Name	Title/Role	Organization	Phone Number	E-mail Address
Jennah Oshiro	Regulatory Agency	HDOH	[redacted]	[redacted]
Alexander Casey	Contracting Officer	USAF	[redacted]	[redacted]
Tracy Kissler	Contracting Officer's Representative	USAF	[redacted]	[redacted]
Jennifer Wehrmann	Remedial Project Manager	USAF	[redacted]	[redacted]
Michael Rachanow	Base Civil Engineer	USAF	[redacted]	[redacted]
William "Charlie" Lawton	Cultural Resource Manager	USAF	[redacted]	[redacted]
Larry deVries	Munitions and Environmental Division Manager	GSINA	[redacted]	[redacted]
Eric Wetzstein	Environmental Program Manager	GSINA	[redacted]	[redacted]
Bryan Chinaka	Project Manager	GSINA	[redacted]	[redacted]
Courtney deVries	Corporate Quality Manager	GSINA	[redacted]	[redacted]
Carl McGraw	Corporate Health and Safety Manager	GSINA	[redacted]	[redacted]
Kathie Englert	Quality Manager	GSINA	[redacted]	[redacted]
Rachel DeRosa	Project Chemist	GSINA	[redacted]	[redacted]
Kimberly Kim	Field Manager/Geologist	GSINA	[redacted]	[redacted]
Craig Morris	Site Safety and Health Officer	GSINA	[redacted]	[redacted]
Alejandro Conde	Geographic Information Systems Analyst / Data Manager	GSINA	[redacted]	[redacted]
Ned Murphy	Geochemist (Subject Matter Expert)	Central Planet Repair[1]	[redacted]	[redacted]
Tanya Lee-Greig	Archaeological Monitor (Principal Archaeologist)	‘Āina Archaeology[1]	[redacted]	[redacted]
Kevin Rogers	Drilling Subcontractor Project Manager	GeoTek Hawaii, Inc.[1]	[redacted]	[redacted]
Chris Hayes	O&M Work	C Hayes Excavation[1]	[redacted]	[redacted]
Canaan Shon	Utility Clearance Support (Ground Penetrating Radar)	Hawaii Geophysical Services[1]	[redacted]	[redacted]
Shelby McCabe	Analytical Laboratory (Soil)	Eurofins[1]	([redacted]	[redacted]

Name	Title/Role	Organization	Phone Number	E-mail Address
Harry O'Neill	Analytical Laboratory (Soil Vapor)	Beacon Environmental Services, Inc.[1]	[redacted]	[redacted]
Christian Polanco	Analytical Laboratory (Microbial DNA)	Microbial Insights, Inc. [1]	[redacted]	[redacted]
Mark Forsyth	Third-Party Data Validator	Synectics[1]	[redacted]	[redacted]

Notes:
Field personnel may change and qualifications will be verified at the time of field operations.
[1] Subcontracted by GSINA as the prime contractor.
DNA - Deoxyribonucleic Acid
TBD - To Be Determined
USAF - U.S. Air Force

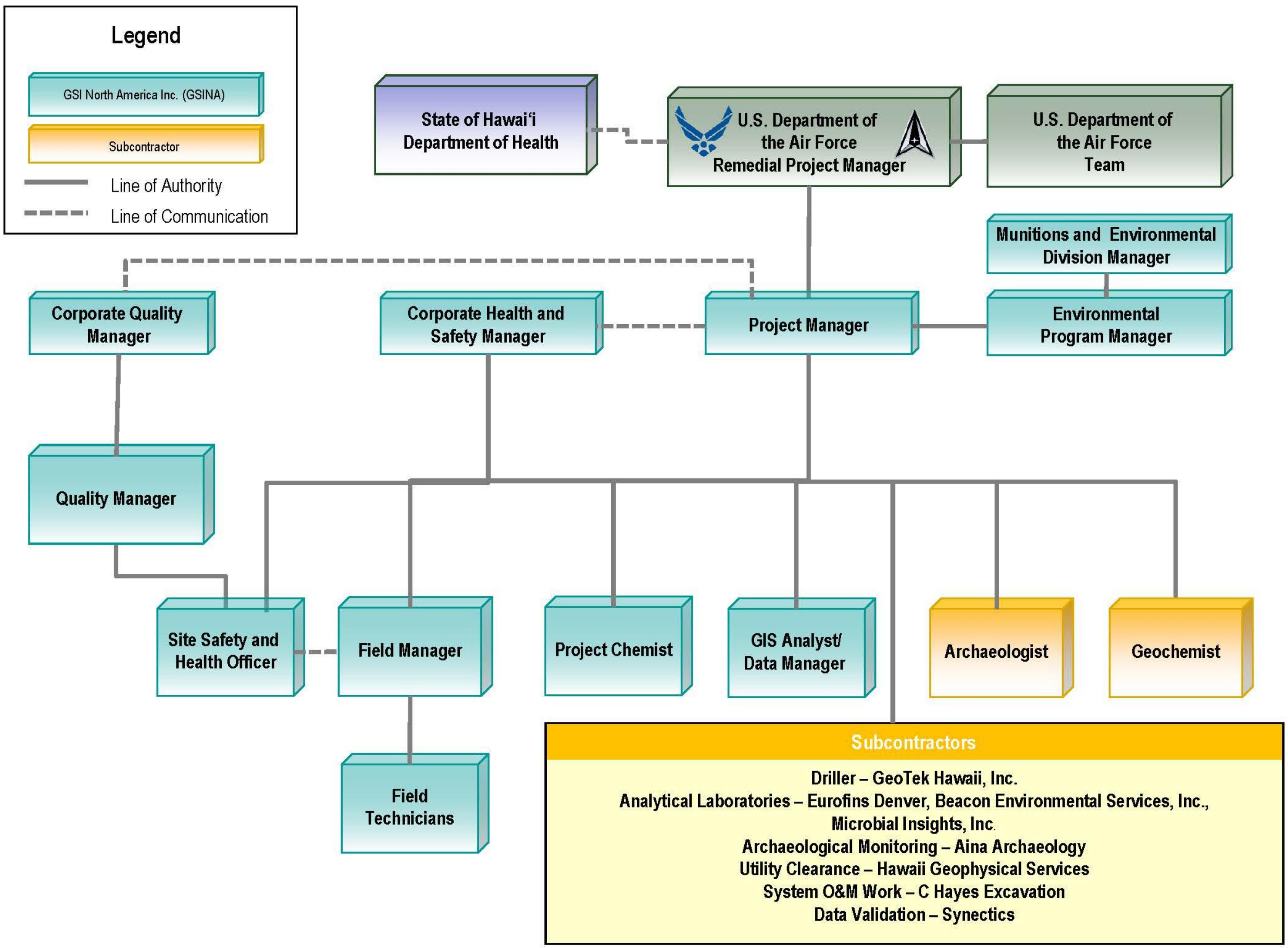

Figure 5-1: Project Organizational Chart

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5.2 Community Engagement

The DAF holds bi-weekly (every other week) meetings with local community members. GSINA will support the DAF and present technical information and provide logistical support (e.g., facilities, audiovisual, handouts, report(s), recordings, verbatim transcripts, translations, slides, synopsis) for events and/or meetings.

5.3 Mobilization and Site Preparation

5.3.1 Mobilization

Prior to mobilization and annually throughout the project, all project personnel (both on site and in office) will watch the film "Haleakalā: A Sense of Place" which aims to educate and foster a sense of stewardship for the cultural significance and natural diversity found on Haleakalā (https://amostech.com/haleakala-sense-of-place/). The pre-mobilization and annual review of the video will be documented on a training log form.

Field mobilization will begin with travel coordination and contractor pre-screening to facilitate site access. Upon planning document approval and notification to proceed, the project team will mobilize the necessary personnel and equipment to the site. GSINA personnel will finalize coordination efforts with the DAF personnel on any pertinent items that are needed to execute the project in a safe and efficient manner.

Readiness reviews will be conducted to verify that personnel are properly prepared to execute the planned fieldwork activities. Once on site, field personnel (including subcontractors) will be familiarized with the site and evaluate routes of ingress and egress. Before field operations commence, all personnel will attend a site-specific indoctrination training. The purpose of the training will be to review field activities, project equipment, and emergency response procedures as specified in the project RAWP, SAP, and HSP. Training attendance forms will be used to document the completion of each training session.

All equipment that is required to be inspected and approved by the NPS will be scheduled prior to mobilization to the summit. A tentative list of planned equipment for use during RA field activities is provided in Table 5-2. A copy of the NPS permit is included in Appendix B. Prior to mobilization, all equipment will be sanitized for bioenvironmental/invasive species IAW NPS guidance to ensure that non-native/invasive species are not introduced to the site (refer to the EPP [Appendix F] for additional details). Equipment will also be furnished with spill response kits and fire extinguishers IAW the HSP (Appendix E). Additionally, equipment will be inspected daily by GSINA personnel/subcontractors prior to use.

Multiple mobilizations may be required to install additional soil gas monitoring points and bioventing wells. Field personnel intend to access the site on a regular basis to maintain the bioventing system and inspect the landfarm. A final mobilization, as part of this effort, will include decommissioning the bioventing system and the landfarm. If the drill rig is demobilized from the site following the initial bioventing well installation, it will require approximately three to four weeks to schedule a remobilization of the equipment.

Table 5-2: Planned Equipment List

Equipment[1]	Quantity[2]	Utilization[3]
Trucks	TBD	Site operations
Drill rig	1	Soil sampling and well installation activities
Drill rig support truck	1	Soil sampling and well installation activities
Water truck or trailer	1	Soil boring support and decontamination (washing tools and sampling equipment)
Forklift	1	Move/stage the supersacks during the landfarm activities
Mini-excavator	1	Soil sampling and well installation activities
Skid steer loader	1	Move the soil to the final resting place at the end of landfarm activities
PID	2	Carry out health and safety monitoring to determine possible worker hazards and exposures; screen soil samples, measure soil vapor gas during O&M
Multi-gas meter	1	Carry out health and safety monitoring to determine possible worker hazards and exposures; measure parameters during characterization and active bioventing system O&M activities
Various small equipment	various	Soil sampling and well installation equipment (Terra Core®, slide hammer, coolers, spatula, silica sand, etc.), hand tools (hammers, impact drill, saw, etc.) to construct the landfarm
55-gallon drums on pallets with spill containment	TBD	Investigation-derived waste containment for soil sampling, well installation/sampling activities

Notes:
[1] The exact types of equipment to be utilized will be determined by availability and may change based on field observations or as conditions change.
[2] The exact quantity of each piece of equipment may be changed to meet the proposed schedule.
[3] The intended use may change as required to meet project objectives.

5.3.2 Site Preparation

Site preparation activities will consist of setting up temporary facilities and staging areas, locating utilities, and surveying sampling locations, DU boundaries, and well installation locations.

The primary staging area will be established next to the existing generator or at an alternative location as determined by the DAF personnel. Field personnel will work out of the vehicles and/or the Butler Building (as authorized) located on the north side of the MSSC. The staging area may be used for staging equipment. All equipment (i.e., drill rig and support vehicle) will be placed on hardstand (concrete or asphalt) and covered in plastic when not in use (each night).

A Global Positioning System (GPS) unit will be used to record bioventing well installation locations, DU boundaries, landfarm locations, etc. Locations will be temporarily marked with pin flags or stakes as applicable, and GPS coordinates will be collected for each location. The GPS will also be used to relocate prior boreholes and the excavation footprints from the prior field activities. Refer to standard operating procedure (SOP) G-2 *Surveying and Mapping* (Attachment B of the SAP [Appendix D]) for additional details.

Utilities will be identified and marked with flagging/stakes prior to subsurface activities. Utilities will be identified by reviewing historical documents/reports, performing a site walk to confirm visible above-ground utility features, conducting public and private utility locates (e.g., using ground penetrating radar and electromagnetic survey [or similar]) as necessary, and notifying the applicable local utility owner(s). Soil boring and bioventing well installation locations will be compared against known utility information and boring/bioventing well locations will be relocated for avoidance as necessary.

5.4 Bioventing Well Installation

Prior to well installation, a ground penetrating radar and electromagnetic survey will be performed to locate subsurface utilities and other obstructions (Section 5.3.2).

A total of 10 bioventing wells will be installed across six locations (four nested[7] well locations [with two wells at each location] within the spill area and two locations [with a single well at each location] downslope of the spill area) as part of an active bioventing system to remediate petroleum-contaminated soil at the site. At the four nested well locations, there will be two 2-inch inside diameter bioventing wells installed at 25 ft bgs (screened from 5-25 ft bgs) and 50 ft bgs (screened from 30 to 50 ft bgs). The bioventing wells were selected to be screened from 5-25 ft bgs and 30-50 ft bgs to divide the contaminated zone in half as the higher COPC concentrations were located in the upper half. At the two single well locations, there will be a 2-inch inside diameter bioventing well installed at 30 feet bgs (screened from 5-30 ft bgs). At each of the four nested bioventing well locations, direct push soil cores will be used to collect soil samples as described in Section 5.6. There will be no soil sampling conducted at the two single inlet well locations. The pilot holes (direct push holes generated by direct push technology [i.e., Geoprobe® Soil Probing Machine]) at each location (and the two single inlet well locations without pilot holes) will then be over drilled with an 8-inch diameter hollow stem auger and 2-inch inside diameter well casings will be inserted into the holes generated by the hollow stem auger; this will establish the 10 bioventing wells. Refer to SOP ENV-10 *Bioventing Well Installation and Abandonment* (Attachment B of the SAP [Appendix D]) for details on well installation.

Downhole tooling will be decontaminated with water and Alconox® (or similar). Decontamination water will be added to the cuttings landfarm for onsite evaporation as detailed in the Waste Management Plan (Attachment C of the SAP [Appendix D]).

If deemed necessary, in the future, up to three additional soil gas monitoring points and three vent wells to 40 ft bgs may be installed at the site, upon DAF approval.

[7] *Nested wells referenced for this project are defined as wells installed into co-located borings.*

5.5 Landfarm Installation, Management, and Decommissioning

One landfarm will be established at the site and used to remediate cuttings generated during active bioventing well installation activities that exhibit evidence of contamination and TCRA (supersack) soil previously excavated from the AOI.

5.5.1 Soil Cutting Screening

Headspace readings using a PID will be collected from soil cuttings generated from the soil boring and bioventing well installation activities to assist with soil segregation. Cuttings with peak headspace readings below 10 parts per million (ppm) will be spread on the surface in the vicinity of the boring from which they originated. Cuttings with peak headspace readings greater than 10 ppm will be containerized and stored on site in supersacks or drums until the volume requiring remediation is determined. Once the total volume of cuttings requiring remediation and TCRA supersack soil is known, a landfarm will be constructed as described in Section 5.5.2.

5.5.2 Landfarm Construction

The landfarm will be constructed as follows and as shown on Figure 5-2:

- Placing two layers of geotextile fabric on asphalt to mitigate the chance of puncture;
- Erecting a continuous 2-ft-high retaining wall via 2x4 lumber and plywood stored at the equipment staging area on site;
- Lining the holding cell with minimum 20-mil polyethylene sheeting, both on the floor and on the interior of the retaining walls:
  - Sheeting will be fastened to the exterior of the containment wall to minimize punctures within the holding cell; and
  - A board will be secured to the outside of the retaining walls, over the plastic fastening, to securely anchor the sheeting.
- Placing plywood on the floor of the containment, on top of the plastic sheeting;
- Placing slotted polyvinyl chloride pipes throughout the containment to increase natural airflow and ventilation throughout the soil layer instead of only from the exterior. The pipes will be evenly spaced and placed horizontally throughout the short axis of the containment area;
- Transporting the supersacks stored on site to the holding cell location and placing the soil within the holding cell;
- Covering the holding cell and soil with a layer of geotextile fabric; and
- Anchoring the cover sheeting in a manner that will withstand storm events but that may still be removed for periodic O&M (e.g., placing wood or cinder blocks [or similar ballast weights] and ropes/straps across the top to hold down the cover and stop the cover from flapping in the wind).

Two proposed locations for the landfarm are shown on Figure 5 (Appendix A), one of which will be selected for the landfarm installation. The landfarm will be maintained IAW the O&M Plan (Appendix G).

5.5.3 Sampling and Maintenance

During landfarm construction, GSINA will collect a discrete soil sample for microbial DNA analysis to assess the presence of microbes involved in aerobic and anaerobic biodegradation of TPH and associated constituents. Samples will be collected using a flat-bottom scoop as described in Section 6.2.2 of the SAP (Appendix D). It is not anticipated that there will be insufficient levels of biodegrading microorganisms present; however, if the situation occurs, the results will be discussed with the DAF and the need for corrective actions will be assessed. Additionally, MI samples comprising 60 increments will be collected from the landfarm for analysis of benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), and TPH-DRO as described in Section 6.2.2 of the SAP.

After one year of ex-situ aeration, confirmation MI samples will be collected from the landfarm using the same methods as the initial samples and will be analyzed for BTEX, PAHs, and TPH-DRO and the results will be compared to the cleanup goals (i.e., Table 3-2; unrestricted HDOH Tier 1 EALs). Soil sampling will be conducted at the landfarm DU following annual turning of the soil as described in the O&M Plan (Appendix G). Detailed sampling methods are provided in the SAP (Appendix D).

Additional years/months of operations and maintenance of the landfarm will be conducted IAW the O&M Plan. Confirmation samples will be collected annually as described in the SAP (Appendix D) until COPC concentrations fall below the unrestricted EALs.

5.5.4 Landfarm Decommissioning

Decommissioning of the landfarm will be performed per the direction of the DAF and as described in Section 5.5.2 of the SAP (Appendix D) for the following scenarios:

- If landfarm soil confirmation samples indicate concentrations of all COPCs are less than the restricted EALs, the soil may be reused on site within the AOI and managed as in-situ soil under the LT-EHMP; or
- If landfarm soil confirmation samples confirm COPC concentrations less than or equal to the unrestricted EALs, the soil may be reused on site, both within and outside of the AOI.

If landfarm soils contain COPC concentrations exceeding the clean-up goals and above the unrestricted EALs, the soil will remain in the appropriate landfarm to be managed.

Decommissioning of the landfarm may also occur if it is determined that contaminant concentrations are not being further reduced by the landfarm. Note, the landfarm may not remain at the site indefinitely and will eventually need to be decommissioned and removed.

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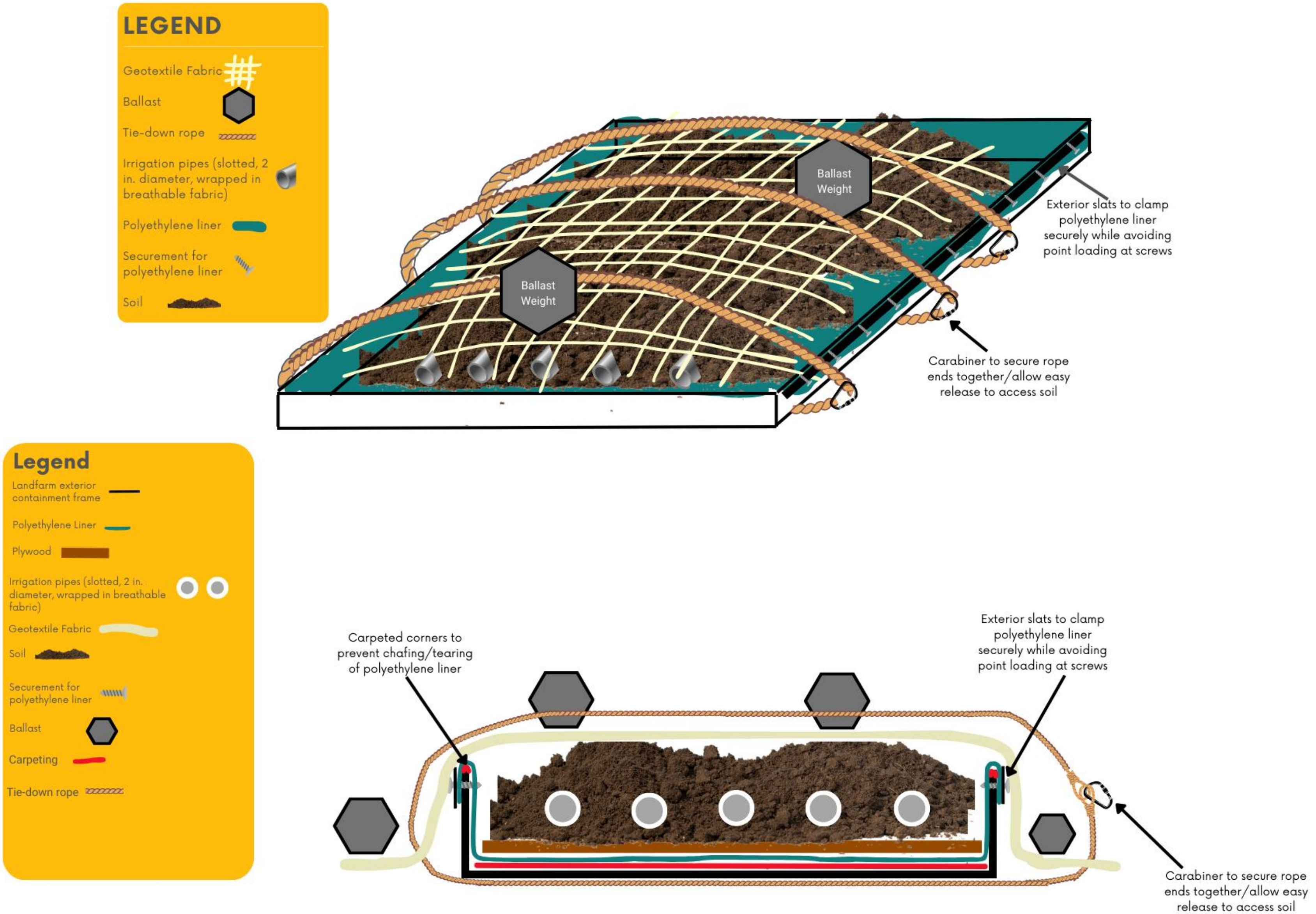

Figure 5-2: Landfarm Diagrams

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5.6 In-Situ Soil Sampling and Analysis

In-situ soil samples will be collected for additional site characterization of the fuel spill area utilizing the HDOH HEER Office TGM MI soil sampling approach. Surface and subsurface DUs will be established to identify areas of contamination. Surface boundary DUs (RA-B1 to RA-B5 and additional stepout surface boundary DUs [RA-B6 to RA-B13]) (Figure 5, Appendix A) and lateral subsurface DU (RA-S1) (Figure 6, Appendix A) and its associated vertical DU layers will be established. A modified MI sampling approach will be utilized for subsurface DUs due to significant site access limitations. Refer to the project SAP (Appendix D) for details on the number and locations of the surface and subsurface DUs.

Surface DU soil sampling will be accomplished using a flat-bottom scoop and disposable Terra Core® (or similar). Subsurface DU soil sampling will be accomplished utilizing the direct push rig and 5-ft Macro-Core® samplers. Soil samples will be analyzed for BTEX by EPA method 8260D (with modified 5035 preparation [refer to Section 6.3.1.3 of the SAP]) (volatile analysis for subsurface samples only), TPH-DRO by method EPA method 8015D, and PAHs by EPA method 8270E by an analytical laboratory accredited under the Department of Defense Environmental Laboratory Accreditation Program (i.e., Eurofins Denver). Soil leachate via Synthetic Precipitation Leaching Procedure by EPA method 1312 will also be analyzed for the same analytes as stated above. Specific analytes are presented in Tables 4-2 and 4-3 of the SAP (Appendix D).

Additionally, discrete soil samples will be collected from each vertical layer in RA-S1 (12 samples total) for microbial qualitative polymerase chain reaction (qPCR) analysis to assess the presence of the functional genes of microbes involved in aerobic and anaerobic biodegradation of TPH and associated constituents. Samples will be collected using a flat-bottom scoop. Refer to Section 6.3.1.1 of the project SAP for details on sample collection.

Refer to the SAP (Appendix D) for details on in-situ soil sampling activities and analysis.

5.6.1 Confirmation Sampling

Surface and subsurface confirmation samples will be collected from each DU with COPC concentrations exceeding the most conservative EALs (i.e., unrestricted HDOH Tier 1 EALs[8]), using the same methods as the initial samples from the Phase 3 DUs. Additional confirmation samples will be collected as necessary IAW with the SAP decision statement section (SAP Section 5.5.1). As described in Section 5.5.1 of the SAP, HDOH guidance includes stipulations regarding if/when/how many confirmation samples need to be collected based on the relative standard deviations (RSDs) of the initial results. Since this information is currently unknown, it can only be estimated that the need for collection of confirmation samples in the source DU (the subsurface samples) will be approximately three years after system installation, but the timeline will be adjusted based on system performance (and the results of the initial RA sampling). Surface confirmation sampling will depend on the results and methods chosen to address the soil if EAL

[8] *Unrestricted sites within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

exceedances are detected (e.g., based on the results, DAF may decide to excavate the soil and add it to the landfarm, or leave it in place for management by land use controls under the LT-EHMP [e.g., install fencing]). To ensure project team concurrence, after the results from the initial sampling is received and data evaluated (SAP Section 5.5.1), the proposed follow-on confirmation sampling or alternative path forward (e.g., leave in-place, excavate to landfarm) will be presented to the project team for review prior to sampling.

Once all analytes are below the cleanup levels (i.e., Table 3-2; restricted HDOH EALs[9]), the active bioventing system can be decommissioned, removed, and the site restored. However, an LT-EHMP is required as long as any contaminants remain on site at concentrations exceeding the unrestricted EALs. Refer to Section 5.5 of the SAP (Appendix D) for details on the RA decision rules.

5.7 Active Bioventing System Installation, Management, and Decommissioning

Bioventing is an in-situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents sorbed to soils in the unsaturated zone (EPA, 2017). The activity of indigenous bacteria is enhanced by increasing oxygen flow through the unsaturated zone, using injection wells, and is effective in remediating releases of petroleum products. Bioventing can be performed as an active or passive technology. In passive technology, the gas exchange through the vent wells occurs only by the effects of barometric pressure. GSINA will implement active bioventing, using a FALCO 300 blower to draw ambient air into the subsurface through wells outside the contaminated region. This will draw additional oxygen through the contaminated zone and allow for more efficient biodegradation via indigenous microbes.

The FALCO 300 system will provide an added benefit of capturing volatile organic compounds (VOCs) from the subsurface and efficiently destroying them via catalytic oxidation. VOCs are mixed with dilution air, electrically heated to reactive temperature, and then pass through a metal catalyst where they are converted to carbon dioxide, water, and heat which is then recovered through a heat exchanger. Startup and operation for the active bioventing system are detailed in the project O&M Plan (Appendix G).

The active bioventing system will comprise the FALCO 300, its housing, and a network of 10 individual bioventing wells that will be installed as described in Section 5.4. The proposed installation location of the active bioventing system housing container and connection lines are shown on Figure 7 (Appendix A).

The blower package combines with the FALCO 300 catalytic oxidizer to form an integrated vapor extraction and treatment system (Figures 5-3 and 5-4). The blower is 10 horsepower, three phase, explosion proof, and regenerative. Components of the system are mounted on frames joined by forklift beams. One frame supports the blower, Vapor Control Valve (Figure 5-4), and accessories. The second frame supports the FALCO 300 system (Figures 5-3 and 5-4). The total system weighs 1,425 pounds and is 4 ft wide, 5 ft and 7 inches long, and 6 ft 2 inches tall. The system will be

[9] *Restricted sites not within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

housed in a 20-ft storage container to protect it from the elements and severe weather that often occurs on the Haleakalā summit.

Upon request and written approval by the DAF, a bypass around the oxidizer can be accomplished as long as the untreated vapor stream is diverted and not run through the cold oxidizer. Any changes to the system will need to be documented (in writing and the system vendor must be notified) and a warning label will need to be posted to the FALCO control panel not to operate the blower package. If the oxidizer needs to be run again, all system components can be put back into the original configuration. The return to the original system configuration will also be documented. Refer to the O&M Plan Section 3.2.2 for additional details.

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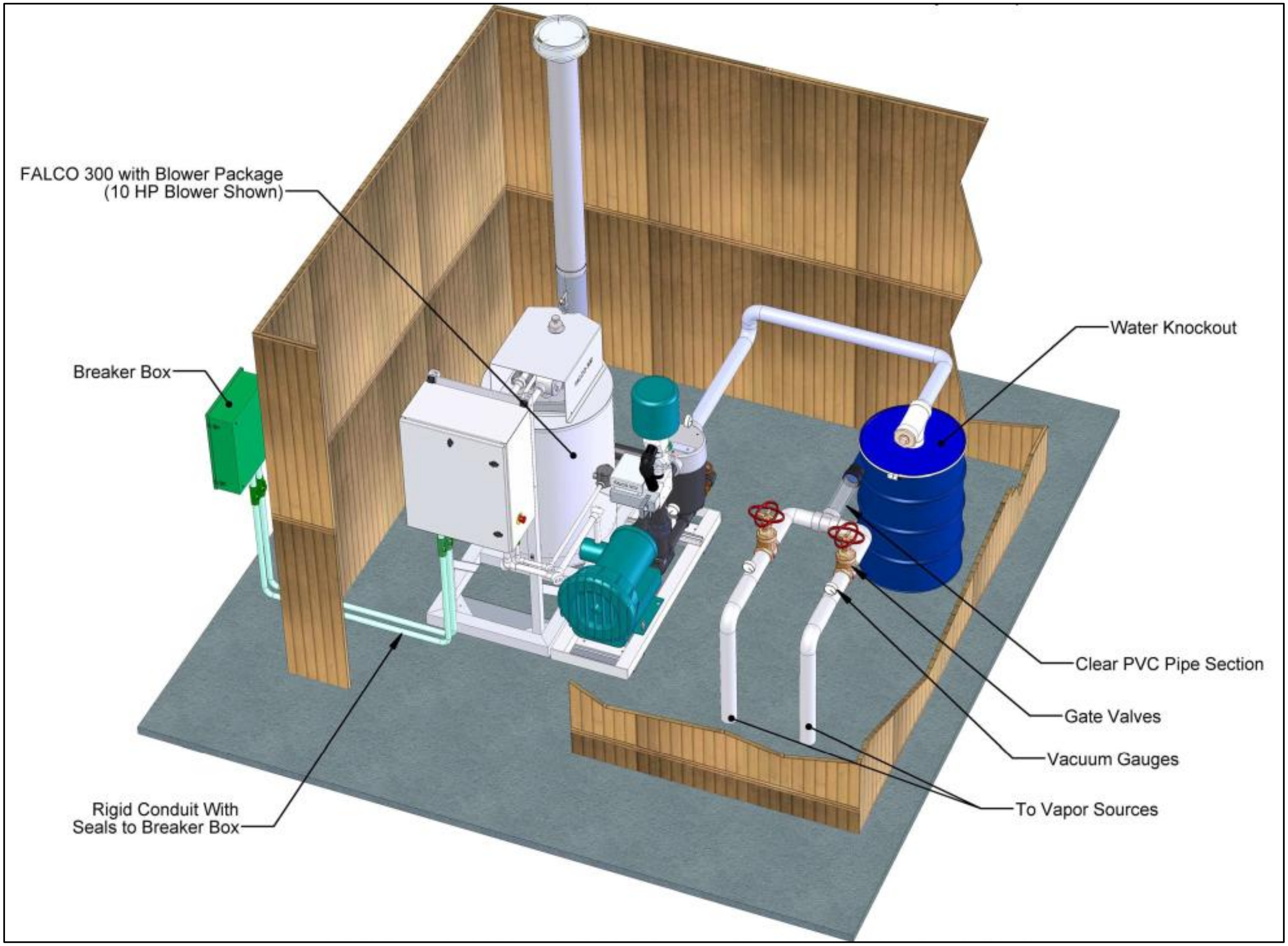

Figure 5-3: FALCO 300 Regenerative Blower Package, 3-Dimensional View

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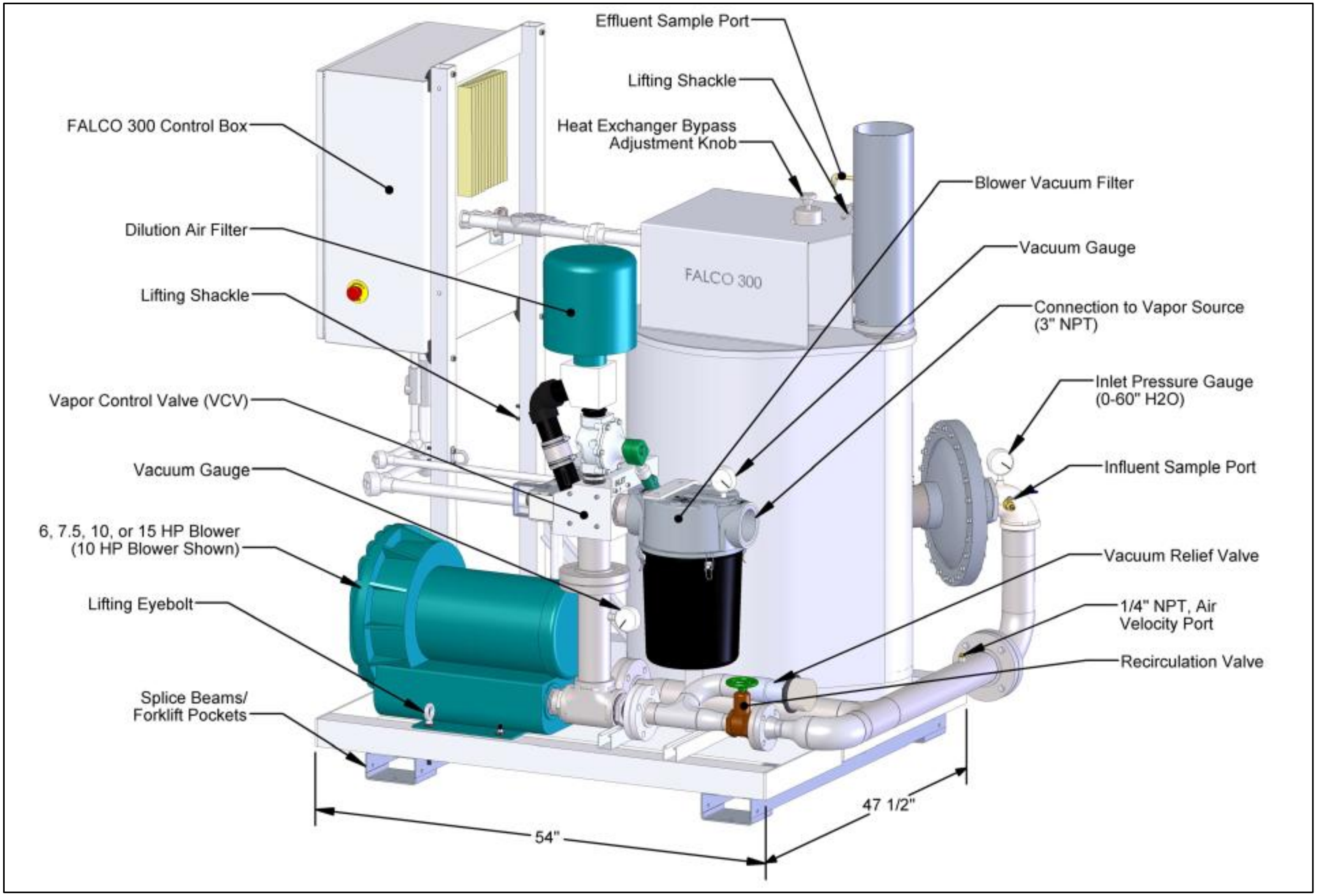

Figure 5-4: Major Components of FALCO 300 with Regenerative Blower Package

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As described in Section 5.4, the 10 wells will be grouped into four sets of nested wells comprising two wells each, in the generator vicinity; and two single wells downslope. Each well will be 2inches in inside diameter with an 8-inch annulus (void surrounding the 2-inch inside diameter well casing).

The four sets of nested wells will be installed within the spill area, manifolded together, and connected to the FALCO 300 (Figure 5-5). The remaining two single wells will be placed outside the spill area and serve as a pathway for ambient air to enter the subsurface. The two single wells are not connected to the FALCO 300 system.

To expedite the project timeline, GSINA will conduct additional soil characterization (Section 5.6) and well installation (Section 5.4) while the FALCO 300 and its housing are prepared (expected to require approximately four months from approval of RAWP). The prior installation of the bioventing wells will allow passive bioventing to occur while active components of the system are procured.

Following blower installation and manifolding of wells, GSINA will conduct a small-scale pilot test as described in the O&M Plan (Appendix G) to evaluate the radius of influence, estimate initial degradation rates, and adjust the system as necessary for optimal performance.

Biweekly (i.e., every other week) O&M of the active bioventing system will begin after the blower is connected and the active bioventing system is started up. Refer to the O&M Plan (Appendix G) for further information and detailed O&M procedures. Soil vapor field monitoring and sampling of the bioventing wells will be performed as described in Section 5.8.

5.7.1 Active Bioventing System Decommissioning

Decommissioning of the bioventing system will be performed per the direction of the DAF, including removing all system components, disposing of components as required by State and Federal Law, restoring the site to pre-existing site conditions, and preparing a Decommission Report. As described in Section 5.5.2 of the SAP (Appendix D), if COPCs are detected in both soil (surface and subsurface) and soil vapor at concentrations above the unrestricted EALs but equal to or below the clean-up goals, decommissioning of the active bioventing system and continuation of management of residual contamination in place under the site LT-EHMP will be recommended. Decommissioning of the active bioventing system may also occur if it is determined that contaminant concentrations are not being further reduced by the system. Note, the active bioventing system wells may not remain at the site indefinitely and will eventually need to be decommissioned and removed.

Also refer to SOP ENV -10 *Bioventing Well Installation and Abandonment* (Attachment B of the SAP [Appendix D]) for well abandonment procedures.

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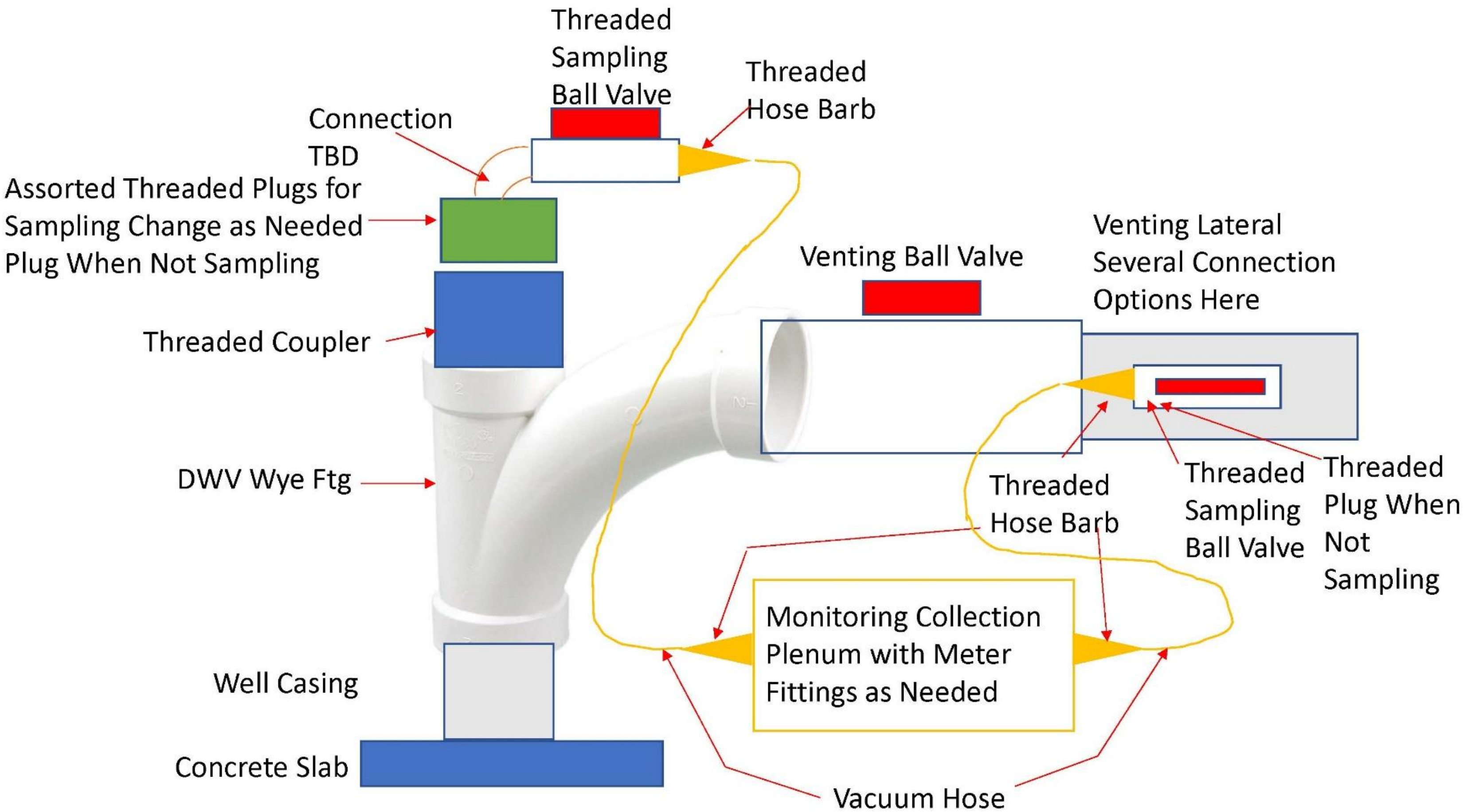

Figure 5-5: Well Head Diagram

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5.8 Soil Vapor Sampling

Soil vapor field monitoring and sampling will be conducted periodically throughout the duration of the project. Field screening will be performed using a PID during initial bioventing well installation and soil sampling. A PID will be used to assess the potential presence of VOCs in site soil, soil gas, and ambient air. Ambient air PID readings will be collected at each soil boring location during bioventing well installation for worker protection purposes. PID headspace readings will also be collected from 1) boring soil cuttings to assist with soil segregation and 2) soil cores to augment analytical data and aid in refining DU boundaries, if necessary. Refer to Section 6.1.1 of the SAP for PID reading decision criteria details.

Field measurements will be collected using both a PID and multi-gas meter (oxygen, carbon dioxide, and methane) during O&M activities of the active bioventing system. Headspace readings will be collected from each bioventing well during biweekly (i.e., every other week) O&M inspections. Additionally, digital barometer/thermometer readings will be collected in each bioventing well prior to deployment of each soil vapor sampler and following sampler recovery (before and after soil vapor sampling).

Passive soil vapor sampling will be conducted immediately following bioventing well installation (prior to any bioventing) to obtain baseline site data from the eight source area wells (nested well locations). Soil vapor sampling will be performed annually thereafter as part of ongoing O&M activities to track contaminant trends over time and assist with optimizing the active bioventing system. Soil vapor sampling will not be performed at the two inlet/intake wells. Passive soil vapor sampling will use adsorbent samplers to adsorb VOCs and semi-volatile organic compounds in soil vapors over time, which can yield a more representative sample than active soil vapor methods.

Soil vapor sampling will be performed at the eight bioventing wells located within the lateral soil vapor DU (RA-V1) for the presumed spill area (corresponding to and overlapping with DU RA-S1) (Figure 6, Appendix A) (four nested wells [containing two wells each]). The RA-V1 will be further subdivided into two vertical DU layers. The soil vapor DUs will be used to designate the shallower (higher COPC concentration) from the deeper (lower COPC concentrations) soils. Soil vapor samples/field monitoring will be collected from both the shallow and deeper DUs, and results will be used to help target/adjust the active bioventing system.

Immediately following bioventing well installation (prior to any bioventing) and one year after, soil vapor samples will be collected from the eight bioventing wells located within the RA-V1. Additional years of passive soil vapor sampling may be performed as part of O&M activities for the active bioventing system IAW the O&M Plan (Appendix G). Soil vapor samples will be analyzed for VOCs, PAHs, and project-specific TPH compounds by EPA Method TO17 as presented in Table 4-3 of the SAP. The soil vapor sampling results will be presented in the Remedial Action Report (RAR) and will be used to identify if the remedy (active bioventing) was effective or if additional information and/or operating time is required to achieve the RAOs. Refer to Section 5.5 of the SAP (Appendix D) for additional details on the RA decision rules.

Refer to the SAP (Appendix D) for details on soil vapor sampling activities and analysis.

5.9 Waste Management

Waste in the form of solid waste (e.g., sampling materials, soil cuttings, trash, personal protective equipment) and liquid waste (e.g., decontamination water) will be generated during the RA field activities. No soil will be removed from the summit of Haleakalā without written permission from the Government. Liquid investigation-derived waste (i.e., decontamination fluids, bioventing system water) generated during the sampling and system operation activities will consist of light detergent and tap water, and water/condensate from the extraction wells. The volume and concentration of liquid waste will be sufficiently low to allow onsite evaporation (i.e., emptied into the landfarm for onsite evaporation). Refer to the Waste Management Plan for details on waste management procedures (Attachment C of the SAP [Appendix D]).

5.10 Data Management

Various types of data will be collected throughout the course of the RA field activities and may be stored as either electronic files or hard copies, with hard copies scanned for retention in the digital file. Examples of electronic data include GPS and geographic information system data. Examples of hard copy data include logbooks, field forms, and chain-of-custody forms. All electronic and hard copy data generated during the RA field activities will be verified and validated as detailed in the project SAP (Appendix D). Laboratory analytical data will be evaluated by a third-party data validator. The validated data will also be submitted for incorporation into the Environmental Resources Program Information Management System (ERPIMS). Additional data collection and management procedures are described in Section 8.1 of the SAP (Appendix D) and SOP G-7 *Data Management Plan* (Attachment B of the SAP [Appendix D]).

5.11 Demobilization

At the completion of the RA field activities, a site walk will be performed with the DAF to document the successful completion of site restoration activities. All personnel and field equipment will be demobilized. All project materials will be removed and remain in the possession of the contractor. Demobilization will only occur after approval by the DAF Project Manager.

5.12 Reporting

Upon completion of the RA activities, a RAR will be prepared IAW HDOH HEER TGM Section 18.5.15. The RAR will summarize the activities performed during the RA and present the results. The report will also summarize all previous investigations, including a description of the prior site characterization work, and will identify if the remedy was effective or if additional information and/or operating time is required to achieve the RAOs. Any future actions for the site will be recommended, as necessary. Refer to Section 8.2 of the SAP (Appendix D) for additional details.

A LT-EHMP will also be prepared for the site. The LT-EHMP will provide pre-planned measures for protecting human and ecological receptors from exposure and periodic inspections to ensure engineering and institutional controls remain effective. Refer to Section 8.3 of the SAP (Appendix D) for additional details.

Monthly O&M Reports will also be prepared during the O&M activities. The monthly report at a minimum will include a summary of the O&M activities performed during the month, field measurements, analytical results (when applicable), and provide recommendations, if necessary.

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Section 6 Schedule

The key project tasks and schedule are presented in Table 6-1 below.

Table 6-1: Project Tasks and Schedule

Task		Organization	Dates		Deliverable	Deliverable Due Date[1, 2]
			Anticipated Date of Initiation[1]	***Anticipated Date of Completion***[1]		
Remedial Action Work Plan (e.g., HSP, RAWP, SAP, EPP, O&M Plan, AMP)		GSINA	March 2024	January 2025	Draft, Draft Final, Final	January 2025
LT-EHMP		GSINA	May 2024	January 2025	Draft, Draft Final, Final	January 2025
RA Field Activities	Mobilization and Site Preparation	GSINA	February 2025	February 2025	RAR (below)[4]	See below
RA Field Activities	Bioventing Well Installation	GSINA with Subcontractor[3]	January 2025	March 2025	RAR (below)[4]	See below
RA Field Activities	Landfarm Installation, Management, and Decommissioning	GSINA with Subcontractor[3]	TBD	TBD (installation completion) / TBD (O&M) / TBD (decommissioning)	RAR (below)[4] / Monthly O&M Report	TBD
RA Field Activities	In-Situ Soil Sampling and Analysis	GSINA	February 2025	April 2025	RAR (below)[4]	See below
RA Field Activities	Active Bioventing System Installation, Management, and Decommissioning	GSINA with Subcontractor[3]	March 2025	April 2025 (installation completion) / TBD (O&M) / TBD (decommissioning)	RAR (below)[4]/ Monthly O&M Report / Closure Report	See below
RA Field Activities	Soil Vapor Sampling	GSINA	March 2025	March 2026	RAR (below)[4] / Monthly O&M Report	See below
RA Field Activities	Waste Management	GSINA	February 2025	March 2026	RAR (below)[4]	See below
RA Field Activities	Data Management	GSINA	February 2025	March 2026	RAR (below)[4]	See below
RA Field Activities	Demobilization	GSINA	February 2025	March 2026	RAR (below)[4]	See below
Remedial Action Reports (e.g., RAR, O&M Report, Analytical Data		GSINA	February 2025	July 2025	Draft, Draft Final and Final	July 2025

Notes:
[1] As a living schedule, dates are subject to change
[2] Date of Final version submittal
[3] Managed and subcontracted by GSINA as the prime contractor.
[4] Several field documents will be generated from the field activities and will be included in the RAR. Refer to the project SAP for a list of documents.

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Section 7 References

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Appendix A
Site Maps

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List of Figures included in this appendix:

Figures:

- Figure 1: Site Location;
- Figure 2: SS014 Generator Fuel Spill Site;
- Figure 3: Soil Types;
- Figure 4: Phase 2 SCAE Soil Boring Results;
- Figure 5: Surface Soil and Landfarm DUs;
- Figure 6: Subsurface Soil DUs; and
- Figure 7: Soil Vapor DUs.

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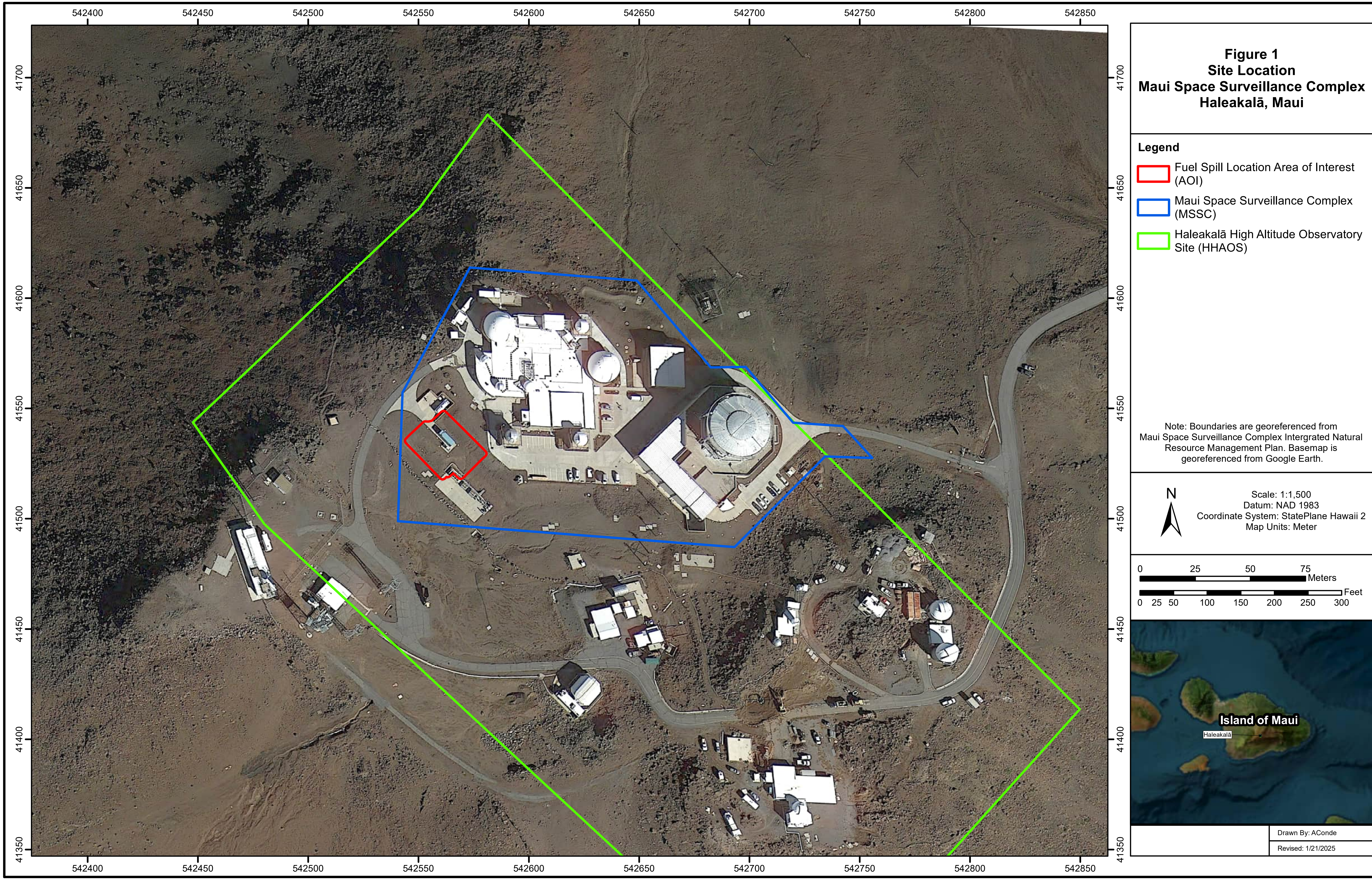

Figure 1
Site Location
Maui Space Surveillance Complex
Haleakalā, Maui
Legend
Fuel Spill Location Area of Interest (AOI)
Maui Space Surveillance Complex (MSSC)
Haleakalā High Altitude Observatory Site (HHAOS)
Note: Boundaries are georeferenced from Maui Space Surveillance Complex Intergrated Natural Resource Management Plan. Basemap is georeferenced from Google Earth.
N
Scale: 1:1,500
Datum: NAD 1983
Coordinate System: StatePlane Hawaii 2
Map Units: Meter
0 25 50 75 Meters
0 25 50 100 150 200 250 300 Feet
Island of Maui
Haleakalā
Drawn By: AConde
Revised: 1/21/2025
542400 542450 542500 542550 542600 542650 542700 542750 542800 542850
41700 41650 41600 41550 41500 41450 41400 41350

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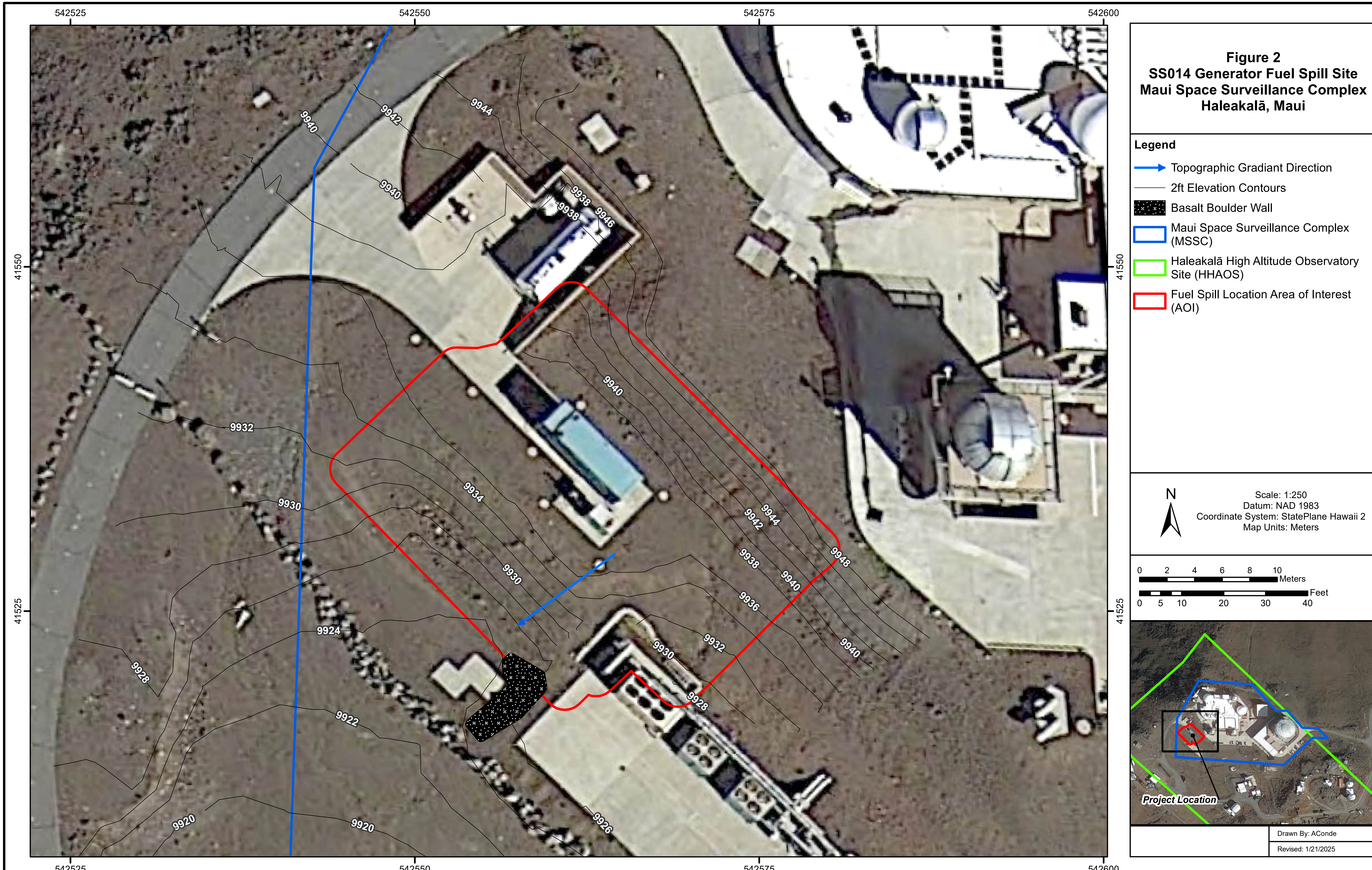
Figure 2
SS014 Generator Fuel Spill Site
Maui Space Surveillance Complex
Haleakalā, Maui
Legend
Topographic Gradiant Direction
2ft Elevation Contours
Basalt Boulder Wall
Maui Space Surveillance Complex (MSSC)
Haleakalā High Altitude Observatory Site (HHAOS)
Fuel Spill Location Area of Interest (AOI)
N
Scale: 1:250
Datum: NAD 1983
Coordinate System: StatePlane Hawaii 2
Map Units: Meters
0 2 4 6 8 10 Meters
0 5 10 20 30 40 Feet
Project Location
Drawn By: AConde
Revised: 1/21/2025
542525
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542600
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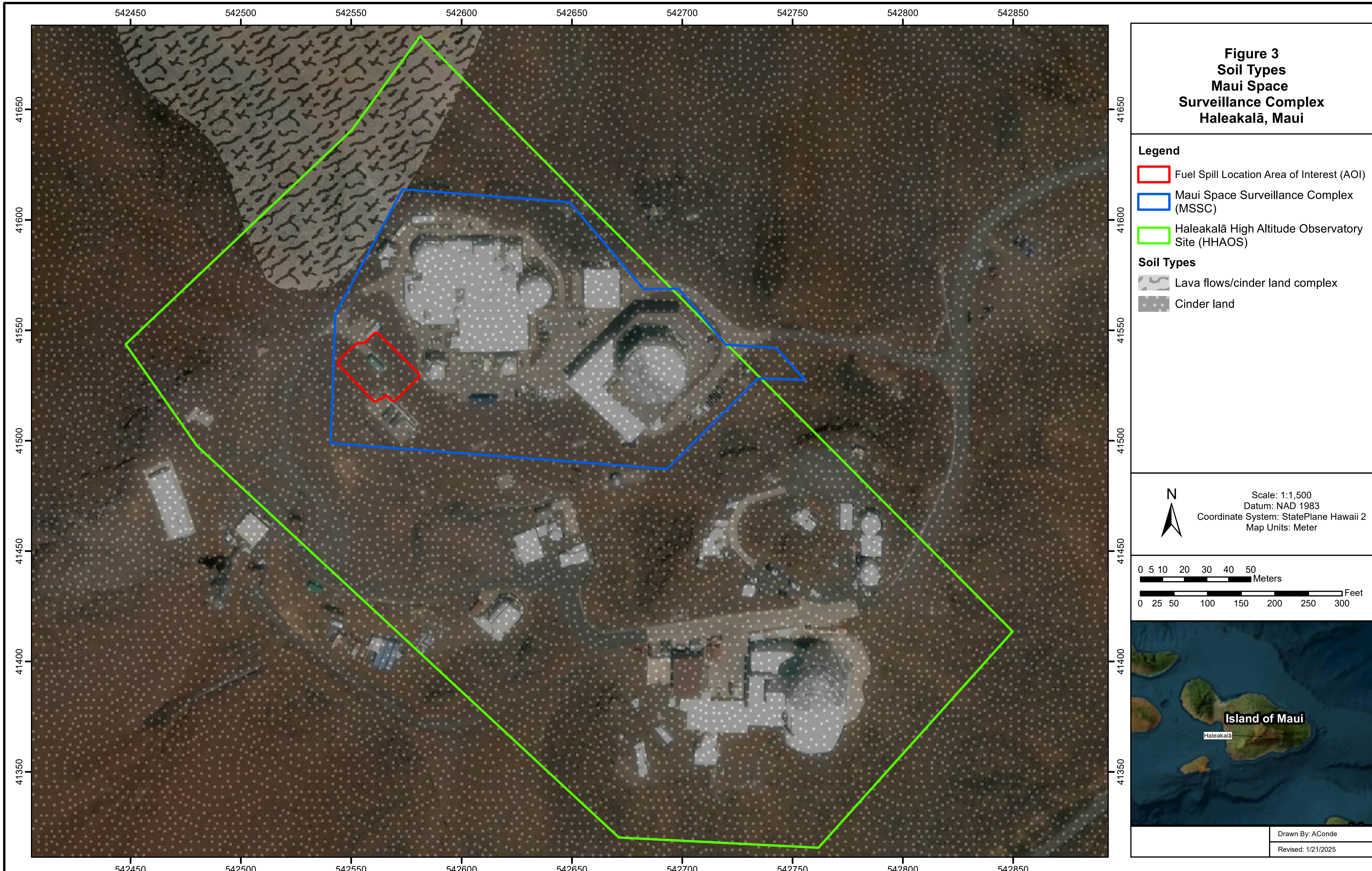

Figure 3
Soil Types
Maui Space
Surveillance Complex
Haleakalā, Maui
Legend
Fuel Spill Location Area of Interest (AOI)
Maui Space Surveillance Complex (MSSC)
Haleakalā High Altitude Observatory Site (HHAOS)
Soil Types
Lava flows/cinder land complex
Cinder land
N
Scale: 1:1,500
Datum: NAD 1983
Coordinate System: StatePlane Hawaii 2
Map Units: Meter
0 5 10 20 30 40 50
Meters
Feet
0 25 50 100 150 200 250 300
Island of Maui
Haleakalā
Drawn By: AConde
Revised: 1/21/2025
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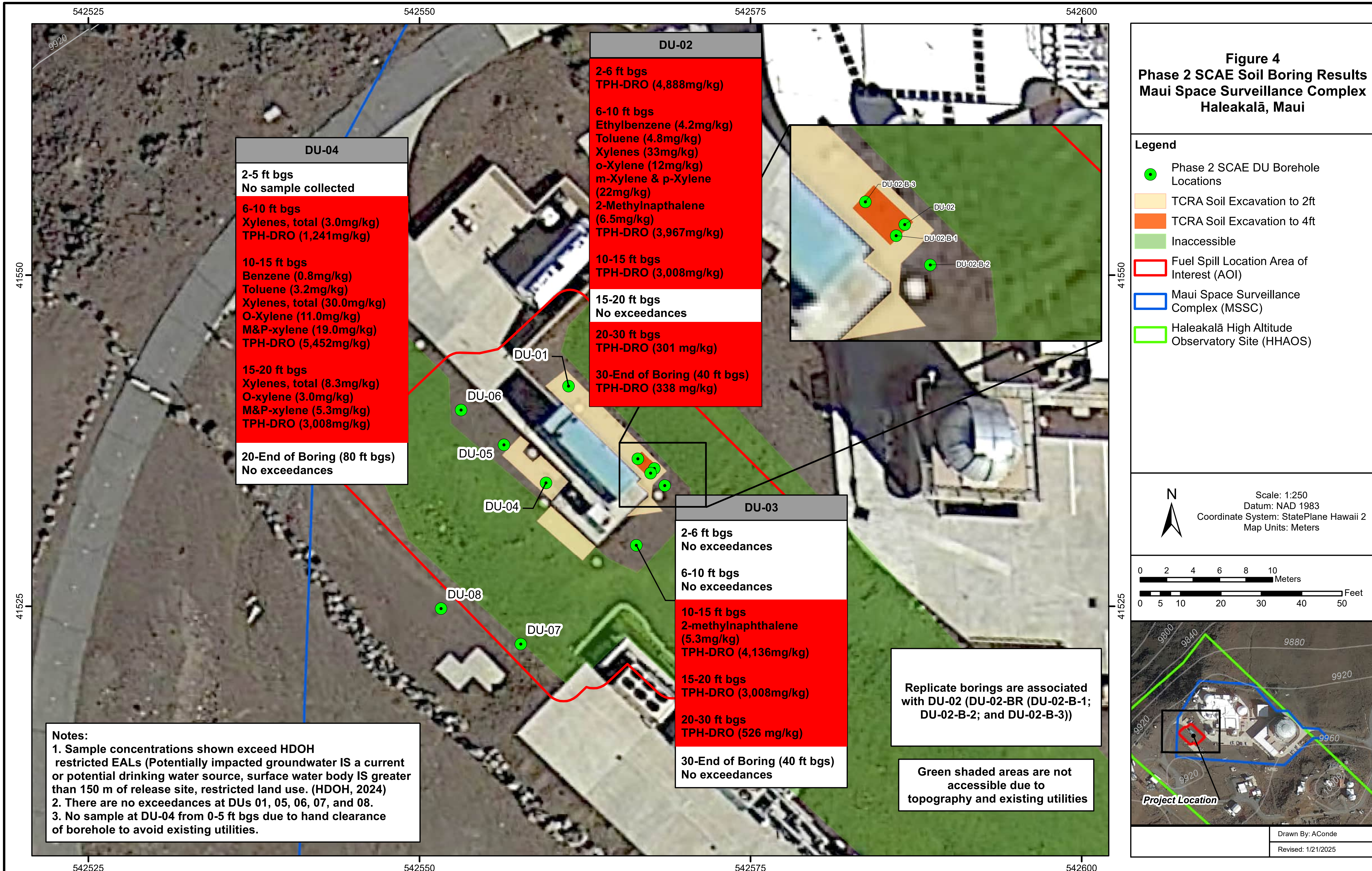
Figure 4
Phase 2 SCAE Soil Boring Results
Maui Space Surveillance Complex
Haleakalā, Maui
DU-04
2-5 ft bgs
No sample collected
6-10 ft bgs
Xylenes, total (3.0mg/kg)
TPH-DRO (1,241mg/kg)
10-15 ft bgs
Benzene (0.8mg/kg)
Toluene (3.2mg/kg)
Xylenes, total (30.0mg/kg)
O-Xylene (11.0mg/kg)
M&P-xylene (19.0mg/kg)
TPH-DRO (5,452mg/kg)
15-20 ft bgs
Xylenes, total (8.3mg/kg)
O-xylene (3.0mg/kg)
M&P-xylene (5.3mg/kg)
TPH-DRO (3,008mg/kg)
20-End of Boring (80 ft bgs)
No exceedances
DU-02
2-6 ft bgs
TPH-DRO (4,888mg/kg)
6-10 ft bgs
Ethylbenzene (4.2mg/kg)
Toluene (4.8mg/kg)
Xylenes (33mg/kg)
o-Xylene (12mg/kg)
m-Xylene & p-Xylene (22mg/kg)
2-Methylnapthalene (6.5mg/kg)
TPH-DRO (3,967mg/kg)
10-15 ft bgs
TPH-DRO (3,008mg/kg)
15-20 ft bgs
No exceedances
20-30 ft bgs
TPH-DRO (301 mg/kg)
30-End of Boring (40 ft bgs)
TPH-DRO (338 mg/kg)
DU-03
2-6 ft bgs
No exceedances
6-10 ft bgs
No exceedances
10-15 ft bgs
2-methylnaphthalene (5.3mg/kg)
TPH-DRO (4,136mg/kg)
15-20 ft bgs
TPH-DRO (3,008mg/kg)
20-30 ft bgs
TPH-DRO (526 mg/kg)
30-End of Boring (40 ft bgs)
No exceedances
DU-01
DU-05
DU-06
DU-07
DU-08
DU-02-B-3
DU-02-B-1
DU-02-B-2
Replicate borings are associated with DU-02 (DU-02-BR (DU-02-B-1; DU-02-B-2; and DU-02-B-3))
Green shaded areas are not accessible due to topography and existing utilities
Notes:
1. Sample concentrations shown exceed HDOH restricted EALs (Potentially impacted groundwater IS a current or potential drinking water source, surface water body IS greater than 150 m of release site, restricted land use. (HDOH, 2024)
2. There are no exceedances at DUs 01, 05, 06, 07, and 08.
3. No sample at DU-04 from 0-5 ft bgs due to hand clearance of borehole to avoid existing utilities.
Legend
Phase 2 SCAE DU Borehole Locations
TCRA Soil Excavation to 2ft
TCRA Soil Excavation to 4ft
Inaccessible
Fuel Spill Location Area of Interest (AOI)
Maui Space Surveillance Complex (MSSC)
Haleakalā High Altitude Observatory Site (HHAOS)
N
Scale: 1:250
Datum: NAD 1983
Coordinate System: StatePlane Hawaii 2
Map Units: Meters
0 2 4 6 8 10 Meters
0 5 10 20 30 40 50 Feet
Project Location
Drawn By: AConde
Revised: 1/21/2025
542525
542550
542575
542600
41550
41525

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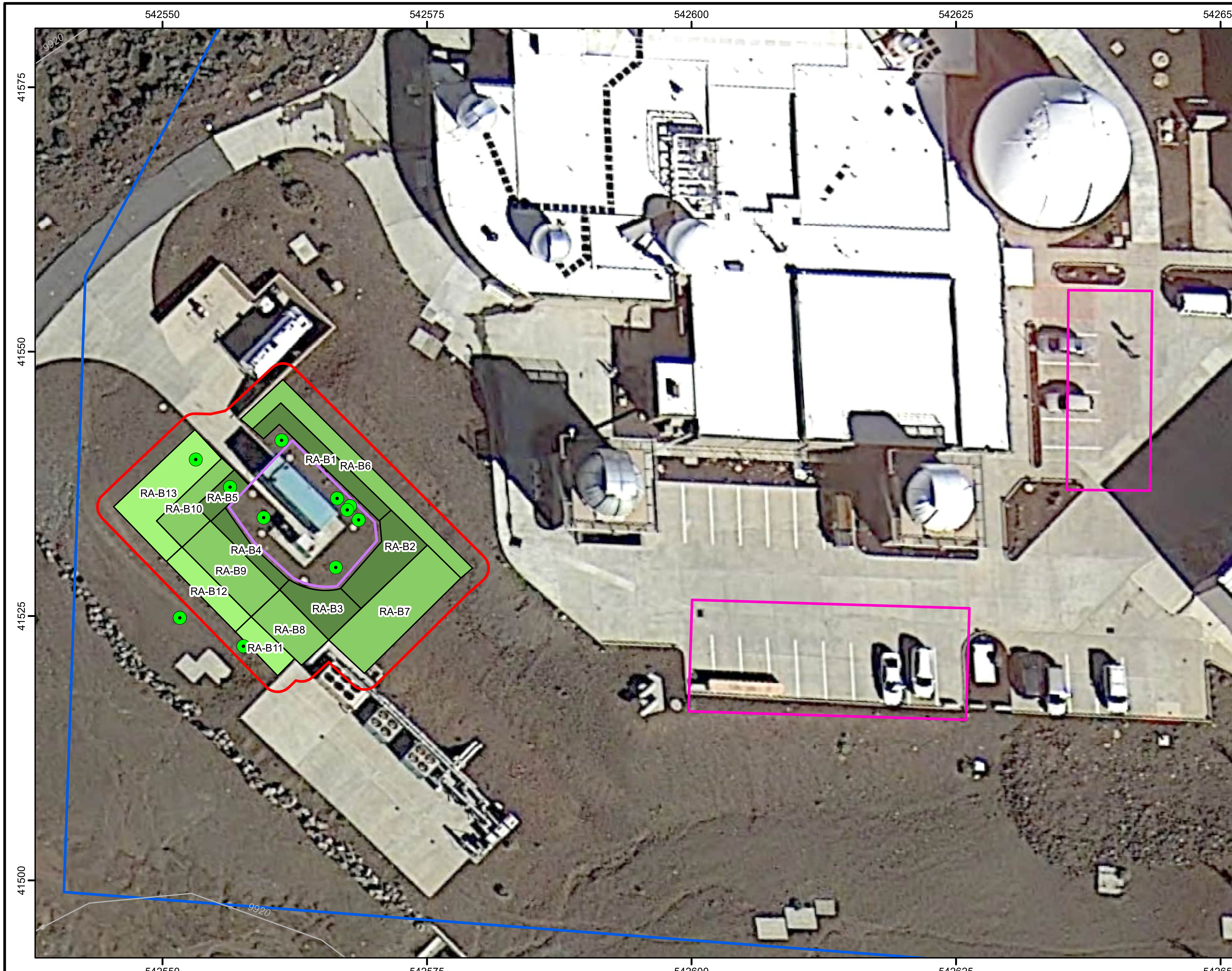
Figure 5
Surface Soil and Landfarm DUs
Maui Space Surveillance Complex
Haleakalā, Maui



Legend

- Phase 2 SCAE DU Borehole Locations
- DU RA-S1
- Surface Soil DUs
- Surface Soil Stepout DUs 1
- Surface Soil Stepout DUs 2
- Proposed Landfarm Location (DU RA-S2)
- Maui Space Surveillance Complex (MSSC)
- Haleakalā High Altitude Observatory Site (HHAOS)
- Fuel Spill Location Area of Interest (AOI)

Note: two proposed locations for the landfarm are shown, one of which will be selected for the landfarm installation.

N

Scale: 1:350
Datum: NAD 1983
Coordinate System: StatePlane Hawaii 2
Map Units: Meters

0 5 10 15 20 Meters
0 20 40 60 Feet

Drawn By: AConde

Revised: 1/2/2025

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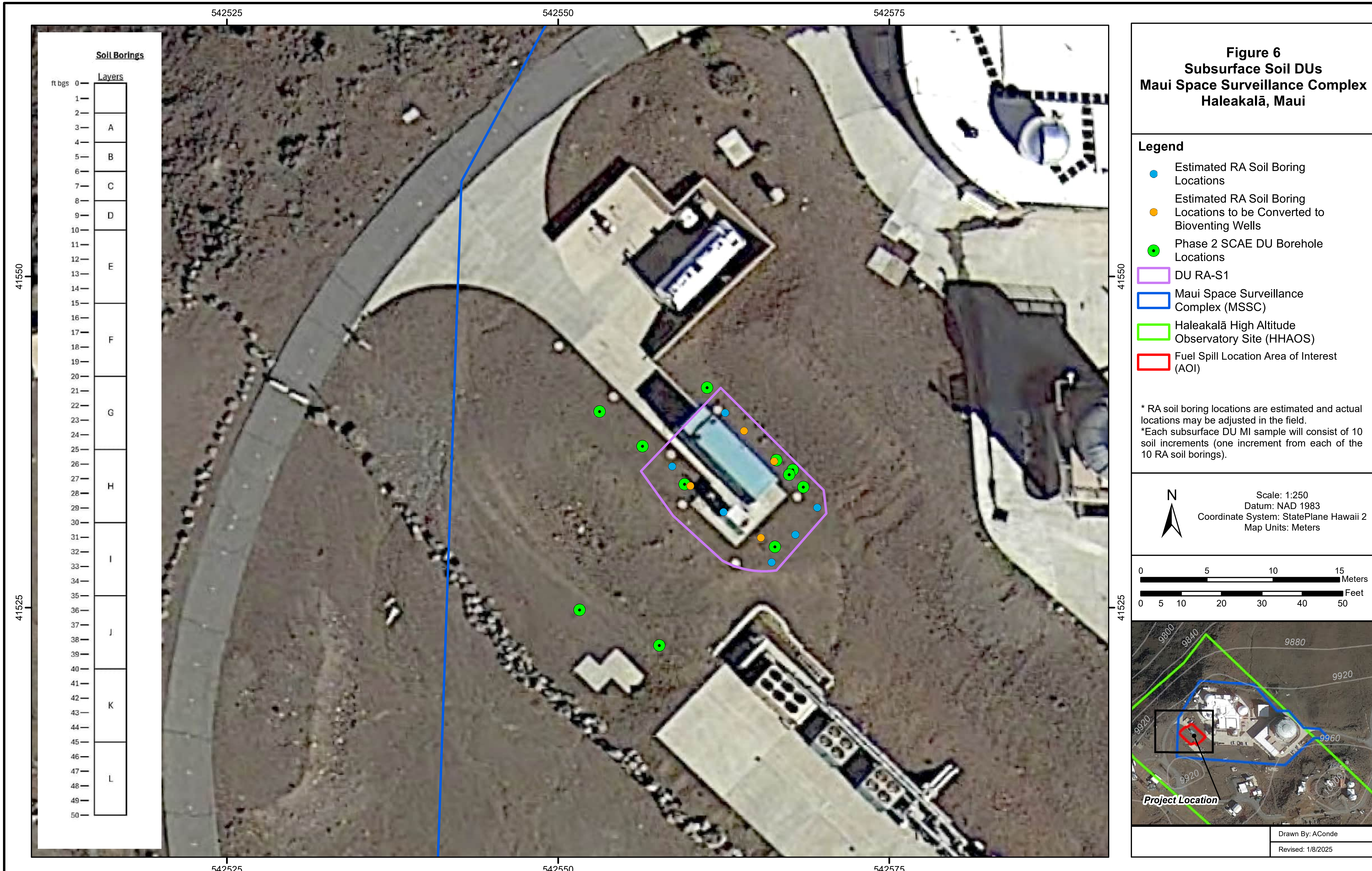

Figure 6
Subsurface Soil DUs
Maui Space Surveillance Complex
Haleakalā, Maui

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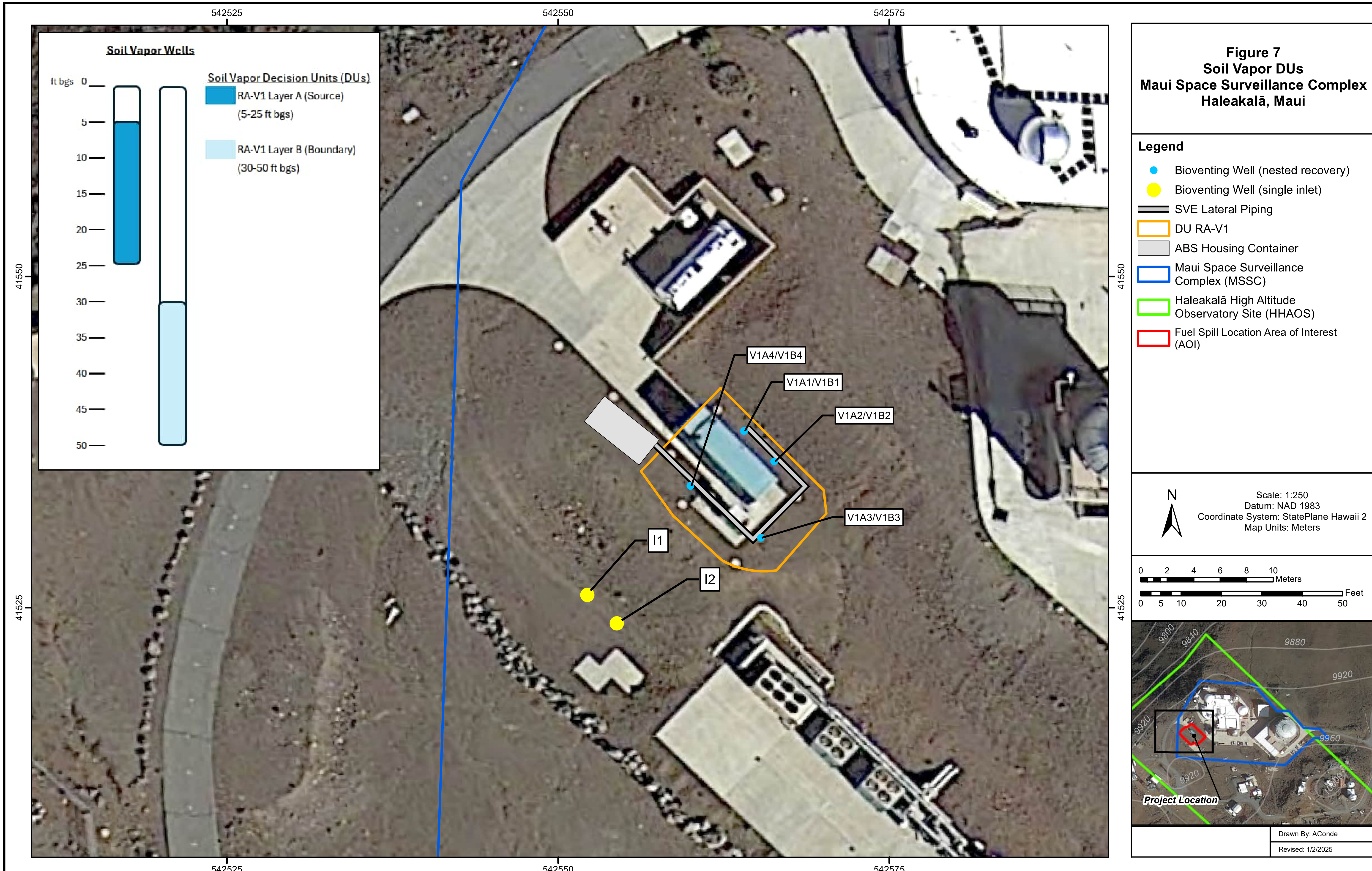

Figure 7
Soil Vapor DUs
Maui Space Surveillance Complex
Haleakalā, Maui

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Appendix B
NPS Commercial & Construction Vehicles (Access) Permit

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SPECIAL USE PERMIT

Haleakalā National Park
PO Box 369 Makawao, HI 96768
hale_commercial_manager@nps.gov

Permittee information
Permittee name:
KAYLA MEISENZAHL
Company/Organization:
GSI NORTH AMERICA, INC.
Street address:
181 SOUTH KUKUI STREET
City:
HONOLULU
State:
HAWAII
Country:
USA
Zip code:
96813
Mobile phone number:
[redacted]
Fax number:
N/A
Email address:
[redacted]

Park alpha code: [redacted]

Permit # [redacted] (renewal)

Type of use:
☐ Special event
☐ Filming or still photography
☐ Demonstration, sale or distribution of printed matter, etc.
☐ Agricultural or grazing
☒Other: Access (Construction/Commercial Vehicles)

NEPA compliance:
☒Categorically excluded
☐EA/FONSI
☐EIS
☒PEPC #116393
☐Other ______________________

Authorizing legislation or other authority:
☒54 U.S.C. § 100101: Organic Act
☒54 U.S.C. § 100751(a): Regulations
☒54 U.S.C. § 103104: Cost Recovery
☐54 U.S.C. § 100905: Commercial Filming, Still Photography and Audio Recording
☐Other authority: ____________
☒Park-specific legislation: Public Law 86-744 (39 Stat. 432)

<u>The Permittee is authorized to use the following described lands or facilities in Haleakalā National Park:</u>
Park road, known as "Crater Road" (NPS designation "HALE Route 10") from park boundary near MM 10.19, to the intersection with "Summit Road" (NPS designation "HALE Route 100"), turn south, and proceed along "Summit Road" to the "Observatories Access Road" (NPS designation "HALE Route 200"), turn south and proceed along "Observatories Access Road" to the park boundary at the cattle grate near Haleakalā Observatories entrance. Prohibited, except in emergencies, is use of all parking lots/parking areas within the Summit District to include, Hosmer Grove, and/or Hosmer Grove Spur Road (NPS designation "HALE Route 202"), and/or the Summit (Pu`u`ula`ula), and/or Haleakalā Visitor Center, and/or Sliding Sands (Keonehe`ehe`e) Trailhead.

Note: Subcontractor to the Department of the Air Force at Maui Space Surveillance Complex for environmental remediation services.

This permit begins at 7:00am on 1/6/2025 and expires at 5:00pm on 1/13/2026.

Application fee	Received _X_	Not Required ___	Amount $ 150.00
Performance bond	Received ___	Not Required _X_	Amount $
Liability insurance	Received _X_	Not Required ___	Amount $
Cost recovery	Received ___	Not Required ___	Amount $ TBD Vehicle Inspections
Location fee	Received ___	Required ___	Amount $ N/A
Other authorized fee	Received ___	Required ___	Amount $ N/A

Issuance of the permit is subject to the below-listed general and park-specific terms and conditions. The undersigned hereby accepts this permit subject to those terms and conditions and agrees to be bound by them.

[redacted]	GSI North America	12/3/24
Permittee signature, Kayla Meisenzahl	Title: Environmental Scientist 1	Date:
[redacted]	[redacted]	
Authorizing NPS official, Mickenzy Grissom	Title: Budget Technician	Date:
[redacted]		
Authorizing NPS official, Natalie B Gates	Title: Superintendent	Date:

General Terms and Conditions

1) The Permittee must perform the work or conduct the activities authorized by this permit in accordance with the permit's terms and conditions and in accordance with all applicable federal, state, or local law, including the regulations in 36 C.F.R. chapter I; the regulations in 43 C.F.R. part 5; and all applicable workplace-safety and public-health orders, rules, and requirements. If the Permittee fails to do so, then the Superintendent of Haleakala National Park may immediately suspend or revoke this permit without notice.

2) The Superintendent may immediately suspend or revoke this permit without notice if destruction of, loss of, or injury to any park property or resource has occurred, is occurring, or appears imminent. In accordance with the System Unit Resource Protection Act, 54 U.S.C. §§ 100721-100725, any person that destroys, causes the loss of, or injures any park system unit resource will be liable to the United States for response costs and damages resulting from the destruction, loss, or injury.

3) The Superintendent may revoke this permit at any time after providing 24 hours' written notice to the Permittee setting forth the reasons for the revocation.

4) If this permit is revoked for any reason or upon its expiration, the Permittee must repair all damage to park property or resources in accordance with the Superintendent's direction and must restore the Permitted Area to its original, pre-permit condition.

5) The Permittee must obtain all federal, state, or local permits, licenses, inspections, or other reviews or approvals legally required to perform the permitted work or conduct the permitted activities.

6) This permit does not grant the Permittee exclusive use of the Permitted Area. Unless the Superintendent restricts public access to or closes the Permitted Area in accordance with 36 C.F.R. § 1.5, the Permitted Area will remain open to the public to the same extent that it is open to the public during regular park visiting hours, and the permitted work or activities may not unduly interfere with the public's use and enjoyment of the Permitted Area.

7) This permit may not be transferred or assigned to another party without the Superintendent's prior written approval.

8) The Permittee waives all demands, claims, and causes of action against the United States and its officers, employees, agents, and representatives, and releases the United States and its officers, employees, agents, and representatives from all liability, arising out of or resulting from the permitted work or activities. The National Park Service issues this permit upon the express condition that the United States and its officers, employees, agents, and representatives will be free from all liability of any sort whatsoever arising out of or resulting from the permitted work or activities. Accordingly, the Permittee hereby agrees to indemnify, defend, and save and hold harmless the United States and its officers, employees, agents, and representatives from and against all liability of any sort whatsoever arising out of or resulting from the permitted work or activities.

9) If the Superintendent requires liability insurance as a condition of issuing this permit, then the Permittee must obtain general liability insurance against claims occasioned by the acts or omissions of the Permittee and its officers, employees, agents, representatives, and contractors while performing the work or conducting the

activities authorized by this permit. The policy must be in the amount of $1,000,000 per occurrence and $3,000,000 aggregate; must be issued by a company licensed to do business and in good standing in Hawaii; and must name the United States of America as an additional insured. The Permittee must provide the Superintendent with a Certificate of Insurance with the proper endorsements before the permit's effective date.

10) If the Superintendent requires a bond as a condition of issuing this permit, then the Permittee must deposit with the Park, before the effective date of this permit, a bond in the amount of $_____0______ from a bonding company licensed to do business and in good standing in Hawai'i or in the form of cash or cash equivalent, to guarantee that all financial obligations to the Park will be satisfied.

11) As authorized by 54 U.S.C. § 103104 or 54 U.S.C. § 100905 and in accordance with other applicable law and policy, the National Park Service will recover all costs of providing necessary services associated with this permit, including the costs of administering the permit and monitoring the permitted work or activities. The National Park Service may bill the Permittee for either actual costs or estimated costs. Payment is due at the time of billing. If the National Park Service bills the Permittee for estimated costs, and actual costs exceed the estimated amounts, then the National Park Service will bill the Permittee for the excess. If the National Park Service bills the Permittee for estimated costs, and actual costs are less than the estimated amounts, then the National Park Service will refund the difference to the Permittee after the permitted work or activities have concluded and the permit has expired or been terminated. Under no circumstances will the National Park Service be liable for interest on any refunded amount.

12) The Permittee designates **KIMBERLY KIM** [redacted] as the on-site person responsible for adherence to the permit's terms and conditions. The on-site person must have full authority to make all decisions about the permitted work or activities; must be reachable at all times; and is responsible for all persons or entities performing the permitted work or activities, including the Permittee's contractors and subcontractors.

13) Nothing in this permit binds the National Park Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or allocated by the National Park Service for the purpose of this permit, or to involve the National Park Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

14) If any provision of this permit is found to be invalid or unenforceable, the remaining provisions of this permit will not be affected and may be enforced to the full extent authorized by applicable law.

15) Use of the National Park Service Arrowhead Symbol is governed by 36 C.F.R. part 11. The Arrowhead Symbol is the official emblem and a registered trademark of the National Park Service. The National Park Service must authorize any use of the Arrowhead Symbol, including incidental use. Using the Arrowhead Symbol for advertising, promotional, or other commercial purposes is prohibited. Unauthorized use of the Arrowhead Symbol may subject an individual to criminal penalties under 18 U.S.C. § 701.

16) Approval of the special use permit does not constitute and should not be construed as a Government endorsement of the permittee's views, activities, products, goods, services, or enterprise. The permittee shall not refer to special use permits awarded by the National Park Service for commercial purposes, in advertising, or in a manner which states or implies that, by issuing the special use permit, the views, activities, products, goods, services, or enterprises undertaken pursuant to this permit are approved of or endorsed by the Government.

17) Credit Lines recognizing the NPS issuance of this permit may be approved through additional terms and conditions.

18) Federal regulations prohibit any person from knowingly giving false information on an application for a permit and from knowingly giving a false report for the purpose of misleading a government employee or agent in the conduct of official duties. 36 C.F.R. §§ 2.32(a)(3) and 2.32(a)(4). Any violation of those regulations will result in this permit's immediate revocation.

Park-specific Terms and Conditions

19) The permittee is authorized to the use the following described lands. Park road, known as "Crater Road" (NPS designation "HALE Route 10") from park boundary near MM 10.19, to the intersection with "Summit Road" (NPS designation "HALE Route 100"), turn south, and proceed along "Summit Road" to the "Observatories

Access Road” (NPS designation “HALE Route 200”), turn south and proceed along “Observatories Access Road” to the park boundary at the cattle grate near Haleakalā Observatories entrance. Prohibited, except in emergencies, is use of all parking lots/parking areas within the Summit District to include, Hosmer Grove, and/or Hosmer Grove Spur Road (NPS designation “HALE Route 202”), and/or the Summit (Pu`u`ula`ula), and/or Haleakalā Visitor Center, and/or Sliding Sands (Keonehe`ehe`e) Trailhead.

20) The Permittee and each authorized vehicle shall always carry a complete hard copy of this Permit for the duration authorized on the face of this Permit. If contacted by a Park Ranger, the Permittee may be asked, and is required to show proof of permit.
21) Haleakalā National Park will charge the Permittee all National Park Service costs associated with correcting matters associated with this permitted activity, should he/she not explicitly carry out these park specific special conditions.
22) All vehicles shall park correctly in legal parking spaces. Vehicles cannot impede road traffic or visitor access in any way. Commercial transportation is not authorized within the boundaries of the park, unless specifically approved in advance. In support of the park’s commitment to reduce its carbon footprint, idling of vehicles is strictly prohibited.
23) The permitted activity must be well planned and scheduled. Last minute changes will not be accommodated unless the changes are contingent upon weather or other emergency conditions and approved by the NPS onsite representative. No activity(s) is/are permitted before or after the designated hours that appear on the face of this Permit.
24) All law enforcement incidents, accidents, injuries, and visitor confrontations shall be reported immediately to the NPS onsite representative or NPS Dispatch at 808-985-6170. For emergencies, call 911 or 877-428-6911.
25) Message of Cultural Sensitivity for Haleakalā National Park: “Upon entering Haleakalā National Park, you are a guest of the Hawaiian culture, which considers the entire area sacred. Each person should behave as if entering a temple or reverent place in his or her own culture or belief system. The rocks, the plants and even the silence are part of the sacredness and should not be disturbed.
26) For Native Hawaiians, Haleakalā represents an important place within their culture. Key among aspects of this importance, relate to quietness and sense of place. Originally, within cultural practices, Ancients came to Haleakalā for only very important reasons, and conducted these visits in silence. Therefore, the Special Park Use Permittee agrees to carry out the activities of this Special Park Use Permit with deference to, and respect for, this cultural belief.
    a) The Special Park Use Permittee (hereinafter “Permittee”) and their participants/associates shall carry out the authorized activity in such a manner to be as quiet as possible, in all aspects of conducting the activities authorized in this Special Park Use Permit.
    b) The Permittee is reminded that voices and noise carry easily over long distances in the thin atmosphere at altitude.
    c) The Permittee and their participants/associates shall to the extent possible, carry out the authorized activity in such a manner to be dignified and respectful to the Haleakalā sense of place.
    d) This Permit is applicable only for the use of the area(s) and terms designated in the Permit.
    e) The Permittee shall not construct any temporary or permanent structures of any kind anywhere within the boundaries of the park and shall not be assigned any facilities or portions thereof, located within the park, except as allowed to the general public.
    f) The Permittee shall exercise the utmost care to ensure that natural, historic, and/or cultural features are not injured, nor disturbed in any manner whatsoever.
27) The Permittee and/or participants/associates under this Permit shall follow a leave-no-trace policy and restore the area of use to the same condition prior to use, or better.
28) The Permittee and/or participants under this Permit shall dispose of all such waste and debris associated with activities authorized within this Permit outside the park boundaries. The Permittee and/or participants under this Permit shall not use garbage collection facilities provided for the public within the park, for the disposal of refuse associated with this Permit.
29) The Permittee and/or participants/associates under this Permit is/are expressly prohibited from entering any closed areas or from leaving established trails, walkways, and visitor areas. Vehicle or foot travel off designated roadways, walkways, sidewalks, or trails is not permitted due to endangered bird, insect, and plant species habitats.
30) Permittee and/or participants/associates under this Permit shall not attach anything to any NPS facility, structure, rock, or vegetation. Permittee and/or participants under this Permit shall not cover or remove signs, fences, or posts, etc.
31) The Permittee and/or participants/associates under this Permit shall not engage in any ground disturbing activities, whatsoever. Native materials shall not be disturbed and/or used for props except, as a natural backdrop.
32) Electrical power is not furnished. The Permittee and/or participants under this Permit shall not connect to any power sources located anywhere within park boundaries. Generators are not authorized.

33) The driver of each vehicle authorized under this Permit, is responsible for presenting a copy of this Permit to the Park Ranger at the entrance station to enter the park. Failure to adhere to this condition may result in the vehicle refused entry.
34) The Permittee, employees, contractors, and subcontractors registered under this Permit are subject to all Park Specific Conditions, Attachments, Addendums, etc.
35) Any changes in the status of the company and/or business occurring at any time after the Authorization of this Permit are grounds for immediate suspension/revocation. The Permittee shall immediately notify the NPS Business and Revenue Office, in writing, of any change of status in the company and/or business registered under this Permit. Failure to do so is grounds for immediate suspension/revocation. Changes of status in company and/or business include, but are not limited to:
    a) Dissolution of the company and/or business, and/or
    b) Change in the name of the company and/or business, and/or
    c) Any change (i.e., transfer of assets, etc.) that permits the exercise of managerial authority over the actions and operations of the Permittee, and/or
    d) Sales of shares, which result in appointment of new officers and directors, (new management) and/or
    e) Sales of all stock and replacement of management which results in a change of control, and/or of management, and/or
    f) Any change in the name of the Permittee, and/or
    g) Any change in (i.e., replacement of) the Permittee.

See Attachment A – Park Specific Conditions Pertaining to Construction and Commercial Vehicles

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Appendix C
Archaeological Monitoring Plan

Due to its sensitive nature, the Archaeological Monitoring Plan (AMP) will be submitted under separate cover.

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Appendix D
Sampling and Analysis Plan

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FINAL
SAMPLING AND ANALYSIS PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawaiʻi

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

Prepared by:

GSI North America Inc.
181 South Kukui St., First Floor
Honolulu, HI 96813

January 2025

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Attachments

Attachment A Quality Control Criteria
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Acronyms and Abbreviations

°C	Degrees Celsius
%	Percent
%D	Percent Difference
%R	Percent Recovery
$\mu g/m^3$	Micrograms per Cubic Meter
AOI	Area of Interest
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CA	Corrective Action
CAR	Corrective Action Report
COC	Chain-of-Custody
COPC	Contaminant of Potential Concern
CQM	Corporate Quality Manager
CSM	Conceptual Site Model
cy	Cubic Yard(s)
DAF	Department of the Air Force
DL	Detection Limit
DNA	Deoxyribonucleic Acid
DOT	Department of Transportation
DQI	Data Quality Indicator
DQO	Data Quality Objective
DRO	Diesel Range Organics
DU	Decision Unit
EAL	Environmental Action Level
EPA	U.S. Environmental Protection Agency
FCR	Field Change Request
ft	Foot/Feet
GPS	Global Positioning System
GSINA	GSI North America Inc.
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDOH	State of Hawaiʻi Department of Health
HEER	Hazard Evaluation and Emergency Response
HSP	Health and Safety Plan
IAW	In Accordance With
ID	Identifier
IDW	Investigation-Derived Waste
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation
LT-EHMP	Long-Term Environmental Health and Management Plan
MeOH	Methanol
mg/kg	Milligrams per Kilogram
MI	Multi-Increment

mL	Milliliter(s)
MPC	Measurement Performance Criteria
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSSC	Maui Space Surveillance Complex
N/A	Not Applicable
NCR	Nonconformance Report
NFA	No Further Action
O&M	Operations and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
PM	Project Manager
ppm	Parts Per Million
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QM	Quality Manager
RA	Remedial Action
RAM	Response Action Memorandum
RAO	Remedial Action Objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RCA	Root Cause Analysis
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SCAE	Site Characterization and Alternatives Evaluation
sf	Square Foot/Feet
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SSHO	Site Safety and Health Officer
TBD	To Be Determined
TCRA	Time Critical Removal Action
TGM	Technical Guidance Manual
TPH	Total Petroleum Hydrocarbons
UH	University of Hawaiʻi
U.S.	United States
VOC	Volatile Organic Compound

Section 1 Introduction and Purpose

1.1 Introduction

This Sampling and Analysis Plan (SAP) was prepared on behalf of the United States (U.S.) Department of the Air Force (DAF), under contract number FA8903-24-C-0008 for Environmental Remediation Services to Conduct a Remedial Action (RA) at the Generator Fuel Spill Site (SS014) located at the Maui Space Surveillance Complex (MSSC), Haleakalā, Hawaiʻi.

This SAP has been prepared in accordance with (IAW) the State of Hawaiʻi Department of Health (HDOH) Hazard Evaluation and Emergency Response (HEER) Office Technical Guidance Manual (TGM) for the Implementation of the Hawaiʻi State Contingency Plan (HDOH, 2009) and describes the methods that GSI North America Inc. (GSINA) will utilize to conduct RA activities at the site. This SAP provides details on the types and quantities of samples to be collected, sampling design, and quality assurance (QA)/quality control (QC) procedures to ensure that the sampling design meets the data quality objectives (DQOs). This SAP is to be utilized in conjunction with the project Remedial Action Work Plan (RAWP), Health and Safety Plan (HSP) (Appendix E of the RAWP), Environmental Protection Plan (Appendix F of the RAWP), and Operations and Maintenance (O&M) Plan (Appendix G of the RAWP).

1.2 Purpose and Scope

A lightning strike occurred on 29 January 2023, that resulted in an emergency generator releasing fuel onto a generator pad and into the surrounding soil area at the summit of Haleakalā. A Response Action Memorandum (RAM) was prepared by the DAF to present the preferred remedial alternatives selected for the Generator Fuel Spill Site (SS014) (DAF, 2024b). The purpose of the Phase 3 RA project is to implement the remedy selected by the RAM, which includes remediation of the contaminated soil through active bioventing (in-situ soil) and ex-situ aeration (ex-situ soil), to achieve the Remedial Action Objectives (RAOs). Additionally, data gaps will be addressed to further define the nature and extent of contamination within the area of interest (AOI) to allow for final decision-making. The main project sampling and analysis activities include:

- Field monitoring/screening via photoionization detector (PID), handheld multi-gas meter, and handheld precision digital barometer/thermometer;
- In-situ surface soil sampling to assess impacts from fuel outside of the immediate vicinity of the generator within areas previously unsampled;
- Landfarm soil sampling to assess achievement of the RAO cleanup goals;
- In-situ subsurface soil sampling to assess achievement of the RAO cleanup goals and determining the effectiveness and need for ongoing operation or decommissioning of the active bioventing system; and
- Soil vapor sampling to assess achievement of the RAO cleanup goals and determining the effectiveness and need for ongoing operation or decommissioning of the active bioventing system.

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Section 2 Background

Refer to Section 2 of the RAWP for site description (climate, topography, soil/geology, surface water, groundwater), cultural land use, historic land use, and current/future land use.

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Section 3 Investigation History

Refer to Section 2.5 of the RAWP for a summary of previous environmental investigations conducted at the site.

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Section 4 COPCs and Conceptual Site Model

4.1 Contaminants of Potential Concern

4.1.1 Site COPCs

Based on the generator fuel leak and results of the Phase 2 Site Characterization and Alternatives Evaluation (SCAE) as described in Section 3, the site contaminants of potential concern (COPCs) include toluene, ethylbenzene, xylenes (total), total petroleum hydrocarbons (TPH) diesel range organics (DRO), 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene (Table 4-1). These COPCs were selected as they were determined to exceed the restricted (commercial/industrial) HDOH Environmental Action Levels (EALs) during the Phase 2 SCAE as presented in Table 4-1 (DAF, 2024a). The Phase 2 SCAE supersack soil sampling concentration ranges and their applicable unrestricted HDOH EALs are also shown in Table 4-1. EALs presented in the table have been updated to reflect the 2024 HDOH EALs (HDOH, 2024).

Additionally, Synthetic Precipitation Leaching Procedure (SPLP) data will be collected during the Phase 3 RA to determine contaminant mobility using HDOH’s Batch Test Leaching Model (HDOH, 2007).

Table 4-1: Soil COPCs

COPC	Phase 2 SCAE In-Situ Soil Sampling Concentration Range (mg/kg)	Phase 2 SCAE Supersack Soil Sampling Concentration Range (mg/kg)	Restricted EAL[1] (mg/kg)	Unrestricted EAL[2] (mg/kg)
Toluene	0.00082 – 4.8	0.08	3.2	0.78
Ethylbenzene	0.00067 – 4.2	0.08	3.7	0.90
Xylenes, total	0.0011 – 33	0.08	2.1	1.4
TPH-DRO	5.3 – 12,032	650 - 777	210	180
1-Methylnaphthalene	0.019 – 5.8	0.160 - 0.267	4.2	0.89
2-Methylnaphthalene	0.032 – 8.5	0.170 - 0.247	4.1	1.9
Naphthalene	0.071 – 6.4	0.077	4.4	3.1

Notes:
[1] Restricted (commercial/industrial) EAL, Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air (respectively), sites not within 150 meters of a surface water body and where groundwater is a potential drinking water source (HDOH, 2024)
[2] Unrestricted (residential) HDOH EALs; Table A-2, Soil Action Levels, Potentially impacted groundwater IS a current or potential drinking water source; Surface water body IS located within 150 m of release site (HDOH, 2024).
mg/kg - Milligrams per Kilogram

4.1.2 Applicable Environmental Action Levels

For the RA sampling activities, the site will be evaluated based on a comparison of the analytical results to the Tier 1 EALs for unrestricted (residential) land use of sites within 150 meters of a surface water body and where groundwater is a current or potential drinking water source which are the most conservative EALs (Table A-2, Soil Action Levels, *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater, Volume 2, Appendix 1*; HDOH, 2024).

Any analytical results exceeding the unrestricted EALs will also be compared to the EALs for restricted (commercial/industrial) land use of sites not within 150 meters of a surface water body and where groundwater is a potential drinking water source (Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air [respectively], *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater, Volume 2, Appendix 1*; HDOH, 2024) which are applicable to the site (Sections 2.1.4 and 2.1.5). EALs for soil and soil vapor are presented in Tables 4-2 and 4-3.

Additionally, for RAO cleanup levels, since the supersacked soil is planned to be reused as unrestricted cover or fill in the vicinity of the fuel spill following remediation, Tier 1 EALs (unrestricted) are used as the cleanup levels for the supersacked soils. For in-situ soil, site-specific EALs (restricted) are used as the cleanup levels (Table 4-2).

Table 4-2: Soil Cleanup Goals, EALs, and Laboratory-Specific Limits

Analyte	**Cleanup Goals[1] (mg/kg)**	**Unrestricted EALs[2] (mg/kg)**	**Restricted[3] EALs (mg/kg)**	**Laboratory Limits**		
				LOQ (mg/kg)	**LOD (mg/kg)**	**DL (mg/kg)**
Volatiles (EPA 8260D, with modified SW846 5025 Preparation)						
Benzene	None	0.30	0.30	0.25	0.2	0.05
Toluene	3.2 (in-situ)	0.78	3.2	0.25	0.2	0.05
Ethylbenzene	3.7 (in-situ)	0.90	3.7	0.25	0.2	0.05
Xylenes (total)	2.1 (in-situ)	1.4	2.1	0.25	0.2	0.05
Extractable Hydrocarbons (EPA 8015D)						
TPH-DRO	180 (supersack)/ 210 (in-situ)	180	210	10.0	8.00	4.00
PAHs (EPA 8270E)						
1-Methylnaphthalene	4.2	0.89	4.2	0.133	0.08	0.04
2-Methylnaphthalene	4.1	1.9	4.1	0.133	0.08	0.04
Acenaphthene	None	120	120	0.133	0.08	0.04
Acenaphthylene	None	5.5	130	0.133	0.08	0.04
Anthracene	None	4.2	4.2	0.133	0.08	0.04
Benzo[a]anthracene	None	10	10	0.133	0.08	0.04
Benzo[a]pyrene	None	3.6	15	0.133	0.08	0.04
Benzo[b]fluoranthene	None	5.8	5.8	0.133	0.08	0.05
Benzo(g,h,i)perylene	None	35	35	0.133	0.08	0.04
Benzo(k)fluoranthene	None	35	35	0.133	0.08	0.04

Analyte	Cleanup Goals[1] (mg/kg)	Unrestricted EALs[2] (mg/kg)	Restricted[3] EALs (mg/kg)	Laboratory Limits		
				LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Chrysene	None	7.3	7.3	0.133	0.08	0.04
Dibenzo(a,h)anthracene	None	1.1	18	0.133	0.08	0.04
Fluoranthene	None	87	120	0.133	0.08	0.04
Fluorene	None	93	93	0.133	0.08	0.04
Indeno(1,2,3-cd)pyrene	None	5.7	5.7	0.267	0.2	0.1
Naphthalene	4.4 (in-situ)	3.1	4.4	0.133	0.08	0.04
Phenanthrene	None	69	580	0.133	0.08	0.04
Pyrene	None	44	44	0.133	0.08	0.04
Microbial DNA analysis (QuantArray®- Petro[4])						
Toluene/Benzene Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Phenol Hydroxylase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Toluene 2 Monooxygenase/ Phenol Hydroxylase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Toluene Ring Hydroxylating Monooxygenases	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Xylene/Toluene Monooxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Ethylbenzene/ Isopropylbenzene Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Biphenyl/Isopropylbenze Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Methylibium petroleiphilum PM1	None	None	None	1,000 cells/sample	N/A	10 cells/sample
TBA Monooxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Naphthalene Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Naphthalene-inducible Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Phenanthrene Dioxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Alkane Monooxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Alkane Monoxygenase	None	None	None	1,000 cells/sample	N/A	10 cells/sample

Analyte	Cleanup Goals[1] (mg/kg)	Unrestricted EALs[2] (mg/kg)	Restricted[3] EALs (mg/kg)	Laboratory Limits		
				LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)
Benzoyl Coenzyme A Reductase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Benzylsuccinate Synthase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Benzene Carboxylase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Naphthylmethsylsuccinate Synthase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Napthalene Carboxylase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Alkylsuccinate Synthase	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Total Eubacteria	None	None	None	1,000 cells/sample	N/A	10 cells/sample
Sulfate Reducing Bacteria	None	None	None	1,000 cells/sample	N/A	10 cells/sample

Notes:
[1] Cleanup goals for in situ soil are restricted (commercial/industrial) HDOH EAL; Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air (respectively), greater than 150 meters from surface water; above a potential drinking water resource (HDOH, 2024). Cleanup goals for supersacked soil are unrestricted (residential) HDOH EALs; Table A-2, Soil Action Levels, Potentially impacted groundwater IS a current or potential drinking water source; Surface water body IS located within 150 m of release site (HDOH, 2024).
[2] Unrestricted (residential) HDOH EALs; Table A-2, Soil Action Levels, Potentially impacted groundwater IS a current or potential drinking water source; Surface water body IS located within 150 m of release site (HDOH, 2024).
[3] Restricted (commercial/industrial) HDOH EAL; Table I-2, Table E-1, and Table C-1b, Soil Action Levels for Direct Exposure, Leaching, and Vapor Emissions to Indoor Air (respectively), greater than 150 meters from surface water; above a potential drinking water resource (HDOH, 2024).
[4] QuantArray®-Petro is an advanced quantitative polymerase chain reaction method that quantifies a suite of functional genes involved in aerobic and anaerobic biodegradation of VOCs, TPHs, and PAHs.

DL - Detection Limit
DNA - Deoxyribonucleic Acid
EPA - U.S. Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantitation
N/A - Not Applicable
PAH - Polycyclic Aromatic Hydrocarbon
VOC - Volatile Organic Compound

Table 4-3: Soil Vapor EALs and Laboratory-Specific Limits

Analyte	Unrestricted EALs[1] (µg/m3)	Restricted EALs[2] (µg/m3)	Laboratory Limits		
			LOQ (µg/m3)	LOD (µg/m3)	DL (µg/m3)
Volatiles (EPA TO17)					
Benzene	720	6,300	2.34	0.94	0.94
Toluene	2,100,000	18,000,000	3.10	1.24	1.24
Ethylbenzene	22,000	200,000	1.46	0.58	0.58
Xylenes (total)	42,000	350,000	N/A	N/A	N/A
p & m-Xylenes	N/A[3]	N/A[3]	1.41	0.56	0.56
o-Xylenes	N/A[3]	N/A[3]	1.41	0.56	0.56
Extractable Hydrocarbons (EPA TO17)					
TPH-DRO (C9-C15)	260,000	2,200,000	359.44	179.72	179.72
PAHs (EPA TO17)					
1-Methylnaphthalene	100,000	860,000	1.63	0.65	0.65
2-Methylnaphthalene	5,800	49,000	1.63	0.65	0.65
Naphthalene	1,300	11,000	1.55	0.62	0.62

Notes:
[1] HDOH EALs for unrestricted (residential) land use, Table C-2 *Shallow Soil Vapor Action Levels For Evaluation of Potential Vapor Intrusion Hazards* (HDOH, 2024).
[2] HDOH EALs for restricted (commercial/industrial) land use, Table C-2 *Shallow Soil Vapor Action Levels For Evaluation of Potential Vapor Intrusion Hazards* (HDOH, 2024).
[3] The sum of the p & m and o-xylenes results will be calculated and compared to the EALs for total xylenes.
µg/m^3 - Micrograms per Cubic Meter

4.2 Preliminary CSM

Refer to Section 3.5 of the RAWP for the conceptual site model (CSM)

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Section 5 Data Quality Objectives

The following sections define the investigation and DQOs required for final decision making.

5.1 Problem Statement

The generator fuel leak at MSSC resulted in approximately 700 gallons of fuel being released onto the generator pad and the surrounding soil area. Initial soil sampling conducted in July 2023 during the Phase 2 SCAE indicated the presence of COPCs exceeding the restricted EALs up to 20 feet (ft) below ground surface (bgs)[1] in one boring, however, the extent of contamination was not fully delineated during the initial sampling event due to the performance of screening only sampling (i.e., exploratory single borehole decision units [DUs]) and site access restrictions (e.g., site topography limitations for drill rigs access), thus additional information is required for decision-making IAW the HDOH TGM. Additionally, the fuel release poses cultural concerns that need to be addressed through remediation of ex-situ and in-situ contaminated soils.

5.2 Objectives and Contaminants of Potential Concern

The primary goal is to implement the remedy selected by the RAM as described in Section 4.1 of the RAWP, which includes remediation of the contaminated soil through active bioventing (in-situ soil) and ex-situ aeration (ex-situ soil), to achieve the RAOs. Additionally, the RA activities to be performed at Site SS014 during Phase 3 will address data gaps to further define the nature and extent of contamination within the AOI to allow for final decision-making. Data gaps to be addressed include:

- Delineation of the horizontal magnitude and extent of contamination via surface sampling as the plume boundary is likely in a region inaccessible to drill rig;
- Delineation of the vertical magnitude and extent of contamination within the source DU (RA-S1), where drilling is feasible;
- Determination of the presence/absence of microorganisms suitable for breaking down petroleum products; and
- Determination of contaminant mobility (SPLP data).

Site COPCs include toluene, ethylbenzene, xylenes (total), TPH-DRO, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene as described in Section 4.1.

5.3 Data Information Needs

Sampling and analysis data to be collected for this project (e.g., field screening, in-situ soil, supersack soil, soil vapor, microbial DNA data) will be used to directly compare concentrations of the COPCs listed in Tables 4-2 and 4-3 to the applicable EALs and make final decisions for the site as described in Section 4.1.2.

[1] *At least 40 ft bgs when compared to the 2024 revised EALs (HDOH, 2024).*

5.4 Define the Decision Units

A DU is an area (and volume) where a decision is to be made regarding the extent and magnitude of contaminants with respect to potential environmental hazards and associated risks to human health and the environment. While typically used for soil, the term will also be applied to soil vapor during this investigation.

5.4.1 Soil

Soil sampling will be conducted in-situ concurrent with the installation of active bioventing wells. A multi-increment (MI) soil sampling approach will be utilized as detailed in Sections 6.2 and 6.3.

5.4.1.1 Surface DUs

Surface boundary DUs (RA-B1 to RA-B5) will be established and sampled from 0 to 4 inches bgs to assess impacts from fuel outside of the immediate vicinity of the generator, within previously unsampled areas. If one or more COPC concentrations from the initial boundary DUs exceed the unrestricted EALs, then adjacent stepout surface boundary DUs (RA-B6 to RA-B13, as applicable) will be sampled, until the horizontal extent of surface contamination is bound. For example, if analytical results from RA-B4 exceed the unrestricted EALs then RA-B9 will be sampled, or if analytical results from RA-B2 exceed the unrestricted EALs then both RA-B6 and RA-B7 will be sampled. The surface DUs will be sampled using the methods described in Section 6.2.1. The surface DUs are presented in Table 5-1 and Figure 5 (Appendix A of the RAWP).

Confirmation samples will be collected from each DU with COPC concentrations exceeding the most conservative EALs (i.e., unrestricted HDOH Tier 1 EALs[2]), using the same methods as the initial samples. Additional confirmation samples will be collected as necessary IAW with the SAP decision statement section (SAP Section 5.5.1). Surface confirmation sampling will depend on the results and methods chosen to address the soil if EAL exceedances are detected (e.g., based on the results, DAF may decide to excavate the soil and add it to the landfarm, or leave it in place for management by land use controls under the LT-EHMP [e.g., install fencing]). To ensure project team concurrence, after the results from the initial sampling is received and data evaluated (Section 5.5.1), the proposed follow-on confirmation sampling or alternative path forward (e.g., leave in-place, excavate to landfarm) will be presented to the project team for review prior to sampling.

[2] *Unrestricted sites within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

Table 5-1: Surface DU Summary

DU ID	Approximate Surface Area (sf)	Approximate Volume[1] (cy)	Selection Rationale
RA-B1	272	3.4	Potential impacts from source area
RA-B2	320	4.0	Potential impacts from source area; highest expected COPC concentration
RA-B3	223	2.8	
RA-B4	131	1.6	
RA-B5	109	1.3	Potential impacts from source area
RA-B6	486	6.0	Stepout boundary DU to be sampled if unrestricted EAL exceedances are detected in the adjacent boundary DU; potential impacts from source area
RA-B7	628	7.8	
RA-B8	258	3.2	
RA-B9	367	4.5	
RA-B10	224	2.8	
RA-B11	133	1.6	
RA-B12	204	2.5	
RA-B13	498	6.1	

Notes:
Each surface boundary DU will comprise 60 increments and be sampled from 0 to 4 inches bgs.
[1] Estimated volume is calculated based on the approximate surface area and 4-inch sampling depth.
cy - Cubic Yards
ID - Identifier

5.4.1.2 Subsurface DUs

Lateral subsurface DU (RA-S1) and its associated vertical DU layers will also be established to better characterize subsurface impacts from downward migration of the release. Due to access limitations, each DU will consist of 10 soil increment locations (soil borings). RA-S1 will be divided into 12 vertical DU layers for subsurface sampling. The subsurface soil DUs will be sampled using the methods described in Section 6.3. The subsurface DUs are presented in Table 5-2 and Figure 6 (Appendix A of the RAWP).

Confirmation samples will be collected from each DU with COPC concentrations exceeding the most conservative EALs (i.e., unrestricted HDOH Tier 1 EALs[3]), using the same methods as the initial samples. Additional confirmation samples will be collected as necessary IAW with the SAP decision statement section (Section 5.5.1). As described in Section 5.5.1, HDOH guidance includes stipulations regarding if/when/how many confirmation samples need to be collected based on the relative standard deviations (RSDs) of the initial results. Since this information is currently unknown, it can only be estimated that the need for collection of confirmation samples in the source DU (the subsurface samples) will be approximately three years after system installation, but the timeline will be adjusted based on system performance (and the results of the initial RA sampling). To ensure project team concurrence, after the results from the initial sampling is received and data evaluated (Section 5.5.1), the proposed follow-on confirmation sampling will be presented to the project team for review prior to sampling.

[3] *Unrestricted sites within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

Table 5-2: Subsurface DU Summary

DU ID	Layer	DU Type	Depth Interval (ft bgs)	Number of Increments	Approximate Surface Area (sf)	Approximate Volume[1] (cy)	Selection Rationale
RA-S1	A	Source	2 to 4	10	1,188	88 each	Known source area; highest COPC concentration expected
	B		4 to 6	10			
	C		6 to 8	10			
	D		8 to 10	10			
	E		10 to 15	10		220 each	Anticipated spill impact
	F		15 to 20	10			
	G		20 to 25	10			
	H	Boundary	25 to 30	10			COPC concentrations expected to be below restricted EALs
	I		30 to 35	10			
	J		35 to 40	10			
	K		40 to 45	10			
	L		45 to 50	10			

Note:
[1] Estimated volume is calculated based on the approximate surface area and the applicable 2-ft or 5-ft sampling depth interval.

5.4.1.3 Landfarm DU

One landfarm will be established at the site and used to remediate cuttings generated during active bioventing well installation activities that exhibit evidence of contamination (visual, olfactory, or via field monitoring as described in Section 6.1.1) and TCRA (supersack) soil previously excavated from the AOI. The landfarm DU will be sampled using the methods described in Section 6.2.2. Confirmation samples will be collected from the landfarm DU presented in Table 5-3 IAW the schedule prescribed in the Phase 3 O&M Plan (Appendix G of the RAWP). The landfarm installation location will be established over an existing paved area and the location will be coordinated with the DAF and MSSC.

Table 5-3: Landfarm DU Summary

DU ID	DU Type	Depth Interval (inches bgs)	Number of Increments	Approximate Surface Area (SF)	Approximate Volume (cy)	Selection Rationale
RA-S2	Source	TBD[1]	60	TBD[2]	TBD[2]	Soil cuttings exhibiting evidence of contamination with an initial average DRO concentration exceeding the restricted EAL and TCRA (supersack)[3] soil

Notes:
[1] The soil sampling depth will be based on the thickness of the landfarm soil. The discrete samples will be collected from the center of the soil layer (e.g., if the thickness is 10 inches, then increment samples will be collected from approximately 5 inches below the top of the soil). The MI samples will be collected to represent the entire thickness of the landfarm.
[2] The size of the landfarm will be dependent on the amount of soil cuttings determined to be contaminated that require landfarm remediation and the TCRA (supersack) soil. Refer to the RAWP and SOP UXO-04 (Attachment B) for details on landfarm construction and management.
[3] Phase 1 TCRA excavated soil was placed into 41 supersacks, with a total estimated volume of approximately 30 cy, which is the approximate volume of soil that will be placed in RA-S2 along with the soil cuttings generated from the RA activities.

SOP - Standard Operating Procedure
TBD - To Be Determined

5.4.2 Soil Vapor

The lateral soil vapor DU will be established for the presumed spill area (RA-V1; corresponding to RA-S1) (Figure 7, Appendix A of the RAWP). RA-V1 consists of four nested[4] bioventing wells (containing two wells each). DU RA-V1 will be further subdivided into 2 vertical DU layers based on the screened intervals of the active bioventing system wells as presented in Table 5-4. The soil vapor DUs will be used to designate the shallower (higher COPC concentration) from the deeper (lower COPC concentrations) soils. Soil vapor samples/field monitoring will be collected from both the shallow and deeper DUs, and results will be used to help target/adjust the active bioventing system. Soil vapor will be sampled using the methods described in Section 6.4. Soil vapor sampling will not be performed at the two single inlet/intake wells.

Soil vapor sampling will be conducted immediately following bioventing well installation to obtain baseline site data, and IAW the schedule prescribed in the Phase 3 O&M Plan thereafter (Appendix G of the RAWP).

[4] *Nested wells referenced for this project are defined as wells installed into co-located borings.*

Table 5-4: Soil Vapor DU Summary

DU ID	Layer	DU Type	Depth Interval (ft bgs)	Number of Wells	Approximate Surface Area (sf)	Selection Rationale
RA-V1	A	Source	5 to 25	4	1,188	Known source area; highest COPC concentration expected
	B	Boundary	30 to 50	4		COPC concentrations expected to be below restricted EALs

5.5 Decision Statements

The following subsections define the decision rules to be applied during the RA.

5.5.1 Soil Data Quality Evaluation

If the criteria described below are met and the replicate RSD is less than or equal to 35 percent (%), data will be considered acceptable for final decision making and compared to the applicable EALs (Tables 4-2 and 4-3) for the replicate samples analyzed and all DUs they represent. Collection of follow-up confirmation samples for DUs where remediation is necessary will not be required for laterally and vertically adjacent boundary DUs that meet target action levels. Minimum data evaluation criteria include:

- Samples were collected via the prescribed procedures;
- Minimum required sample mass was met for each sample;
- Laboratory processing and analysis were conducted as described;
- Holding times were met;
- The number and type of replicates collected met or exceeded the specified number; and
- RSD was calculated for all replicate samples.

If the minimum data evaluation criteria above are met and the replicate RSD is greater than 35% but less than or equal to 50%, data will be considered acceptable for final decision making and compared to the applicable EALs (Tables 4-2 and 4-3) for the replicate samples analyzed and all DUs they represent. However, field and laboratory sampling and processes will be reviewed for potential sources of error and summarized in the Remedial Action Report (RAR). Collection of follow-up confirmation samples for DUs where remediation is necessary will be required for laterally and vertically adjacent boundary DUs even if the initial results meet target action levels.

If the minimum data evaluation criteria described previously are met and the replicate RSD is greater than 50% but less than or equal to 100%, the following actions will be taken:

- Field and laboratory sampling and processes will be reviewed for potential sources of error and summarized in the RAR;
- The mean concentration of COPCs will be compared to the applicable EALs for DUs with replicate sample data;

- For DUs without replicate data, the reported COPC concentrations will be adjusted upwards by the RSD calculated for the DU representing them prior to being compared to the applicable EALs;
- Additional evidence for data acceptance (or rejection) will be provided in the RAR to support decision making purposes, including site history, adequacy of methods used in collecting, processing, and analyzing samples, closeness of data to EALs, safety margins built into EALs, and other information as available and pertinent; and
- Collection of follow-up confirmation samples for DUs where remediation is necessary, including laterally and vertically adjacent boundary DUs even if they meet target action levels. Additional increments[5] and/or subsamples will be collected during confirmation sampling to increase the resulting bulk sample mass.

If the minimum data evaluation criteria described previously are met and the RSD is greater than 100%, data will not be considered acceptable for final decision making unless approved by the HDOH HEER Office and the following actions are taken:

- Field and laboratory sampling and processes will be reviewed for potential sources of error and summarized in the RAR:
  - If most total error is determined to be due to laboratory subsampling or (less likely) analysis, the laboratory will be required to reprocess and retest the samples, including milling of samples, if necessary. Additional laboratory replicates will be prepared and tested.
- Consider the collection of new field samples using the following approach:
  - If known, designate suspected source areas as separate DUs for individual characterization;
  - Increase the number of increments to 75 or more; and
  - Increase the bulk sample mass to 2 – 3 kilograms.
- Collect replicate samples in all anticipated high-concentration and high-risk DUs;
- Additional evidence for data acceptance (or rejection) will be provided in the RAR to support decision making purposes, including site history, adequacy of methods used in collecting, processing, and analyzing samples, closeness of data to EALs, safety margins built into EALs, and other information as available and pertinent; and
- Collection of replicate confirmation samples for DUs where RA occurs is necessary. Additional confirmation samples will be collected from laterally and vertically adjacent boundary DUs even if they meet target action levels. Additional increments (when possible) and/or subsamples will be collected during sampling to increase the confirmation sample bulk mass.

[5] *Placement of more than 10 borings (i.e., core increments) for confirmation samples in DU RA-S1 is infeasible due to dense utilities and steep slopes.*

5.5.2 Additional Investigation and Management

If COPCs are non-detect or are detected in surface soil below the unrestricted EALs, the release will be considered confined to the upslope portion of the AOI (both shallow and deeper soils), in the immediate vicinity of the generator. Surface soil DUs will be excluded from the AOI and will no longer be subject to management under the LT-EHMP.

If COPCs are non-detect or are detected in both soil (surface and subsurface) and soil vapor at concentrations below the unrestricted EALs, discontinuation of the LT-EHMP will be recommended and a no further action (NFA) designation for the site from the HDOH HEER Office will be requested.

If COPCs are detected in surface soil above the unrestricted EALs, no additional excavation or remediation activities will be taken. However, the DU from which the soil originated will continue to be managed under the LT-EHMP until such a time as future confirmation sampling indicates COPC concentrations are less than or equal to the unrestricted EALs.

If COPCs are detected in subsurface soil at concentrations above the clean-up goals, continued operation of the active bioventing system IAW with the RAWP and O&M Plan as well as ongoing management of the site under the LT-EHMP will be recommended[6].

If COPCs are detected in both soil (surface and subsurface) and soil vapor at concentrations above the unrestricted EALs but equal to or below the clean-up goals, decommissioning of the active bioventing system and continuation of management of residual contamination in place under the site LT-EHMP will be recommended, and a designation of NFA with institutional controls from the HDOH HEER Office will be requested.

If landfarm soil confirmation samples indicate concentrations of all COPCs are less than the restricted EALs, the soil may be reused on site within the AOI and managed as in-situ soil under the LT-EHMP.

If landfarm soil confirmation samples confirm COPC concentrations less than or equal to the unrestricted EALs, the soil may be reused on site, both within and outside of the AOI.

If landfarm soils contain COPC concentrations exceeding the clean-up goals and above the unrestricted EALs, the soil will remain in the appropriate landfarm for additional remediation IAW the RAWP and O&M Plan (Appendix G of the RAWP). These soils will be managed as ex-situ soil under the LT-EHMP.

AOI boundaries under the LT-EHMP may be adjusted based on the findings of soil sampling conducted during the bioventing well installation.

[6] *Decommissioning of the active bioventing system will be recommended when soil vapor levels have stabilized and system adjustments do not yield additional results (refer to the RAWP and O&M Plan for additional details).*

5.5.3 Soil Reuse and Disposal

Soil placed outside the AOI will not be subject to ongoing management under the site LT-EHMP. Landfarm soil placed within the AOI will be managed under the LT-EHMP regardless of confirmation sampling results.

All soil will remain on site, except for soil sent to the mainland for laboratory analysis. The portion of the soil samples not consumed during analysis will be either 1) returned to the landfarm for remediation if COPCs are detected above the restricted EALs or 2) returned to the AOI if COPCs are detected at concentrations below the restricted EALs. Refer to the Waste Management Plan (Attachment C) for additional details on soil reuse and disposal.

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Section 6 Description of Sampling Activities

This section describes the RA project sampling activities. Refer to the RAWP for descriptions of other project tasks such as mobilization and site preparation, active bioventing system installation, waste management, data management, and demobilization. Also refer to the O&M Plan (Appendix G of the RAWP) for details on O&M of the active bioventing system.

Soil and soil vapor samples will be collected as summarized in this section and detailed in SOPs ENV-07 *Multi-Increment Soil Sampling* and ENV-09 *Soil Vapor Sampling* (Attachment B). The sample matrices, number of samples, number and types of field QC samples are included in tables within this section. Sample volumes, sample container specifications, preservation requirements, and maximum holding times are identified in Table 6-7. All samples will be properly labeled and packaged carefully to avoid breakage or cross contamination. Sample handling, packaging, and shipping requirement procedures are presented in SOP ENV-01 *Sample Handling, Packing, and Shipping* (Attachment B).

The sampling results will be compared to the EALs listed in Tables 4-2 and 4-3 and will be evaluated as described in Section 5.5. Although not anticipated since disposable sampling equipment are planned for use, if sampling-related investigation-derived waste (IDW) is generated from non-disposable equipment, decontamination will be managed IAW SOP ENV-02 *Sampling Decontamination* (Attachment B) and the Waste Management Plan (Attachment C).

During field activities, personnel will strictly adhere to the HSP (Appendix E of the RAWP). Field personnel will consist of a Field Manager, Site Safety and Health Officer (SSHO), and field technicians. Additionally, a qualified archaeological monitor will be present during all ground disturbing activities (e.g., bioventing well installation, soil sampling) associated with the project. If an archaeological site or burial site is inadvertently discovered, all work in the immediate area shall cease and the area will be protected and the DAF Contracting Officer’s Representative as well as appropriate agencies such as the Hawai‘i State Historic Preservation Division will be contacted. If a cultural artifact is identified, it will be inspected by the archaeological monitor and handled IAW the Archaeological Monitoring Plan (Appendix C of the RAWP). Refer to the Archaeological Monitoring Plan for details on archaeological monitoring procedures. Additionally, the DAF will provide a cultural advisor/monitor who will be on site during the Phase 3 RA field activities and will inspect all soil samples prior to removal from the summit.

Also, although not anticipated, if any rare, threatened, or endangered species are identified within RA work areas, they will be immediately reported to the DAF. Refer to the Environmental Protection Plan for additional details (Appendix F of the RAWP).

6.1 Field Monitoring

Field screening using a PID and handheld multi-gas meter as described below will be conducted during this investigation to:

- Aid in refining source area DU boundaries;
- Pre-screen samples to optimize laboratory analysis; and

- Carry out health and safety monitoring to determine possible worker hazards and exposures.

Temperature, barometric pressure, and humidity measurements will also be collected during the active bioventing well O&M activities to better understand the in-ground conditions.

6.1.1 PID Field Monitoring

Environmental monitoring using a PID will be performed to assess the potential presence of VOCs in site soil, soil gas, and ambient air. The PID will be bump tested in the field each day IAW with manufacturer guidance, prior to the start of monitoring. If the total VOC concentration in the workspace atmosphere exceeds 10 parts per million (ppm) for a sustained 30 seconds or more, personal protective equipment requirements will be upgraded to Level C as described in the HSP (Appendix E of the RAWP)[7].

Field monitoring via headspace measurements will be conducted at each soil boring location during subsurface soil sampling using a PID equipped with a moisture filter. Refer to SOP ENV-07 *Multi-Increment Soil Sampling* (Attachment B) for PID measurement procedures.

Headspace readings will also be collected from boring cuttings to assist with soil segregation. Cuttings with peak headspace readings greater than 10 ppm will be added to the landfarm (DU RA-S2) for remediation via ex-situ aeration. Cuttings with peak headspace readings below 10 ppm may be spread on the surface in the vicinity of the boring from which they originated.

Following active bioventing well installation, PID readings will be collected from each active bioventing well according to the schedule provided in the O&M Plan (Appendix G of the RAWP). Refer to SOP ENV-09 *Soil Vapor Sampling* (Attachment B) for details on PID use.

6.1.2 Multi-Gas Meter Field Monitoring

Environmental monitoring using a multi-gas meter with a confined space attachment will be conducted IAW the schedule provided in the project O&M Plan (Appendix G of the RAWP) to monitor the presence of oxygen, carbon dioxide, and methane during O&M of the active bioventing system and wells. Prior to collecting O&M readings, the multi-gas meter will be bump tested IAW manufacturer's guidance to ensure proper functioning. Readings will be collected biweekly (i.e., every other week) including during concurrently scheduled quarterly visits and annual sampling. Refer to SOP ENV-09 *Soil Vapor Sampling* (Attachment B) for details on multi-gas meter use.

6.1.3 Temperature and Barometric Pressure Measurements

A handheld precision digital barometer/thermometer will be used to measure the temperature and barometric pressure in each active bioventing well to better understand in-ground conditions. Readings will be collected prior to deployment of each soil vapor sampler and following sampler recovery (before and after soil vapor sampling).

[7] *This condition is not anticipated.*

Refer to SOP ENV-09 *Soil Vapor Sampling* (Attachment B) for details on temperature, and barometric pressure measurement procedures.

6.2 *Surface Soil Sampling*

A MI soil sampling approach will be utilized IAW the HDOH HEER Office TGM to evaluate the presence of COPCs in surface soil at the surface boundary DUs (RA-B1 to RA-B5 and stepout DUs RA-B6 to RA-B13, as applicable) (Figure 5, Appendix A of the RAWP) and landfarm DU (RA-S2), as defined in Section 5.4. Sections 6.2.1 and 6.2.2 describe the surface DU in-situ hand sampling and landfarm sampling approaches, respectively.

6.2.1 In-Situ Hand Sampling

Surface soil sampling will be performed in surface boundary DUs RA-B1 to RA-B5 (Figure 5, Appendix A of the RAWP) to assess impacts from fuel outside of the immediate vicinity of the generator. The MI surface soil samples will be collected by hand at 0 to 4 inches bgs using a disposable flat-bottom scoop and will be analyzed for TPH-DRO and PAHs as presented in Table 4-2. Sixty increments will be systematically randomly collected and combined into one analytical sample from each DU. For each increment, approximately 17 grams of soil will be collected and placed in a re-sealable plastic bag for a total bulk sample mass of approximately 1,000 grams. Surface soil DU samples, including QC samples will be collected as listed in Table 6-1 and described in SOP ENV-07 *Multi-Increment Soil Sampling* (Attachment B).

If one or more COPC concentrations from the initial boundary DUs (RA-B1 to RA-B5) exceed the unrestricted EALs, then adjacent stepout surface boundary DUs (RA-B6 to RA-B13, as applicable) will be sampled, until the horizontal extent of surface contamination is bound. For example, if analytical results from RA-B4 exceed the unrestricted EALs then RA-B9 will be sampled, or if analytical results from RA-B2 exceed the unrestricted EALs then both RA-B6 and RA-B7 will be sampled.

Table 6-1: Surface DU Sampling Locations and Methods

DU ID/ Location Description	Sample ID[1]	QC[2]	Sample Depth (inches bgs)	Area (sf)	Number of Increments	Increment Spacing[3] (ft)	Analytes and EPA Analytical Method
RA-B1	03001Sxxx	Sample to be processed for laboratory replicate[4]-	0-4	272	60	2.1	TPH-DRO (8015D), PAHs (8270E), SPLP (1312)
RA-B2	03001Sxxx	MS/MSD[5]	0-4	320	60	2.3	
RA-B3	03001Sxxx	--	0-4	223	60	1.9	
	03001Sxxx	Field replicate[6]					
	03001Sxxx	Field replicate[6]					
RA-B4	03001Sxxx	--	0-4	131	60	1.5	
RA-B5	03001Sxxx	--	0-4	109	60	1.3	

DU ID/ Location Description	Sample ID[1]	QC[2]	Sample Depth (inches bgs)	Area (sf)	Number of Increments	Increment Spacing[3] (ft)	Analytes and EPA Analytical Method
RA-B6	03001Sxxx	Contingent on RA-B1 through RA-B5 results[7]	0-4	486	60	2.8	TPH-DRO (8015D), PAHs (8270E)[8]
RA-B7	03001Sxxx		0-4	628	60	3.2	
RA-B8	03001Sxxx		0-4	258	60	2.1	
RA-B9	03001Sxxx		0-4	367	60	2.5	
RA-B10	03001Sxxx		0-4	224	60	1.9	
RA-B11	03001Sxxx		0-4	133	60	1.5	
RA-B12	03001Sxxx		0-4	204	60	1.8	
RA-B13	03001Sxxx		0-4	498	60	2.9	

Notes:

[1] Sample ID where xxx is chronological numbers, starting from 001. The sample ID is a blind identification number that is listed on COC forms, labels, etc. which allows samples to be submitted blind to the laboratory (refer to SOP ENV-07 for additional details on sample IDs).

[2] Additional QC samples that may be collected but are not listed on this table include equipment rinsates (if necessary). Disposable sampling equipment is planned for use, however, if reusable equipment is used, equipment rinsate blanks will be collected for any parameters sampled using reusable equipment at a rate of 1 per day. Equipment rinsate blanks will consist of clean water run over or through decontaminated field sampling equipment. Refer to SOP ENV-07 for details on QC samples. If more than 10 surface DUs require sampling and analysis (not anticipated), an additional set of field replicates will be collected from the DU expected to contain the highest concentration of COPCs to assess RSDs near method detection limits.

[3] Increment spacing is calculated using the formula of sqrt(area/#increments)

[4] Laboratory replicates will be requested to be prepared and analyzed by the laboratory at a minimum rate of one replicate set per 20 samples to test the precision of the laboratory's subsampling process. A request will be made to the laboratory to prepare the soil sample submitted for replicate analysis (i.e., the laboratory will generate three samples from the one sample submitted using their MI subsampling process and will analyze the three samples).

[5] MS/MSD pairs are utilized to determine the project matrix effect upon target analytes and will be evaluated at a rate of one MS/MSD pair for every 20 field samples or part thereof. Extra soil sample volume for MS/MSD analysis on MI samples is not required for this project, and the analysis can be conducted using the primary sample with a note on the COC requesting that MS/MSD analysis be performed.

[6] Field replicates will be collected using the same method as primary MI samples as described in Section 6.2.1. However, replicate samples will be collected from completely independent, systematically random-selected locations to test small-scale variability within the DU. Replicate increment locations will be collected in a triangular pattern, with one replicate increment collected from each point of an equilateral triangle. Triangle points will be located one quarter of the calculated increment spacing from the triangle midpoint.

[7] Stepout samples (RA-B6 to RA B-13) will only be collected if there are exceedances of unrestricted EALs in adjacent surface boundary DUs. If stepout samples are collected, field replicate sample sets will be collected for every 10 primary samples (or part thereof).

[8] SPLP analysis for the stepout samples will not be necessary as there will be sufficient data from the source DU and other DUs to make a determination on mobility.

COC - Chain-of-Custody
MS - Matrix Spike
MSD - Matrix Spike Duplicate

For surface soil DUs, confirmation samples will be collected from each DU with COPC concentrations exceeding the most conservative EALs (i.e., unrestricted HDOH Tier 1 EALs[8]), using the same methods as the initial samples. Additional confirmation samples will be collected as necessary IAW with the SAP decision statement section (SAP Section 5.5.1). Surface confirmation sampling will depend on the results and methods chosen to address the soil if EAL exceedances are detected (e.g., based on the results, DAF may decide to excavate the soil and add it to the landfarm, or leave it in place for management by land use controls under the LT-EHMP [e.g., install fencing]).

6.2.2 Landfarm Sampling

During landfarm construction, discrete sampling for microbial DNA analysis and MI sampling for VOC and non-VOC analysis will be conducted.

6.2.2.1 Discrete Sampling

One 50-gram discrete sample will be collected from the landfarm soil for microbial DNA analysis by QuantArray®- Petro method to assess the presence of microbes involved in aerobic and anaerobic biodegradation of TPHs and associated constituents. Refer to Table 4-2 for specific analytes. Samples will be collected using a disposable flat-bottom scoop. The discrete soil sampling depth will be based on the thickness of the landfarm soil. Samples will be collected from the center of the soil layer (e.g., if the thickness is 10 inches, then discrete samples will be collected from approximately 5 inches below the top of the soil). The discrete soil sample will be placed in the laboratory-provided container as listed in Table 6-7. The collection of QC samples (e.g., duplicates) for the microbial DNA analysis will not be required since the data will be used for general informational purposes only and not for decision making. It is not anticipated that there will be insufficient levels of biodegrading microorganisms present; however, if the situation occurs, the results will be discussed with the DAF and the need for corrective actions will be assessed.

6.2.2.2 MI Sampling for Non-VOC Analysis

Similar to the surface soil DU sampling described in Section 6.2.1, the MI soil samples from the landfarm(s) DU will consist of 60 increments that will be systematically randomly collected and combined into one analytical sample from each DU. The soil sampling depth will be based on the thickness of the landfarm soil and the sampling equipment best suited to the soil. If soil is obtained via slide hammer, an approximately 17-gram subsample will be collected as a wedge from the entire thickness of each of the 60 core increments. If the sample is best collected via shovel and flat bottom scoop, 20 individual 17-gram increments will be collected from the bottom, middle, and top thirds of the landfarm (total of 60 increments) using a systematic random approach IAW the HDOH TGM. Increments within each DU will be combined into a single sample and placed into a re-sealable plastic bag for a total bulk sample mass of approximately 1,000 grams. The MI soil sample will be analyzed for TPH-DRO and PAHs as summarized in Tables 4-2 and 6-2.

[8] *Unrestricted sites within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

6.2.2.3 MI Sampling for VOC Analysis

Soil samples for VOC analysis (e.g., benzene, toluene, ethylbenzene, and xylene [BTEX]) will also be collected by using a 5-gram Terra Core® (or similar) sampler to minimize loss of volatile chemicals during sample collection. From each of the 60 increments described in Section 6.2.2.2, approximately 5 grams of soil will be collected from the lower portion of the slide hammer increment (greater than 6 inches below the stockpile surface) with a disposable Terra Core® (or similar) sampler and placed into a glass jar containing 25 milliliters (mL) of a methanol (MeOH) preservative (for volatile analysis), for a 1:1 ratio. This will yield 25 grams of soil per jar and 300 grams collectively per DU. Multiple jars will be required for each MI sample as the MeOH in each jar must cover the sample in its entirety while also not exceeding the volume which may be shipped in an individual container as allowed by the Department of Transportation (DOT).

The basis for this volatiles sampling method is SW846 5035. To reduce the amount of soil leaving the site out of respect for the cultural significance of the site, a modified SW846 5035 sampling approach will be used where the appropriate sample mass is added to the pre-weighed jars with a known volume of MeOH and allowed to extract for a minimum of 24 hours. The jars will be weighed in the field immediately after the soil is added to determine the actual soil mass collected, then stored in a cooler with ice or in a chest freezer on site. After 24 hours, the MeOH will be carefully decanted (to avoid transferring soil) from the original jars into clean jars. Following decanting, soil will be removed from the original jars using paper towels and a MeOH squeeze bottle and combined in a large bowl. The decanted MeOH will quickly be returned to the original jar and sealed to minimize VOC loss. The soil in the bowl will be exposed to air to allow for the residual MeOH to evaporate prior to adding the soil to the landfarm (RA-S2).

Table 6-2: Landfarm DU Sampling Locations and Methods

DU ID/ Location Description	Sample ID[1]	QC[2]	Sample Depth (inches bgs)	Area (sf)	Number of Increments	Analytes and EPA Analytical Method
RA-S2 Soil Cuttings and TCRA Supersack Soil	03001Sxxx	--	TBD[3]	TBD[4]	1 (discrete)	Microbial DNA analysis (QuantArray®-Petro)
		MS/MSD[5]	TBD[3]	TBD[4]	60	BTEX (8260D), PAH (8270E), TPH-DRO (8015D)
	03001Sxxx	Field replicate[6]	TBD[3]	TBD[4]	60	
	03001Sxxx	Field replicate[6]	TBD[3]	TBD[4]	60	

Notes:

Samples listed in this table are the planned samples per each sampling event (i.e., initial sampling event [after landfarm establishment] and during each confirmation sampling event).

[1] Sample ID where xxx is chronological numbers, starting from 001. The Sample ID is a blind sample ID that is listed on COC forms, labels, etc. which allows samples to be submitted blind to the laboratory (refer to SOP ENV-07 for additional details on sample IDs).

[2] Additional QC samples that will be collected but are not listed on this table include trip blanks and equipment rinsates (if necessary). One trip blank will be required to accompany each cooler with samples to be analyzed for VOCs. The trip blank is provided by the laboratory and accompanies the associated methanol sample jars as closely as practical (e.g., taken to the sampling site in the cooler, stored in cooler/refrigerator with samples during the MeOH soaking/decanting process) and returned to the laboratory unopened. Disposable sampling equipment is planned for use, however, if reusable equipment is used, equipment rinsate blanks will be collected for any parameters sampled

using reusable equipment at a rate of 1 per day. Equipment rinsate blanks will consist of clean water run over or through decontaminated field sampling equipment. Refer to SOP ENV-07 for details on QC samples. The collection of QC samples (e.g., duplicates) for the microbial DNA analysis will not be required since the data will be used for general informational purposes only and not for decision making.

[3] The soil sampling depth will be based on the thickness of the landfarm soil. The discrete samples will be collected from the center of the soil layer (e.g., if the thickness is 10 inches, then discrete samples or increment will be collected from approximately 5 inches below the top of the soil). The MI samples will be collected to represent the entire thickness of the landfarm.

[4] The size of the landfarm will be dependent on the amount of soil cuttings determined to be contaminated that require landfarm remediation and the TCRA (supersack) soil. Refer to the RAWP and SOP UXO-04 *Heavy Equipment and Earthmoving Machinery Operations* (Attachment B) for additional details on the landfarm.

[5] MS/MSD pairs are utilized to determine the project matrix effect upon target analytes and will be evaluated at a rate of one MS/MSD pair for every 20 field samples or part thereof. Extra soil sample volume for MS/MSD analysis on MI samples is not required for this project, and the analysis can be conducted using the primary sample with a note on the COC requesting that MS/MSD analysis be performed.

[6] Field replicates will be collected using the same method primary MI samples as described in Section 6.2.2. However, triplicate samples will be collected from completely independent, systematically random-selected locations to test small-scale variability within the DU. Replicate increment locations will be collected in a triangular pattern, with one replicate increment collected from each point of an equilateral triangle. Triangle points will be located one quarter of the calculated increment spacing from the triangle midpoint.

For the landfarm DU, confirmation MI samples will be collected from the landfarm after one year of ex-situ aeration, using the same methods as the initial samples and will be analyzed for BTEX, PAHs, and TPH-DRO and the results will be compared to the cleanup goals (i.e., Table 3-2; unrestricted HDOH Tier 1 EALs). Soil sampling will be conducted at the landfarm DU following annual turning of the soil as described in the O&M Plan (Appendix G). Confirmation samples will be collected annually as described in the SAP (Appendix D) until COPC concentrations fall below the unrestricted EALs.

6.3 Subsurface Soil Sampling

A modified MI sampling approach will be utilized to collect subsurface soil samples from the lateral source area DU (RA-S1) and its associated vertical DU layers as described in Section 5.4 to better characterize subsurface impacts from downward migration of the release. The sampling will be conducted in conjunction with bioventing well installation.

Utility toning will be conducted prior to subsurface sampling. Archaeological monitoring will also be performed as described in Section 6.

6.3.1 In-Situ Sampling from Borings

Modified MI subsurface samples collected from lateral DU RA-S1 (Figure 6, Appendix A of the RAWP) will consist of 10 core increments representative of an equivalent volume of soil. Core increment spacing has been determined using the square root of the DU area divided by the targeted number of increments as described in the HDOH HEER TGM Section 4.2.4.1. The estimated dimensions, volume of soil represented, and ideal core increment spacing[9] are presented in Table 6-3.

[9] *Actual increment spacing is anticipated to be strongly influenced by surface obstructions, utilities, and slopes.*

Table 6-3: DU Area, Volume, and Ideal Core Increment Spacing

DU ID	Area (sf)	Approximate Volume (cy)	Core Increment Spacing[1] (ft)
RA-S1	1,188	2,200	11

Note:
[1] Increment spacing is calculated using the formula of sqrt(area/#increments)

The selected locations will be drilled with a track-mounted, hydraulic, direct-push sampling rig to drive a macro-core sampler with acetate liners at each of the core increment locations. In the event of refusal, an alternative core increment location near the refused boring will be selected (refer to Section 5.4.4 *Refusal/Inaccessibility* of SOP ENV-07 *Multi-Increment Soil Sampling* (Attachment B) for procedures on refusal and inaccessibility.

6.3.1.1 Discrete Sampling

To assess the presence of microbes involved in aerobic and anaerobic biodegradation of TPHs and associated constituents (refer to Table 4-2 for specific analytes), GSINA will collect one 50-gram discrete sample for microbial DNA analysis from each vertical DU depth interval in RA-S1 (12 samples total) during well installation. GSINA's geologist will select the borings that the DNA samples will be collected from based on field observations. Samples will be collected using the wedge technique described in Section 6.3.1.2.

6.3.1.2 MI Sampling for Non-VOC Analysis

For each subsample for non-volatiles analysis, approximately 100 grams of soil will be collected as a continuous, thin wedge from the entire depth interval specified in Table 6-5. Subsamples will be collected with a disposable scoop (or stainless-steel spatula) and placed in a re-sealable plastic bag for a total sample mass of approximately 1,000 grams. If non-disposable sampling spatulas are used, they will be decontaminated between DUs as described in Section 6.7 and SOP ENV-02 *Sampling Decontamination* (Attachment B). Similarly, for the SPLP VOC analysis, increment samples (separate from the increments that make up the 1,000 gram sample) from each DU (total of 10 increment [one from each boring DU]) will be collected and placed into unpreserved glass jars per required volume specified in Table 6-7.

6.3.1.3 MI Sampling for VOC Analysis

A total of 60 subsamples for volatiles analysis will be collected from each DU (six from each core increment) as closely as field conditions allow to the spacings specified in Table 6-4. For each subsample, approximately 5 grams of soil will be collected with a disposable Terra Core® (or similar) sampler and placed into a glass jar containing 30 mL of a MeOH preservative (for volatile analysis), for a 1:1 ratio and total mass of approximately 300 grams. Multiple jars will be required for each MI sample as the MeOH in each jar must cover the sample in its entirety while also not exceeding the volume which may be shipped in an individual container as allowed by the DOT.

Table 6-4: Bulk Sample Mass and Subsample Spacing for Volatile Analysis

DU ID	Target Bulk Sample Mass (grams)	Target Volatiles Sample Mass (grams)	Number of Core Increments	DU Layer	Layer Thickness (ft)	Volatiles Subsample Spacing (inches)
RA-S1	1,000 each (100 per boring)	300 each (30 per boring)	10	A	2 each	4
				B		
				C		
				D		
				E	5 each	10
				F		
				G		
				H		
				I		
				J		
				K		
				L		

The same modified SW846 5035 decanting method for VOC samples as described in Section 6.2.2.3 will be utilized to minimize the amount of soil leaving the site. Subsurface DU samples, including QC samples will be collected as listed in Table 6-5 and as described in SOP ENV-07 *Multi-Increment Soil Sampling* (Attachment B).

Unused soil and soil cuttings will be returned to the vicinity of borehole from which they originated if cuttings pass PID screening (Section 6.1.1). Cuttings with headspace readings greater than 10 ppm will be added to the landfarm (RA-S2) for remediation.

Table 6-5: Subsurface DU Sampling Locations and Methods

DU ID	Approximate Surface Area (sf)	Layer	Sample ID[1]	QC[2]	Sample Depth Interval (ft bgs)	Number of Increments	Analytes and EPA Analytical Method
RA-S1 (Source)	1,140	A	03001Sxxx	-	2 to 4	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		B	03001Sxxx	-	4 to 6	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)

DU ID	Approximate Surface Area (sf)	Layer	Sample ID[1]	QC[2]	Sample Depth Interval (ft bgs)	Number of Increments	Analytes and EPA Analytical Method
		C	03001Sxxx	Sample to be processed for laboratory replicate[3]	6 to 8	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
				--		1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
			03001Sxxx	Field subsample replicate[5]		10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
			03001Sxxx	Field subsample replicate[5]			
		D	03001Sxxx	MS/MSD[4]	8 to 10	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		E	03001Sxxx	--	10 to 15	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
			03001Sxxx	Field subsample replicate[5]		10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
			03001Sxxx	Field subsample replicate[5]			
		F	03001Sxxx	-	15 to 20	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		G	03001Sxxx	-	20 to 25	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)

DU ID	Approximate Surface Area (sf)	Layer	Sample ID[1]	QC[2]	Sample Depth Interval (ft bgs)	Number of Increments	Analytes and EPA Analytical Method
RA-DU3 (Boundary)		H	03001Sxxx	-	25 to 30	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		I	03001Sxxx	-	30 to 35	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		J	03001Sxxx	-	35 to 40	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		K	03001Sxxx	-	40 to 45	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)
		L	03001Sxxx	-	45 to 50	10	BTEX (8260D), PAH (8270E), TPH-DRO (8015D), SPLP (1312)
						1 (discrete)	Microbial DNA analysis (QuantArray®- Petro)

Notes:

[1] Sample ID where xxx is chronological numbers, starting from 001. The Sample ID is a blind sample ID that is listed on COC forms, labels, etc. which allows samples to be submitted blind to the laboratory (refer to SOP ENV-07 for additional details on sample IDs).

[2] Additional QC samples that will be collected but are not listed on this table include trip blanks and equipment rinsates (if necessary). One trip blank will be required to accompany each cooler with samples to be analyzed for VOCs. The trip blank is provided by the laboratory and accompanies the associated methanol sample jars as closely as practical (e.g., taken to the sampling site in the cooler, stored in cooler/refrigerator with samples during the MeOH soaking/decanting process) and returned to the laboratory unopened. Disposable sampling equipment is planned for use, however, if reusable equipment is used, equipment rinsate blanks will be collected for any parameters sampled using reusable equipment at a rate of 1 per day. Equipment rinsate blanks will consist of clean water run over or through decontaminated field sampling equipment. Field replicates will not be collected for subsurface soils during this investigation due to limited drill rig access within the AOI. The site has a slope which cannot be safely drilled upon and has limited area for soil borings, due to the presence of utility lines. Refer to SOP ENV-07 for details on QC samples.

[3] Laboratory replicates will be requested to be prepared and analyzed by the laboratory at a minimum rate of one replicate set per 20 samples to test the precision of the laboratory's subsampling process. A request will be made to the laboratory to prepare the soil sample submitted for replicate analysis (i.e., the laboratory will generate three samples from the one sample submitted using their MI subsampling process and will analyze the three samples).
[4] MS/MSD pairs are utilized to determine the project matrix effect upon target analytes and will be evaluated at a rate of one MS/MSD pair for every 20 field samples or part thereof. Extra soil sample volume for MS/MSD analysis on MI samples is not required for this project, and the analysis can be conducted using the primary sample with a note on the COC requesting that MS/MSD analysis be performed.
[5] Field subsample replicates will be collected to test field subsampling precision IAW the HDOH HEER Office TGM, Section 3.6.5 and Section 4 Appendix L.2. Subsample field replicates will be collected using the same methods described in Section 6.3, from the same core increments as the primary sample.

For subsurface soil DUs, confirmation samples will be collected from each DU with COPC concentrations exceeding the most conservative EALs (i.e., unrestricted HDOH Tier 1 EALs[10]), using the same methods as the initial samples. Additional confirmation samples will be collected as necessary IAW with the SAP decision statement section (Section 5.5.1). As described in Section 5.5.1, HDOH guidance includes stipulations regarding if/when/how many confirmation samples need to be collected based on the RSDs of the initial results. Since this information is currently unknown, it can only be estimated that the need for collection of confirmation samples in the source DU (the subsurface samples) will be approximately three years after system installation, but the timeline will be adjusted based on system performance (and the results of the initial RA sampling).

6.4 Soil Vapor Sampling

Passive soil vapor sampling will be conducted immediately following bioventing well installation (prior to any bioventing) to obtain baseline site data. Sampling will be performed annually thereafter as part of ongoing O&M activities to track contaminant trends over time and assist with optimizing the active bioventing system. Passive soil vapor sampling will use adsorbent samplers to adsorb VOCs and semi-volatile organic compounds in soil vapors over time, which can yield a more representative sample than active soil vapor methods.

Soil vapor sampling will be performed at the 8 bioventing well located within two lateral soil vapor DUs (Figure 6, Appendix A of the RAWP) for the presumed spill area (RA-V1; corresponding to and overlapping with RA-S1) (four nested wells [containing two wells each]). RA-V1 will be further subdivided into two vertical DU layers. Immediately following bioventing well installation (prior to bioventing) and one year after, soil vapor samples will be collected from each of the bioventing wells located within the DUs. Additional years of passive soil vapor sampling may be performed as part of O&M activities for the active bioventing system. Soil vapor samples will be analyzed for VOCs, project-specific TPH compounds and PAHs by EPA Method TO17 as presented in Table 4-3. Soil vapor samples, including QC samples will be collected as listed in Table 6-6 and as described in SOP ENV-09 *Soil Vapor Sampling* (Attachment B). Soil vapor sampling will not be performed at the two inlet/intake wells.

[10] *Unrestricted sites within 150 meters of a surface water body, where groundwater is a potential drinking water source.*

The sampling results will be presented in the RAR and will be used to identify if the remedy was effective or if additional information and/or operating time is required to achieve the RAOs.

Table 6-6: Soil Vapor DU Sampling Locations and Methods

DU ID	Layer	Well ID	Sample ID[1]	QC[2]	Depth Interval (ft bgs)	Analytes and EPA Analytical Method
RA-V1	A (Source)	V1A1	03001Vxxx	-	5 to 25	VOCs, TPH-DRO, PAHs (Method TO17)
		V1A2	03001Vxxx	-		
		V1A3	03001Vxxx	Laboratory duplicate[3,4]		
			03001Vxxx	Field duplicate[3,5]		
		V1A4	03001Vxxx	-		
	B (Boundary)	V1B1	03001Vxxx	-	30 to 50	
		V1B2	03001Vxxx	-		
		V1B3	03001Vxxx	-		
		V1B4	03001Vxxx	-		

Notes:
[1] Sample ID where xxx is chronological numbers, starting from 001. The Sample ID is a blind sample ID that is listed on COC forms, labels, etc. which allows samples to be submitted blind to the laboratory (refer to SOP ENV-07 for additional details on sample IDs).
[2] Additional QC samples that will be collected but are not listed on this table include trip blanks. Trip blanks will be collected at a rate of 1 per cooler (to accompany VOC samples only) (typically provided by the laboratory when they send sample containers). MS/MSD samples are not applicable for soil vapor sampling activities for this project. Refer to SOP ENV-09 for details on QC samples.
[3] For this project, in order to test the reproducibility of co-located samplers (field duplicates), during the first sampling event, both blind duplicate samples (deployment of separate samplers concurrently) and known duplicates (laboratory duplicates) (analysis of second absorbent cartridge from the Beacon Sampler) will be performed. The duplicate sampling method that produces the lowest average relative % difference will be carried forward during subsequent sampling events.
[4] Laboratory duplicates (i.e., laboratory will analyze the second absorbent cartridge from a single Beacon Sampler) to test reproducibility.
[5] Field duplicates will be collected to provide information on consistency and reproducibility of passive soil vapor sampling and laboratory procedures IAW the HDOH HEER Office TGM, Section 7.13.4.1. Field duplicates are intended to test reproducibility at individual sampling locations and are not to be applied to the DU as a whole.

6.5 Sample Preservation, Chain-of-Custody, and Transportation

All samples will be handled, packaged, and shipped IAW Table 6-7 and SOP ENV-01 *Sample Handling, Packing, and Shipping* (Attachment B).

Table 6-7: Sampling Containers, Preservation, and Hold Times

Matrix	Analyte/ Analytical Group	Method/ SOP[1]	Sample Volume[2]	Container(s) (number, size, type per sample)	Preservation	Maximum Holding Time (preparation[3]/ analysis)[4]
Soil	VOCs (volatiles)	Method Modified 5035A / 8260D DV-OP-0013, DV-MS-0010	40 mL vial (used to dilute MeOH)	MI VOC sampling. Terra Core® syringe to deliver (6X) 5-gram plugs per jar containing 30 mL of MeOH. Samples filtered after 24 hours to remove soil prior to shipping to lab. Soil stays at MSSC.	Cool to 4 ± 2°C	14 days for MeOH preserved
	TPH-DRO (extractable hydrocarbons)	Method 3546/8015D DV-OP-0013, DV-OP-0015, DV-OP-0007, DV-GC-0027	30 grams	1, 1 kilogram for MI sampling, gallon plastic bag (double bagged)	Cool to 4 ± 2°C	14 days / 40 days
	PAHs (semivolatiles)	Method 8270E DV-OP-0013, DV-MS-0012	30 grams			
	Microbial DNA analysis (QuantArray®-Petro[5])	MI SOP QuantArray	50 grams	4 ounce poly jar or whirl pack bag	Cool to 4 ± 2°C	24 hours / 48 hours[6]
Soil Leachate via SPLP	VOCs (volatiles)	SPLP Preparation Method 1312 DV-IP-0012 and Same methods as for soil	25 grams (two jars required)	2, 4 ounce glass jar (unpreserved)[7]	Cool to 4 ± 2°C	14 days (collection to start of leach)/ 14 days (start of extraction to analysis)
	TPH-DRO (extractable hydrocarbons)	SPLP Preparation Method 1312 DV-IP-0012 and Same methods as for soil	Same as for soil	Same as for soil[8]	Same as for soil	Same as for soil
	PAHs (semivolatiles)	SPLP Preparation Method 1312 DV-IP-0012 and Same methods as for soil	Same as for soil	Same as for soil[8]	Same as for soil	Same as for soil
Soil Vapor	VOCs, TPH-DRO, PAHs	Method TO17 SOP 7 rev 17	N/A	Sorbent tube	N/A	30 days

Notes:
[1] SOPs are evaluated and reviewed annually and therefore are subject to change. The laboratory will adhere to the most current limits and SOPs.

[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume may be needed for the laboratory MS/MSD sample analysis.

[3] MI sample preparation and extraction by the analytical laboratory will be performed for soil samples IAW SOP procedures which are compliant with HDOH TGM Section 4.2.6 (HDOH, 2009).

[4] Maximum holding time is calculated from the time the sample collection begins to the time the sample is prepared/extracted. Due to the time required to collect subsurface samples, holding times are expected to be considerably exceeded. However, sample increments will be immediately preserved and refrigerated/frozen on site pending collection of additional increments.

[5] QuantArray®-Petro is an advanced quantitative polymerase chain reaction method that quantifies a suite of functional genes involved in aerobic and anaerobic biodegradation of VOCs, TPHs, and PAHs.

[6] Similar to as stated in footnote 4, due to the time required to collect samples and inherent shipping logistics from Hawaiʻi to the mainland, holding times are expected to be considerably exceeded. While impossible to achieve the 24 hour hold time, the laboratory (Microbial Insights) was consulted and plans to immediately filter and freeze samples upon receipt to arrest hold times which is the best option to maintain integrity of data for qPCR analysis.

[7] Soil will be collected from the field into an unpreserved 4 ounce glass jar for SPLP preparation and subsequent VOC analysis.

[8] SPLP preparation and subsequent analysis will be performed using soil from the same field-collected 1 kilogram bag of MI soil.

°C - Degrees Celsius

6.6 Sample Identification

All samples collected will be labeled in a clear and precise way to facilitate tracking by the project and laboratory personnel. Separate sample ID numbers will be assigned to each replicate sample which will be submitted blind to the laboratories. Corresponding DUs for the replicate samples will be documented in the field notes. Refer to Tables 6-1, 6-2, 6-5, and 6-6, SOP ENV-07 *Multi-Increment Soil Sampling* and SOP ENV-09 *Soil Vapor Sampling* for sample ID naming conventions (Attachment B).

6.7 Decontamination Procedures

Disposable sampling equipment is planned for use. However, if non-disposable sampling equipment is utilized, it will be decontaminated after use to prevent cross contamination. Refer to SOP ENV-02 *Sampling Decontamination* for detailed procedures (Attachment B).

6.8 List of Equipment, Containers, and Supplies

Refer to the SOPs for the lists of sampling equipment and supplies (Attachment B).

6.9 Investigation-Derived Waste

Waste in the form of solid waste (e.g., sampling materials, soil cuttings, trash, personal protective equipment) and liquid waste (e.g., decontamination water) will be generated during the RA field activities. Any soil cutting (excess soil) generated from soil boring operations or bioventing well installation activities, will either be redistributed at the surface in the vicinity of the origination boring if PID headspace readings are less than 10 ppm, or if PID headspace readings are greater than 10 ppm, the contaminated soil will temporarily be stored in supersacks, until the landfarm is established (RA-S2) and the soil is added to the landfarm for remediation. No soil will be removed from the summit of Haleakalā without written permission from the Government. Liquid IDW (i.e., decontamination fluids) generated during the sampling activities will consist of light detergent and tap water. The volume and concentration of the decontamination fluids will be sufficiently low to allow onsite evaporation. Refer to the Waste Management Plan for details on IDW management (Attachment C).

Section 7 Quality Assurance/Quality Control Plan

7.1 Introduction

This Quality Control Plan (QCP) was developed for the RA to be performed at MSSC, Haleakalā, Island of Maui, Hawai‘i. The QCP addresses the QC procedures that are to be followed during the RA activities. The QCP applies to all work performed by GSINA and its subcontractors and adheres to the requirements specified in industry standard guidance documents published by the Department of Defense and the DAF. Specific guidance documents used to prepare this QCP include but are not limited to:

- EPA Guidance for Quality Assurance Project Plans (EPA, 2002).

The objective of this QCP is to describe the project-specific procedures to ensure that the quality of the work performed conforms to the contract requirements and the accepted proposal, and the planning documents (e.g., SAP, RAWP).

Specifically, this QCP:

- Identifies the QC program approach such as the data quality indicators (DQI) assessment, and other project related QC activities;
- Establishes the framework for project specific training and supervision to ensure that workers are qualified and properly perform various tasks;
- Describes procedures for addressing defects, performing root cause analysis (RCA), and identify corrective action (CA); and
- Presents methods to identify and implement process improvements.

The goal of QC is to identify and correct defects in a process or product. QC activities are not intended to eliminate or reduce errors, but rather to measure their effects. Data gathered during QC activities will be used to evaluate compliance and make appropriate decisions to ensure a quality product is delivered to the client.

7.2 Inspections

General inspections will be performed throughout the field activities for this project to ensure fieldwork is conducted IAW the project SAP, RAWP, and contract requirements. Inspections include verifying that the necessary resources, equipment, conditions, and controls are in place before starting work activities.

Field and laboratory QA/QC procedures will be implemented to ensure that the data gathered during the field investigation will meet the needs of the project objectives. Field activities will be performed as previously described. Analytical data generated will follow EPA methods and laboratory SOPs, and QA/QC guidelines for sample analysis.

7.2.1 Training

All personnel will be properly trained and qualified for the activities performed during fieldwork. The SSHO will verify site personnel possess the following training and certification requirements per the Performance Work Statement and below:

- 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Course;
- 8-Hour HAZWOPER Annual Refresher Course;
- First aid and cardiopulmonary resuscitation (at least two personnel on site); and
- Project specific training (e.g., sample data collection).

Prior to mobilization and annually throughout the project, all project personnel (both on site and in office) will also watch the film, "Haleakalā: A Sense of Place" which aims to educate and foster a sense of stewardship for the cultural significance and natural diversity found on Haleakalā (https://amostech.com/haleakala-sense-of-place/). The pre-mobilization and annual review of the video will be documented on a training log form.

7.2.2 Equipment Inspections

All tools, instruments, and equipment deployed to the project site and used by the analytical laboratory will be properly assembled, calibrated, maintained, and inspected IAW the instrument manufacturer specifications, standard industry practice, or SOPs. This applies to equipment used in the field such as PID and multi-gas meter as well as analytical instrumentation such as Gas Chromatography/Mass equipment used for analyzing volatiles.

Upon mobilization, all field equipment will be properly assembled to ensure all components are present, in good working order, and the equipment functions as required for the project. Preventive maintenance on equipment will be performed timely according to the manufacturer's instruction manual or recommendations. Critical spare parts will be kept on hand to minimize downtime. All repair and maintenance activities will be recorded in the logbook and/or equipment specific forms.

Every instrument operator will calibrate and inspect their instruments to ensure proper function. Laboratory related tables in Attachment A and SOPs detail measurement performance criteria (MPCs)/measurement quality objectives for the equipment testing requirements.

7.3 Calibration Procedures and Frequency

Calibration will be performed IAW the SOPs on all laboratory instruments and field equipment.

7.3.1 Field Equipment Calibration

During the field investigation, equipment used for screening purposes (e.g., PID, multi-gas meter) will be inspected and maintained as recommended by the manufacturer and through a visual inspection of damage. Field equipment will be bump tested daily prior to use as specified by the manufacturer. All bump test activities will be logged in the field logbook. Refer to SOPs ENV-07

Multi-Increment Soil Sampling and ENV-09 *Soil Vapor Sampling* (Attachment B) for details on field equipment testing.

7.3.2 Laboratory Instrument Calibration

The analytical laboratory is responsible for inspecting, maintaining, and calibrating laboratory equipment as described in their laboratory QA plan as specified by the analytical method used. Analytical instrument calibration acceptance criteria and CAs for each analytical method are presented in Attachment A.

7.4 Quality Control Samples

7.4.1 Field Quality Control Checks

7.4.1.1 Types of Field QC Samples

Several QC samples will be collected and analyzed for this project to provide a means to assess field and laboratory performance. Field QC samples consist of field replicates (e.g., MI soil samples) or duplicates (e.g., soil vapor samples), trip blanks (for VOC only), equipment rinsate (if non-disposable equipment is used), and MS/MSD. Each type of field QC sample undergoes the same preservation, analysis, and reporting procedures as the related environmental samples. Frequencies of field QC sample collection and analysis are presented in Tables 6-1, 6-2, 6-5, and 6-6. Field QC samples are also discussed in SOPs ENV-07 *Multi-Increment Soil Sampling* and ENV-09 *Soil Vapor Sampling* (Attachment B).

7.4.1.2 Statistical Calculations

Replicate samples allow for the statistical calculation of several important values including the arithmetic mean, standard deviation, RSD, and relative percent difference (RPD) as described below.

7.4.1.2.1 Arithmetic Mean

The arithmetic mean (or average) is a statistical measure of central tendency. In this case, the normal and replicate samples are used to calculate a mean value when the sum of the values in the data set is divided by the total number of values. The average is used to compare the subject DU to the relevant EALs.

7.4.1.2.2 Standard Deviation

Standard deviation is a measure of the variation from the mean among a group of samples and can be calculated for triplicate samples collected from a DU. The lower the standard deviation (the closer the replicate data are to the mean) the more precise the site data are as an estimate of average contaminant concentration in the DU under investigation.

Where replicate sampling is used to adjust DUs, the standard deviation of the contaminant(s) in the selected replicate DU is added to the contaminant levels of the other DUs in the batch for comparison to the relevant EALs. When a DU contaminant average concentration is close to the EALs, a lower standard deviation for the replicates provides a better chance to demonstrate that the contaminant concentration may be below the EALs. A low standard deviation is achieved by reducing variation in sample results due to errors in field sampling/processing, laboratory subsampling/processing, or laboratory analysis to the extent feasible.

7.4.1.2.3 Relative Standard Deviation

The field replicate data are also used to demonstrate that the investigation error for each contaminant is within a reasonable range that supports a conclusion that average contaminant concentrations (e.g., mean plus standard deviation) are below or above the relevant EALs. Typically, the RSD of the field replicates (triplicates) is used for this evaluation. The RSD is expressed as a percentage and is calculated using the following formula:

$$RSD\% = \frac{100 \times \text{Standard Deviation}}{\text{Mean}}$$

The lower the RSD of the triplicate data the better. Generally, an RSD% of approximately 35% or less indicates the amount of estimated total error is within a reasonable range for decision making. However, this evaluation will also depend on the DQO established for the site investigation, as well as how close the contaminant concentrations are to the relevant EALs. In general, the closer the contaminant level is to the EAL, the more impact this statistical measure will have on site decisions. The higher the RSD%, the less confidence there is that the averages approximate a normal distribution, and that the average contaminant concentrations are adequately representative of the DU(s). As the RSD exceeds 50%, and if the average DU concentrations are near the EALs, there is increasing uncertainty that the data are adequately representative. As the RSD% approaches 100% there is very little confidence that the sampling data is useful for decision-making.

7.4.1.2.4 Relative Percent Difference

Field duplicate RPD is used for the same purpose and in the same manner as the RSD is used for triplicates. The RPD is expressed as a percentage and is calculated using the following formula:

$$RPD\% = 100 \times \frac{|A-B|}{(A+B)/2}$$

Where:

A = First duplicate concentration
B = Second duplicate concentration

The lower the RPD of the replicate data the better.

7.4.2 Laboratory Quality Control Checks

Laboratory QC encompasses a host of other checks performed during sample preparation and analysis. Frequencies for laboratory QC checks are provided in Attachment A and in the method-specific laboratory QA/QC procedures. QC samples will include method blanks, laboratory control samples (LCSs), surrogate analysis for organics, and second source reference standard analysis for metals. Analytical QC acceptance criteria and CAs for each analytical method are presented in Attachment A.

7.5 Data Quality Assessment

The MPCs are often expressed in terms of DQIs. The principal indicators of data quality are accuracy/bias, precision, representativeness, comparability, completeness, and sensitivity (EPA, 2012). A brief summary of these parameters is provided in the following sections.

7.5.1 Accuracy/Bias

Accuracy is a measure of the closeness of an individual measurement to a known or reference value. It includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations. Bias is the systematic or persistent distortion of a measurement process resulting in error in one direction. Examples of accuracy include the ability of the Global Positioning System (GPS) equipment to record the correct positional information. Examples of bias include measurement of materials with a known concentration (e.g., performance evaluation or reference materials), analysis of MSs, or the use of LCSs and equipment blanks.

Accuracy control limits are established by the analysis of control samples, which are water and/or solid/waste matrices. For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the blank spike. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis of soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The percent recovery (%R) for spiked investigative sample analysis (e.g., MS) provides a tool for evaluating how well the method worked for the respective matrix. These values are used by the client to assess a reported result within the context of the project DQOs. For results that are outside control limits provided as requirements in the SAP, CA appropriate to the project will be taken and the deviation will be noted in the case narrative accompanying the sample results.

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This is measured as a percent difference (%D) from the reference value and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration. The laboratory will review the QC samples and surrogate recoveries for each analysis to ensure that the %R lies within the control limits listed in the project SAP. Otherwise, data will be flagged by the laboratory.

7.5.2 Precision

Precision is an evaluation of the agreement amongst replicate measurements of the same property under similar conditions. It is also referred to as random error or measurement variability and usually expressed as standard deviation, variance, %D, or range, in either absolute or relative terms. Overall project precision is measured by collecting data from collocated field replicates or duplicate samples. Precision specific to the laboratory is measured by analyzing laboratory duplicate (or replicate) samples.

The most commonly used estimates of precision are the RPD for cases in which only two measurements are available, and the RSD when three or more measurements are available. This is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentration indigenous to samples.

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or LCS purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes for organic analyses. For multi-analyte methods, the LCS or blank spikes may contain only a representative number of target analytes rather than the full list.

The RSD and RPD for replicate/duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrix. For this project MI samples will be collected IAW with the HDOH TGM, therefore, the measurement criteria for soil field replicates are an RSD less than 35%. Refer to Table 4-3 of the HEER TGM for recommendations for assessment of data quality based on the RSDs of replicate samples (HDOH, 2009). Refer to Attachment A for additional QC criteria.

7.5.3 Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on the proper design of the sampling program. Data representativeness can be accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within the project SAP. Field personnel will be responsible for collecting and handling samples according to the procedures in the project SAP so that samples are representative of field conditions. Errors in sample collection, packaging, preservation, or COC procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

7.5.4 Comparability

Comparability is a qualitative term describing the degree to which different processes, methods, or data agree or can be represented as similar. It describes the confidence that two datasets can contribute to a common analysis and interpolation. Comparability criteria must be determined for each matrix, analytical group, concentration level, and analyte (if possible). The use of standardized field and analytical procedures ensures comparability of analytical data. Sample collection and handling procedures will adhere to EPA-approved protocols and SOPs presented herein. Laboratory procedures will follow standard analytical protocols, use standard units, use standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

7.5.5 Completeness

Completeness refers to an evaluation of the amount of data needed to be obtained from a measurement system. It can be expressed as a percentage of the number of measurements that should have been collected or were planned to be collected. Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample. The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis. The completeness objective for this project will be 90% or greater.

Percent completeness is calculated using the following equation:

$$Completeness\ (\%C) = \frac{(T - R) \times 100}{T}$$

Where:

T = The total number of sample results
R = total number of rejected sample results

7.5.6 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate the parameter of interest at the level of interest. Terms sometimes used to describe sensitivity include DL, LOD, and LOQ. Sensitivity is the ability of the analytical test method and/or instrumentation to differentiate between detector responses to varying concentrations of the target constituent. Methodology to establish sensitivity for a given analytical method or instrument includes examination of standardized blanks, instrument DL studies, and calibration of the quantitation limit. The findings of the usability of the data relative to sensitivity will be included in the report, including any limitations on the data set and/or individual analytical results.

7.5.7 Determining if Data Meets DQOs

Data will be considered to meet DQOs if the criteria described in Section 7.5 and the decision(s) listed in Section 5.5.1 meet the project purpose as defined in Sections 1.1 and 5.2.

7.6 Deviations and Process Improvement

7.6.1 Overview

The basic role of the QC Program is to establish and monitor conformance to the project requirements. Deviations or nonconformance is expected and it demonstrates the program is working. It is the responsibility of all personnel on the project to identify deficiencies and nonconforming conditions to their supervisor or manager as soon as they are identified so that the activity can be stopped, RCA performed, and CA implemented to correct the problem. Deficiencies or nonconforming conditions can be considered opportunities to improve processes or procedures. Therefore, it is important that the quality team solicit lessons learned from team members periodically as well as solicit feedback from the DAF and other project team members regularly.

7.6.2 Nonconformance, Root Cause Analysis, and Corrective Action

7.6.2.1 Nonconformance

If a deficiency or nonconformance occurs, a nonconformance report (NCR) will be generated to document the issue. Personnel will notify the Quality Manager (QM) when quality issues occur via phone or email within 24 hours. The severity of the issue will be annotated as Critical, Major, or Minor. Definitions are presented below:

- Critical: A nonconformance that is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the supplies or services. Written response is required within 24 hours;
- Major: A nonconformance, other than critical, that is likely to result in failure of supplies or services or materially reduce the usability or the supplies or services for their intended purpose. Written response is typically required within five calendar days; and
- Minor: A nonconformance that is not likely to materially reduce the usability of the supplies or services for their intended purpose or is a departure from established standards having little bearing on the effective use or operations of the supplies or services. Written response is typically required within seven calendar days.

Deficiencies, nonconformances, and/or deviations will also be documented in the project report (i.e., RAR).

7.6.2.2 Root Cause and Corrective Action

The determination of the root cause is an integral part of the QC process. The depth and extent of the RCA depends on the situation. It may be as simple as an overlooked step or procedure or be a complicated process that requires more time to understand the issue. Input will be obtained as necessary from field personnel and technical advisors to identify the factors that led to the problem.

Following the RCA, analysis of potential solutions/CAs will be performed to determine which potential CA is most effective in correcting the problem. The process will include all appropriate personnel and may be documented via meeting notes provided as an attachment to the NCR. Potential CAs considered may include:

- Supplemental personnel training;
- Changes to equipment or modification of equipment currently in use;
- Modification of existing procedures;
- Implementation of new procedures;
- Increasing QC monitoring/audit frequency; and
- Rework.

All parties involved in the nonconformance should agree upon the CAs prior to implementation. Quality personnel will monitor that the CA(s) was properly implemented and problem has been corrected to prevent recurrence. If the re-inspection indicates that the nonconformance has been corrected, then the NCR will annotate in the monitoring section of the report and the issue can be closed out. If the re-inspection indicates the issue has not been corrected, the report will remain open until CA is completed or new CA(s) is identified, implemented, re-inspected successfully. All NCRs will be filed to the project server/SharePoint and provided in the RAR.

7.6.3 Submittals and Document Changes

7.6.3.1 Submittal Reviews

A tiered document preparation and review process is used for document submittals. Subject matter experts and quality personnel are utilized for technical authoring and peer reviews, and senior reviews are completed by senior project/program staff to reduce errors and maintain contract compliance.

7.6.3.2 Field Change Requests

Situations may arise in which the requirements specified in the SAP cannot be achieved or procedures may need to be modified or refined based on field conditions. Discrepancies between current conditions and approved plans are typically resolved using Field Change Requests (FCRs). In addition, process improvements can be captured and implemented by preparing FCRs. An FCR will be completed to document the procedural changes and the FCR will be provided to the appropriate project team members depending on the change.

Any field team member assigned to perform or supervise a task that recognizes the necessity for a change is responsible for initiating the FCR process. The Project Manager (PM) or quality personnel are responsible for completing the FCR for appropriate subject matter expert review and approval. The PM will submit all proposed FCRs including supporting documents as needed to the DAF PM, who will request review and concurrence from the required DAF personnel. The DAF will also notify stakeholders/regulatory agencies if significant changes to the contract or RAWP or SAP occur. HDOH will be provided notification and solicitation of feedback/concurrence on major and/or significant FCRs. A major/significant change will be considered a modification to the project DQOs presented in Section 5. Notification of minor/administrative FCRs (procedural changes that do not affect the overall DQOs) will be provided for awareness only.

Upon FCR approval, the applicable planning documents will be updated and revised versions made available to the project team. The Field Manager or SSHO will brief the team and conduct training as required on the approved changes to these documents at the earliest opportunity. This training on changes to existing documents could occur at the daily safety meetings or in a more formal presentation as necessary. The FCR briefing and follow on training, as required, will be documented in the field logbook. All FCRs will be filed to the project server/SharePoint and provided in the RAR.

7.6.4 Process Improvement

Personnel will be briefed by the QM or Corporate Quality Manager (CQM) on the importance of quality workmanship and a process improvement plan will be communicated to the team. The plan is aimed at ensuring that all site personnel understand GSINA’s commitment to quality and will be held accountable for the quality of their work. All project team members are encouraged to identify potential quality issues to their supervisor immediately and to suggest solutions where applicable. The SSHO or QM may conduct periodic quality related briefings during the morning safety meeting. These briefings will cover topics such as results from general inspections, nonconformances and CAs, process improvement, and FCRs.

Learning occurs on every project. Lessons learned are the knowledge gained from the process of performing the project. Team members and management team are strongly encouraged to share lessons learned among project team members to prevent repeating the same mistakes and for implementing best practices. Lessons learned can be used to improve future projects and future stages of current projects. Lessons learned will be captured and documented in the Lessons Learned Report.

7.6.5 Customer Complaints

Customer complaints will be addressed immediately. The complaint may come in the form of a verbal comment, written correspondence (i.e., email), or a Corrective Action Request (CAR) form from the Contracting Officer or Contracting Officer’s Representative. Depending on the severity of the complaint, the Field Manager, SSHO, QM, or PM will provide written responses via email to verbal and written notifications or utilize an NCR for responding to CARs. The NCR will include the RCA and the recommended CAs to ensure the measures are adequate to prevent recurrence. The NCR will be provided to the DAF for review and approval. The CAs on the CAR are not considered complete until the verification inspection has been performed by the QM and accepted by the DAF, and CQM, and/or PM.

Section 8 Documentation and Reporting

This section outlines the procedures and requirements for maintaining comprehensive and accurate documentation throughout the project and reporting requirements.

8.1 Field Documentation

Various types of data will be collected throughout the course of the RA field work and may be stored as either electronic files or hard copies, with hard copies eventually scanned in as part of digital files. Examples of electronic data include GPS and geographic information system data. Examples of hard copy data include logbooks. Project records will be maintained on site with field management personnel and all project documents will be loaded to the GSINA project server/SharePoint. All records will be stored such that they can be found using the project name and date created with unique subfolders for each type of data. Project documentation will be checked daily and/or weekly by the designated personnel for accuracy and completeness before being included in the project file. Field documentation will include, but not be limited to the following:

- GPS data;
- Logbook;
- Daily Activity Report;
- Daily Safety Brief;
- Soil Boring Logs;
- Sample Collection Sheet;
- Passive Soil Gas Sample Log;
- COC forms;
- O&M Form;
- Well Construction Form; and
- Well Abandonment Form (if applicable).

Additionally, photographs will be taken during the project. However, site photography is limited due to the presence of secure buildings at the site. Photography will be limited to sampling locations, samples collected, and general project activities which fit within the specified security parameters. Refer to SOP G-7 *Data Management Plan* for additional details (Attachment B).

8.2 Remedial Action Report

Upon completion of the RA activities, a RAR will be prepared IAW HDOH HEER TGM Section 18.5.15. The RAR will summarize the activities performed during the RA and present the results. Results from the RA analytical sampling will be compared to HDOH EALs as described in Section 4.1. The report will also summarize all previous investigations, including a description of the prior site characterization work, and will identify if the remedy was effective or if additional information and/or operating time is required to achieve the RAOs. Any future actions for the site will be recommended, as necessary. Attachments to the RAR will include, but not be limited to, site figures, laboratory analytical results, validation reports, field forms (e.g., sampling logs), copies of monthly O&M reports, and photographic documentation.

8.3 Long-Term Environmental Health and Management Plan

An LT-EHMP will be prepared for the site. If COPC concentrations within the AOI soil remain above the unrestricted EALs, an LT-EHMP will be used for managing contamination in place. The LT-EHMP will provide pre-planned measures for protecting human and ecological receptors from exposure and periodic inspections to ensure engineering and institutional controls remain effective. The LT-EHMP and any associated land use controls (as applicable) would be maintained until COPC concentrations are acceptable for unrestricted use of the site (i.e., below the unrestricted HDOH EALs).

Section 9 Schedule

Scheduling of the RA will begin as soon as possible following approval of the RAWP, which includes the SAP. Refer to the Section 6 of the RAWP for a schedule of the project tasks including the RA field activities.

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Section 10 References

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National Response Corporation/US Ecology, 2023. *Removal Action Report, Backup Generator Diesel Spill Initial Response Action, Maui Space Surveillance Complex (MSSC), Haleakala, Maui County, Hawaii*. Prepared by Tetra Tech Inc. 26 April (revised).

State of Hawai‘i, 1995. HAR Title 11, Chapter 451. *Hawai‘i State Contingency Plan.*

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Attachment A
Quality Control Criteria

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List of tables included in this appendix:

Tables:

- Table A-1: Measurement Performance Criteria for Field and Internal Quality Control Samples;
- Table A-2: Analytical Instrument Calibration;
- Table A-3: Analytical Instrument and Equipment Maintenance, Testing, and Inspection; and
- Table A-4: Analytical Control Samples and CA.

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Table A-1: Measurement Performance Criteria for Field and Internal Quality Control Samples

Data Quality Indicator	QC Sample or Measurement Performance Activity	MPC
BTEX (EPA 8260D) Soil		
Overall Precision	Field Replicates	RSD ≤ 35% (soil) when target analytes are detected in both samples ≥ sample-specific LOQ.
Analytical Accuracy/Bias (laboratory)	LCS	DoD QSM 5.4 Limits
Analytical Precision (laboratory)	LCS Duplicate[1]	RPD ≤ 20%
Analytical Accuracy/Bias (matrix interference)	MS/MSD	DoD QSM 5.4 Limits
Analytical Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Accuracy/Bias (contamination)	Method blank Equipment Blank[2]	No analytes detected > 1/2 LOQ or > 1/10th the amount measured in the associated samples whichever is greater.
Sensitivity	Comparison of Laboratory LOQ to PAL	LOQ should be 3 to 10 times lower than the PAL to ensure that the method is sufficiently sensitive to detect the analyte at and close to the PAL.
Completeness	Evaluate analytical results for investigative samples. Missing data (due to loss of sample in laboratory) or rejected ® data due to QC sample deficiencies identified during data validation are considered incomplete.	90% completeness for investigative samples
TPH-DRO (EPA 8015D) Soil		
Overall Precision	Field Replicates	RSD ≤ 35% (soil) when target analytes are detected in both samples ≥ sample-specific LOQ.
Analytical Accuracy/Bias (laboratory)	LCS	DoD QSM 5.4 Limits
Analytical Precision (laboratory)	LCS Duplicate[1]	RPD ≤ 30%
Analytical Accuracy/Bias (matrix interference)	MS/MSD	DoD QSM 5.4 Limits
Analytical Precision (matrix interference)	MS/MSD	RPD ≤ 30%
Overall Accuracy/Bias (contamination)	Method blank Equipment Blank[2]	No analytes detected > 1/2 LOQ or > 1/10th the amount measured in the associated samples whichever is greater.
Sensitivity	Comparison of Laboratory LOQ to PAL	LOQ should be 3 to 10 times lower than the PAL to ensure that the method is sufficiently sensitive to detect the analyte at and close to the PAL.
Completeness	Evaluate analytical results for investigative samples. Missing data (due to loss of sample in laboratory) or reject®(R) data due to QC sample deficiencies identified during data validation are considered incomplete.	90% completeness for investigative samples

Data Quality Indicator	QC Sample or Measurement Performance Activity	MPC
PAHs (EPA 8270E) Soil		
Overall Precision	Field Replicates	RSD ≤ 35% (soil) when target analytes are detected in both samples ≥ sample-specific LOQ.
Analytical Accuracy/Bias (laboratory)	LCS	DoD QSM 5.4 Limits
Analytical Precision (laboratory)	LCS Duplicate[1]	RPD ≤ 20%
Analytical Accuracy/Bias (matrix interference)	MS/MSD	DoD QSM 5.4 Limits
Analytical Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Accuracy/Bias (contamination)	Method blank Equipment Blank[2]	No analytes detected >1/2 LOQ or > 1/10th the amount measured in the associated samples whichever is greater.
Sensitivity	Comparison of Laboratory LOQ to PAL	LOQ should be 3 to 10 times lower than the PAL to ensure that the method is sufficiently sensitive to detect the analyte at and close to the PAL.
Completeness	Evaluate analytical results for investigative samples. Missing data (due to loss of sample in laboratory) or rejected (R) data due to QC sample deficiencies identified during data validation are considered incomplete.	90% completeness for investigative samples
VOCs (EPA TO17) Soil Gas		
Overall Precision	Field Duplicate	RPD ≤ 25% (soil gas) when target analytes are detected in both samples ≥ sample-specific LOQ.
Analytical Accuracy/Bias (laboratory)	LCS	DoD QSM 5.4 Limits
Analytical Precision (laboratory)	LCS Duplicate[1]	RPD ≤ 20%
Analytical Accuracy/Bias (matrix interference)	N/A	N/A
Analytical Precision (matrix interference)	N/A	N/A
Overall Accuracy/Bias (contamination)	Method blank Equipment Blank[2]	No target analyte concentr½ons ≥ 1/2 LOQ
Sensitivity	Comparison of Laboratory LOQ to PAL	LOQ should be 3 to 10 times lower than the PAL to ensure that the method is sufficiently sensitive to detect the analyte at and close to the PAL.
Completeness	Evaluate analytical results for investigative samples. Missing data (due to loss of sample in laboratory) or Rejected (R) data due to QC sample deficiencies identified during data validation are considered incomplete.	90% completeness for investigative samples

Data Quality Indicator	QC Sample or Measurement Performance Activity	MPC
Microbial DNA (QuantArray®-Petro) Soil		
Accuracy	Method blank	CT ≤ Assay Negative Control
Accuracy	LCS	Calculated concentration within +/-20% of same concentration on standard curve

Notes:
[1] The LCS Duplicate will not be required, however, if it is included in batch QC for precision evaluation, the MPC noted above will be used for data validation.
[2] Equipment blanks will only be collected if non-dedicated sampling equipment is used.
≥ - Greater Than or Equal To
≤ - Less Than or Equal To
+/- - Plus/Minus
% - Percent
BTEX - Benzene, Toluene, Ethylbenzene, and Xylene
CT – Cycle Threshold
DNA - Deoxyribonucleic acid
DoD - Department of Defense
EPA – United States Environmental Protection Agency
LCS - Laboratory Control Sample
LOQ - Limit of Quantitation
MPC - Measurement Performance Criteria
MS/MSD - Matrix Spike/Matrix Spike Duplicate
PAH - Polycyclic Aromatic Hydrocarbon
PAL - Project Action Limit
QC - Quality Control
QSM - Quality System Manual
RPD - Relative Percent Difference
RSD - Relative Standard Deviation
TPH-DRO - Total Petroleum Hydrocarbon – Diesel Range Organic
VOC - Volatile Organic Compound

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Table A-2: Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
BTEX (EPA 8260D) Soil						
GC/MS	Mass Calibration	At instrument set-up; at least annually or as specified by the manufacturer, whichever is more frequent; after major maintenance; and when needed based on method requirements or QC results, before analysis. Mass calibration shall be performed using the calibration compounds and procedures prescribed by the manufacturer.	As recommended or required by the instrument manufacturer.	Correct problem, then repeat mass calibration. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0010
GC/MS	Tune Check	Before ICAL	Specific ion abundance criteria of BFB or DFTPP from the reference method revision used for analysis and reporting.	Retune instrument and verify. If the method requires an ICAL after a change in tuning parameters, follow the reference method as written Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0010
GC/MS	ICAL for all analytes	At instrument set-up and when needed based on method requirements or QC results, before sample analysis.	Minimum 5 levels when using evaluation by %RSD or linear regression and 6 levels for evaluation by quadratic regression. Each analyte shall meet one of the three options below: <u>Option 1:</u> %RSD for each analyte ≤ 20%, unless the specific method referenced has tighter criteria, in which case the method shall be followed; <u>Option 2:</u> linear least squares regression for each analyte: r2 ≥ 0.99;	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0010

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			Option 3: non-linear least squares regression (quadratic) for each analyte: $r2 \geq 0.99$; If the specific version of a reference method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional requirements shall also be met.			
GC/MS	%RE or %RSE	Each ICAL using options 2 or 3 above shall also be evaluated for relative error either by determination of the %RE at or near the mid-range of the ICAL and at less than or equal to the LOQ, or by the determination of the %RSE.	The laboratory shall meet the criteria listed in the reference method revision used for analysis and reporting. If no criteria are listed, the laboratory shall develop its own criteria; however, the maximum allowable %RE at or near the mid-range and low level of the calibration shall be 20% and 50%, respectively. The maximum allowable %RSE shall be 30%.	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0010
GC/MS	RT and RRT establishment	Once per ICAL and at the beginning of the analytical sequence. Established for each analyte and surrogate.	RT or RRT shall be set using the midpoint standard of the ICAL when ICAL is performed, or on days when ICAL is not performed, the initial	N/A	Lab Manager/ Analyst	DV-MS-0010

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			CCV for the sequence shall be used.			
GC/MS	RRT window width IS Used	With each sample.	RRT window width is ± 0.06 from the established RRT.	N/A	Lab Manager/ Analyst	DV-MS-0010
GC/MS	CCV	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within their respective retention time window and within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV. If the specific version of a reference method requires additional evaluation (e.g., average RFs) these additional requirements shall also be met.	Where an assignable cause isolated to only the CCV is identified, one CCV may be reanalyzed immediately (i.e., within one hour and no samples analyzed). If the immediate CCV is acceptable, proceed with analysis. Sample reanalysis is not required. Otherwise, correct problem and analyze passing CCV or recalibrate. All affected samples since last passing CCV shall be reanalyzed. If the samples cannot be reanalyzed, apply qualifier to affected analyte results and explain in the case narrative.	Lab Manager/ Analyst	DV-MS-0010
GC/MS	IS If Used	Every field sample, standard, and QC sample.	RT within ± 10 seconds from RT of the midpoint standard in	Inspect mass spectrometer and GC for malfunctions	Lab Manager/ Analyst	DV-MS-0010

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			the ICAL; EICP area within – 50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV may be used. Common contaminants (Methylene chloride, Acetone, 2- Butanone, and Phthalates) shall not be detected > LOQ.	and correct problem. All affected samples shall be reanalyzed. If the samples cannot be reanalyzed, apply qualifier to analyte results associated with the IS outside acceptance criteria and explain in the case narrative.		
TPH-DRO (8015D) Soil						
GC-FID	**Other Performance Checks** If the reference method includes additional performance checks such as peak tailing evaluation, the checks shall be performed and evaluated as described in the reference method.	RTs must be verified at the beginning of each 12-hour work shift.	As recommended or required in the reference method.	Correct problem, then repeat performance checks. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-GC-0027
GC-FID	ICAL for all analytes	At instrument set-up and when needed based on QC results, before sample analysis.	Minimum 5 levels for when using evaluation by %RSD or linear regression and 6 levels for evaluation by	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-GC-0027

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			quadratic regression. Each analyte shall meet one of the three options below: Option 1: %RSD for each analyte ≤ 20%, unless the specific method referenced has tighter criteria, in which case the method shall be followed; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$. Quantitation for multicomponent analytes such as chlordane, toxaphene, and Aroclors shall be performed using a 5-point (minimum) calibration. Results shall not be quantitated using a single point.			

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC-FID	%RE or %RSE	Each ICAL using options 2 or 3 above shall also be evaluated for relative error either by determination of the %RE at or near the mid-range of the ICAL and at less than or equal to the LOQ, or by the determination of the %RSE.	The laboratory shall meet the criteria listed in the reference method revision used for analysis and reporting. If no criteria are listed, the laboratory shall develop its own criteria; however, the maximum allowable %RE at or near the mid-range and low level of the calibration shall be 20% and 50%, respectively. The maximum allowable %RSE shall be 30%.	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-GC-0027
GC-FID	RT or RRT establishment	Once per ICAL and at the beginning of the analytical batch. Established for each analyte and surrogate.	RT or RRT shall be set using the midpoint standard of the ICAL when ICAL is performed or on days when ICAL is not performed, the initial CCV for the batch shall be used.	NA.	Lab Manager/ Analyst	DV-GC-0027

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC-FID	RT window width No IS Used	At method set-up and after major maintenance (e.g., column change). Calculated for each analyte and surrogate.	RT width is ± 3 times standard deviation for each analyte RT from the 72-hour study or 0.03 minutes, whichever is greater. For analytes reported across a RT range (e.g., TPH variations, chlordane), the RT window of the method-defined marker compounds are established as stated above. The RT range is calculated based on the lower limit of the RT window for the first marker compound and the upper limit of the RT window for the last marker compound.	NA.	Lab Manager/ Analyst	DV-GC-0027
GC-FID	CCV	At the beginning of each analytical batch before sample analysis when ICAL is not performed, after every 10 field samples, and at the end of the analytical batch.	All reported analytes and surrogates within established RT windows. All reported analytes and surrogates within ± 20% of true value, unless the specific reference method has tighter criteria, in which case the reference method shall be followed.	Where an assignable cause isolated to only the CCV is identified, one CCV may be reanalyzed immediately (i.e., within one hour and no samples analyzed). If the immediate CCV is acceptable, proceed with analysis. Sample reanalysis is not required. Otherwise, correct problem and analyze passing CCV or	Lab Manager/ Analyst	DV-GC-0027

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
				recalibrate. All affected samples since last passing CCV shall be reanalyzed. If the samples cannot be reanalyzed, apply qualifier to affected analyte results and explain in the case narrative.		
PAHs (8270E) Soil						
GC/MS	Mass Calibration	At instrument set-up; at least annually or as specified by the manufacturer, whichever is more frequent; after major maintenance; and when needed based on method requirements or QC results, before analysis. Mass calibration shall be performed using the calibration compounds and procedures prescribed by the manufacturer.	As recommended or required by the instrument manufacturer.	Correct problem, then repeat mass calibration. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0012
GCMS	Tune Check	Before ICAL or as stated in the reference method, whichever is most frequent.	Specific ion abundance criteria of BFB or DFTPP from the reference method revision used for analysis and reporting.	Retune instrument and verify. If the method requires an ICAL after a change in tuning parameters, follow the reference method as written (e.g. 8270E). Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0012

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC/MS	Performance Check (SVOC, except when analyzing only PAHs or PCBs)	EPA Method 8270E: prior to initial calibration. EPA Methods 8270D and any other SVOC GC/MS method: at the beginning of each 12-hour period, before analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol present at their normal responses and tailing factor ≤ 2.	Correct problem, then repeat performance check. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0012
GC/MS	ICAL for all analytes	At instrument set-up and when needed based on method requirements or QC results, before sample analysis.	Minimum 5 levels when using evaluation by %RSD or linear regression and 6 levels for evaluation by quadratic regression. Each analyte shall meet one of the three options below: <u>Option 1:</u> %RSD for each analyte ≤ 20%, unless the specific method referenced has tighter criteria, in which case the method shall be followed; <u>Option 2:</u> linear least squares regression for each analyte: r2 ≥ 0.99; <u>Option 3:</u> non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99; If the specific version of a reference method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0012

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			requirements shall also be met.			
GC/MS	%RE or %RSE	Each ICAL using options 2 or 3 above shall also be evaluated for relative error either by determination of the %RE at or near the mid-range of the ICAL and at less than or equal to the LOQ, or by the determination of the %RSE.	The laboratory shall meet the criteria listed in the reference method revision used for analysis and reporting. If no criteria are listed, the laboratory shall develop its own criteria; however, the maximum allowable %RE at or near the mid-range and low level of the calibration shall be 20% and 50%, respectively. The maximum allowable %RSE shall be 30%.	Correct problem, then repeat ICAL. Qualification of data is not appropriate.	Lab Manager/ Analyst	DV-MS-0012
GC/MS	RT and RRT establishment	Once per ICAL and at the beginning of the analytical sequence. Established for each analyte and surrogate.	RT or RRT shall be set using the midpoint standard of the ICAL when ICAL is performed, or on days when ICAL is not performed, the initial CCV for the sequence shall be used.		Lab Manager/ Analyst	DV-MS-0012
GC/MS	RT window width No IS Used	At method set-up and after major maintenance (e.g., column change). Calculated for each analyte and surrogate.	RT width is ± 3 times standard deviation for each analyte RT from the 72-hour study or 0.03 minutes, whichever is greater. For analytes reported across a RT range (e.g., TPH variations, chlordane), the RT	NA	Lab Manager/ Analyst	DV-MS-0012

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			window of the method-defined marker compounds are established as stated above. The RT range is calculated based on the lower limit of the RT window for the first marker compound and the upper limit of the RT window for the last marker compound.			
GC/MS	RRT window width IS Used	With each sample.	RRT window width is ± 0.06 from the established RRT.	NA	Lab Manager/ Analyst	DV-MS-0012
GC/MS	CCV	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within their respective retention time window and within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV. If the specific version of a reference method requires additional evaluation (e.g., average RFs) these additional requirements shall also be met.	Where an assignable cause isolated to only the CCV is identified, one CCV may be reanalyzed immediately (i.e., within one hour and no samples analyzed). If the immediate CCV is acceptable, proceed with analysis. Sample reanalysis is not required. Otherwise, correct problem and analyze passing CCV or recalibrate. All affected samples since last passing CCV shall be reanalyzed. If the samples cannot be	Lab Manager/ Analyst	DV-MS-0012

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
				reanalyzed, apply qualifier to affected analyte results and explain in the case narrative.		
GC/MS	IS If Used	Every field sample, standard, and QC sample.	RT within ± 10 seconds from RT of the midpoint standard in the ICAL; EICP area within – 50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV may be used. Common contaminants (Methylene chloride, Acetone, 2- Butanone, and Phthalates) shall not be detected > LOQ.	Inspect mass spectrometer and GC for malfunctions and correct problem. All affected samples shall be reanalyzed. If the samples cannot be reanalyzed, apply qualifier to analyte results associated with the IS outside acceptance criteria and explain in the case narrative.	Lab Manager/ Analyst	DV-MS-0012
VOCs (TO17) Soil Gas						
GC/MS	Tune Check (BFB Tuning Verification)	Prior to ICAL, and prior to each 12-hour period of sample analysis	Ion abundance criteria as described in Table 2 or 3 of SOP 7, (EPA Method TO17)	1) Repeat BFB analysis 2) Retune instrument	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	See SOP 7, (EPA Method TO17) ICAL – minimum of five levels for all analytes including surrogates	Minimum of Quarterly and Initially or if continuing calibration no longer meets criteria	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% (Table B4 DOD QSM 5.4);	Remake standard, reanalyze, then recalibrate Minimum 5 levels for linear and 6 levels for quadratic. No samples shall be	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			Option 2: linear least squares regression for each analyte: $r2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r2 \geq 0.99$.	analyzed until ICAL has passed. Perform system maintenance if necessary		
GC/MS	RT window position establishment	Once per ICAL and at the beginning of the analytical sequence	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used. Calculated for each analyte and surrogate.	NA	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	Evaluation of RRT	With each sample.	RRT of each reported analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL After maintenance is performed which may affect retention times, RRTs may be updated based on the daily CCV. RRTs shall be compared with the most recently updated RRTs.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	ICV or LCSD	Once after each ICAL, analysis of second source standard prior to sample analysis.	Percent difference of +/-20% (Table B4 DoD QSM 5.4)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
				Problem must be corrected. Samples may not be analyzed until there is a valid ICV.		
GC/MS	CCV or LCS	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	Concentration the same as the mid-point calibration standard (or lower). All reported analytes within +/-20% of true value. Note: If CCV is biased high and analyte is not detected results are acceptable. It will be noted in case narrative. All reported analytes and surrogates withing +/-50% for end of analytical batch Closing CCV	1) Reanalyze CCV [DoD: Analyze two additional CCVs] 2) Identify and correct problem; re-analyze or if necessary, qualify the data (if reanalysis not possible). 3) Repeat initial calibration if CCV CA is unsuccessful.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	Method Blank	One per preparatory batch	No analytes detected > 1/2 LOQ or 1/10 the amount measured in any associated sample, or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, re-prep and reanalyzed method blank and all samples processed with the contaminated blank.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	IS	All samples, duplicates, blanks and standards	1) RT must be <10 sec from most recent valid calibration (ICAL midpoint or CCV) 2) Area response 50% to +100% of IS area response of most recent valid calibration	1) Identify and correct the problem 2) Reanalyze the sample unless obvious matrix interference exists. 3) Problem persists, qualify data (if	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
			(ICAL midpoint or CCV) 3) RT of each IS must be within +/-0.06 RTT units.	reanalysis not possible).		
GC/MS	Surrogate Standards	All samples, duplicates, blanks and standards	70-130% recovery unless specified in DOD QSM 5.4, see Table C-23 Method 8260 Solid Matrix in DOD QSM Version 5.4	1) Identify and correct the problem 2) Reanalyze the sample unless obvious matrix interference exists 3) If problem persists, qualify data	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	LOQ	Quarterly verification required	1) At or above the low standard of the current initial calibration. 2) % recovery for each analyte within laboratory generated control limits.	1) Reanalyze 2) Identify and correct problem; reanalyze. 3) Repeat verification at higher level to set higher LOQ if CA is unsuccessful.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)
GC/MS	Detection Limit with LOD Verification	Quarterly verification required	LOD Verification - Response with a minimum signal to noise ratio of 3:1	1) Repeat detection limit determination and LOD verification at higher concentration or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.	Dept. Supervisor, however other trained analysts in the team may be responsible.	SOP 7, (EPA Method TO17)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
Microbial DNA (QuantArray®-Petro)						
QS12K	Initial	Primary	Standard curve r^2 >0.95	Rerun assay / check reagents.	Lab area supervisor	MI SOP QuantArray®
QS12K	Continuing Calibration Verification	Secondary – every plate (assay)	CT value within +/- 20% of known value	Rerun assay / check reagents.	Lab area supervisor	MI SOP QuantArray®
QS12K	Dye Calibration	Annual-per manufacturer's recommendation	Manufacturer's specifications	Manufacturer reruns	Manufacturer	MI SOP-QuantArray®

Notes:
%RE -Relative Error
%RSD - Percent Relative Standard Deviation
%RSE - Relative Standard Error
< - Less Than
BFB - 4-Bromofluoro-Benzene
CA - Corrective Action
CCV - Continuing Calibration Verification
DDT - Dichlorodiphenyltrichloroethane
DFTPP - Decafluorotriphenylphosphine
EICP - Extracted Ion Current Profile
GC-FID - Gas Chromatography – Flame Ionization Detector
GC/MS - Gas Chromatography/Mass Spectrometry
ICAL - Initial Calibration
ICV - Initial Calibration Verification
IS - Internal Standard
LOD - Limit of Detection
MI - Microbial Insights
N/A - Not Applicable
PAHs - Polycyclic Aromatic Hydrocarbons
PCBs - Polychlorinated Biphenyls
r2 - Coefficient of Determination
RRT - Relative Retention Time
RT - Retention Time
SOP - Standard Operating Procedure
SVOC - Semivolatile Organic Compound

Table A-3: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
BTEX (EPA 8260D) Soil								
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	Eurofins Denver Analyst	DV-MS-0010
GC/MS	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Eurofins Denver Analyst	DV-MS-0010
TPH-DRO (EPA 8015D) Soil								
GC-FID	Change septum, clean injection port, change or clip column, install new liner, replace column, filters and seals	Detector signals and chromatogram review	Instrument performance and sensitivity	As needed	CCV passes criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Eurofins Denver Analyst	DV-GC-0027
PAHs (EPA 8270E) Soil								
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	Eurofins Denver Analyst	DV-MS-0012

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Eurofins Denver Analyst	DV-MS-0012
VOCs (EPA TO17) Soil Gas								
TD-GC/MS	Transfer Line	Preventative	Check for leaks and O-ring wear, check cold trap (front Tenax trap),	When responses start to drop, and tune fails.	Tune and CCV pass criteria	Tighten ferrules, inspect for leaks, and check the alignment	Analyst	Beacon Environmental's Quality System Manual, Rev. 13, 3/15/2024 and SOP 20, rev. 9, 5/16/2023
TD-GC/MS	Detector	Preventative	Clean detector, change pump oil	When responses start to drop, and tune fails.	Tune passes, air, and water not present in the scan.	Dissemble detector and check parts; check filaments, reanalyze tune.	Analyst	Beacon Environmental's Quality System Manual, Rev. 13, 3/15/2024 and SOP 20, rev. 9, 5/16/2023
Microbial DNA (QuantArray®-Petro)								
QS12K	Dye calibration	Dye plate	Run dye plate	Annual	Spectra follows normal pattern	Contact manufacturer	Analyst	MI SOP QuantArray®
QS12K	Background	Water plate	Run water plate	Monthly	No spectra detected	Clean instrument and rerun	Analyst	MI SOP QuantArray®

Note:
TD - Thermal Desorption

Table A-4: Analytical Control Samples and CA

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
BTEX (EPA 8260D) Soil						
Method Blank	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.	Where an assignable cause isolated to only the method blank is identified, the method blank may be reanalyzed. Otherwise, reprepare and analyze method blank and all affected QC and field samples in the associated preparatory batch if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Contamination	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.
LCS	One per preparatory batch. Shall contain all surrogates and all reported analytes.	Use customer-provided acceptance criteria. If customer- provided acceptance criteria are not available, use Appendix C limits. If Appendix C limits are not available, use laboratory-developed acceptance criteria.	Where an assignable cause isolated to only the LCS is identified, the LCS may be reanalyzed. Otherwise, reprepare and analyze the LCS and all affected QC and field samples in the associated preparatory batch for the analytes outside acceptance criteria if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Precision and Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
LCSD	If sufficient sample is not available for either a MSD or MD, one LCSD shall be included in the preparatory	Recovery: Same as LCS acceptance criteria. Precision: RPD of all analytes ≤ 30% between LCS and LCSD.	Where an assignable cause isolated to only the LCSD is identified, the LCSD may be reanalyzed. Otherwise, reprepare and analyze the LCSD and all affected QC and field samples in the associated preparatory batch for the analytes outside acceptance criteria if sufficient	Lab Manager / Analyst	Precision and Accuracy/Bias	**Recovery:** Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
	batch. Shall contain all surrogates and all reported analytes.		sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.			**Precision:** RPD ≤ 30%
MS	One per preparatory batch if sufficient material is provided. Shall contain all surrogates and all reported analytes.	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the MS is identified, reanalyze the MS or reprepare and analyze the MS if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Precision and Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
MSD or MD	One per preparatory batch if sufficient material is provided. MSD: Shall contain all surrogates and all reported analytes. MD: Shall be analyzed for all surrogates and all reported analytes.	Recovery: Same as the LCS recovery acceptance criteria. Precision: RPD of all analytes ≤ 30% between MS and MSD or sample and MD. RPD does not apply if both results are below the LOQ.	If an assignable cause isolated to only the MSD or MD is identified, reanalyze the MSD or MD or reprepare and analyze the MSD or MD if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Precision and Accuracy/Bias	**Recovery:** Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits. **Precision:** RPD ≤ 30% RPD does not apply if both results are below the LOQ

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogate Spike If Used	All QC and field samples.	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the surrogates is identified in a field sample, reprepare and analyze the field sample if sufficient sample material is available. If obvious chromatographic interference is present, repreparation and analysis may not be necessary, but the customer shall be notified prior to reporting data. If samples with surrogate recoveries outside acceptance criteria cannot be reprepared and analyzed, apply qualifier to analyte results associated with the surrogates outside acceptance criteria and explain in the case narrative.	Lab Manager / Analyst	Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
TPH-DRO (EPA 8015D) Soil						
Method Blank	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.	Where an assignable cause isolated to only the method blank is identified, the method blank may be reanalyzed. Otherwise, reprepare and analyze method blank and all affected QC and field samples in the associated preparatory batch if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Contamination	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.
LCS	One per preparatory batch. Shall contain all surrogates and	Use customer-provided acceptance criteria. If customer- provided acceptance criteria are not available, use Appendix C limits. If Appendix C limits are not available, use	Where an assignable cause isolated to only the LCS is identified, the LCS may be reanalyzed. Otherwise, reprepare and analyze the LCS and all affected QC and field samples in the associated preparatory batch for	Lab Manager / Analyst	Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
	all reported analytes.	laboratory-developed acceptance criteria.	the analytes outside acceptance criteria if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.			QSM limits, use in-house limits.
MS	One per preparatory batch if sufficient material is provided. Shall contain all surrogates and all analytes to be reported.	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the MS is identified, reanalyze the MS or reprepare and analyze the MS if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
MSD or MD	One per preparatory batch if sufficient material is provided. MSD: Shall contain all surrogates and all reported analytes. MD: Shall be analyzed for all surrogates and all reported analytes.	Recovery: Same as the LCS recovery acceptance criteria. Precision: RPD of all analytes ≤ 30% between MS and MSD or sample and MD. RPD does not apply if both results are below the LOQ.	If an assignable cause isolated to only the MSD or MD is identified, reanalyze the MSD or MD or reprepare and analyze the MSD or MD if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Precision & Accuracy/Bias	Recovery: Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits. Precision: RPD of all analytes ≤ 30% between MS and MSD or sample and MD. RPD does not apply if both results are below the LOQ.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogate Spike	All QC and samples.	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the surrogates is identified in a field sample, reprepare and analyze the field sample if sufficient sample material is available. If obvious chromatographic interference is present, repreparation and analysis may not be necessary, but the customer shall be notified before reporting data. If samples with surrogate recoveries outside acceptance criteria cannot be reprepared and analyzed, apply qualifier to analyte results associated with the surrogates outside acceptance criteria and explain in the case narrative.	Lab Manager / Analyst	Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
PAHs (EPA 8270E) Soil						
Method Blank	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.	Where an assignable cause isolated to only the method blank is identified, the method blank may be reanalyzed. Otherwise, reprepare and analyze method blank and all affected QC and field samples in the associated preparatory batch if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Contamination	No analytes detected > ½ LOQ or > 1/10th the amount measured in the associated samples whichever is greater.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
LCS	One per preparatory batch. Shall contain all surrogates and all reported analytes.	Use customer-provided acceptance criteria. If customer- provided acceptance criteria are not available, use Appendix C limits. If Appendix C limits are not available, use laboratory-developed acceptance criteria.	Where an assignable cause isolated to only the LCS is identified, the LCS may be reanalyzed. Otherwise, reprepare and analyze the LCS and all affected QC and field samples in the associated preparatory batch for the analytes outside acceptance criteria if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.
LCSD	If sufficient sample is not available for either a MSD or MD, one LCSD shall be included in the preparatory batch. Shall contain all surrogates and all reported analytes.	Recovery: Same as LCS acceptance criteria. Precision: RPD of all analytes ≤ 30% between LCS and LCSD.	Where an assignable cause isolated to only the LCSD is identified, the LCSD may be reanalyzed. Otherwise, reprepare and analyze the LCSD and all affected QC and field samples in the associated preparatory batch for the analytes outside acceptance criteria if sufficient sample material is available. If the samples cannot be reprepared and analyzed, apply qualifier to affected analyte results of all samples in the associated preparatory batch and explain in the case narrative.	Lab Manager / Analyst	Precision and Accuracy/Bias	**Recovery:** Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits. **Precision:** RPD of all analytes ≤ 30% between LCS and LCSD. RPD does not apply if both results are below the LOQ.
MS	One per preparatory batch if sufficient material is provided. Shall contain all surrogates and	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the MS is identified, reanalyze the MS or reprepare and analyze the MS if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
	all reported analytes.					
MSD or MD	One per preparatory batch if sufficient material is provided. MSD: Shall contain all surrogates and all reported analytes. MD: Shall be analyzed for all surrogates and all reported analytes.	Recovery: Same as the LCS recovery acceptance criteria. Precision: RPD of all analytes ≤ 30% between MS and MSD or sample and MD. RPD does not apply if both results are below the LOQ.	If an assignable cause isolated to only the MSD or MD is identified, reanalyze the MSD or MD or reprepare and analyze the MSD or MD if sufficient sample material is available, as indicated by the cause. Otherwise, apply qualifier to affected analyte results in the parent sample and explain in the case narrative.	Lab Manager / Analyst	Precisions and Accuracy/Bias	**Recovery:** Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits. **Precision:** RPD of all analytes ≤ 30% between MS and MSD or sample and MD. RPD does not apply if both results are below the LOQ.
Surrogate Spike If Used	All QC and field samples.	Same as the LCS acceptance criteria.	If an assignable cause isolated to only the surrogates is identified in a field sample, reprepare and analyze the field sample if sufficient sample material is available. If obvious chromatographic interference is present, repreparation and analysis may not be necessary, but the customer shall be notified prior to reporting data. If samples with surrogate recoveries outside acceptance criteria cannot be reprepared and analyzed, apply qualifier to analyte results associated with the surrogates outside acceptance criteria and explain in the case narrative.	Lab Manager / Analyst	Precisions and Accuracy/Bias	Use Project limits. If no project limits, use QSM Limits. If no QSM limits, use in-house limits.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
VOCs (EPA TO17) Soil Gas						
Method Blank	1/Batch (20 samples)	No Target Compounds>LOQ; no common lab contaminants >5XRL.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results non-detect.	Analyst / Section Supervisor	Accuracy/ Bias-Contamination	No Target Compounds>RL ; no common lab contaminants >RL.
Instrument Blank	Once per 12 hours if method blank is not run	No Target Compounds>LOQ; no common lab contaminants >5XRL.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results non-detect.	Analyst / Section Supervisor	Accuracy/ Bias-Contamination	No Target Compounds>1/2 RL; no common lab contaminants >RL.
LCS	1/Batch (20 samples)	Refer to Attachment D for LCS control limits.	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst / Section Supervisor	Accuracy/ Bias	Laboratory % Recovery Control Limits
Surrogates	Every sample	Refer to Attachment D for surrogate control limits.	Check calculations and instrument performance; recalculate, reanalyze.	Analyst / Section Supervisor	Accuracy/ Bias	Laboratory % Recovery Control Limits
Microbial DNA (QuantArray®-Petro)						
CCV	Primary – initial	Standard curve $r^2 > 0.95$	Rerun assay / check reagents	Lab area supervisor	Accuracy/ bias	Standard curve r^2 >0.95
CCV	Secondary – every plate (assay)	CT value within +/- 20% of known value	Rerun assay / check reagents	Lab area supervisor	Accuracy/ bias	CT value within +/- 20% of known value
Assay Negative Control (blank)	One per analytical assay plate	Values for positive samples are set above any fluorescence for the negative control	Rerun assay; may have to re-optimize assay	Lab area supervisor	Contamination / bias	Values for positive samples are set above any fluorescence for the negative control

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
DNA Extraction – Negative Control	One per analytical batch	CT ≤ Assay negative control	Rerun assay or re-extract samples if the problem persists	Lab area supervisor	Contamination / bias	CT ≤ Assay negative control
Positive Control	One per analytical assay plate	calculated concentration within +/- 20% of same concentration on standard curve	Rerun assay/check reagents	Lab area supervisor	Contamination / bias	CT value within two units of the same point on the standard curve
Field Duplicate	At client's request and with sample submission	N/A	N/A	Lab area supervisor	Contamination / bias	N/A

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Attachment B
Standard Operating Procedures

ATTACHMENT CONTENT REDACTED

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List of Standard Operating Procedures (SOPs) included in this attachment:

Field SOPs:

- SOP ENV-01, *Sample Handling, Packing, and Shipping*;
- SOP ENV-02, *Sampling Decontamination*;
- SOP ENV-07, *Multi-Increment Soil Sampling*;
- SOP ENV-09, *Soil Vapor Sampling*;
- SOP ENV-10, *Bioventing Well Installation and Abandonment*;
- SOP G-2, *Surveying and Mapping*;
- SOP G-7, *Data Management Plan*; and
- SOP UXO-04, *Heavy Equipment and Earth Moving Machinery Operations*.

Eurofins Denver Laboratory SOPs for Soil:

- DV-GC-0027, *Diesel and Residual Range Organics (DRO and RRO) by GC/FID[SW846 Method 8015 and State Methods]*;
- DV-IP-0012, *Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) [Method No(s). SW846 1311 and 1312]*;
- DV-MS-0010, *Determination of Volatile Organics by GC/MS [8260B/C/D and 624/624.1]*;
- DV-MS-0012, *GC/MS Semi-Volatiles by 8270 and 625.1*;
- DV-OP-006, *Extraction of Aqueous Samples by Separator Funnel, SW846 3510C and EPA 600 Series*;
- DV-OP-007, *Concentration and Clean-up of Organic Extracts [SW-846, 3510C, 3540C, 3546, 3550B, 3550C, 3620C, 3630C, 3660B, 3665A, ASTM Method D7065-11, and EPA 600 Series Methods]*;
- DV-OP-0013, *Incremental Sampling Methodology for Soils and Sediments [ASTM D 6323]*;
- DV-OP-0015, *Microwave Extraction of Solid Samples by Method SW-846 3546*;
- *DV-OP-0016, Ultrasonic Extraction of Solid Samples [SW-846 3550B and 3550c*]; and
- DV-WC-0023, *Percent Moisture in Soils and Wastes [ASTM D2216, CLP ILM05.3, SW-846 3550C]*.

Beacon Environmental Laboratory SOPs for Soil Gas:

- *SOP No. 7 GC/MS Sample Analysis by EPA Methods TO-17 and TO-15.*

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Attachment C
Waste Management Plan

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FINAL
WASTE MANAGEMENT PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawaiʻi

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

Prepared by:

GSI North America Inc.
181 South Kukui St., First Floor
Honolulu, HI 96813

January 2025

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Acronyms and Abbreviations

CFR	Code of Federal Regulations
DAF	Department of the Air Force
DoD	Department of Defense
EPA	U.S. Environmental Protection Agency
GSINA	GSI North America Inc.
GSR	Green and Sustainable Remediation
HSP	Health and Safety Plan
IAW	In Accordance With
IDW	Investigation-Derived Waste
kg	Kilogram(s)
MSSC	Maui Space Surveillance Complex
PPE	Personal Protective Equipment
RA	Remedial Action
SAP	Sampling and Analysis Plan
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
U.S.	United States
WMP	Waste Management Plan

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Section 1 Introduction

This Waste Management Plan (WMP) has been developed for the Remedial Action (RA) to be conducted at the Generator Fuel Spill Site (SS014) located at the Maui Space Surveillance Complex (MSSC), Maui, Hawaiʻi.

1.1 Purpose

The purpose of this WMP is to describe the approach, management, handling, disposal, and operational procedures to be employed concerning waste generation, including green and sustainable remediation (GSR) practices while conducting the RA field activities. The WMP will be implemented in accordance with (IAW) Department of Defense (DoD) Manual 4715.20 *Defense Environmental Restoration Program Management* (DoD, 2012) and will utilize the United States (U.S.) Environmental Protection Agency (EPA) *Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring* (EPA, 2016).

1.2 Roles and Responsibilities

Waste management at the site will be conducted by GSI North America Inc. (GSINA) and its subcontractors. All transport and disposal of project related waste will be coordinated with the Department of the Air Force (DAF) and conducted IAW local, state, and federal regulations.

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Section 2 Waste Generation, Management, and Handling

Based on the planned RA activities at Site SS014, the potential types of waste that are anticipated to be generated during field operations include:

- Trash - items such as personal protective equipment (PPE), paper/plastic bags, cardboard, plastic containers, and paper towels;
- Sampling materials - items used for sample collection such as Terra Cores® (or similar) soil corers, coffee filters, plastic bags, and acetate liners;
- Soil cuttings - solid waste material generated during soil boring and bioventing well installation activities; and
- Liquid waste potentially generated as part of decontamination procedures during sampling and bioventing system water (i.e., water/condensate from the extraction wells), if applicable.

No disposal of waste will be attempted without concurrence of the method and location of disposal by DAF personnel. If additional types of investigation-derived waste (IDW) are generated, GSINA will notify DAF personnel regarding proper management and disposal alternatives. No hazardous waste is expected to be generated as of the date of this document.

2.1 Solid Waste

In general, generation of waste will be kept to a minimum and every effort will be made to segregate and recycle materials where appropriate. Potential solid wastes that will be generated during the RA field operations include solid waste trash, PPE, sampling materials (e.g., acetate sleeves from direct push drill rig, disposable corers), soil cuttings, and residual soil on disposable sampling equipment from sampling activities.

2.1.1 Trash

Trash consisting of plastic/paper bags, cardboard, plastic containers, and paper towels that are not used for collection of samples can be disposed in municipal waste receptacles specifically designated by the DAF. Likewise, construction debris (e.g., stakes, flagging, expended paint cans) and general office-type trash generated in the field will be segregated and disposed or recycled consistent with the method used for municipal solid waste (i.e., non-hazardous domestic trash). Disposal of significant volumes of trash items will only occur at receptacles designated by DAF for the duration of the project.

2.1.2 Sampling Materials

Every effort will be made during the RA field operations to collect the minimum amount of soil necessary to obtain a representative sample volume with limited to no excess soil remaining as IDW. Disposable sampling materials used during sample collection are considered IDW that have been in incidental contact with sample media. However, due to the removal of surficial media by dry decontamination procedures, residual soil mass will be minimal or absent. The condition of the IDW will not meet the characteristics of ignitability, reactivity, or corrosivity. In addition, any residual adhering media will be insufficient to result in the soil/material IDW exceeding toxicity characteristic leaching procedure levels for individual analytes. Therefore, disposable sampling items and PPE will be assumed as non-hazardous and disposed consistent with solid waste trash (Section 2.1.1).

Reusable sampling equipment, such as auger bits and trowels will undergo gross, dry-decontamination to remove any residual solids, followed by decontamination with fluids, as necessary. Refer to standard operating procedure (SOP) ENV-02 *Sampling Decontamination* for decontamination procedures (Attachment B of the project Sampling and Analysis Plan [SAP]).

2.1.3 Soil Cuttings

Soil cuttings generated during soil boring and bioventing well installation operations will either be returned to the vicinity of the originating boring or remediated in an onsite landfarm prior to onsite reuse depending on the results of field screening as described in the project SAP. No soil will be removed from the summit of Haleakalā without written permission from the Government.

Also, as described in the SAP, all soil from a sample not consumed by the laboratory after the laboratory performs their multi-increment sampling, will be returned to the MSSC. It is estimated that for every 1.15 kilograms (kg) of soil per multi-increment sampling sample collected at the site and sent to the laboratory, approximately 0.06 kg will be consumed by the laboratory and approximately 1.09 kg will be returned to the site. Following analysis, the laboratory will ship the unconsumed soil (accompanied with a U.S. Department of Agriculture soil permit) to GSINA's local office. GSINA will coordinate site access with DAF personnel. The soil returned from the laboratory will then be placed back at MSSC in the area of the soil investigation.

Additionally, soil remaining after samples are processed on site using methanol for offsite laboratory VOC analysis, will remain at MSSC. The soil that was exposed to methanol will be placed in a bowl and will be exposed to air to allow for the residual methanol to evaporate prior to adding the soil to the onsite landfarm.

2.2 Liquid Waste

Liquid wastes associated with equipment decontamination and the bioventing system will be managed as described in the following subsection.

2.2.1 Liquid IDW

Non-disposable equipment used for sampling will be decontaminated following each use. A stiff, nylon-bristle brush will be used to remove any dirt adhering to the tools. Additional decontamination will be performed using a three-phase procedure with a non-phosphate detergent and rinsate water (potable and distilled) which will be collected in buckets (or similar, as appropriate), as applicable (refer to SOP ENV-02 [Attachment B of the project SAP] for details on decontamination procedures).

The bioventing system will also utilize a 55-gallon drum to collect water/condensate from the extraction wells. Water generated is expected to be minimum.

If generated, liquid waste will be collected in drums or buckets (or similar, as appropriate) and added to the landfarm for onsite evaporation.

2.3 Investigation-Derived Waste Labeling

IDW requiring special disposal will not be generated during this project. All solid waste IDW (trash and sampling material) is considered acceptable for disposal in municipal receptacles and soil cutting will be remediated using a landfarm on site (Sections 2.1.1 and 2.1.2, and Section 2.2.3, respectively). All liquid IDW (i.e., decontamination fluids, bioventing system water) will be allowed to evaporate on site in the landfarm (Section 2.2.1).

2.4 Hazardous Substances

GSINA does not anticipate the use of potentially hazardous substances, outside of diesel fuel, gasoline, motor oil, or other regulated liquids for equipment operation and sample preservation (e.g., methanol) as part of the RA field operations. Such substances would be present in contained conditions as part of internal combustion engines or in designated containers (e.g., laboratory-provided sample containers). An inventory of all chemicals brought on site and a Safety Data Sheet (SDS) for each will be maintained at the site. All chemicals brought on site will be properly labeled. Site personnel will comply with the storage, handling, and use requirements stated on the SDS for each chemical brought on site by the project team or its subcontractors (refer to the Hazard Communication Program provided in the project Health and Safety Plan [HSP]). If applicable, flammable lockers will be utilized to store any fuels brought on site. Disposal of diesel fuel or gasoline is not anticipated, as most will be consumed during equipment use. However, in case a spill occurs due to vehicle or equipment malfunction that could result in a release of fuel, grease, motor oil, or other lubricants while personnel are conducting field operations, a spill containment kit will also be maintained on site. Refer to the Spill Plan in the HSP.

2.5 Transportation and Disposal Procedures

No soil will be removed from the summit of Haleakalā without written permission from the government.

2.5.1 Non-Hazardous Wastes

Non-hazardous solid waste materials, such as trash and general debris, will be removed and transported off site for disposal through the municipal waste system as described in Sections 2.1.1 and 2.1.2. Routine disposal of municipal solid waste (at least weekly) will be performed to avoid incurring excess waste storage within the work area.

2.5.2 Hazardous Wastes

Generation of waste that meets the criteria of hazardous is not expected as part of the planned field operations. The generation of potentially hazardous waste could occur in association with a leak or spill of hazardous materials. Any soil, absorbent, or fluids containing regulated substances in those situations would be treated as potentially hazardous waste and stored in U.S. Department of

Transportation specified containers, labeled IAW applicable regulations, and sampled for waste characterization. Storage of potentially hazardous waste pending characterization and disposal will be coordinated with the DAF. If a secure location is not available for storage of waste pending classification and disposal, then arrangements will be made for appropriate transport to an alternate location/facility approved by the DAF.

Although not anticipated for this project, any material (liquid or solid) determined to be a hazardous waste will be disposed at a Resource Conservation and Recovery Act-permitted hazardous waste treatment, storage, and disposal facility IAW all applicable Federal, state, and local rules and regulations. The following treatment, storage, and disposal facility will be used for the offsite disposal of any hazardous waste that cannot be treated on site:

Clean Harbors of San Jose, LLC
1021 Berryessa Road
San Jose, CA 95133
Phone: (408) 441-0962
Fax: (408) 453-8105

Appropriately trained individuals will be tasked with managing hazardous waste and arranging for disposal. For the purpose of disposal, the generator of all waste is the government unless specified otherwise by the Contracting Officer's Representative. The hazardous waste will be handled and transported to the appropriate disposal facility by the hazardous waste transportation-licensed subcontractor listed below:

Pacific Commercial Services, LLC
91-254 Olai Street
Kapolei, HI 96707
Phone: (808) 545-4599
Fax: (808) 845-9773

No hazardous waste disposal can be performed without agreement by DAF personnel, who require completed copies of all manifests, land disposal restriction notification forms, and waste profiles a minimum of 10 days prior to shipment. In addition, no disposal can occur without an authorized representative of the DAF signature on the manifest. Hazardous waste manifests will be prepared IAW 40 Code of Federal Regulations (CFR) 260-268 and 49 CFR 171-178. Copies of manifests and associated paperwork will be provided with the RA Report and maintained for a minimum of three years in the project file to comply with 40 CFR 262.40.

Section 3 Green Sustainable Remediation Practices

In support of the DAF's mission of green design and comprehensive sustainability management and following DoD's policy on consideration of GSR practices, GSINA plans to conduct RA activities IAW EPA's guidance for *Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring* (EPA, 2016) and *Green Remediation Best Management Practices: Soil Vapor Extraction & Other Air-Driven Systems* (EPA, 2022), as applicable. Specific actions that will be taken to achieve these goals are as follows:

- Use rechargeable batteries for field equipment, such as Global Positioning System units, photoionization detector, multi-gas meters, if possible;
- Use minimally invasive drilling techniques such as direct-push, when possible to reduce the generation of cuttings;
- Segregate and screen drill cuttings for potential use as onsite backfill (i.e., return uncontaminated soil cuttings back to the area of excavation);
- Treat contaminated soil and IDW liquids on site and dispose of on site, if possible;
- Dispose of solid waste trash at nearest appropriate municipal dumpster to reduce fuel consumption and air emissions;
- Integrate passive air sampling techniques, where appropriate;
- Lay synthetic barriers and containment structures on the ground surface in the contaminated soil treatment areas (i.e., landfarm) to avoid introducing toxic materials to the soil and nearby vegetation;
- Restore any disturbed areas that may impact storm water runoff based on any equipment use;
- Recycle packaging and shipping containers, such as cardboard boxes and plastic containers; and
- Conduct remote meetings that incorporate online collaboration, teleconferencing, and video conferencing options to the extent practical to limit travel to site and reduce fuel consumption and air emissions.

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Section 4 References

DoD, 2012. DoD Manual 4715.20. *Defense Environmental Restoration Program Management*. 9 March.

EPA, 2016. *Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring. Office of Solid Waste and Emergency Response*. Publication 542-F-16-002. September.

_____, 2022. *Green Remediation Best Management Practices: Soil Vapor Extraction & Other Air-Driven Systems*. Publication 542-F-22-002. March.

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Appendix E
Health and Safety Plan

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FINAL

HEALTH AND SAFETY PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawai‘i

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

Prepared by:

GSI North America Inc.
181 South Kukui St., First Floor
Honolulu, HI 96813

June 2024
Revision 01, 28 January 2025

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Health and Safety Plan Acknowledgment

I have read, understand, and agree to abide by the provisions as detailed in this Health and Safety Plan prepared by GSI North America Inc. Failure to comply with these provisions may lead to disciplinary action and/or my dismissal from the work site.

Printed Name	Company	Signature	Date

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Acronyms and Abbreviations

°F	Degrees Fahrenheit
ABS	Active Bioventing System
AED	Automatic External Defibrillator
AHA	Activity Hazard Analysis
AMS	Acute Mountain Sickness
ANSI	American National Standards Institute
AOI	Area of Interest
BBP	Bloodborne Pathogen
BDOC	Base Defense Operations Center
bpm	Beats Per Minute
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
COPC	Contaminant of Potential Concern
CPR	Cardiopulmonary Resuscitation
DAF	Department of the Air Force
dBA	A-Weighted Decibel
DOT	Department of Transportation
DRO	Diesel Range Organics
EAL	Environmental Action Level
EHS	Environmental Health and Safety
EM	Engineer Manual
EMS	Emergency Medical Service
EPA	U.S. Environmental Protection Agency
FM	Field Manager
FMP	Fatigue Management Plan
ft	Foot/Feet
GSINA	GSI North America Inc.
H&S	Health and Safety
HACE	High Altitude Cerebral Edema
HAPE	High Altitude Pulmonary Edema
HAZCOM	Hazard Communication
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDOH	State of Hawaiʻi Department of Health
HEER	Hazard Evaluation and Emergency Response
HSP	Health and Safety Plan
IAW	In Accordance With
ID	Identification
MBSS	Maui Base Support Service
MEDEVAC	Medical Evacuation
mg/kg	Milligrams per Kilogram
MSSC	Maui Space Surveillance Complex
N/A	Not Applicable
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration

PAH	Polycyclic Aromatic Hydrocarbon
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
SPSS	Space Surveillance Squadron
SSHO	Site Safety and Health Officer
TPH	Total Petroleum Hydrocarbons
U.S.	United States
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compound

Section 1 Signature Sheet

GSI North America Inc. (GSINA) has developed this Health and Safety Plan (HSP) under contract number FA8903-24-C-0008, Environmental Remediation Services to Conduct a Remedial Action at the Generator Spill Site (SS014), Maui Space Surveillance Complex (MSSC), Haleakalā, Hawai‘i (the Site). The project will be conducted in accordance with (IAW) the requirements specified in the Performance Work Statement and in compliance with applicable State of Hawai‘i Department of Health (HDOH), Department of Defense, and United States (U.S.) Department of the Air Force (DAF) regulations and guidance.

The individuals referenced below have reviewed and approved this HSP. Procedures for the submission, approval, integration, and implementation of changes to the HSP are discussed throughout the body of the document and will be followed whenever a change will significantly impact the safety of Site personnel, the environment, or offsite personnel. This HSP applies to work to be performed as specified under the current GSINA contract.

Plan Prepared by:

[redacted]

06/12/2024 / 01/28/2025

Tineill Dudoit	*(reviewed)* Craig Morris	Date
Site Safety and Health Officer (SSHO)	SSHO	
Phone: [redacted]	[redacted]	

Plan approved by:

[redacted]

06/12/2024 / 01/28/2025

Kimberly Kim	Carl McGraw	Date
Corporate Health and Safety Manager (CHSM)	CHSM	
Phone: [redacted]	[redacted]	

Plan Concurred by:

[redacted]

06/12/2024 / 01/28/2025

Zachary Payne	Bryan Chinaka	Date
Senior Project Manager (PM)	PM	
Phone: [redacted]	[redacted]	

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Section 2 Project Information

The purpose of the project is to collect additional soil characterization data as part of the MSSC spill response (HDOH Release Identification [ID] 3239), further delineate the extent of contamination, and implement the selected remedial alternative. Specifically, GSINA was contracted to assist in various activities to support the DAF’s Environmental Restoration mission, including development and implementation of an active bioventing system (ABS) and landfarms to treat contaminated soil previously identified at the Site.

2.1 Introduction

This HSP presents the minimum requirements for health and safety (H&S) that must be met by personnel engaged in remedial activities at Site SS014. This HSP provides measures to minimize accidents and injuries that may occur during normal daily activities or during adverse conditions. This HSP does not in any way relieve Site personnel, contractors, or subcontractors from responsibility for the H&S of their personnel. Contractors are required to review Site conditions and the work to be performed and determine specific H&S requirements for their personnel. Visitors to the Site will receive a safety briefing from the SSHO or designee prior to gaining entry to the work area and an onsite visitor log will be maintained. The SSHO will provide all visitors with appropriate personal protective equipment (PPE) while onsite.

The HSP is the interface with the GSINA Corporate Environmental Health and Safety (EHS) program and the project-specific field team. It is prepared to be consistent with all applicable DAF, federal, state, and local H&S requirements, which include the following:

- 29 Code of Federal Regulations (CFR) 1904, 1910, and 1926 (Occupational Safety and Health Administration [OSHA], General Industry and Construction Standards, respectively);
- U.S. Environmental Protection Agency (EPA) Standard Operating Safety Guides, Office of Solid Waste and Emergency Response, June 1992;
- 49 CFR U.S. Department of Transportation (DOT) *Commercial Driver’s License and Shipping*;
- EPA Office of Emergency and Remedial Response Fact Sheet, Publication 9285.1-02, Health and Safety Roles and Responsibilities at Remedial Sites, July 1991;
- U.S. Army Corps of Engineers (USACE) Engineer Manual (EM) 385-1-1, *Safety and Health Requirements Manual*, 30 November 2014; and
- USACE Engineer Regulation 385-1-92, *Safety and Occupational Health Requirements for Environmental Cleanup Projects*, 1 November 2018.

Accident prevention is a key program element to achieve compliance and strive towards GSINA’s goal of zero safety incidents. Personnel active in Site operations will be thoroughly familiar with the programs and procedures outlined in this HSP before conducting work at the Site. All Site personnel, including the project team and subcontractors, who may be covered by this HSP must review or be provided with a detailed briefing on the contents of this document and sign the HSP Acknowledgement before performing work at the Site.

The measures presented here are in effect for the duration of the project. The procedures and guidelines contained herein are based upon the best available information at the time of the plan's preparation. Any revisions to this plan will be made with the knowledge and approval of the DAF.

2.2 Project Location and Background

Site SS014 is located on Pu‘u Kolekole, a promontory at the western edge of the summit caldera of the Haleakalā volcano on the island of Maui, roughly 10,000 feet (ft) above mean sea level. The Site comprises the 4.4-acre MSSC within the 18.2-acre property of the Haleakalā High Altitude Observatory Site. The specific area of interest (AOI) for this project is limited to approximately 5,500[1] square ft in the immediate vicinity of the MSSC generator. The Site is further defined by the City and County of Honolulu Real Property Tax Office as tax map key (2) 2-2-007: 008. The AOI is designated as Release ID 3239 by the HDOH Hazard Evaluation and Emergency Response (HEER) Office, and as Generator Spill Site SS014, by the DAF.

On 29 January 2023, a fuel storage tank for an emergency generator released approximately 700 gallons of fuel onto the generator pad and surrounding soil at the summit of Haleakalā. This spill consisted of a roughly 60/40 mixture of Jet A (a mixture of gasoline and kerosene) and diesel fuel, respectively. Due to the elapsed time since the spill, the lighter Jet A components are expected to have largely evaporated, with the heavier diesel fuel remaining in Site soil.

For project personnel involved with the remedial action field activities to be performed at the site, the contaminant of potential concern (COPC) identified is total petroleum hydrocarbon (TPH) diesel range organics (DRO). TPH-DRO was previously detected at the site during the Phase 2 Site Characterization and Alternatives Evaluation at concentrations ranging from 5.3 to 12,032 milligrams per kilogram (mg/kg) which exceeds the HDOH Construction/Trench Worker Direct Exposure Environmental Action Level (EAL) of 680 mg/kg (HDOH Spring 2024 EAL Surfer, Table I-3; HDOH 2024).

2.3 Project Hazards

The hazards associated with the project include, but are not limited to, the following: motor vehicle accidents; struck by equipment; underground utilities; noise; cold stress; heat stress; severe weather; exposure to potentially contaminated soil and soil gas; high altitude; and steep, uneven, and rocky terrain. An Activity Hazard Analysis (AHA) has been prepared for each of the project tasks. Each AHA includes the anticipated hazards, proposed hazard mitigation strategies (controls), and a risk assessment code for each hazard (Appendix B). All tasks have been assessed as low or medium risk after controls are implemented. Tasks under this contract identified as requiring AHAs are:

- Mobilization;

[1] *Does not include landfarm area(s).*

- Utility locate;
- Installation of bioventing wells and future well abandonment;
- Soil sampling;
- Heavy equipment and earth moving machinery operation;
- Soil vapor sampling; and
- Demobilization.

Other tasks associated with project planning and reporting will be completed independently of project fieldwork.

2.4 Project Objective and Work Description

The project objectives are to 1) further define the nature and extent of contamination within the AOI to allow for final decision-making and 2) to use this information to support the remediation of Site COPCs through active bioventing (in-situ soil) and ex-situ aeration (ex-situ soil). The scope of work includes surface, subsurface, and stockpile soil sampling, installation of ABS wells and blower, landfarm construction, soil vapor sampling, ongoing maintenance of both the ABS and landfarms, and ABS and landfarm decommissioning following remediation. The full scope of work is detailed in the project Remedial Action Work Plan.

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Section 3 Responsibilities and Lines of Authority

To carry out the tasks associated with a successful project, many individuals will be involved, including the GSINA management team, field crews, and additional subcontractors. The PM shall have the overall responsibility for the project while the SSHO shall have the responsibility for the Site. The SSHO has responsibility for safety-related tasks during project work, including but not limited to daily tailgate safety meetings, training the project team on the HSP and AHAs, emergency communications, and safety inspections. While the SSHO reports to the PM and the CHSM, the expectation is that the SSHO will maintain all qualification as specified in EM 385-1-1, IAW the requirements of the contract. The SSHO shall make all safety-related decisions in the field. This includes maintaining safety standards and requiring all subcontractors to abide by safety requirements when on site. If at any time an unsafe condition exists, the SSHO or any personnel has the authority to stop work and determine a safe course of action. A SSHO or their designee will always be present onsite during project work.

3.1 Statement of Employer's Responsibility

As the prime contractor, GSINA is ultimately responsible for the implementation of the EHS Program through enforcing the requirements for this project as stated in this HSP. Senior and corporate management are committed to operating projects in a manner consistent with controlling EHS legislative, regulatory, and client requirements, and other applicable requirements administered by federal agencies. The responsibilities, organizational structure, recordkeeping requirements, and evaluation of the EHS Program are discussed below.

3.2 Identification of Personnel Responsible for Safety

Table 3-1 presents the key project personnel responsible for Safety Program implementation for this project. Key responsibilities of each position are provided in Table 3-2.

Table 3-1: Project Safety Team

Name	Position	Telephone Numbers[1]
Larry deVries	Munitions and Environmental Division Manager	[redacted]
Eric Wetzstein	Environmental Program Manager	[redacted]
Bryan Chinaka	PM	[redacted]
Carl McGraw	CHSM	[redacted]
Craig Morris	SSHO	[redacted]
Kimberly Kim	FM	[redacted]

Notes:
[1] Telephone numbers shall be confirmed/revised prior to field mobilization and revised, as necessary.
FM - Field Manager

Table 3-2: Key Responsibilities

Position	Description of Key Responsibilities
Munitions and Environmental Division Manager: Larry deVries Environmental Program Manager: Eric Wetzstein	▪ Responsible and accountable for project safety; ▪ Ensure project personnel comply with applicable EHS requirements and corporate or client procedures; ▪ Ensure timely and accurate reporting and investigation of incidents, accidents, or injuries involving project personnel, with support from the risk management department; ▪ Ensure corrective actions are implemented completely; and ▪ Ensure proper response and internal notification regarding inspections by regulatory agencies.
PM: Bryan Chinaka	▪ Ensure all project personnel have met the site-specific experience, training, and certification requirements; ▪ Ensure project support is acquired from appropriately qualified safety personnel; ▪ Ensure appropriate safety equipment and materials are provided for the project; ▪ Ensure development and implementation of the project HSP and indicate concurrence with final plans after required EHS reviews; ▪ Act as the primary point of contact (POC) for any situations that would affect final reporting or require additional DAF input; and ▪ Understand the project's quality-related requirements and the plans and procedures for implementing them.
CHSM: Carl McGraw	▪ Approve and ensure the implementation of the GSINA Corporate EHS Program, this HSP, and any amendments; ▪ Ensure that procedures are being carried out IAW established requirements and protocols; ▪ Conduct field audits to assess the effectiveness and implementation of the HSP; and ▪ Evaluate and authorize changes to the HSP based on field and occupational exposure, as necessary.
SSHO: Craig Morris	▪ Act as primary onsite POC, in direct contact with PM and CHSM regarding larger decisions; ▪ Perform inspections of safety compliance; ▪ Prepare daily safety forms; ▪ Responsible for ensuring that onsite personnel follow the requirements of the HSP; ▪ Halt any project work activities that represent an imminent hazard; ▪ Review Site personnel training and experience documentation to ensure compliance with the HSP; ▪ Coordinate changes/modifications to the HSP with the appropriate personnel; ▪ Conduct or coordinate project-specific training, including daily safety meetings; ▪ Implement safety corrective actions through training and reinforced awareness; and ▪ Maintain exposure data.
FM: Kimberly Kim	▪ Monitor all activities during sampling activities; ▪ Ensure that procedures are being carried out IAW established requirements and protocols; and ▪ Understand the project's operational-related requirements and the plans and procedures for implementing them.

3.3 Competent Person

According to OSHA Regulation 29 CFR 1926.32, Site personnel will include a Competent Person. No work shall be performed without a Competent Person onsite. A list of competent person requirements and regulatory references is presented in Table 3-3. Mr. Craig Morris meets these requirements and has been approved by GSINA’s Corporate EHS Management.

Mr. Craig Morris is a competent person as stated in OSHA 29 CFR 1926.32. As required by EM 385-1-1, Mr. Craig Morris has at least five years of applicable safety experience and has successfully completed the OSHA 30-hour construction safety course (or equivalent course). Mr. Craig Morris performed work on a site(s) of similar hazard, risk, and complexity to the task assignment, and is certified in first aid, cardiopulmonary resuscitation (CPR), and use of an automatic external defibrillator (AED). Mr. Craig Morris also has at least two years of experience implementing safety and occupational health procedures and experience conducting exposure monitoring to select and adjust PPE.

Ms. Kimberly Kim may serve as an alternate competent person during site activities if not concurrently supporting the role of FM (i.e., FM and SSHO will not be dual hatted). Ms. Kim meets the minimum requirements listed above and has over eight years of experience implementing safety and occupational health procedures and experience conducting exposure monitoring to select and adjust PPE.

The SSHO will maintain the qualifications of site-specific personnel onsite. The certifications and overall qualifications of GSINA personnel are maintained and current (Appendix A).

Table 3-3: Competent Person Requirements

Competent Person Requirement	Regulatory Reference	Designated Person
SSHO	EM 385-1-1 Sec. 01.A.17	Craig Morris; Kimberly Kim (alternate)
General Inspections of Construction Sites	EM 385-1-1.01.A.12 29 CFR 1926.20	Craig Morris; Kimberly Kim (alternate)
Unsanitary Conditions	EM 385-1-1.02 29 CFR 1926.27	Craig Morris; Kimberly Kim (alternate)
Hearing Protection	EM 385-1-1.05.C 29 CFR 1926.101	Craig Morris; Kimberly Kim (alternate)

3.4 Qualified Person

Site personnel will also include a Qualified Person. GSINA will permit only those employees qualified by training or experience to operate equipment and machinery, such as vehicles and utility vehicles, in compliance with OSHA 29 CFR 1926.20(b)(4). According to OSHA 29 CFR 1926.32, "qualified" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project. The qualified person for this project will be Mr. Craig Morris.

The SSHO will meet the requirements of EM 385-1-1 for the position assigned. The certifications and overall qualifications of all project team personnel are maintained in a database supported by the project team and the qualifications of all Site personnel will be maintained onsite. Documentation will be reviewed and maintained by the SSHO and will be available for the DAF review upon request.

3.5 Pre-Task Health and Safety Analysis

Pre-Task H&S Analysis begins for the project team at the proposal phase utilizing available documentation and site visits. The process continues through development of the HSP AHAs (Appendix B).

The SSHO will ensure that a survey is conducted for each work area during mobilization to identify sources of all types of hazards and confirm that the HSP and AHAs address these hazards. If necessary, the AHAs (Appendix B) will be updated to reflect any additional hazards identified.

3.6 Management Accountability for Safety

GSINA managers and supervisors are held directly accountable for the H&S of their employees, for subcontractor activities, and for the continual communication of hazards and hazard controls to the workforce. The CHSM will assess the safety and health performance of employees. This same requirement and expectations are expected from all subcontractors as well.

The accountability of supervisors and managers for the implementation of the H&S program is ensured through project reviews with senior management and through annual employee performance evaluations.

Section 4 Subcontractors and Suppliers

GSINA will provide oversight and coordinate onsite field activities to ensure the successful execution of tasks described within this HSP. Each subcontractor is responsible for providing supervision of its employees and will provide qualified personnel and/or competent personnel where required by law or regulation. Each subcontractor will be responsible for managing and recording any injury or incident involving its employees as required by OSHA or other applicable laws and regulations. At a minimum, a copy of the HSP and the applicable AHAs shall be provided to subcontractors and shall be discussed with each affected employer at a scheduled preparatory meeting.

GSINA is ultimately responsible for ensuring subcontractor and supplier compliance with the HSP for this project. Subcontractors will assign a Site Safety Representative who will be responsible for coordinating projects and safety responsibilities for their personnel as designated and directed by the SSHO. Non-compliance with this plan will result in a stop work order, as determined by the SSHO.

The Site Safety Representative will interact with the SSHO to ensure compliance with this HSP. Subcontractor employees are expected to comply with this HSP, AHAs, and other applicable regulations governing their safety while on the project. In the event of a conflict, more stringent requirements will apply. Any changes in key project personnel will be coordinated with DAF.

The Site Safety Representative will:

- Attend all H&S briefings;
- Address worker issues and immediately stop work if unsafe acts/conditions exist or if uncertainty associated with how a task is to be performed exists;
- Coordinate corrective action with the SSHO prior to resuming operations;
- Participate in any incident investigations;
- Inspect operations and work areas daily, in conjunction with the SSHO;
- Ensure subcontract workers have the proper PPE; and
- Control all hazardous material brought onsite.

The subcontractor may be asked to participate in the development and implementation of sections of the project HSP or develop an AHA in areas where they provide specific expertise or support. GSINA subcontractor employees are covered by this HSP and will be required to sign the Acknowledgement Form within the HSP indicating that they have read and understand the HSP and agree to follow the requirements stated in this document. The SSHO will obtain and verify the subcontractor personnel training records prior to subcontracted work activities commencing.

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Section 5 Health and Safety Training

This section describes general project training, safety meetings, site-specific training, hazard communication (HAZCOM), first aid, CPR/AED, and other additional training and/or certifications needed to work on the Site. Most of the training will occur before mobilization to the project Site and is typical of training required for work on an environmental clean-up site. All personnel shall receive orientation, procedural, and communications training before being granted Site access. Records of the required training and certifications are maintained in the GSINA Corporate EHS database and records of required training will be available onsite.

5.1 Health and Safety Indoctrination

All site workers are required to complete H&S indoctrination training appropriate to their project role and responsibility level. The SSHO will be present during field operations and serve as a technical safety advisor and provide technical assistance and support. The SSHO will also conduct daily safety meetings for site personnel to discuss the day’s activities, equipment used and associated hazards and to ensure there are no training deficiencies with any new site staff. The SSHO will review site personnel training records and evaluate experience to ensure compliance with the HSP requirements.

Site-specific safety indoctrination training is vital for the staff and for the success of the project and will occur before mobilization to the AOI. The SSHO will present training material on the specific hazards of the Site, the AHAs, and the emergency response protocols. The SSHO shall ensure the project team clearly understands and can safely execute the emergency response plan documented in this HSP.

Site-specific training topics will include:

- Accident prevention;
- Accident reporting (how and to whom);
- Medical facilities for emergency treatment and/or assistance;
- Safe work/stop work responsibilities;
- Reporting and correcting unsafe conditions;
- Job hazards/hazard control (e.g., altitude sickness which is a top hazard at the Haleakalā summit);
- Site layout;
- Emergency response and notification;
- Hearing conservation;
- PPE;
- Buddy system;
- Spill prevention;

- Fire prevention;
- HAZCOM;
- Visitor access; and
- Any specific training required by regulations.

5.2 Mandatory Training and Certifications

Listed below are the training and certifications required for onsite workers associated with the Site SS014 project activities:

- Initial OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER);
- 8-hour HAZWOPER Refresher, and OSHA 30-hour Construction Safety Training (applies at a minimum, to the SSHO);
- 24 hours of safety training over the previous three years (applies at a minimum, to the SSHO);
- Fire extinguisher training (minimum two people, subcontractors will have at least one trained individual onsite); and
- First aid/CPR/AED/bloodborne pathogens (BBPs) (minimum two people, subcontractors will have at least one trained individual on site).

5.3 Periodic Health and Safety Training

The SSHO will conduct daily onsite tailgate meetings which will be held before each workday to reinforce pertinent topics from the site-specific training, coordinate work activities, address task-specific hazards and protection levels, and anticipate problems that may arise during the day. Topics will include site-specific hazards, accident investigation results, and any specific employee concerns that may arise during the project.

The SSHO will review and document the items discussed at the tailgate meetings. Attendance and the items discussed at the meeting will be documented using the appropriate form (Appendix C) as part of the daily documentation for the Site.

5.4 Emergency Response Training

At least two site personnel will have current training in first aid and CPR/AED and will implement emergency response procedures, if needed. All Site personnel will participate in the use of BBP universal precautions and shall use and maintain appropriate PPE when performing first aid or other tasks that may include exposure to blood or other potentially infectious materials.

All site personnel will be trained in the use of fire extinguishers to provide emergency response procedures. In the event specialized/elevated care is necessary, either GSINA or the local on-call emergency medical service (EMS)/ambulance service will transport the injured person to the appropriate medical facility.

All site personnel will be trained in emergency response procedures during initial indoctrination training discussed above as well as continual training throughout the project. During this training, personnel will be briefed on the HAZCOM Program, emergency equipment, and first-aid procedures. Personnel will also be briefed on emergency recognition and response procedures, which include:

- Pre-emergency planning;
- Personnel and lines of authority for emergency situations;
- Criteria and procedures for emergency recognition and Site evacuation;
- Decontamination and medical treatment of injured personnel (offsite or onsite treatment);
- Emergency medical facilities and telephone numbers for responders;
- Criteria for alerting local community responders (ambulance or helicopter necessary);
- Fire prevention, protection, and response; and
- Spills.

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Section 6 Emergency Recognition and Response

Potential onsite emergencies are expected to be restricted to fires, injuries to Site personnel, and/or minor spills. Site conditions are expected to be within the limits of response measures that can be taken by onsite personnel. Any emergency that is life-threatening, or that poses a potential threat to the public, will be considered a situation requiring outside assistance from emergency response agencies. The Fire Department will provide first-response support for fire, medical, and rescue emergencies. During any onsite emergency, work activities in the affected area will cease until the emergency is brought under control. Site workers will report incidents to the SSHO, who will report to the PM and 15th Space Surveillance Squadron (SPSS) Emergency Coordinator, who will in turn report incidents to the client and the appropriate agencies, as needed.

6.1 Pre-Emergency Planning

The SSHO will function as the coordinator for emergency operations at the Site and will function as the primary POC for response teams arriving at the Site. The SSHO will assign additional roles during an emergency as needed.

To prepare for an emergency and to minimize the impacts, the SSHO will:

- Ensure the roster of all employees and subcontractors is updated daily;
- Ensure that Site personnel check-in daily with Base Defense Operations Center (BDOC) security;
- Ensure that an eyewash station, first aid supplies, and fire extinguishers are available at the Site;
- Have working knowledge of all safety equipment available at the Site; and
- Ensure that a map detailing the most direct route to the hospital is kept in each Site vehicle, complete with all necessary telephone numbers.

6.1.1 Emergency Equipment

Table 6-1 lists emergency equipment which will be maintained onsite and available for use during site operations. It will be the responsibility of the SSHO to maintain and inspect the Site emergency equipment. The SSHO will inspect all emergency equipment at least weekly to ensure completeness and proper working condition. Any time that emergency equipment is used, it will be reported to the SSHO so that those items can be replaced immediately. Site operations will not be allowed to continue if the required emergency equipment is not immediately available onsite.

Table 6-1: Emergency Equipment

Emergency Equipment	Quantity	Location Used/Stored	Operation Requiring Equipment
First aid Kit (Section 6.3.1)	1	AOI	All operations
Biohazard Kit (Section 6.3.1)	1	AOI	All operations
Portable Eye Wash Kit (Section 6.3.1)	1	AOI	All operations

Emergency Equipment	Quantity	Location Used/Stored	Operation Requiring Equipment
Fire Extinguisher (Section 6.4)	1	Each Vehicle and AOI	All operations
Spill Kit (Section 6.5)	1	AOI	All operations

Note:
Oxygen is a DAF/SPSS supplied/maintained emergency item, and is not stored on/near the AOI, and is not maintained/inspected by GSINA.

6.1.2 Evacuation Routes

Potential reasons for Site evacuation include severe storms, earthquakes, fires, or explosions. Evacuation routes will be identified daily by the SSHO and the 15th SPSS. In the unlikely event of Site evacuation, verbal notification or three long repeated blasts on a vehicle or equipment horn will be used to sound the alarm. Personnel will exit the Site by the nearest means of egress during accidents requiring evacuation and report to the northwest parking lot or MSSC lower parking lot as appropriate, where the SSHO will conduct a head count. Any missing person will be brought to the attention of the SSHO. If necessary, the SSHO will notify emergency personnel as soon as possible. If appropriate and safe, the SSHO and FM should remain near the Site following evacuation to assist local responders and advise them of the nature of the incident.

6.1.3 Hospital Location

A map showing the route to the hospital will be in each Site vehicle, and a written description of the route will be attached to the map. The hospital route will be verified prior to work initiation.

Maui Memorial Medical Center at 221 Mahalani Street in Wailuku is the designated offsite emergency medical facility (Figure 6-1). The travel time from the Site SS014 to the hospital is approximately 1.5 hours.

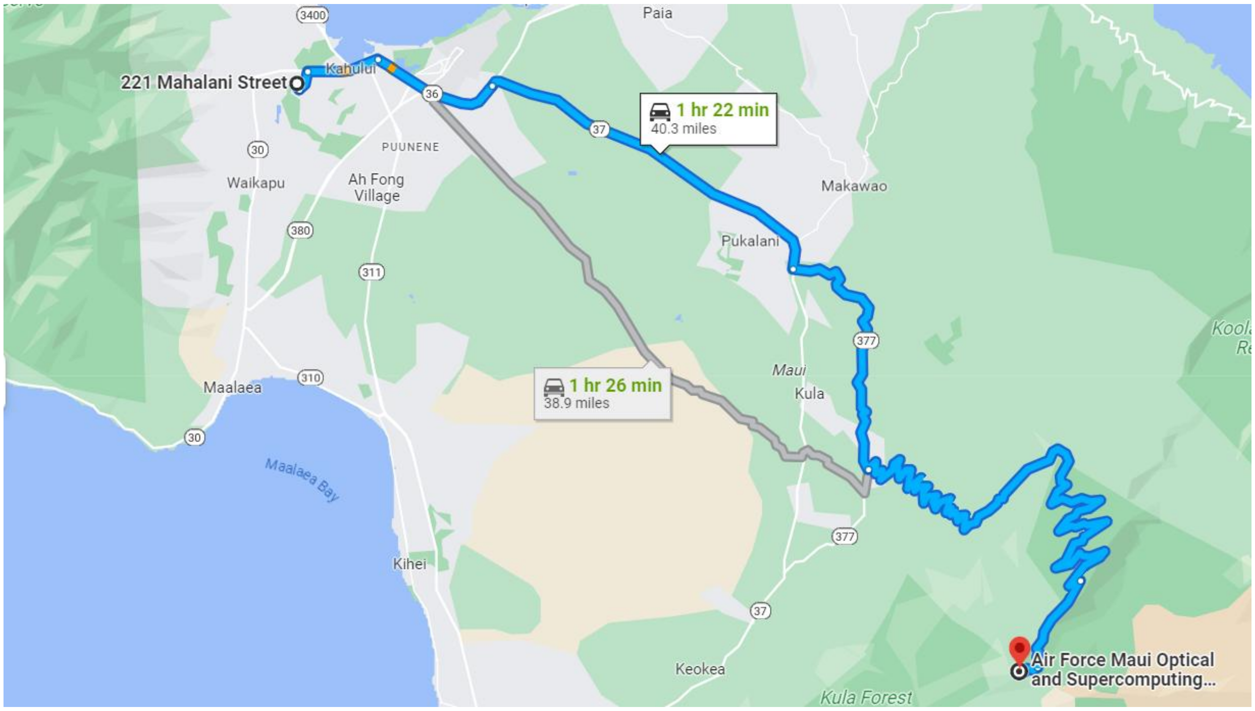

Figure 6-1: Hospital Route

6.2 Worker Injury or Illness

The SSHO will be responsible for monitoring the general health of Site workers. Site illnesses, conditions, or injuries that can be expected given the working conditions include heat/cold stress, exposure to Site COPCs, construction-related injuries, and injuries caused by slips, trips, and falls.

These conditions will be prevented by properly training Site workers in the appropriate use of H&S equipment, dressing appropriately, monitoring the breathing zone atmosphere, wearing appropriate PPE, and maintaining good housekeeping procedures.

The specific response to an injury or illness will depend on its type and severity, but in general, first aid will be administered in the field by the SSHO, who will be trained in first aid and CPR. The worker may then be transported to the hospital designated in this HSP.

6.3 Medical Emergency Response Procedures

The first worker who notices that a medical emergency or personal injury has occurred will immediately make a subjective decision about whether the emergency is life-threatening and/or is otherwise serious and will then proceed as described in the following subsections. If decontamination is needed, refer to Personnel Decontamination in Section 9.1.1, General Decontamination in Section 13, and AHAs in Appendix B.

The minimum actions taken will be as follows:

- All work will cease;

- All affected employees and subcontractors will be warned/notified of the emergency;
- The area will be isolated; and
- Appropriate notifications will be made.

6.3.1 First Aid

Trained personnel will use approved training means and methods for first aid treatment. For minor injuries, routine first aid procedures will be used. For major injuries, an ambulance will be called immediately and the appropriate first aid administered while awaiting the arrival of the ambulance or helicopter.

General guidelines for first aid are as follows:

- For minor injuries, routine first aid procedures will be used;
- For major injuries, call the appropriate emergency medical number[2] (dial 911):
  - Provide the following information:
    - Nature of the emergency;
    - Location of the emergency; and
    - Your name and the phone number from which you are calling.
  - Do not move the victim unless absolutely necessary;
  - Notify the SSHO, the 15th SPSS Company Commander, and the Emergency Coordinator;
  - Call for personnel trained in CPR and first aid to provide the required assistance prior to the arrival of the professional help; and
  - Use approved measures to administer treatment.
- If first aid personnel is unavailable, as a minimum:
  - Stop any bleeding with firm pressure on the wound (note: avoid contact with blood or other bodily fluids);
  - Clear the air passages using the Heimlich Maneuver in case of chocking; and
  - In case of rendering assistance to personnel exposed to hazardous materials, consult the Safety Data Sheet (SDS) and wear the appropriate personal protective safety equipment. Attempt fist aid only if trained and qualified.

First aid kits are assigned and approved by the SSHO. At a minimum, the requirements for a Class B First Aid Kit, as specified in National Standards Institute (ANSI)/International Safety Equipment Association Z308.1-2021. Table 6-2 lists the contents needed for a Class B First Aid kit; the

[2] *Due to limited cell phone reception at the site, a landline is available in the Butler Building for emergency calls. When placing a call, "99" must be dialed prior to entering the phone number.*

minimum standard of first aid kits that will be present at the AOI during work. The size and number of first aid kits will be sufficient to accommodate the maximum number of people onsite at any given time.

Eyewash stations will comprise sufficient sterile saline to flush the eyes for a minimum of 15 minutes and will be located within immediate use (approximately 10 seconds) of areas with injurious substances.

Table 6-2: Contents for Class B First Aid Kit

Description	Quantity	Description
Adhesive Bandage	50	1 x 3 inches
Adhesive Tape	2	2.5 yards
Antibiotic Application	25	0.14 fluid ounces
Antiseptic	50	0.14 fluid ounces
Breathing Barrier	1	N/A
Burn Dressing (gel soaked)	2	4 x 4 inches
Burn Treatment	25	1/32 ounces
Cold Pack	2	4 x 5 inches
Eye covering, with means of attachment	2	2.9 square inches
Eye/skin Wash	1	4 fluid ounces total
First Aid Guide	1	N/A
Hand Sanitizer	10	1/32 ounce
Medical Exam Gloves	4 pairs	N/A
Roller Bandage	2 1	2 inches x 4 yards 4 inches x 4 yards
Scissors	1	N/A
Splint	1	2.5 x 24 inches
Sterile pad	4	3x3 inches
Tourniquet	1	1 inch (width)
Trauma pad	4	5 x 9 inches
Triangular Bandage	2	40x40x56 inches

Note:
N/A - Not Applicable

6.3.2 Non-Life-Threatening Incident

If it is determined that no threat to life is present, the worker who first encounters the injured person will assist the injured person to a safe location and contact the SSHO. The injured person will then be treated and monitored by the IAW standard first aid training procedures and the HSP procedures below.

6.3.3 Life-Threatening and/or Otherwise Serious Incident

If a life-threatening incident occurs, emergency medical assistance will be immediately requested. If an apparent life-threatening and/or otherwise serious incident has occurred, the first person who identifies the situation will summon the SSHO. The SSHO will determine whether emergency assistance should be summoned and any information that must be relayed about the Site. The SSHO will provide emergency action principles that are consistent with the injury and EMS recommendations. The SSHO will appoint a staff person or persons who will meet the emergency responders and take them quickly to the injured person.

If a helicopter medical evacuation (MEDEVAC) is necessary for a medical emergency/trauma, the SSHO will work with EMS to ensure the area is safe to enter, render first aid as necessary, call 911 and describe the event to the operator and request MEDEVAC transport. The SSHO and authorities will monitor and help direct the helicopter approach to a safe landing location and direct affected members to avoid the aircraft operations in a designated safe area. The site will be secured until an accident investigation is conducted, and project activities have been approved for follow-on work activities.

During an emergency, the following actions will be taken, with some actions conducted concurrently.

- No one will attempt emergency response/rescue until the situation has been assessed by the SSHO, or their alternate if the SSHO is unable to perform their duties;
- Field activities will cease, personnel will be warned, and the area isolated; and
- After SSHO (or their alternate) assessment, the employee may be removed from the work area if it can be done safely and without aggravating medical conditions.

An injured individual should be moved only under the following circumstances:

- When there is immediate danger (e.g., risk of fire/explosion, lack of oxygen, collapsing structure);
- When the location of the individual is obstructing co-workers or emergency personnel from caring for another individual who needs immediate attention; or
- When the movement is necessary to administer proper care (e.g., transfer of the individual to a firm, flat surface for cardiopulmonary resuscitation).

6.3.3.1 Emergency Personnel Decontamination

Whenever possible, personnel injured onsite who have been exposed to chemical hazards will be decontaminated prior to transport to the medical facility, so long as such procedures do not further compromise the H&S of the injured individual. Emergency worker decontamination should consist of removing protective clothing/PPE and washing affected areas with soap and water as necessary. If necessary, protective clothing/PPE will be cut away to minimize additional trauma to the injured person.

The following procedures will be initiated as soon as possible in response to chemical exposures:

- For eye exposure, wash the victim's eyes immediately at the emergency eyewash station using large amounts of water for 15 minutes and lifting the lower and upper eyelids occasionally. If irritation persists, the victim will be instructed to see a physician;
- For skin exposure, remove any contaminated clothing and wash the contaminated skin areas promptly using soap or mild detergent and water. Obtain medical attention immediately if there are symptoms of chemical exposure (e.g., redness, blistering, or ulceration of the skin);
- For inhalation exposure, move the person to an area with clean air immediately (unless the scene is determined to be unsafe, or other injuries make moving the victim inadvisable). Keep the affected individual warm and at rest. Do not give anything to drink to an unconscious person. If the person was or is unconscious, obtain medical attention immediately; and
- For ingestion, refer to the appropriate SDS and contact the Poison Help Line (1-800-222-1222) regarding the emergency response procedures specific to the ingested chemical.

6.3.4 Emergency Contacts

In the event specialized/elevated care is necessary while at the Site, either the project team or the local on-call EMS/ambulance service will transport the injured person to the hospital and the SSHO will notify the 15th SPSS Emergency Coordinator. The local Fire and EMS can be notified of emergencies by using the telephone numbers listed in Table 6-3. For minor injuries, routine first aid procedures will be used; and for major injuries, an ambulance or MEDEVAC will be called immediately, and the appropriate first aid administered while awaiting the arrival of the ambulance.

Table 6-3: Emergency and Medical Contact Numbers

Organization/Point of Contact	Telephone Number[1]	Additional Info
Ambulance Police Medical Evacuation Fire	911	
Fire Department (direct)	(808) 879-2741	
Paramedics (direct)	(808) 270-7561	
Police	(808) 244-6400	
Federal Protective Service	(808) 874-1601	
Security (if applicable)	[redacted]	[redacted]
Building Manager (if applicable)	[redacted]	
Haleakalā National Park Services	(808) 572-4400	
15th SPSS Company Commander	[redacted]	Lt Col Phillip Wagenbach
15th SPSS Emergency Coordinator (primary)	[redacted]	MSgt Nicholas Keating
15th SPSS Emergency Coordinator (alternative)	[redacted]	Mr. Joshua Johnson
Maui Base Support Service (MBSS) Coordinator	[redacted]	Captain Corey Tsujioka (location: building 550)

Organization/Point of Contact	Telephone Number[1]	Additional Info
GSINA	(808) 834-4631 (O‘ahu office)	Corporate Headquarters in New Jersey (908) 824-7452
Maui Memorial Medical Center 221 Mahalani St, Wailuku, HI 96793	(808) 244-9056	mauihealth.org
24-hr Medical Emergency & Toxicological	(888) 478-0798	Will reach answering service; leave a number to call back.
NCNS Environmental, Inc.	(808) 847-5438	Medical waste disposal
HDOH HEER Office	(808) 586-4249	For releases exceeding reportable quantities
Spill Response – Chemical Transportation Emergency Center	(800) 424-9300	
National Response Center	(800) 424-8802	
Poison Control Center	(800) 222-1222	
EPA National Response Center	(800) 424-8802	For environmental emergencies
County of Maui Department of Water Supply	(808) 270-7633	(24/7 emergency) and applicable to building 550 only
Hawaiian Electric Company	[redacted]	Point of contact is David Tester/[redacted] [redacted] (alternative)
Munitions and Environmental Division Manager - Larry deVries	[redacted]	
Environnemental Division Manager - Eric Wetzstein	[redacted]	
PM - Bryan Chinaka	[redacted]	
CHSM - Carl McGraw	[redacted]	
FM/Alternate SSHO[2] - Kimberly Kim	[redacted]	
SSHO - Craig Morris	[redacted]	

Note:
[1] When calling from a building on the site (e.g., Butler Builiding), you must first dial “99” to get an outside line.
[2] May support as an alternate SSHO if not concurrently supporting the role of FM (i.e., FM and SSHO will not be dual hatted).

6.4 Fire Prevention, Protection, and Response

Fire extinguishing equipment meeting 29 CFR Part 1926, Subpart F, shall be on-hand and ready for use to control fires. Fire extinguishers will be available in each vehicle (minimum 5 pounds ABC), on each piece of heavy equipment (minimum 10 pounds ABC), and immediately available within the AOI (minimum 20 pounds BC). Fire extinguishers will receive a full inspection annually by a qualified service technician, and a visual inspection will be made monthly by the SSHO and by the CHSM during each Site audit. Fire extinguishers will be recharged as necessary by a qualified service technician. Types of fire suppression systems include multipurpose ABC portable fire extinguishers.

Flammable liquids will be properly stored in safety cans and/or flammable cabinets. Housekeeping will be performed daily to limit fuel loads.

Potential sources of fuel include diesel, gasoline, methanol, and combustible loads such as paper. Sources of ignition include combustion engines and electrical sources. Fire risks will be minimized through proper monitoring of the work areas, proper work procedures, good housekeeping, and maintaining adequate fire extinguishers on Site.

The following fire prevention measures shall be implemented during work at the Site:

- Flammable materials will be properly labeled, stored, handled, and used:
  - No smoking or use of open flame-producing devices within 50 ft of flammable and combustible materials;
  - All containers are to be properly labeled with contents, the word “Flammable” IAW HAZCOM requirements;
  - Store materials in well-ventilated areas that are free of ignition sources and flame or sparks;
  - Ensure that incompatible materials are stored in remote locations from each other (e.g., keep flammables from oxidizers);
  - Limit quantities to minimum required;
  - Store cylinders in upright and secure positions;
  - Bond and ground containers as (and where) necessary;
  - Use proper storage cabinets for flammable and combustible materials; and
  - Use only approved containers; and use and dispense only in well-ventilated areas.
- Combustible materials (solids):
  - Solid combustible materials include wood, paper, and cloth. Proper housekeeping reduces concerns for combustion of these materials. Use proper receptacles for disposal and dispose of routinely.
- Electric Appliances:
  - Do not use electric appliances near flammable or combustible materials; and
  - Never place an appliance on an unstable surface.
- Smoking:
  - Smoking is allowed only in outdoor, designated areas, and not within the work area. Smokers are to maintain smoking areas in a clean and safe condition. Ensure that receptacles for disposal of cigarettes and other smoking materials are appropriately constructed, free of combustible debris and when necessary, are cool before emptying into waste receptacles.
- Housekeeping:
  - Personnel will keep work areas free of combustible materials and debris.

In the event of a fire or unplanned detonation, if possible, Site personnel will try to put out the fire. If unable to do so, Site personnel will notify the local fire department listed in Table 6-3. Site personnel will not engage in fire-fighting activities beyond the incipient stage and adhere to the 15th SPSS Fire Emergency Protocol.

The following fire protocol will be implemented by Site personnel:

- When the fire is discovered:
  - Evacuate the area immediately;
  - Activate the nearest fire alarm (if installed);
  - Notify the local Fire Department by calling (808) 879-2741 or 911:
    - Indicate what is happening, the location of the fire, and whether there are injuries;
    - Comply with requests from the 911 operator or Emergency Responder for information; and
    - Do not hang up until told to do so by the operator or allow the operator to hang up first.
  - If the fire alarm is not available, notify the site personnel about the fire emergency by the following means:
    - Voice Communication;
    - Phone;
    - Paging;
    - Radio; and
    - Other.
  - Fight the fire ONLY if:
    - The Fire Department has been notified;
    - The fire is small and not spreading to other areas;
    - Escaping the area is possible by backing up to the nearest exit; and
    - The fire extinguisher is in working condition and personnel are trained to use it.
- Assemble in the designated area:
  - MSSC lower parking lot;
  - Northwest parking lot; and
  - Remain outside until the competent authority announces conditions are safe.
- Designated Official, Emergency Coordinator, SSHO, and supervisors:
  - Disconnect utilities (only trained personnel) and equipment unless doing so jeopardizes his/her safety;
  - Coordinate an orderly evacuation of personnel;
  - Perform a head count of personnel to the designated area;

  - Determine a rescue method to locate missing personnel;
  - Provide the Fire Department personnel with the necessary information; and
  - Provide an assessment and coordinate weather forecast office emergency closing procedures.

- Upon completion of the emergency phase, comply with incident notification procedures.

If the fire is small and manageable with fire-extinguishing equipment at hand, and you are trained in the use of this equipment, you may make the decision to use this equipment while waiting for advanced assistance. Never place yourself in danger, always have a plan for escape, and never attempt to fight a fire if there are any doubts about the type of fire or your ability to successfully fight the fire. Never allow the fire to get between you and your escape route.

6.5 Spills

Care will be taken to prevent spills during the handling of liquids. Any spill of contaminated soil, fuel, or chemicals will be contained and cleaned up immediately. Spill control materials will be immediately available to all chemical and waste handling areas. These materials will include the appropriate absorbent pads for the materials, noncombustible granular absorbent material, polyethylene sheeting, DOT-approved drums/containers, shovels and assorted hand tools, and appropriate PPE. Personnel handling contaminated materials shall be current in the training specified in this HSP.

The following procedures comprise the spill containment program in place for activities at the Site. Spill procedures will be reviewed by the SSHO with team members.

Measures for preventing fuel spills include:

- Taking care when transferring fuels;
- Inspect all fuel storage containers for leaks daily; and
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (e.g., absorbent, pillow, shovels) will be stationed in the immediate area. The spill containment equipment must be sufficient to contain and isolate the entire volume of fuel being transferred.

The following response procedures shall be followed for spills of flammable fuels greater than 5 gallons in volume:

- Shut down operation in area immediately;
- Limit ignition sources;
- Suppress vapors as required; and
- Survey area with combustible gas indicator if available.

Don protective equipment as necessary;

- Pump liquids into drums;
- Recover contaminated solids and place in containers; and
- Clean up all residues.

6.5.1 Notifications

In the event of a spill or release exceeding reportable quantities, the SSHO will inform the CHSM and PM, who will then notify the DAF. The SSHO will file an incident report within 24 hours of the release. DAF will submit a verbal notification to the HDOH HEER Office via the number provided in Table 6-3 and provide a written follow-up to the HEER Office within 30 days of the release.

6.6 Incident Reporting and Communication

Site personnel must report all incidents to the SSHO immediately. The SSHO will ensure that the appropriate notifications are made. Examples of emergencies to be reported by site personnel are medical, fire, severe weather, bomb threat, chemical spill, structure climbing/descending, extended power loss, and an active shooter.

During fieldwork, the SSHO will document all incidents, including onsite first aid, IAW the GSINA *Incident Reporting, Investigation, and Review* procedure. In addition, in the event of an OSHA recordable injury, or an at-fault vehicle incident, or equipment or property damage, the SSHO shall be responsible for notifying the PM immediately for resolution.

An Accident Investigation Report (Appendix C) will be completed and submitted to the PM within 24 hours of the incident. All recordable incidents will be reported as soon as possible but no later than 24 hours after the incident.

Accident follow-up will be performed on reported incidents in the Accident Investigation Form in Appendix C. Immediately following a serious accident, the appropriate notifications will be made to GSINA, other installation contacts, and the appropriate agencies. The PM is responsible for notifying all appropriate agencies. In all cases, the appropriate DAF notifications will be made. Following all accidents and near-misses, an investigation will be initiated by the GSINA SSHO, in coordination with the CHSM, via an Accident/Loss Report form. The focus of all investigations will be to collect accurate information, to discern the underlying causes of the accident, to implement appropriate control measures to prevent future accidents, and to improve future emergency response procedures. Corrective actions will be implemented based on the findings; corrective actions will be tracked, and all affected employees will be notified.

Section 7 Hazard Communication Plan

The GSINA HAZCOM Program procedures and project-related chemical documentation will be kept electronically by the SSHO and made available to all onsite workers upon request. Where required or requested, the project team and subcontractors will provide trainings, SDSs, records of contractor employee training, and an inventory of hazardous materials (including approximate quantities and a location map) that will be brought onsite. The SSHO will also perform the following:

- Complete an inventory of all chemicals brought onsite;
- Confirm that an inventory of chemicals brought onsite by GSINA subcontractors is available;
- Request and confirm locations of SDSs from the client, contractors, and subcontractors for chemicals to which GSINA employees potentially are exposed;
- Before or as the chemicals arrive onsite, obtain an SDS for each hazardous chemical;
- Label chemical containers with the identity of the chemical and with hazard warnings;
- Give employees required chemical-specific HAZCOM training; and
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

Note: If non-English speaking employees will be using chemicals, information shall be presented in their language as well. The employee will examine each chemical container and verify that each has an appropriate label. GSINA will rely on the manufacturer's accuracy as to label contents and does not have to verify that the label information is correct.

Site personnel shall not remove or deface labels on incoming containers of chemicals.

If chemicals covered by this plan are purchased in bulk and later transferred to smaller temporary individual containers, labels must be affixed to the individual containers presenting the same label information as required on the label from the manufacturer, or the product identifier and words, pictures, symbols or a combination thereof, which in combination with other information immediately available to employees, provide specific information regarding the hazards of the chemicals.

For small temporary containers where the complete listing of the label information is impractical (due to container space restrictions), it is permissible to mark both the temporary container and the original bulk source container with a common referencing name or number, if all affected employees are trained on this identifying system.

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Section 8 Site Control

The SSHO coordinates access control and security onsite. Authorized personnel are those who have completed the required training and meet medical requirements. During onsite operations, the SSHO will order operations to cease if nonessential personnel are observed within the AOI. To ensure safety, Site controls include the following:

- Site personnel must be cleared by the 15th SPSS prior to accessing the site;
- Site personnel must check-in each day with BDOC security;
- A DAF/SPSS escort is required to be onsite with Site personnel at all time;
- Operations cease if nonessential personnel are present;
- The SSHO or their designee will escort authorized visitors;
- All personnel entering the AOI, including visitors, will wear the proper PPE and sign in and out on the site visitors' log;
- The SSHO maintains a log to ensure accurate accountability of personnel onsite;
- The SSHO or designee provides a safety briefing to all personnel entering the AOI to inform them of potential Site hazards. All personnel must acknowledge this briefing by signing the safety log; and
- In case of an emergency, personnel will exit the AOI and move to the safe area designated by the SSHO.

The SSHO will make daily inspections of the work area and employee work practices to ensure compliance with this HSP, note changed conditions, and identify new hazards. These inspections will be recorded in the daily log, and all necessary corrective actions will be implemented in a timely manner. Additionally, periodic in-depth inspections will be performed. These inspections should include, but are not limited to: housekeeping, implementation of tailgate meetings, employee training, employee exposure monitoring, project recordkeeping, accident investigation and recordkeeping, equipment maintenance and inspections, compliance with standard work procedures, response to employee safety concerns, and specific hazard communications.

The SSHO will conduct additional H&S inspections IAW Table 8-1. The SSHO will ensure that project personnel are conducting daily vehicle inspections, equipment inspections, and communication equipment checks.

Table 8-1: Audit Frequency

Inspected by	Item	Daily	Weekly	Monthly	Quarterly
SSHO or designee	First Aid Kit		X		
SSHO or designee	Fire Extinguisher		X		
SSHO or designee	Vehicles (Cars/Trucks)	X			
SSHO or designee	Heavy Equipment	X[1]			
SSHO or designee	Supplies	X[1]			
SSHO	Emergency Communications	X			

Note:
[1] Inspections to be performed daily before and after daily activities to verify that heavy equipment and supplies are properly stored.

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Section 9 Standard Safety Procedures, Engineering Controls, and Work Practices

If Site conditions change significantly or unanticipated hazardous conditions are encountered, work will be suspended. The PM will be notified, and the appropriate procedures will be developed and submitted for approval before work is resumed.

9.1 Decontamination

Decontamination activities shall include PPE required on the AHA and follow the procedures detailed in the Standard Operating Procedure ENV-02 *Sampling Decontamination* (Attachment B of the project *Sampling and Analysis Plan*). Emergency personnel decontamination procedures are described in Section 6.3.3.1. General decontamination procedures are described below.

9.1.1 Personal Decontamination

Work shoes/boots must be brushed daily before and after site activities to avoid tracking any dust/dirt/rocks to or from the Site. Disposable PPE will be placed in trash bags and disposed of in municipal trash receptacles for subsequent disposal. Personal decontamination will be commensurate to the degree of contamination encountered. Gross/dry decontamination is mandatory when leaving the Site to limit the spread of contaminated soil. As needed, wash tubs with soap and water and rinse tubs will be provided for decontamination of boots and non-disposable gloves. Soap and running water will be available for personnel to wash up after work, prior to eating, drinking, or smoking, or if any skin contact occurs during the workday.

9.1.2 Equipment Decontamination

Prior to mobilization, all equipment will be sanitized for bioenvironmental/invasive species IAW National Parks Service guidance to ensure that non-native/invasive species are not introduced to the site (refer to the Environmental Protection Plan [Appendix F the project Remedial Action Work Plan] for additional details). All vehicles, heavy equipment, and other equipment must also be cleaned (e.g., plant/seed and dust/soil/rock debris removed) daily before the entrance to and exit of the Haleakalā National Park.

All equipment, working surfaces, and non-working surfaces will be decontaminated after contact with contaminated materials. A solution of 10 parts water to one part Alconox® will be used to clean contaminated areas. General decontamination procedures include:

- Any equipment leaving the Site will be inspected, and if needed, will be cleaned with soap and water to remove any visible soil;
- Contaminated, sharp objects will be cleaned up using mechanical means, such as a brush and dustpan. Sharp objects will not be picked up directly with the hands and will be disposed of in a sharp specific container; and
- Only those workers directly involved with the decontamination efforts will be allowed in the work area while cleaning is taking place.

9.2 Site Rules and Prohibitions

Using common sense, operating under the buddy system (or two-person rule), and following safe practices can reduce hazards due to normal project activities.

The following apply to all Site activities:

- All employees must complete the required training programs and submit copies of required certifications prior to starting work at the Site;
- No consumption or possession of alcoholic beverages or illegal drugs will be allowed onsite. Anyone reporting to work under the influence of alcohol and/or illegal drugs will be subject to disciplinary action. Any employee under a physician’s care and taking prescribed narcotics must notify the SSHO;
- PPE is required in the AOI. As described in Section 11, such equipment may include, but is not necessarily limited to: hard hat, safety glasses with side shields, protective-toe boots, high-visibility garments, gloves, and earplugs/earmuffs;
- Smoking is allowed only in designated areas. Eating, drinking, smoking, vaping, and chewing gum or tobacco are not allowed within the AOI;
- Changes in work practices or work rules will be implemented only after approval by the SSHO and/or the CHSM;
- Construction equipment always has the right-of-way over regular vehicles;
- Employees must listen for warning signals on construction equipment and must always yield to construction equipment. When working around heavy equipment, employees shall routinely establish eye contact with the equipment operator so that they are certain that the operator has seen them and knows where they are;
- All equipment operators must pay deliberate attention to workers on the ground who may be in their path and provide these people with warning before moving the equipment;
- The wearing of seat belts in personal vehicles, trucks, and equipment is mandatory;
- All workers must explicitly follow emergency procedures and instructions from the SSHO;
- For any potentially hazardous compounds brought to the Site, an SDS will be provided and will be kept in an onsite binder; and
- All workers will demonstrate proper etiquette, as the Site is a significant cultural feature.

9.2.1 Buddy System

Work at the Site will be performed using the buddy system. Team members will always keep in visual contact with one another. Team members will be made aware of any slip, trip, and lifting hazards along with any potential exposure to chemical substances, heat or cold stress, and general hazards within their work area.

9.2.2 Designated Eating and Break Areas

Eating and break areas will be located away from the AOI. No food or beverages will be allowed in the AOI. Lunch will be eaten in vehicles and all trash (especially food related items) will be stored inside the cab of project vehicles and disposed of in approved receptacles not located in the work area at the end of each workday.

9.2.3 Designated Smoking Areas

Regulations governing approved areas for smoking and spark generation will be strictly followed. Smoking, including the use of electronic cigarettes, is prohibited except in designated smoking areas and not within the AOI. The SSHO will identify designated smoking areas. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines.

9.2.4 Sanitation

GSINA shall establish and maintain hygienic sanitation provisions for Site personnel. General housekeeping activities will occur daily.

9.2.4.1 Drinking Water

An adequate supply of potable water (bottled) shall be provided for both drinking and personal cleansing. Non-potable water shall be identified with markings and be kept separate from potable water.

Cool drinking water shall be provided during hot weather. Only approved potable water systems may be used for the distribution of drinking water. “Reclaimed water” (treated wastewater) use in potable water systems is strictly prohibited.

9.2.4.2 Hygiene Facilities

Fixed toilet facilities are available at the Site. The SSHO will ensure that adequate breaks are given for personnel to use the toilet facilities. The SSHO will ensure that employees wash their hands and faces thoroughly before and after breaks, before lunch, and at the end of the workday.

9.2.4.3 Vermin Control

The Site will be kept clean and organized. Organics such as foods will be wrapped and then discarded to avoid attracting pests.

9.2.4.4 Waste Disposal

All waste will be removed in a manner that avoids creating a menace to health and should be discarded as often as necessary or appropriate to maintain sanitary conditions at the Site.

9.2.5 Material Handling Procedures

All loading trucks shall be equipped with falling objects protection systems and back-up alarms. Work areas and means of access will be maintained safely and orderly. Tools, materials, extension cords, hoses, or debris will not cause tripping or other hazards. Storage at the Site will be kept free from the accumulation of combustible materials.

9.2.6 Traffic

Traffic hazards may be encountered commuting to the Site. Site access is gained through the Haleakalā National Park, with a drive along a winding road to the summit of Haleakalā. Along the road, personnel will pass and come upon many tourists walking, biking, or parking alongside the road. Vehicle operators will drive with caution, especially around blind turns. Personnel must be aware of their surroundings including the possibility of encountering tourists on bikes, or in cars or vans, and grazing livestock. Seat belts will be worn when driving and all posted traffic signs will be adhered to. Refer to Section 10.1.1 for additional details.

Site activities are not anticipated to require work to be performed in the roadway. Cones or pylons will be set up around each drilling location and work area, as coordinated with the property manager.

9.2.7 Drug Awareness and Drug-Free Workplace

GSINA fully supports all aspects of the Drug-Free Workplace Act of 1988. As such, the project team has implemented and strictly enforces a Drug-Free Workplace Policy. All project team employees, as a condition of employment, have documented understanding and receipt of this policy.

Employees will not use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances while on duty. Employees found to be under the influence of or consuming such substances will be immediately removed from the Site. Contractors will enforce the project team’s Drug-Free Workplace requirements.

Any employee under a physician’s treatment and taking prescribed narcotics or any medication, including over-the-counter pharmaceuticals, that may prevent a person from being ready, willing, and able to safely perform their duties, will provide a medical clearance statement to their supervisor from the attending physician.

The project team’s policy emphasizes supervisor training, provisions for self-referral to treatment, and maximum respect for individual confidentiality, as well as a provision for identifying and dealing with illegal drug users, including testing. The project team’s practice also provides for education, counseling, rehabilitation, and coordination with available community resources.

9.3 Health Hazard Control Plan

The AHAs, presented in Appendix B, define the activities to be performed for the project and identify the sequence of work, specific hazards anticipated (Section 10), Site-specific conditions, equipment and materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk. Reviews of the project-associated hazards will occur periodically and updated when field activities or conditions change. Project tasks and related AHAs are described in Section 2.3.

GSINA has determined that field project personnel are at the medium exposure risk level IAW OSHA guidance. This risk assessment listing is provided in Section 10 with applicable AHAs in Appendix B.

9.4 Employee Duty Schedule and Basic Fatigue Management

The purpose of this Fatigue Management Plan (FMP) is to provide guidance in the assessment of the causes of fatigue and mitigate the related hazards during the execution of all associated tasks, operations, and work beyond the typical 8-hour operations shift period. The FMP is a chance for GSINA to allow long or demanding work hours when needed but ensures that fatigue is considered as a risk factor.

GSINA has an obligation to minimize risk due to fatigue on employees, subcontractors, and visitors whilst at the workplace. Where the effects of fatigue and/or the nature of the work being performed induces fatigue causing impairment to a person's H&S, GSINA will ensure that appropriate and reasonable management action is taken.

If extended periods of working long hours are required, the SSHO will monitor employees for outward signs of fatigue. Employee rotations may need to be adjusted to allow for individual differences in how fatigue-related stress is handled and for employee-specific roles on the project.

When employees are working extended hours, employee travel time to and from work will be minimized to allow for sufficient rest and should be considered in determining hours per day and per week limits. Group transportation to and from the work location and lodging will be used to address this situation. Consideration should be given to "awake" time and not just the hours logged on to a timesheet.

9.4.1 Personnel Responsibilities

The management of fatigue is considered a shared responsibility between GSINA and its employees. GSINA is responsible for providing a safe system of work which includes the development, implementation, and management of working time schedules, workload, and the establishment of a safe work environment and work practice. Employees are responsible for ensuring they are fit for duty by considering their lifestyle and medical factors that could influence fatigue and managing these appropriately.

All personnel active in Site operations will be thoroughly familiar with the information outlined in the FMP before conducting work at the Site. All Site personnel, including GSINA and subcontractors, must review, and be provided, a detailed briefing on the contents of this document, and sign the HSP Acknowledgement before performing work at the Site.

Compliance with fatigue management requirements must be assessed weekly for the first month of work and then monthly thereafter to ensure controls are in place and operating effectively. Deficient controls must be remedied in a timely manner.

9.4.1.1 Senior Management

- Assist supervisors in the implementation of this procedure;
- Approve extended work hours;
- Process requested variances to the FMP through the GSINA CHSM; and
- Attend FMP training.

9.4.1.2 Site Safety and Health Officer

- Conduct fatigue risk assessments and review effectiveness of existing control methods;
- Ensure compliance with the FMP and conduct periodic effectiveness reviews;
- Ensure fatigue-related incidents are reported and documented;
- Consider fatigue factors in accident/incident investigations;
- Coordinate and assist the FMP training; and
- Investigate any instances of non-compliance of FMP and review with PM.

9.4.1.3 Field Manager

- Ensure all employees under their supervision are aware and compliant with the FMP;
- Implement controls for mitigating and managing fatigue;
- Report all fatigue related incidents to the SSHO;
- Seek approval for extended shift hours; and
- Attend FMP training.

9.4.1.4 Site Workers

- Comply with the FMP;
- Maintain fit for work readiness at the beginning and throughout ones' shift;
- Notify supervisor if at any time personal readiness is less than fit for work;
- Monitor for signs and symptoms of fatigue in themselves and co-workers; and
- Attend FMP training.

9.4.2 Work Hour Limitations

GSINA's general project work hours are anticipated to be five 8-hour days totaling 40 hours a week.

If the Site dictates a change in the general work schedule such as longer hours or additional days, all Site personnel shall observe the following specifications for work hour limitations:

- The SSHO will monitor employees for outward signs of fatigue;
- Employee rotations may need to be adjusted to allow for individual differences in how fatigue-related stress is handled and for employee-specific roles on the project; and
- When employees are working extended hours, employee travel time to and from work will be minimized to allow for sufficient rest and should be taken into account in determining hours per day and per week limits.

9.4.2.1 Equipment Operators

Equipment operations during field activities will be limited. At no time will a heavy equipment operator be allowed to operate equipment longer than 12 hours in any 24-hour period. This would include time worked at any other site as well. A minimum of eight consecutive hours of rest between shifts in a 24-hour period is required.

9.4.2.2 Motor Vehicle Operators

Operators of motor vehicles, while on duty, shall not operate vehicles for a continuous period of more than 10 hours in any 24-hour period; moreover, no employee, while on duty, may operate a motor vehicle after being in a duty status for more than 12 hours during any 24-hour period. A minimum of 8 consecutive hours shall be provided for rest in each 24-hour period.

9.4.3 Understanding Fatigue

Fatigue can be defined as a state of impairment that can include physical and/or mental elements, associated with decreased alertness and reduced performance related to sleep deprivation and/or physical/mental exertion. Employees experiencing fatigue are likely to have increased incidents of accidents and injury. As well as these immediate problems, chronic fatigue can lead to long-term health problems.

9.4.3.1 Contributing Factors

Some of the factors that contribute to employee fatigue are rooted within the workplace such as shift schedules, work environment, and production demands. Other factors occurring outside of the workplace (lifestyle, personal health, family issues), have an equally important impact on employee fatigue in the workplace.

Fatigue can contribute to accidents by impairing performance, and in extreme cases causing people to fall asleep. Fatigue-related “micro sleeps” are very hard to predict or prevent and can place the individual and others safety at risk.

9.4.3.2 Fatigue in Coworkers

Symptoms of fatigue that are easily recognizable may include long eye blinks, repeated yawning, frequent blinking, bloodshot eyes, poor reaction time, slow speech, loss of energy, and an inability to concentrate.

If you notice a co-worker experiencing symptoms of fatigue you should notify your supervisor immediately. Other actions that may be appropriate include:

- Utilize stop work authority;
- Alternate tasks;
- Alternate schedules; and
- Reduce high stress task frequency.

9.4.3.3 Avoiding Fatigue

Rest is the most important control measure for managing fatigue. Time spent away from the immediate work environment allows workers to recover from fatigue, thereby improving work performance, vigilance, safety, and efficiency.

Conditions for restful sleep must be provided and breaks must be taken during the work shift and not be traded for an early finish time for the shift. Studies demonstrate most adults need seven to eight hours of sleep in every 24 hours to feel well rested.

Quality and quantity of sleep plays a major role in fatigue. Regular bedtime routines: ensuring the bedroom is dark, cool, and comfortable; and getting treatment for sleeping disorders, if necessary, can help improve sleep. Make sleep a priority.

9.4.4 Fatigue Risk Assessment

Risk management is important in an effective FMP. This involves hazard identification and risk assessment, control of the risks, and evaluation of the effectiveness of the process. A fatigue risk assessment must identify the impact of fatigue risk factors, considering relevant local regulations. Work-related risk factors shall be addressed as they may reduce physical performance, impact on psychological factors such as judgment, concentration, vision, and decision-making processes. Fatigue risk factors will be assessed as LOW, MEDIUM, or HIGH:

- LOW - Controls in place are adequate to mitigate the risks and do not need active management;
- MEDIUM - Controls require active management while tasks are being performed; and
- HIGH - Must be addressed with additional controls and reassessed.

Examples of some fatigue risk factors are listed below:

- Working without a rest break to meet critical deadlines/milestones;

- Sleep patterns affected by frequent call-outs over a limited period and extended hours of work;
- Work tasks or activities requiring concentration or high levels of muscular exertion for extended periods of time;
- Tedious and monotonous work;
- Heavy or exhausting physical activity;
- Working in high-risk situations;
- Working successive shifts; or
- Working in high heat or cold temperatures or humid conditions.

9.4.4.1 Identification of Fatigue

Fatigue identification can be accomplished by observing many different signs and symptoms. Some common signs and symptoms are listed below:

Physical:
- Lacking energy;
- Yawning;
- Heavy eyelids;
- Eye-rubbing;
- Head drooping; and
- Microsleeps.

Mental:
- Difficulty concentrating on a task;
- Lapses in attention;
- Difficulty remembering what you are doing;
- Failure to communicate important information;
- Failure to anticipate events or actions;
- Doing the wrong thing (error); and
- Not doing the right thing (omission).

Emotional:
- More quiet than usual;
- Mood changes;
- Decreased tolerance; and
- Emotional outbursts of aggression or rage.

9.4.4.2 Project Specific Risks Leading to Fatigue

During the completion of the risk assessment, the most likely activities or factors leading to workplace fatigue are as follows:

- Weather conditions;
- Repetitive motion activities;
- Heat stress or cold stress;
- Difficult jobsite terrain;
- Driving operations; and
- Likelihood of longer hours of work.

These factors leading to risk have been addressed in this HSP and in the project AHAs. Frequent breaks, cooling methods, and temperature monitoring are just a few of the controls implemented to prevent fatigue.

9.4.5 Assessment of Control Effectiveness

Control effectiveness can be reviewed by examining reports of fatigue and mishaps where fatigue is a factor. The effectiveness of controls can also be monitored by examining personnel and circumstances where extended shifts need to be worked. Compliance with fatigue management requirements must be assessed to ensure controls are in place and operating effectively. Deficient controls must be remedied in a timely manner. Any risks deemed HIGH must be addressed with additional controls which allow a reassessment of LOW or MEDIUM. Completed assessments must not contain risks assessed as HIGH.

The risk assessment and management plan must be documented and reviewed when work schedules or job roles are significantly modified.

9.4.6 Worksite Controls

GSINA recognizes controls to mitigate hazards that cause fatigue can be different for different jobs, positions, and even individuals. Through understanding the nature of fatigue, work-hour limitations, fatigue risk assessments, and employee training, GSINA shall implement controls for mitigating fatigue. The number of employees at risk and the level of risk must be considered when implementing controls.

The hazard of fatigue and the controls have also been addressed in the project specific HSP and AHAs. The following are a few examples of controls to reduce or eliminate fatigue.

9.4.6.1 Personal Controls

- Routine bedtime;
- Sleep in quiet, comfortable area;
- Ensure quality and quantity of sleep;

- Seek medical attention for sleep disorders;
- Avoid alcohol consumption; and
- Avoid stimulants like coffee and tea at bedtime.

9.4.6.2 Administrative Controls

- Alternate work tasks;
- Rotating jobs to prevent repetitive work tasks;
- Allow for more frequent or longer breaks;
- Alternate transportation for long commutes;
- Schedule high-risk tasks when most alert;
- Breaks at critical times in the work cycle; and
- Limit or eliminate night shifts.

9.4.6.3 Operator Controls

- Be sure to get an adequate amount of sleep each night;
- If possible, you should take a nap when feeling drowsy or less alert or switch out with another vehicle operator;
- Avoid medications that may make you drowsy if you plan to get behind the wheel;
- Recognize the signs of drowsiness;
- Behaviors such as smoking, turning up the radio, drinking coffee, opening the window, and other "alertness tricks" are not real cures for drowsiness and may give you a false sense of security; and
- Rotate driving responsibilities with other operators.

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Section 10 Activity Hazard Analysis

This section summarizes the potential physical, biological, and chemical hazards that may be associated with the project activities. Personnel working most directly with project activities will have the greatest chance of encountering these hazards; however, all personnel on the Site may encounter them at one time or another.

10.1 Physical Hazards

Due to the nature of planned Site operations, the potential risk for exposure to safety hazards is moderate.

The primary physical hazards potentially associated with the Site are expected to include:

- Poor visibility;
- Slips, trips, and falls;
- Head, back, hand, and eye injuries;
- Electrical;
- Noise;
- Inclement weather;
- Heat Stress;
- Cold stress;
- Dust;
- Fire;
- Equipment and vehicular traffic;
- Underground utilities; and
- Pressurized lines.

10.1.1 Equipment and Traffic

Vehicles, heavy equipment, and other equipment will be used at the Site. Only qualified operators and drivers, with demonstrated training and experience, will be permitted to operate the equipment. Operators must ensure that equipment movements are deliberate and predictable. Safe vehicle speeds for each area of the Site each operation will be established, considering slope, soil conditions and moisture, types and weights of vehicles, and ground obstructions. All drivers and operators will be required to maintain vehicle speeds that allow them to always keep their equipment under control and are required to obey the maximum Site speed limit. If operators demonstrate an inability to maintain this control, they will be removed from the operation of that equipment or vehicle.

Operators of ride-on equipment will wear seat belts at all times of operation. Parking brakes must be set, and attachments and buckets lowered to the ground when units are parked. Equipment must be shut off when left unattended. All personnel operating such equipment will be made aware of the presence of other Site personnel. Communication between workers on the ground and operators will be by line of sight, utilizing standard construction hand signals. Spotters will be utilized when equipment is backed in areas with limited visibility, or when it is moved in proximity to overhead hazards or utilities.

Surface obstructions, overhead hazards and utilities, road hazards, and vehicle routes will be clearly demarcated using cones, tapes, and/or signs. Heavy equipment will have the right of way on Site. The SSHO will inspect work areas daily to verify that roads and work areas are in acceptable condition.

Onsite personnel will be made aware of the presence of construction equipment and the unique hazards of working around each piece of equipment. Ground personnel must stand clear of the swing radius and routes of equipment travel and must never stand under suspended loads or under blades or buckets. Workers on the ground must make sure they are always visible to operators and drivers and should always maintain line of sight. Ground personnel will be reminded of the need to approach equipment only after acknowledgement from the operator.

All personnel working around heavy equipment must wear high-visibility vests on the outside of all clothing. Hearing protection must be worn by operators and by ground personnel working in proximity to equipment, as needed based on ambient noise levels.

Equipment must be equipped with rollover protection where appropriate, and with working backup alarms, and must carry at least one 10-pound fire extinguisher rated for A, B, & C fires (ABC fire extinguisher). Heavy equipment must be marked with the maximum lifting or load capacity. Prior to use onsite, all equipment must be inspected by a qualified person. Additionally, daily inspections will be performed by operators. Recordkeeping forms for these inspections are included in Appendix C of this HSP. All heavy equipment repairs will be performed in a protected area by a qualified person.

Fuel storage containers will be protected from damage, marked with “NO SMOKING” signs, have appropriately rated fire extinguishers within 25 ft, and have spill control materials and eyewashes readily available.

10.1.2 Underground Utilities

All locations with the potential for subsurface activity will be evaluated for underground utilities. GSINA will review utility maps and will use geophysical methods including electromagnetic induction, magnetometry, and/or ground-penetrating radar to clear potential subsurface obstructions prior to soil excavation. All utilities and surface encumbrances that may be undermined will be protected adequately to prevent their collapse. Hand excavation must precede equipment use within 3 ft of all marked utilities.

10.1.3 Pressurized Lines

Pressurized lines attached to compressed air or equipment hydraulics lines may whip around violently if the fittings become disconnected. All hose ends and connections must be secured to prevent accidental disconnects and to restrict whipping in the case of a disconnect. All hose and related equipment must be inspected daily for damage. Personnel working with high-pressure lines must take care not to point the stream at any body part, and must wear the appropriate eye, face, and skin protection. Before being disconnected, all pressurized lines must be bled to relieve the pressure and verified to be depressurized.

Pressure relief valves, vacuum, and pressure gauges for ABS must be routinely inspected and tested IAW with the project Operations and Management Plan.

10.1.4 Use of Small Tools

Hand and power tools will be used, inspected, and maintained IAW the manufacturer’s instructions and recommendations and will be used only for the purposes for which they are designed. The following requirements will be adhered to:

- Tools designed to accommodate guards will be equipped with such guards when in use;
- Tools will be inspected to ascertain safe operating conditions and are to be kept clean and free of accumulated dirt;
- Electric power tools and extension cords will be used with ground fault circuit interrupters;
- Portable power cords will be designated as hard usage or extra hard usage and will not be used if damaged, patched, oil-soaked, worn, or frayed;
- Connections on pneumatic lines will be secured with a safety lashing; and
- Hand tools, such as hammers and chisels, will be inspected and dressed if necessary to remove mushroomed heads, which may separate and become projectile hazards.

All tools used during this project will be inspected daily and prior to each use. Personnel shall use tools solely for their intended purpose and have knowledge/training on how to use them. Personnel will note possible pinch points on equipment and wear appropriate work gloves when needed. All tools, materials, and objects to be handled will be inspected for rough and sharp edges and handled while using appropriate precautions.

10.1.5 Limited Visibility

Limited visibility may be caused by fog, snow, and heavy rain. When fog is encountered while driving to the Site, personnel shall reduce speed and use low beam lights or fog lights if available to improve sight distance. If fog is present onsite, the SSHO may have to suspend activities involving heavy equipment and vehicles until the fog lifts. Similar safety precautions must be taken during heavy precipitation events.

10.1.6 Slips, Trips, and Falls (Rough Terrain)

Rough terrain complicates work activities and adds to or increases risk. Physical hazards associated with rough terrain include slipping, tripping, and falling (slips/trips/falls). When working on foot, steep inclines and vegetation can hide holes or breaks in the terrain, increasing the risk of slips, trips, and falls. Personnel working on rough terrain should maintain a high level of physical conditioning due to increased body stress and exertion.

The Site crew will be alert and observe terrain while walking to minimize slips, trips, and falls. Boots will be ankle high or higher to provide additional support and stability. Work will be completed in adequate natural light. Site personnel will conduct an initial walkover, and the "buddy system" will be implemented. Site personnel must warn others or flag locations of serious hazard.

10.1.7 Head, Back, Hand and Eye Injuries

Prevention of head, neck, back, hand, and eye injuries is expected to be accomplished using protective equipment and proper work and lifting procedures. Site personnel will be required to wear an ANSI Z89.1-compliant hard hat when working around heavy equipment. Hard hats must be worn properly and not altered in any way that would lessen the degree of protection offered.

Eye protection (ANSI Z87.1-compliant), including safety glasses with side shields, will be required during all work onsite.

Wherever possible, material handling will be done mechanically. Where manual handling is necessary, personnel will be instructed in safe handling techniques, and will be instructed to use the appropriate protective gear to prevent abrasions, cuts, and struck-by accidents. Personnel also will be encouraged to request assistance from other Site personnel when lifting large, heavy (greater than 50 pounds), or awkward objects. The following steps describe the proper method for lifting.

- Get a good footing;
- Place your feet about shoulder width apart;
- Bend your knees to pick up the load. Never bend from the waist;
- Keep your back straight;
- Get a firm hold. Grasp opposite corners of the load, if possible;
- Keep your back as upright as possible;
- Lift gradually by straightening your legs;
- Do not jerk the load,
- Keep the weight as close to your body as possible; and
- When changing directions, turn your entire body, including your feet. Do not twist your body or make awkward moves which force you to be off balance.

10.1.8 Electrical Hazards

All electrical equipment and sources at all voltages should be considered dangerous. Before work begins at any location involving power supply lines or electrical equipment, existing conditions will be determined by an inspection or test by qualified personnel. Electrical equipment and power supply lines will be considered energized until determined to be de-energized by tests or by other means.

All electrical equipment must be handled with care by trained personnel. All electrical power tools and extension cords must be protected by ground fault circuit interrupters. Personnel must be insulated or guarded from any energized source or conductive object. Tools should have non-conducting handles and hoses. All electrical equipment must be double insulated or grounded. Power cords must be Underwriters Laboratories-listed. Extension cords must be grounded, and grounding plugs must not be removed or disabled. Any tools or cords with loose connections, damaged or frayed wiring, or damaged insulation/shielding must be taken out of service immediately and either repaired or discarded. Flexible power cords passing through areas that would leave them susceptible to damage must be covered or elevated.

10.1.9 Noise

The operation of heavy equipment, powered hand tools, and drilling equipment is expected to create a noise hazard for Site personnel. Excessive noise can be identified readily by workers if they experience difficulty in hearing verbal communication at normal volume level at approximately an arm's length away. Workers will be briefed on noise hazards and protection as part of the Site-specific training, and this information will be included in the regular tailgate sessions and documented. All Site personnel will be offered hearing protection such as ear plugs with an assigned Noise Reduction Rating (NRR) which properly worn will attenuate exposure levels below 85 A-weighted decibels (dBA) as an 8-hour time weighted average. Site personnel working with or near heavy equipment, powered hand tools, or drilling equipment are required to wear hearing protection as directed by the SSHO.

10.1.10 Inclement Weather

Weather conditions are expected to vary during field work, and it is possible to experience severe weather during this project. Wind and moisture may combine with low or high temperatures to create unfavorable working conditions. Additionally, rapid changes in weather, extreme weather conditions, and natural disasters can create subsequent hazards such as poor working conditions and additional slip, trip, and fall hazards. Natural disasters can create many secondary hazards, such as the release of hazardous materials to the environment, structural failures, and fires.

The following are procedures for inclement weather:

- Earthquake:
  - Stay calm and await instructions from the SSHO, SPSS Emergency Coordinator, or designated official;

- Assist personnel and people with disabilities in finding a safe place;
- Keep away from overhead fixtures, windows, filing cabinets, and electrical power; and
- Evacuate as instructed by the SSHO, SPSS Emergency Coordinator, or designated official.

▪ Flood:

- Climb to high ground and stay there;
- Avoid walking or driving through flood water; and
- If vehicle stalls, abandon it immediately and climb to higher ground.

▪ Hurricane:

- The nature of a hurricane provides for more warning than other natural and weather disasters. A hurricane watch is issued when a hurricane becomes a threat to a coastal area. A hurricane warning is issued when hurricane winds of 74 mph or higher, or a combination of dangerously high water and rough seas, are expected in the area within 24 hours.
- Once a hurricane watch has been issued:
  - Stay calm and await instructions from the SHHO, SPSS Emergency Coordinator, or the designated official;
  - Continue to monitor local TV and radio stations for instructions;
  - Move early out of low-lying areas or from the coast, at the request of officials;
  - If you are on high ground, away from the coast and plan to stay, secure the buildings, move all loose items indoors and board up windows and openings; and
  - Collect drinking water in appropriate containers.
- Once a hurricane warning has been issued:
  - Be ready to evacuate as directed by the SHHO, SPSS Emergency Coordinator, and/or the designated official; and
  - Leave areas that might be affected by storm tide or flooding.
- During a hurricane:
  - Remain indoors and consider the following:
    - Small interior rooms on the lowest floor and without windows;
    - Hallways on the lowest floor away from doors and windows; and
    - Rooms constructed with reinforced concrete, brick, or block with no windows.

In the event a storm threatens the area through observation (lightning observation and thunder) of a storm system, halt all field work and listen for weather service bulletins and civil defense messages on local radio and television stations (if available in an adjacent building). The SSHO will determine through visual observations and weather updates (gathered through the radio or television) when it is necessary to halt work and when to re-start field activities, which include observing the "30-30-30" rule that states:

- If you see lightning and thunder is heard within 30 seconds (approximately six miles), seek shelter;
- If you hear thunder, but did not see the lightning, you can assume that lightning is within six miles and you will seek shelter; and
- Remain in the shelter for 30 minutes following the last lightning strike.

Additionally, when wind speed exceeds gusts of 40 miles per hour, the following actions will be taken:

- Follow manufacturer instructions in assessing the limitations associated with field equipment;
- Shut down outdoor activities involving work at elevation;
- Move mobile items stored outside to indoor locations;
- Secure any items that cannot be moved inside;
- Be careful opening exterior doors;
- Stay away from power lines; and
- Be cautious about downed power lines, tree limbs, and debris on roads.

If weather remains unstable for more than one hour, the SSHO will monitor weather bulletins to further assess changing conditions.

10.1.11 Altitude Sickness

Altitude sickness is a condition that occurs when people ascend 8,000 ft or higher too fast, due to the lower density of oxygen in the surrounding air at that elevation. Generally, altitude sickness can be categorized into three groups: Acute Mountain Sickness (AMS), High Altitude Cerebral Edema (HACE), or High-Altitude Pulmonary Edema (HAPE).

Most people experience AMS, typically the least life-threatening form of altitude sickness.

HACE occurs when the brain accumulates excess fluid and swells up, impairing its ability to function normally.

Lastly, HAPE can be a result of the body's reaction to HACE, wherein excess fluid enters the lungs. However, HAPE can occur independently of HACE.

10.1.11.1 Symptoms

AMS symptoms include headaches, loss of normal appetite, nausea (with or without vomiting), insomnia, and unusual weariness and exhaustion. On the moderate to severe end of AMS, a person might experience difficulties with coordination and shortness of breath that can interfere with his/her activities.

HACE symptoms include confusion, coordination problems (e.g., an inability to walk a straight line or stand straight with feet together and eyes closed), exhaustion, or loss of control. Signs and symptoms often include a severe headache unrelieved by rest and medication, bizarre changes in personality, loss of consciousness, seizures, coma, and death.

HAPE symptoms often appear initially as a dry cough, soon followed by shortness of breath even when resting, difficulties in breathing, lethargy, and physical weakness.

10.1.11.2 Treatment

The treatment is to utilize supplemental oxygen[3], descend, or to stop ascending and wait for improvement before going higher. Continuing to ascend in the presence of symptoms is not recommended. If the illness progresses, descent is needed and outside medical intervention may be required.

10.1.12 Heat Stress

One of the most common types of stress that can affect field personnel is heat stress. Heat stress can be a serious hazard to workers due to 1) required PPE or 2) excessive layering in cold weather.

The SSHO will monitor Site conditions, collect periodic ambient temperature measurements, and implement appropriate control measures to provide for the comfort and safety of project personnel. Preventive measures (e.g., rest breaks in sheltered areas, availability of appropriate clothing based on weather conditions, and hydration breaks) may be implemented for the protection of the workers. At least one quart of potable water per hour per worker will always be available onsite when heat stress conditions are present. Workers will be encouraged and provided the opportunity to drink water at regular intervals and electrolyte replacement drinks will be provided as necessary.

Workers will have access to a shaded location during hot conditions to take refuge from the heat as necessary to prevent heat stress. Shade will be available when the predicted high temperature will be 85 degrees Fahrenheit (ºF) or higher. Shade will be set up if the predicted high will reach 90 ºF. Suitable acclimatization periods will be provided for workers to establish their resistance to heat stress gradually, especially during the use of protective clothing.

Solar radiation exposures and sunburn will be minimized by wearing long-sleeved shirts, hats, ultraviolet-rated sunglasses, and gloves to cover exposed skin; using high sun protection factor

[3] Available at the Site but must be self-administered.

barrier cream for exposed skin areas; and encouraging employees to take cover out of direct sunlight when work activities permit.

The SSHO will monitor workers' conditions for heat stress and implement the appropriate controls, as described below. If any of the following conditions are present in a worker, the individual will be removed from heat exposure until her/his recovery is complete:

- Sustained (several minutes) heart rate in excess of 180 beats per minute (bpm) minus the individual's age in years for individuals with assessed normal cardiac performance;
- Body core temperature greater than 101.3ºF for acclimatized personnel, or greater than 100.4ºF for unacclimated workers;
- Recovery heart rate at one minute after a peak work effort greater than 110 bpm; or
- Symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness.

The following measures should be followed to prevent heat stress:

- Provide adequate fluid intake;
- Workers should drink one half to one quart of fluid (primarily water) per hour in high heat conditions;
- Provide a shaded area for rest breaks;
- When possible, shade the work area;
- Discourage the intake of caffeinated drinks during working hours;
- Monitor for signs of heat stress as described above;
- Encourage workers to maintain a good diet during work periods;
- If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions;
- Acclimate workers to work conditions by slowly increasing workloads (e.g., do not begin work activities with extremely demanding tasks);
- Encourage workers to wear lightweight, light-colored, loose-fitting clothing;
- In extremely hot weather, conduct field activities in the early morning and evening;
- Good hygienic standards must be maintained by frequent showering and changes of clothing; and
- Clothing should be permitted to dry during rest periods.

Workers will be trained to identify the symptoms of heat stress in themselves and their co-workers, the conditions during which it may occur, the precautions to take, and the need to report all observed heat stress symptoms immediately. Heat stress symptoms include heat rash, heat cramps, heat exhaustion, and heat stroke. These conditions are described further in the following subsections.

10.1.12.1 Heat Rash

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation and is aggravated by chafing clothes. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impairs a worker’s performance.

Symptoms – Mild red rash, especially in areas of the body that come into contact with protective gear.

Treatment – Decrease amount of time spent working in protective gear and provide body powder to help absorb moisture and decrease chafing. Heat rash can be prevented by showering, resting in a cool place, and allowing the skin to dry.

10.1.12.2 Heat Cramps

Heat cramps are caused by inadequate electrolyte intake. The individual may be receiving an adequate amount of water; however, if not combined with an adequate supply of electrolytes, the blood can thin to the point where it seeps into the active muscle tissue, causing cramping.

Symptoms – Acute painful spasms of voluntary muscles, most notably the abdomen and extremities.

Treatment – Move the victim to a cool area and loosen clothing. Have the victim drink one to two cups of cool potable water or diluted commercial electrolyte solution (e.g., Gatorade, Quench) immediately, and then every 20 minutes thereafter until symptoms subside. Electrolyte supplements can enhance recovery; however, it is best to double the amount of water required by the dry mix package directions or add water to the liquid form.

10.1.12.3 Heat Exhaustion

Heat exhaustion is a state of weakness or exhaustion caused by the loss of fluids from the body. Heat exhaustion is not as dangerous as heat stroke, but if not properly managed in the field, it may lead to heat stroke.

Symptoms – Pale, clammy, and moist skin, profuse perspiring, and extreme weakness. Body temperature may be normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, vomit, feel dizzy, and be irritable or confused.

Treatment – Move the victim to a cool, air-conditioned or temperature-controlled area, loosen clothing, place in a position with the head lower than the feet (shock prevention), and allow the victim to rest. Consult a physician. Ensure that the victim is not nauseated or vomiting. If not nauseated or vomiting, give the victim small sips of cool water or diluted electrolyte replenishment solution (one to one dilution with water, or if mixing from powder, double the water added). If this is tolerated, have the victim drink one to two cups of fluid immediately, and every 20 minutes thereafter until symptoms subside. Seek medical attention at the advice of the consulting physician.

10.1.12.4 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the body’s heat regulating mechanisms (e.g., the individual’s temperature control system [sweating] stops working correctly). Body temperature rises so high that brain damage and death may result if the person is not cooled quickly.

Symptoms – Red, hot, dry skin (although the person may have been sweating earlier); nausea, dizziness, confusion, extremely high body temperature (e.g., 104°F or greater as measured with an oral thermometer), rapid respiratory and pulse rate, seizures or convulsions, unconsciousness or coma.

Treatment – Immediately call EMS. Remove the victim from the source of heat and cool the victim quickly. If the body temperature is not brought down quickly, permanent brain damage or death may result. Remove all PPE and as much personal clothing as decency permits. Fan the person while sponging or spraying with cool or tepid water. Apply ice packs (if available) to the back of the neck, armpits, groin area, or behind the knees. Place the victim flat on their back or with head and shoulders slightly elevated. If conscious, and not nauseated or vomiting, the victim may be provided sips of cool water. Do not give the victim coffee, tea, or alcoholic beverages. EMS will take over treatment when they arrive.

10.1.13 Cold Stress

Due to the climate and location of the Site, cold stress may be a factor. Cold temperature extremes can be made more dangerous by water and wind speed. Measures to prevent cold stress, including the wearing of appropriate layers insulating and wind-and-moisture-resistant clothing, and recognition of symptoms of cold stress.

The SSHO will use the tailgate safety briefing to inform Site personnel of the measures to be utilized in the prevention and control of cold stress. The SSHO will also use meteorological data and current Site conditions to inform Site personnel of the expected weather effect to be expected during the day’s activities. Prevention methods shall utilize the following:

- Use the “Buddy System” to keep aware of each team member’s physical condition;
- Eat well-balanced meals and maintain adequate intake of non-alcoholic, decaffeinated fluids;
- Wear adequate, appropriately layered clothing, including a water repellent outer layer, if precipitation is forecasted;
- Wear a hat and gloves to help retain body heat (when working with static sensitive materials, 100 percent cotton material is recommended);
- Remove outer layers of clothing during breaks in a sheltered location to prevent excessive sweating;
- In windy, cold conditions, cover all exposed skin;
- Protect clothing from getting wet, including with sweat; and

- Seek shelter in a warm protected area when signs and symptoms of cold stress become evident.

Cold stress consequences can include hypothermia, and frostbite. If the SSHO observes or suspects hypothermia or frostbite, appropriate first aid will be given as described below, including taking the victim to a warm, dry area to relieve the symptoms.

10.1.13.1 Hypothermia

Hypothermia is characterized by a significant loss of body heat. Moderate cases may exhibit the first seven symptoms listed below. Severe cases are indicated with extremely cold skin, loss of consciousness, faint pulse, shallow infrequent or apparently absent respiration, and death.

Symptoms:

- Severe shivering;
- Abnormal behavior;
- Slowing of movements;
- Stumbling;
- Weakness;
- Repeated falling;
- Inability to walk;
- Collapse;
- Stupor; and
- Unconsciousness.

Treatment:

- A severely shivering worker shall immediately terminate work and exposure to cold;
- Seek qualified medical help immediately in the case of moderate to severe hypothermia;
- Remove the victim from the hypothermia-producing environment;
- Keep handling to a minimum, DO NOT rub or massage the victim;
- Cover the victim lightly with blankets, plastic may be used for further insulation; and
- If the victim is conscious, administer hot drinks, encourage activity, and do not administer any form of sedative, tranquilizer, or analgesic, as they may facilitate further heat loss.

10.1.13.2 Frostbite

Frostbite includes localized injury resulting from exposure to cold temperatures and includes several degrees of severity.

Symptoms:

- Blanching or whitening of the skin (frostnip or incipient frostbite);
- Has a waxy or white appearance and is firm to the touch, but the tissue beneath is resilient (superficial frostbite); and
- Tissues are cold, pale, and solid (deep frostbite).

Treatment:

- Slow re-warming in water at 103 to 105ºF;
- Give warm drinks (no alcohol); and
- Avoid re-warming too fast.

10.1.14 Dust

Dust generation will be prevented when possible and controlled when necessary. Work practices will be adjusted in a manner to minimize dust generation, such as not letting soil free-fall from equipment buckets, and traveling slowly on dirt roads. Personnel will avoid working in dust by positioning themselves upwind of dust-generating activities. Excessive dust will be controlled by suppression with water. Dust that is not appropriately mitigated by engineering controls may necessitate the use of respiratory protection.

10.1.15 Fire

Appropriate measures will be taken to reduce the risk of fire as described in Section 6.4.

No smoking or other ignition sources shall be allowed within the AOI. Fuel containers must be DOT-approved. Fuel containers must be closed completely when not in use and secured to the vehicle if kept in a vehicle during movement. Gasoline and diesel fuels will not be used as cleaning solvents or for any purpose other than to power vehicles and generators.

Generators and gas cans SHALL NOT be filled or refueled in the bed of a pickup truck. The generator or gas container must be placed on the ground during filling or refueling. A suitable tray or other containment device must be placed beneath the generator or gas container to capture any fuel spilled during refueling. Persons performing fueling must ensure that the fill spout always remains in contact with the fill port during refueling, to prevent a fire hazard from static electricity. Generators will not be refueled in areas where combustibles (including tall grass) are present. Each fueling area will be located no more than 25 ft from at least one fire extinguisher with a minimum rating of 20 for B and C fires (BC).

10.2 Biological Hazards

Biological hazards which may be encountered in the field include contact with biting and stinging insects. The degree of hazard can range from annoyance to anaphylactic shock. Recognition and avoidance are important in maintaining a safe work site.

10.2.1 Bites and Stings

Given the location of the Site, biological hazards associated with insects, arachnids, and scorpions are expected to be minimal. Insect bites or stings are usually nuisances (localized swelling, itching, and minor pain) that can be handled by first aid treatment.

For mild reactions:

- Move to a safe area to avoid more stings;
- Scrape or brush off the stinger with a straight-edged object such as credit card or the back of a knife;
- Swab the site with disinfectant;
- Do not try to pull out the stinger with tweezers or your fingers as doing so may release more venom;
- Do not take any sedatives; and
- Reduce pain and swelling by applying ice or a cold pack.

The bites of certain spiders and scorpions contain sufficient poison to warrant medical attention. The greatest hazard and most-common cause of fatalities from insect bites, particularly bees, wasps and spiders are from a sensitivity reaction. Shock due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems, which also can result in death.

For severe reactions:

- Severe reactions may progress rapidly. Call for emergency medical assistance if you experience any of the following signs or symptoms: difficulty breathing, swelling of your lips or throat, faintness, confusion, rapid heartbeat, hives, nausea, cramps, and vomiting; and
- While waiting for emergency transportation, have the person lie down. If the person is unconscious and breathing, lay the person on his or her side to allow drainage from the mouth. Check to see if the person is carrying an allergy kit containing epinephrine. Watch for and treat signs of shock.

If an assigned employee has a history of allergic reactions to bites or stings, they will be required to have their prescribed treatment with them, and the SSHO and FM will know where it is located. All stings or bites will be taken seriously. Anyone stung or bitten will be required to stop work while that person is observed for signs of severe swelling, shortness of breath, nausea, or shock. If there is any doubt, medical attention will be obtained.

Personnel will carefully check beneath equipment and materials before moving or lifting to verify no stinging insects are present. If a scorpion is located, personnel will leave it alone and move to another area until the scorpion has moved away.

10.2.2 Bloodborne Pathogens

BBPs are pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B Virus, Hepatitis C Virus, and Human Immunodeficiency Virus. All GSINA employees will be responsible for identifying potential exposures and reporting them to the SSHO. It is anticipated that the only potential exposure to BBPs would occur during first aid given to injured persons onsite. First aid responders will utilize the appropriate PPE located in the first aid kit.

For minor injuries where the injured employee can function, he/she will clean up and properly dispose of his/her own blood or other potentially infectious materials.

Personnel administering care or cleanup of BBP must have successfully completed BBPs training and must implement BBP exposure control measures. PPE is the first line of defense against BBPs. All personnel with previous cuts or abrasions must ensure the proper dressings are correctly applied before administering first aid to prevent cross contamination. The following protective equipment will be available onsite for personnel administering first aid:

- Nitrile (latex and powder free) surgical gloves – must be worn when contact with blood or other body fluids is possible or the care provider has non-intact skin areas on his/her hands;
- Masks/eye protection/face shields – will be worn when slashes, sprays, or droplets of blood or body fluids are likely to occur and can contaminate the eyes, nose, or mouth of the care provider; and
- Coveralls/jacket – will be donned if the possibility exists for contamination of the body of the care provider.

To ensure that equipment is used effectively, employees will adhere to the following practices when using PPE:

- Any garments soiled by blood or possible infectious materials are to be removed, bagged, and properly labeled pursuant to Hawai‘i Administrative Rules, Title 11, Chapter 104.1 (HAR 11-104.1) as soon as feasible;
- All PPE will be removed prior to leaving the Site and placed in a suitable container for decontamination and/or disposal;
- Disposable gloves are to be replaced as soon as practical after contamination or if they are torn, punctured, or otherwise lose their ability to function as an exposure barrier; and
- All medical waste must be treated as infectious, segregated from other waste, and disposed of offsite by the authorized biohazard waste company provided in Table 6-3.

10.3 Chemical Hazards

During project activities, employees may be exposed to 1) chemical products brought onsite to complete the scope of work and 2) Site COPCs.

Exposure to chemical hazards may occur through inhalation, skin and eye contact, ingestion, or injection. Inhalation is the most common route of exposure.

Many chemicals can be absorbed through the skin. The skin and its film of lipid and sweat often act as an effective barrier; absorption is faster through skin that has been damaged by lacerations or abrasions, inflammation, or sunburn. Organic solvents remove lipids from the skin; solvents enhance the permeability of skin and facilitate skin absorption of other materials. Chemicals can also be absorbed through the eye and enter the bloodstream; the eye can also be easily damaged by chemicals.

Ingesting or swallowing a chemical is an unlikely route of exposure provided that proper work practices are followed. Chemicals can be ingested if they are left on hands or clothing, or if food or drink is consumed prior to washing hands and face. On dusty sites, ingestion of contaminants adsorbed onto particulates is possible if dust suppression techniques and appropriate respiratory protection (if warranted) are not utilized.

Injection exposure is the least common route of exposure. If an open wound is exposed to a chemical, however, direct contact with blood is possible.

Factors that influence toxicity of chemicals include the amount and duration of exposure, the route of exposure, and the susceptibility of the individual. Individual susceptibility is determined by many factors including age, sex, diet, inherited traits, overall physical health, and the use of alcohol, tobacco products, medications, and drugs.

Proper safety precautions must be taken to prevent contamination and unwarranted exposure. Since innocuous materials can cause hypersensitivity reactions when in the powdered form, all unknown powders and dusts should be considered hazardous. Vapors and many powdered substances can react with perspiration to produce localized skin irritation, and in some cases, severe chemical burns. All unknown chemicals should be considered hazardous until proven otherwise and appropriate protective measures should be taken to protect the skin, lungs and eyes.

Chemical products used at the Site include fuels and lubricants for equipment and preservatives (methanol) for soil sampling activities. SDSs will be obtained for each chemical product brought onsite and will be maintained onsite by the SSHO. The SSHO shall assure that all personnel handling such materials or working close enough to be exposed to the materials are familiar with the contents of the SDSs and any specific precautions needed to work safely with the materials. Personnel will use the appropriate storage and handling precautions and protective equipment, including handling these materials only in well-ventilated areas, preventing spillage, and storing them in ventilated areas away from incompatible materials.

The following procedures will be followed when a spillage occurs:

When a large chemical spill has occurred:

- Immediately notify the SSHO, SPSS Emergency Coordinator, and designated official:
  - Contain the spill if trained and with available equipment (e.g., pads, booms, absorbent powder). *Note: This is performed by the MBSS contactor's Spill Response Team*;
  - Secure the area and alert other site personnel;
  - Do not attempt to clean the spill unless trained to do so;
  - Attend to the injured personnel and call the emergency medical number;
  - Call local spill company or Fire Department (if an arrangement has been made) to perform a large chemical (e.g. mercury) spill cleanup;
  - Name of Spill Cleanup Company: Sun-contracted by MBSS contract; and
  - Evacuate building as necessary.
- When a small chemical spill has occurred:
  - Notify the SSHO, SPSS Emergency Coordinator, and designated official;
  - If toxic fumes are present, secure the area (with caution tape or cones) to prevent other personnel from entering;
  - Deal with spill IAW the instructions in the SDS;
  - Small spills must be handled in a safe manner, while wearing the proper PPE; and
  - Review the general cleanup procedures.

Site COPCs are listed in Table 2-1 (see Section 2.2) and further described in the following subsections.

10.3.1 Total Petroleum Hydrocarbons

TPH-DRO is a known Site COPC. It is derived from crude oil through a refining process known as fractional distillation, which separates different components of the oil based on their boiling points. Diesel fuel is heavier and oilier than gasoline and evaporates more slowly. TPH-DRO consists of a complex mix of hydrocarbons, generally in the carbon chain length range of C9 to C20.

Exposure to TPH-DRO during the cleanup of spills or while working in DRO-contaminated soil poses specific health risks due to the nature of the contaminants and the mode of exposure. In these scenarios, individuals are at risk of inhaling vapors or coming into direct contact with diesel compounds, which can lead to a range of adverse health effects, including:

- Skin, eye, nose, and throat irritation;
- Headaches;

- Nausea;
- Cardiopulmonary disease; and
- Cancer.

10.3.2 Volatile Organic Compounds

Volatile organic compounds (VOCs), specifically ethylbenzene, toluene, and xylenes, are key Site COPCs. These VOCs are commonly found as components in products such as paints, lacquers, and TPH. Ethylbenzene, toluene, and xylenes share similar properties due to their chemical structures: they are colorless, flammable liquids with distinct, sweet odors and are known for their rapid evaporation rates.

Exposure to these VOCs during cleanup activities or while working in areas contaminated with these substances poses health risks related to their volatile nature and toxicity. Individuals involved in such scenarios might be exposed through inhalation of vapors, dermal contact, or incidental ingestion. The health risks associated with exposure to ethylbenzene, toluene, and xylenes include:

- Eye and throat irritation;
- Skin irritation;
- Headache;
- Dizziness/lightheadedness and syncope;
- Altered mental states/personality changes;
- Nausea/vomiting;
- Abdominal pain;
- Ear damage;
- Kidney damage; and
- Cancer.

10.3.3 Polynuclear Aromatic Hydrocarbons

Polynuclear Aromatic Hydrocarbons (PAHs), specifically naphthalene and methylnaphthalenes (1- and 2-methylnaphthalene), are recognized Site COPCs. PAHs are a group of organic compounds composed of multiple aromatic rings, and are commonly produced by the incomplete burning of organic materials like coal, oil, and wood. Naphthalene, the simplest PAH, is a white, solid substance with a strong, mothball-like odor, while methylnaphthalenes are its methylated derivatives.

PAHs can occur in air attached to dust particles. Some PAH particles such as the listed Site COPCs above span the bridge between highly volatile PAHs and VOCs and can readily evaporate into the air. Workers can be exposed through inhalation of vapors, direct skin contact with contaminated materials, or incidental ingestion. The health risks associated with exposure to these PAHs include:

- Headache;
- Nausea/vomiting;
- Diarrhea;
- Altered mental states/personality changes;
- Cataracts/retinal hemorrhage;
- Convulsions;
- Anemia;
- Liver damage;
- Neurological damage; and
- Coma.

10.3.4 Methane

Methane may be encountered at the Site as a byproduct of fuel degradation. Methane is a colorless, odorless gas and the simplest hydrocarbon. Methane is highly flammable, making it both a valuable energy source and a safety hazard in certain contexts.

In the context of site remediation or exposure during cleanup operations, methane poses specific health and environmental risks. While it is non-toxic and does not directly cause irritation or long-term health issues like some other contaminants, its primary risks arise from its physical properties. H&S concerns related to methane exposure include asphyxiation and explosion.

High levels of methane can reduce the amount of oxygen breathed from the air. This can result in mood changes, slurred speech, vision problems, memory loss, nausea, vomiting, facial flushing and headache. In severe cases, there may be changes in breathing and heart rate, balance problems, numbness, and unconsciousness. If exposure is large or continues for a longer period, it can result in death by asphyxiation.

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Section 11 Personal Protective Equipment

PPE to be used for this work was selected based on expected hazards at the Site (Section 10) and is described below. Personnel performing operations onsite will be required to use the appropriate level of protection as shown in Table 11-1. The effectiveness of the PPE program will be evaluated by the SSHO. If additional hazards are identified requiring a higher level of protection and changes to the program are necessary, the SSHO will inform the CHSM and amend the PPE requirements.

Note: IAW OSHA 29 CFR 1910, Subpart I, PPE will be provided, used, and maintained in a sanitary and reliable condition. All PPE will be of the construction, design, and material to provide employees with protection against known or anticipated hazards. PPE will be selected that properly and appropriately fits the employee. Project team employees have received OSHA compliant training. Any concerns regarding the use of appropriate PPE will be brought to the attention of the SSHO, who will contact the CHSM for assistance in the evaluation of PPE as necessary.

The initial level of PPE required for project tasks will be Level D, as specified in the AHAs presented in Appendix B of this HSP. These levels are also defined in the following lists.

Table 11-1: Minimum PPE Requirements

Work Activity	Level of PPE
Mobilization and Site Preparation (e.g., utility locate)	Level D
Bioventing Well Installation	Level D
In-Situ Soil Sampling and Analysis	Level D
ABS Blower System Installation	Level D
Soil Vapor Sampling	Level D
Ex-Situ Treatment of Supersacked Soil (optional contract task)	Level D
Additional Soil Boring for Confirmation Sampling (optional contract tasks)	Level D
Installation of Additional Nested Bioventing Wells (optional contract task)	Level D
Landfarm Construction (optional contract task)	Level D
ABS Operations and Maintenance for Additional Years/Months (optional contract tasks)	Level D
Landfarm Operations and Maintenance for Additional Years/Months (optional contract tasks)	Level D
ABS and Landfarm Decommissioning (optional contract task)	Level D
Waste Management	Level D
Data Management	N/A
Demobilization	Level D
Level D PPE consists of outerwear, foot protection, and eye protection during all activities. Hand, head protection, and/or hearing protection is required as activities warrant.	
Outerwear- Work clothes such as long pants, and shirts with sleeves; class two high-visibility safety vest or high-visibility shirt when working around heavy equipment or working in proximity of moving vehicles.	
Hand Protection- Leather or mechanics gloves as necessary for physical hazards, nitrile gloves for chemical hazards. Nitrile gloves should be donned over leather/mechanics gloves when appropriate.	
Foot Protection- American Society for Testing and Materials F2413-compliant safety boots extending to the ankle or higher.	
Eye Protection- ANSI Z87.1-compliant safety glasses or safety goggles over prescription glasses.	
Head Protection- ANSI Z89.1-compliant hard hat required when there is a potential for head injury from impacts, falling or flying objects, or electrical shock.	
Hearing protection- Hearing protection with NRR30 or better must be worn when working in areas with/around equipment emitting noise levels at or above 85 dBA.	

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Section 12 Project Recordkeeping and Reporting

H&S-related documents will be maintained by the SSHO throughout the duration of project activities. These documents include, but are not limited to:

- This HSP and its acknowledgement form;
- Daily H&S forms:
  - Safety log (Daily Safety Briefing);
  - Site safety inspections (Daily Safety Briefing);
  - Vehicle and heavy equipment inspections (Heavy Equipment Inspection Report/ Vehicle Inspection);
  - Tailgate safety meeting records (Daily Safety Briefing); and
  - Sign-in logs (Visitor Sign-In Log).
- Employee training records (Site-Specific Training);
- Accident or incident reports (Safety and Health Deficiency Tracking Log); and
- SDSs.

Examples of project form templates are provided in Appendix C.

All safety-related records generated for the project will be reviewed for completeness and accuracy by the primary project SSHO and will be periodically audited by the CHSM. H&S documentation will be provided to the DAF upon request.

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Section 13 References

49 CFR - *DOT Commercial Driver's License and Shipping*.

ANSI/ISEA Z308.1-2021. *American National Standard – Minimum Requirements for Workplace First Aid Kits and Supplies.*

EPA, 1992. *Standard Operating Safety Guides, Office of Solid Waste and Emergency Response* (OSWER). June.

HDOH, 2024. *Environmental Action Levels Surfer, Hawaiʻi DOH (DRAFT Spring 2024)*. Accessed at https://health.hawaii.gove/heer/guidance/ehe-and-eals/.

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_____, 2015c. *Title 29 CFR Part 1926 Safety and Health Regulations for Construction*. Retrieved from Government Printing Office, Electronic Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?SID=e7045ba57ca7fe20dcb9a63fe3ef8a35&mc=true&node=pt29.8.1926&rgn=div5. 3 November.

USACE, 2014. EM 385-1-1. *Safety and Health Requirements.* 30 November.

_____, 2018. Engineer Regulation 385-1-92. *Safety and Occupational Health Requirements for Environmental Cleanup Projects*. 1 November.

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Appendix A
Resumes and Certifications

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Appendix B
Activity Hazard Analyses (AHAs)

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ACTIVITY HAZARD ANALYSIS

ACTIVITY Mobilization

Activity/Work: Site Mobilization	Overall Risk Assessment Code (RAC) (Use highest code)					**L**
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawaiʻi	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**
Notes: (Field Notes, Review Comments, etc.) This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when mobilizing and demobilizing.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.				**RAC Chart**	
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				**E = Extremely High Risk** **H = High Risk**	
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				**M = Moderate Risk** **L = Low Risk**	

Job Steps	Hazards	Controls	RAC
1) Equipment check	***Chemical Hazards*** ▪ Spills, inhalation, splash from sampling preservatives	▪ Only personnel trained on the hazards of the chemical(s) may work with/around the chemical(s). ▪ Identify, obtain and review SDSs for all chemicals used for sampling. ▪ Wear nitrile gloves when working with chemicals and/or contaminated media. ▪ Practice good hygiene by washing hands with soap and water following handling and prior to eating.	**L**
2) Mobilization to the site	***Biological Hazards:*** ▪ Stings/bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has been sitting without use.	**L**
	Radiation Hazards: ▪ Sun	▪ Use sunblock as appropriate and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary.	**L**

ACTIVITY Mobilization

Job Steps	Hazards	Controls	RAC
Mobilization to the site (continued)		▪ Stay hydrated.	
	Physical Hazards: ▪ Equipment and traffic	***Controls for struck by equipment:*** ▪ Machines must be equipped with backup alarms and lighting. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Wear Class 2 high visibility clothing when exposed to heavy equipment. ▪ Be aware of the swing radius of the machinery. Maintain a minimum 10-foot distance when machinery is in operation. ▪ Make eye contact with operator(s) and indicate your movements with hand signals before approaching machinery. Do not approach equipment in blind spots. ***Controls for vehicle operation:*** ▪ Conduct and document a daily inspection of the equipment. ▪ Only qualified operators may operate equipment (i.e., authorized to drive by the company and possess a valid driver's license from state of residence). ▪ Driver and passengers will use safety belts as required by law. ▪ Vehicle operators will be familiar with and comply with requirements in Health and Safety Plan. ▪ Vehicle operator will obey all traffic laws and regulations. ▪ Vehicle operator will obey all company rules and regulations regarding vehicle use. ▪ Vehicle operator shall report any damage to the vehicle, during the course of operations immediately as required by company policy. ▪ Vehicle operator will report any defect, malfunction, safety hazard or deficiency with motor vehicle to their immediate Supervisor for repair. ▪ Use ground guides in areas of limited visibility and tight clearances. ▪ Vehicle operator will drive with caution, especially around blind turns along the winding road to the summit of Haleakalā. ▪ Personnel must be aware of their surroundings including the possibility of encountering tourists on bikes, or in cars or vans, and grazing livestock.	**L**
	▪ Use of small tools	▪ Keep cutting tools sharp and in good condition. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Mobilization

Job Steps	Hazards	Controls	RAC
Mobilization to the site (continued)		▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket. ▪ Tools shall be inspected prior to use. ▪ Damaged tools will be tagged out of service until repair can be performed by a qualified person.	
	▪ Limited visibility	▪ Reduce vehicle speed and use low beam lights or fog lights, if available. Do not use high beam lights. ▪ Stay in your lane and leave enough distance between yourself and the vehicle in front of you. ▪ In extremely low visibility, turn on hazard lights and pull off the road to a safe location.	**L**
	▪ Slips, trips, and falls	▪ Conduct an initial site walk using the buddy system. ▪ Identify and remove, mark, and/or barricade significant slip, trip, and fall hazards. ▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Head, back, hand, and eye injuries from lifting and pinch points	***Controls to avoid injury due to manual lifting:*** ▪ Use proper lifting techniques such as keeping a straight back and lifting with legs and avoid twisting back. ▪ Use mechanical equipment or get help from others when lifting over 50 lbs. ▪ Seek assistance or break heavy loads into smaller loads when possible. ▪ Verify the path of travel is clear prior to the lift. ***Controls for hands and fingers caught between objects:*** ▪ Coordinate the handling and placement of heavy objects. ▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. ▪ Wear work gloves and avoid placing hands between objects.	**L**
	▪ Electrical Hazards	▪ Consider all electrical equipment and sources at all voltages dangerous. ▪ Do not work with power supply lines or electrical equipment until existing conditions are determined during an inspection or test by qualified personnel. ▪ Protect all electrical power tools and extension cords with ground fault circuit interrupters.	**L**

ACTIVITY Mobilization

Job Steps	Hazards	Controls	RAC
		▪ Remove any tools or cords with loose connections, damaged wiring, or insulation from service immediately and either repair or replace them.	
	▪ Inclement weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	L
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Do not operate heavy equipment when tired. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep. ▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	L
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	L
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	L

ACTIVITY HAZARD ANALYSIS

ACTIVITY Mobilization

Job Steps	Hazards	Controls	RAC
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	L
	▪ Noise	▪ Wear hearing protection when operating or working around heavy equipment, powered hand tools, drilling equipment, and/or whenever regular conversation cannot be carried out at arms' length. ▪ Maintain hearing protection in a clean and reliable condition, ▪ Inspect hearing protection prior to and after use. Repair or discard damaged or deteriorated hearing protection.	L
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L

Equipment to be Used	PPE	Training Requirements	Inspection Requirements
▪ Sampling supplies ▪ Hand and power tools ▪ Trucks/Vehicles ▪ Heavy equipment ▪ Handcarts ▪ Wagons ▪ Fire extinguisher(s) ▪ First aid kit(s)	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt ▪ F2413-compliant safety boots extending to ankle or higher ▪ Gloves ▪ ANSI Z87.1-compliant safety glasses or googles ▪ Hard hat ▪ NRR30 (or better) hearing protection	***Site-Specific:*** ▪ 40 hr-OSHA HAZWOPER ▪ 8-hr HAZWOPER refresher ▪ Adult first aid and CPR ▪ Bloodborne Pathogen competency training within the past 12 months ***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	***Site Inspection:*** ▪ All equipment will be properly stored, inspected, and/or maintained according to the manufacturer's requirements prior to mobilization to the site. ▪ Records of inspections will be maintained by the SSHO. ▪ Equipment will be reinspected once at the site to verify damage did not occur during transit.

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ACTIVITY HAZARD ANALYSIS

ACTIVITY Utility Locating

Activity/Work Task: Utility Locating	Overall Risk Assessment Code (RAC) (Use highest code)					**L**
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawai'i	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**
Notes: (Field Notes, Review Comments, etc.) This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when identifying and locating utilities.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.				**RAC Chart**	
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				**E = Extremely High Risk** **H = High Risk**	
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				**M = Moderate Risk** **L = Low Risk**	

Job Steps	Hazards	Controls	RAC
1) Review mechanical and utility plan documents 2) Use diagrams and equipment to locate and mark utilities	***Biological Hazards:*** ▪ Stings/bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has been sitting without use.	L
	Radiation Hazards: ▪ Sun	▪ Use sunblock as appropriate and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary.	

ACTIVITY HAZARD ANALYSIS

ACTIVITY Utility Locating

Job Steps	Hazards	Controls	RAC
	Physical Hazards: ▪ Use of small tools	▪ Keep cutting tools sharp and in good condition. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools. ▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket. ▪ Tools shall be inspected prior to use. ▪ Damaged tools will be tagged out of service until repair can be performed by a qualified person.	**L**
	▪ Slips, trips, and falls	▪ Conduct an initial site walk using the buddy system. ▪ Identify and remove, mark, and/or barricade significant slip, trip, and fall hazards. ▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Inclement weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	**L**
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	**L**
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Utility Locating

Job Steps	Hazards	Controls	RAC
		▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	L
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L

Equipment to be Used	PPE	Training Requirements	Inspection Requirements
▪ Hand tools ▪ Trucks/vehicles ▪ Electromagnetic induction equipment ▪ Magnetometry and/or ground-penetrating radar ▪ Fire extinguisher(s) ▪ First aid kit(s)	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt ▪ F2413-compliant safety boots extending to ankle or higher ▪ Gloves ▪ ANSI Z87.1-compliant safety glasses or googles	***Site-Specific:*** ▪ 40 hr-OSHA HAZWOPER ▪ 8-hr HAZWOPER refresher ▪ Adult first aid and CPR ▪ Bloodborne Pathogen competency training within the past 12 months ***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	▪ SSHO-conducted safety inspection prior to work start and ongoing monitoring of work practices.

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Activity Hazard Analysis

Activity Soil Sampling

Activity/Work: Soil Sampling	Overall Risk Assessment Code (RAC) (Use highest code)					M
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawai'i	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
Notes: (Field Notes, Review Comments, etc.) This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when soil sampling.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**				
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**				
		H = High Risk				
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk**				
		L = Low Risk				

Job Steps	**Hazards**	**Controls**	**RAC**
1) Select sampling locations 2) Prepare sample containers 3) Collect field measurements and document soil conditions/ characteristics 4) Collect and preserve soil samples 5) Decontaminate Equipment	***Chemical Hazards*** ▪ Spills, inhalation, splash from sampling preservatives ▪ Exposure to site contaminants	▪ Review SDSs for all chemicals onsite. ▪ Ensure personnel working with or around chemicals are trained on their hazards . ▪ Wear SSHO-approved PPE, including nitrile gloves. ▪ Pour liquids carefully. ▪ Decontaminate personnel and equipment IAW SOP ENV-02 Sampling Decontamination. ▪ Suspend work and notify the SSHO if site conditions change or unanticipated hazardous conditions are encountered.	**M**
	Biological Hazards: ▪ Stings/bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has gone without use.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Sampling

Job Steps	Hazards	Controls	RAC
Soil sampling (continued)	***Radiation Hazards:*** ▪ Sun	▪ Use sunblock as appropriate and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary. ▪ Stay hydrated.	**L**
	Physical Hazards: ▪ Equipment and traffic	***Controls for struck by equipment:*** ▪ Machines must be equipped with backup alarms and lighting. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Wear Class 2 high visibility clothing when exposed to heavy equipment. ▪ Be aware of the swing radius of the machinery. Maintain a minimum 10-foot distance when machinery is in operation. ▪ Make eye contact with operator(s) and indicate your movements with hand signals before approaching machinery. Do not approach equipment in blind spots.	**L**
	▪ Use of small tools	▪ Keep cutting tools sharp and in good condition and inspect prior to use. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools. ▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket. ▪ Tag damaged tools as out of service until repair can be performed by a qualified person.	**L**
	▪ Slips, trips, and falls	▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Head, back, hand, and eye injuries from lifting and pinch points	***Controls to avoid injury due to manual lifting:*** ▪ Use proper lifting techniques such as keeping a straight back and lifting with legs and avoid twisting back. ▪ Use mechanical equipment or get help from others when lifting over 50 lbs. ▪ Seek assistance or break heavy loads into smaller loads when possible. ▪ Verify the path of travel is clear prior to the lift. ***Controls for hands and fingers caught between objects:*** ▪ Coordinate the handling and placement of heavy objects.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Sampling

Job Steps	Hazards	Controls	RAC
Soil sampling (continued)		▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. ▪ Wear work gloves and avoid placing hands between objects.	
	▪ Inclement Weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	**L**
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep. ▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	**L**
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	**L**
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	**L**
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	**L**
	▪ Noise	▪ Wear hearing protection when working around heavy equipment, powered hand tools, drilling equipment, and/or whenever regular conversation cannot be carried out at arms' length.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Sampling

Job Steps	**Hazards**	**Controls**	**RAC**
Soil sampling (continued)		▪ Maintain hearing protection in a clean and reliable condition. ▪ Inspect hearing protection prior to and after use. Repair or discard damaged or deteriorated hearing protection.	
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	**L**
	▪ Dust	▪ Avoid working in dust by standing upwind of dust-generating activities. ▪ Control excessive dust with sprayed-on water. ▪ Wear respiratory protection if dust cannot be controlled with wet methods.	**L**
	▪ Compressed gas cylinders	▪ Ensure cylinders are properly labeled and clearly identified. ▪ Leave valve protection caps in place when not in use. ▪ Keep cylinder valves closed except when the cylinder is being used. ▪ Do not subject cylinders to artificially low temperatures or temperatures above 125 F. ▪ Never tamper with or alter cylinders, valves, or safety relief devices. ▪ Do not place cylinders where they become part of an electric circuit or use them as a ground during electric welding. ▪ Replace protective caps and outlet caps or plugs before returning empty cylinders to the supplier. ▪ Avoid dragging or sliding cylinders.	**L**

Equipment to be Used	**PPE**	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
▪ Hand tools ▪ Trucks/Vehicles ▪ Heavy Equipment ▪ Soil sampling supplies (trowels, TerraCores) ▪ Drill rig (with direct push	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt) ▪ F2413-compliant safety boots extending to ankle or higher ▪ Work Gloves (when lifting heavy equipment or using hand tools) ▪ ANSI Z87.1-compliant safety glasses or googles and hard hat	***Site Specific:*** ▪ 40 hour-OSHA, HAZWOPER, 8-hour refresher (if applicable) ▪ Adult First Aid/CPR (at least 2 personnel on-site). ▪ Bloodborne Pathogen competency training within the past 12 months ***Motor Vehicles:***	***Site Inspection:*** ▪ All equipment will be properly stored, inspected, and/or maintained according to the manufacturer's requirements. ▪ Equipment will be inspected daily prior to use. ▪ Records of inspections will be maintained by the SSHO. ▪ The first aid kit will be inspected at the beginning of the project and monthly thereafter.

ACTIVITY Soil Sampling

Job Steps	Hazards	Controls	RAC
and/or auger bits) ▪ Field monitoring equipment (PID, multi-gas meter) ▪ Fire Extinguisher(s) ▪ First aid kit(s)	▪ NRR30 hearing protection	▪ Operators will hold a valid license for the type and class of vehicle they are operating.	

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ACTIVITY HAZARD ANALYSIS

ACTIVITY Bioventing Well Installation and Abandonment

Activity/Work Task: Bioventing Well Installation and Abandonment	Overall Risk Assessment Code (RAC) (Use highest code)					**M**
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawai‘i	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)
This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when bioventing and well installation and abandonment.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**
	H = High Risk
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk**
	L = Low Risk

Job Steps	Hazards	Controls	RAC
Installation: 1) Drill rig inspection and setup	***Chemical Hazards:*** ▪ Spills, inhalation, splash ▪ Exposure to site contaminants	▪ Review SDSs for all chemicals onsite. ▪ Ensure all personnel working with or around hazardous chemicals are trained on the hazards of the chemicals and are properly equipped to safeguard against said hazards. ▪ Wear SSHO-approved PPE, including nitrile gloves. ▪ Pour liquids carefully. ▪ Decontaminate personnel and equipment IAW SOP ENV-02 Sampling Decontamination. ▪ Stop work and notify the SSHO if site conditions change or unanticipated hazardous conditions are encountered.	**M**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Bioventing Well Installation and Abandonment

Job Steps	Hazards	Controls	RAC
2) Drilling 3) Install well casing 4) Backfill annular space 5) Cap well 6) Decontaminate equipment 7) move to next well location 8) Complete wells at the surface once wells are installed <u>Abandonment:</u> 1) Remove well covers 2) Pull casings 3) Backfill borings	***Biological Hazards:*** ▪ Stings/Bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has been sitting without use.	**L**
	Radiation Hazards: ▪ Sun	▪ Use sunblock as appropriate and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary.	**L**
	Physical Hazards: ▪ Equipment and traffic	***Controls for struck by equipment:*** ▪ Machines must be equipped with backup alarms and lighting. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Wear Class 2 high visibility clothing when exposed to heavy equipment. ▪ Be aware of the swing radius of the machinery. Maintain a minimum 10-foot distance when machinery is in operation. ▪ Make eye contact with operator(s) and indicate your movements with hand signals before approaching machinery. Do not approach equipment in blind spots. ***Controls for equipment operation:*** ▪ Conduct and document a daily inspection of the equipment. ▪ Only qualified operators may operate equipment. ▪ Always engage seatbelts during operations. ▪ Use ground guides in areas of limited visibility and tight clearances.	**L**
	▪ Use of small tools	▪ Keep cutting tools sharp and in good condition. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools. ▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Bioventing Well Installation and Abandonment

Job Steps	Hazards	Controls	RAC
Bioventing well installation and abandonment (continued)		▪ Tools shall be inspected prior to use. ▪ Damaged tools will be tagged out of service until repair can be performed by a qualified person.	
	▪ Limited visibility	▪ Reduce vehicle speed and use low beam lights or fog lights, if available. Do not use high beam lights. ▪ Stay in your lane and leave enough distance between yourself and the vehicle in front of you. ▪ In extremely low visibility, turn on hazard lights and pull off the road to a safe location.	**L**
	▪ Slips, trips, and falls	▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Head, back, hand and eye injuries from lifting and pinch points	***Controls to avoid injury due to manual lifting:*** ▪ Use proper lifting techniques such as keeping a straight back and lifting with legs and avoid twisting back. ▪ Use mechanical equipment or get help from others when lifting over 50 lbs. ▪ Seek assistance or break heavy loads into smaller loads when possible. ▪ Verify the path of travel is clear prior to the lift. ***Controls for hands and fingers caught between objects:*** ▪ Coordinate the handling and placement of heavy objects. ▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. ▪ Wear work gloves and avoid placing hands between objects.	**L**
	▪ Electrical Hazards	▪ Consider all electrical equipment and sources at all voltages dangerous. ▪ Do not work with power supply lines or electrical equipment until existing conditions are determined during an inspection or test by qualified personnel. ▪ Protect all electrical power tools and extension cords with ground fault circuit interrupters. ▪ Remove any tools or cords with loose connections, damaged wiring, or insulation from service immediately and either repair or replace them.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Bioventing Well Installation and Abandonment

Job Steps	Hazards	Controls	RAC
Bioventing well installation and abandonment (continued)	▪ Inclement Weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	L
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Do not operate heavy equipment when tired. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep. ▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	L
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen.	L
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	L
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	L
	▪ Noise	▪ Wear hearing protection when operating or working around heavy equipment, powered hand tools, drilling equipment, and/or whenever regular conversation cannot be carried out at arms' length.	L

Activity Hazard Analysis

Activity Bioventing Well Installation and Abandonment

Job Steps	Hazards	Controls	RAC
		▪ Maintain hearing protection in a clean and reliable condition, ▪ Inspect hearing protection prior to and after use. Repair or discard damaged or deteriorated hearing protection.	
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L
	▪ Dust	▪ Avoid working in dust by standing upwind of dust-generating activities. ▪ Control excessive dust with sprayed-on water. ▪ Wear respiratory protection if dust cannot be controlled with wet methods.	L
	▪ Compressed gas cylinders	▪ Ensure cylinders are properly labeled and clearly identified. ▪ Leave valve protection caps in place when not in use. ▪ Keep cylinder valves closed except when the cylinder is being used. ▪ Do not subject cylinders to artificially low temperatures or temperatures above 125 F. ▪ Never tamper with or alter cylinders, valves, or safety relief devices. ▪ Do not place cylinders where they become part of an electric circuit or use them as a ground during electric welding. ▪ Replace protective caps and outlet caps or plugs before returning empty cylinders to the supplier. ▪ Avoid dragging or sliding cylinders.	L
	▪ Utility strike	▪ Provide three lines of evidence for utility clearance. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Do not operate machinery within 3 feet of buried utilities.	M

Equipment to be Used	PPE	Training Requirements	Inspection Requirements
▪ Hand tools ▪ Trucks/Vehicles ▪ Heavy Equipment ▪ Drill rig (with direct push and/or auger bits) ▪ Well construction materials	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt) ▪ F2413-compliant safety boots extending to ankle or higher	***Site-Specific:*** ▪ 40 hour-OSHA, HAZWOPER, 8-hour refresher (if applicable) ▪ Adult First Aid/CPR (at least 2 personnel on-site). ▪ Blood Borne Pathogen competency training within the past 12 months	▪ All equipment will be properly stored, inspected, and/or maintained according to the manufacturer's requirements. ▪ Equipment will be inspected by a qualified person daily, prior to use. ▪ The first aid kit will be inspected at the beginning of the project and monthly thereafter. ▪ Records of inspections will be maintained by the SSHO.

ACTIVITY HAZARD ANALYSIS

ACTIVITY Bioventing Well Installation and Abandonment

Job Steps	Hazards	Controls	RAC
▪ Field monitoring equipment (PID, multi-gas meter, compressed gas cylinders) ▪ Fire extinguisher(s) ▪ First aid kit(s)	▪ Work Gloves (when lifting heavy equipment or using hand tools) ▪ ANSI Z87.1-compliant safety glasses or googles and hard hat ▪ NRR30 (or better) hearing protection	***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Gas Sampling & Air Monitoring

Activity/Work Task: Soil Gas Sampling and Air Monitoring	Overall Risk Assessment Code (RAC) (Use highest code)					L
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawai'i	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.) This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when mobilizing and demobilizing.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)	
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk** **H = High Risk**
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk** **L = Low Risk**

Job Steps	Hazards	Controls	RAC
1) Calibrate direct read equipment 2) Remove well cap 3) Connect direct read equipment 4) Prepare passive sampler and lower into well (if applicable) 5) Replace well cap 6) Move to next sample location 7) Collect analytical samples after 2 weeks, if applicable	***Chemical Hazards*** ▪ Inhalation of site contaminant vapors (TPH, VOCs, PAHs, methane)	▪ Only personnel trained on the hazards of the chemical(s) may work with/around them. ▪ Wear nitrile gloves when working with chemicals and/or contaminated media. ▪ Practice good hygiene by washing hands with soap and water following handling and prior to eating.	L
	Biological Hazards: ▪ Stings/Bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has gone without use.	L
	Radiation Hazards: ▪ Sun	▪ Use sunblock and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary. ▪ Stay hydrated.	L

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Gas Sampling & Air Monitoring

Job Steps	Hazards	Controls	RAC
Soil gas sampling and air monitoring (continued)	***Physical Hazards:*** ▪ Use of small tools	▪ Keep cutting tools sharp and in good condition and inspect prior to use. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools. ▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket. ▪ Tag damaged tools as out of service.	**L**
	▪ Slips, trips, and falls	▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Hand injuries from pinch points and sharp PVC or metal	▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. ▪ Wear work gloves and avoid placing hands between objects.	**L**
	▪ Electrical Hazards	▪ Consider all electrical equipment and sources at all voltages dangerous. ▪ Do not work with power supply lines or electrical equipment until existing conditions are determined during an inspection or test by qualified personnel. ▪ Protect all electrical power tools and extension cords with ground fault circuit interrupters. ▪ Remove any tools or cords with loose connections, damaged wiring, or insulation from service immediately and either repair or replace them.	**L**
	▪ Inclement weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	**L**
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Do not operate heavy equipment when tired. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Soil Gas Sampling & Air Monitoring

Job Steps	Hazards	Controls	RAC
Soil gas sampling and air monitoring (continued)		▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	L
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	L
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	L
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L
	▪ Compressed gas cylinders	▪ Ensure cylinders are properly labeled and clearly identified. ▪ Leave valve protection caps in place when not in use. ▪ Keep cylinder valves closed except when the cylinder is being used. ▪ Do not subject cylinders to artificially low temperatures or temperatures above 125 F. ▪ Never tamper with or alter cylinders, valves, or safety relief devices. ▪ Do not place cylinders where they become part of an electric circuit or use them as a ground during electric welding. ▪ Replace protective caps and outlet caps or plugs before returning empty cylinders to the supplier. ▪ Avoid dragging or sliding cylinders.	L

Activity Hazard Analysis

ACTIVITY Soil Gas Sampling & Air Monitoring

Job Steps	Hazards	Controls		RAC
Equipment to be Used	**PPE**	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**	
▪ Hand and power tools ▪ PID ▪ Multi-gas meter ▪ Manometer ▪ Thermometer ▪ Compressed gas cylinders ▪ Sampling collection kit from Beacon Environmental laboratory ▪ BeSure Passive Soil-Gas Samplers ▪ Fire extinguisher(s) ▪ First aid kit(s)	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt ▪ F2413-compliant safety boots extending to ankle or higher ▪ Gloves ▪ ANSI Z87.1-compliant safety glasses or googles	***Site-Specific:*** ▪ 40 hr-OSHA HAZWOPER ▪ 8-hr HAZWOPER refresher ▪ Adult first aid and CPR ▪ Bloodborne Pathogen competency training within the past 12 months ***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	***Site Inspection:*** ▪ All equipment will be properly stored, inspected, and/or maintained daily, or according to the manufacturer's requirements. ▪ Fire extinguishers and first aid kits will be inspected monthly. ▪ Records of inspections will be maintained in an electronic database.	

ACTIVITY HAZARD ANALYSIS

ACTIVITY Demobilization

Activity/Work: Site Demobilization	Overall Risk Assessment Code (RAC) (Use highest code)					L
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawaiʻi	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)
This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when mobilizing and demobilizing.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk** **L = Low Risk**

Job Steps	Hazards	Controls	RAC
1) Perform site cleanup. 2) Hold exit briefing. 3) Site access passes returned. 4) Demobilize personnel and equipment.	***Chemical Hazards:*** ▪ Unused sampling preservatives ▪ Site contaminants	▪ Personnel will employ storage and handling precautions and wear the proper PPE when handling chemicals and contaminated soil. ▪ Properly decontaminate equipment prior to packaging and removing from the site. All unknown chemicals should be considered hazardous until proven otherwise and appropriate protective measures should taken for skin, lungs and eyes.	**L**
	Biological Hazards: ▪ Stings/bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has been sitting without use.	**L**
	Radiation Hazards: ▪ Sun	▪ Use sunblock as appropriate and avoid direct exposure to UV from the sun for long periods of time. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Demobilization

Job Steps	Hazards	Controls	RAC
Demobilization (continued)	***Physical Hazards:*** ▪ Equipment and traffic	***Controls for struck by equipment:*** ▪ Machines must be equipped with backup alarms and lighting. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Wear Class 2 high visibility clothing when exposed to heavy equipment. ▪ Be aware of the swing radius of the machinery. Maintain a minimum 10-foot distance when machinery is in operation. ▪ Make eye contact with operator(s) and indicate your movements with hand signals before approaching machinery. Do not approach equipment in blind spots. ***Controls for vehicle operation:*** ▪ Conduct and document a daily inspection of the equipment. ▪ Only qualified operators may operate equipment (i.e., authorized to drive by the company and possess a valid driver's license from state of residence). ▪ Driver and passengers will use safety belts as required by law. ▪ Vehicle operators will be familiar with and comply with requirements in Health and Safety Plan. ▪ Vehicle operator will obey all traffic laws and regulations. ▪ Vehicle operator will obey all company rules and regulations regarding vehicle use. ▪ Vehicle operator shall report any damage to the vehicle, during the course of operations immediately as required by company policy. ▪ Vehicle operator will report any defect, malfunction, safety hazard or deficiency with motor vehicle to their immediate Supervisor for repair. ▪ Use ground guides in areas of limited visibility and tight clearances. ▪ Vehicle operator will drive with caution, especially around blind turns along the winding road to the summit of Haleakalā. ▪ Personnel must be aware of their surroundings including the possibility of encountering tourists on bikes, or in cars or vans, and grazing livestock.	**L**
	▪ Use of small tools	▪ Keep cutting tools sharp and in good condition. ▪ Wear eye protection during all work onsite. ▪ Wear hand protection when working with small tools. ▪ Use tools that are the right size and right type for the job. ▪ Never work with oily or greasy hands while utilizing tools.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Demobilization

Job Steps	Hazards	Controls	RAC
Demobilization (continued)		▪ Follow the correct procedure for each tool. ▪ Never carry tools in your pocket. ▪ Tools shall be inspected prior to use. ▪ Damaged tools will be tagged out of service until repair can be performed by a qualified person.	
	▪ Limited visibility	▪ Reduce vehicle speed and use low beam lights or fog lights, if available. Do not use high beam lights. ▪ Stay in your lane and leave enough distance between yourself and the vehicle in front of you. ▪ In extremely low visibility, turn on hazard lights and pull off the road to a safe location.	**L**
	▪ Slips, trips, and falls	▪ Conduct an initial site walk using the buddy system. ▪ Identify and remove, mark, and/or barricade significant slip, trip, and fall hazards. ▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Head, back, hand, and eye injuries	***Controls to avoid injury due to manual lifting:*** ▪ Use proper lifting techniques such as keeping a straight back and lifting with legs and avoid twisting back. ▪ Use mechanical equipment or get help from others when lifting over 50 lbs. ▪ Seek assistance or break heavy loads into smaller loads when possible. ▪ Verify the path of travel is clear prior to the lift. ***Controls for hands and fingers caught between objects:*** ▪ Coordinate the handling and placement of heavy objects. ▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. Wear work gloves and avoid placing hands between objects.	**L**
	▪ Electrical hazards	▪ Consider all electrical equipment and sources at all voltages dangerous. ▪ Do not work with power supply lines or electrical equipment until existing conditions are determined during an inspection or test by qualified personnel. ▪ Protect all electrical power tools and extension cords with ground fault circuit interrupters.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Demobilization

Job Steps	Hazards	Controls	RAC
		▪ Remove any tools or cords with loose connections, damaged wiring, or insulation from service immediately and either repair or replace them.	
	▪ Inclement weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	**L**
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Do not operate heavy equipment when tired. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep. ▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	**L**
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	**L**
	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	**L**
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Demobilization

Job Steps	Hazards	Controls	RAC
		▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	
	▪ Noise	▪ Wear hearing protection when operating or working around heavy equipment, powered hand tools, drilling equipment, and/or whenever regular conversation cannot be carried out at arms' length. ▪ Maintain hearing protection in a clean and reliable condition, ▪ Inspect hearing protection prior to and after use. Repair or discard damaged or deteriorated hearing protection.	L
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L

Equipment to be Used	PPE	Training Requirements	Inspection Requirements
▪ Hand and power tools ▪ Trucks/Vehicles ▪ Heavy equipment ▪ Handcarts ▪ Wagons ▪ Fire extinguisher(s) ▪ First aid kit(s)	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt ▪ F2413-compliant safety boots extending to ankle or higher ▪ Gloves ▪ ANSI Z87.1-compliant safety glasses or googles ▪ Hard hat ▪ NRR30 (or better) hearing protection	***Site-Specific:*** ▪ 40 hr-OSHA HAZWOPER ▪ 8-hr HAZWOPER refresher ▪ Adult first aid and CPR ▪ Bloodborne Pathogen competency training within the past 12 months ***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	▪ All equipment and materials brought to the site to complete the scope of work will be removed from the site. ▪ A final site walk will be conducted by the field manager to verify the site has been returned to an acceptable state.

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ACTIVITY HAZARD ANALYSIS

ACTIVITY Heavy Equipment and Earth Moving Machinery Operations

Activity/Work: Heavy Equipment and Earth Moving Machinery Operations	Overall Risk Assessment Code (RAC) (Use highest code)					**L**
Project Location: Generator Spill Site (SS014), Maui Space Surveillance Complex, Hawai‘i	**Risk Assessment Code (RAC) Matrix**					
Contract Number: FA8903-24-C-0008	**Severity**	**Probability**				
Date Prepared: 1/28/2025		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title): Craig Morris, SSHO	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by (Name/Title): Carl McGraw, CHSM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**
Notes: (Field Notes, Review Comments, etc.) This Activity Hazard Analysis shall be distributed and utilized by GSI field staff when heavy equipment and earth moving machinery operations.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.				**RAC Chart**	
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				**E = Extremely High Risk** **H = High Risk**	
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				**M = Moderate Risk** **L = Low Risk**	

Job Steps	Hazards	Controls	RAC
1) Pre-operational inspection and maintenance. 2) Moving or positioning equipment. 3) Operating equipment. 4) Decontamination. 5) Post-operational inspection and maintenance.	***Chemical Hazards*** ▪ Exposure to site contaminants	▪ Identify, obtain, and review hazards associated with site contaminants. ▪ Wear nitrile gloves when working with contaminated media. ▪ Practice good hygiene by washing hands with soap and water following handling and prior to eating.	**L**
	Biological Hazards: ▪ Stings/bites	▪ Use appropriate insect repellants. ▪ Perform a visual inspection of the areas prior to starting work. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Wear approved safety footwear. ▪ Wear SSHO-approved work gloves when moving objects on the ground. ▪ Shake-out boots when changing shoes to remove any insects. ▪ Shake out PPE before use, after breaks, and whenever PPE has been sitting without use.	**L**
	Radiation Hazards: ▪ Sun	▪ Use sunblock and avoid direct exposure to the sun for extended periods. ▪ Wear lightweight, loose-fitting clothing appropriate for weather conditions. ▪ Utilize work/rest cycles according to ACGIH and NIOSH guidelines, as necessary. ▪ Stay hydrated.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Heavy Equipment and Earth Moving Machinery Operations

Job Steps	Hazards	Controls	RAC
Heavy Equipment and Earth Moving Machinery Operations (continued)	***Physical Hazards:*** ▪ Equipment and traffic	***Controls for struck by equipment:*** ▪ Machines must be equipped with backup alarms and lighting. ▪ Maintain verbal communication and ensure personnel understand hand signals. ▪ Assign a spotter to assist operator(s) while working near utilities and slopes. ▪ Wear Class 2 high visibility clothing when exposed to heavy equipment. ▪ Be aware of the swing radius of the machinery. Maintain a minimum 10-foot distance when machinery is in operation. ▪ Make eye contact with operator(s) and indicate your movements with hand signals before approaching machinery. Do not approach equipment in blind spots. ***Controls for equipment operation:*** ▪ Conduct and document a daily inspection of the equipment. ▪ Only qualified operators may operate equipment. ▪ Always engage seatbelts during operations. ▪ Use ground guides in areas of limited visibility and tight clearances.	**L**
	▪ Limited visibility	▪ Reduce vehicle speed and use low beam lights or fog lights, if available. Do not use high beam lights. ▪ Stay in your lane and leave enough distance between yourself and the vehicle in front of you. ▪ In extremely low visibility, turn on hazard lights and pull off the road to a safe location.	**L**
	▪ Slips, trips, and falls	▪ Conduct an initial site walk using the buddy system. ▪ Identify and remove, mark, and/or barricade significant slip, trip, and fall hazards. ▪ Store materials to prevent ground hazards. Do not leave tools lying on the ground. ▪ Complete work activities in adequate natural light. ▪ Wear required safety footwear during all site work.	**L**
	▪ Head, back, hand, and eye injuries from lifting and pinch points	***Controls to avoid injury due to manual lifting:*** ▪ Use proper lifting techniques such as keeping a straight back and lifting with legs and avoid twisting back. ▪ Use mechanical equipment or get help from others when lifting over 50 lbs. ▪ Seek assistance or break heavy loads into smaller loads when possible. ▪ Verify the path of travel is clear prior to the lift.	**L**

ACTIVITY Heavy Equipment and Earth Moving Machinery Operations

Job Steps	Hazards	Controls	RAC
Heavy Equipment and Earth Moving Machinery Operations (continued)		***Controls for hands and fingers caught between objects:*** ▪ Coordinate the handling and placement of heavy objects. ▪ Inspect materials and objects for rough or sharp edges and use appropriate precautions to avoid skin contact. ▪ Wear work gloves and avoid placing hands between objects.	
	▪ Electrical Hazards	▪ Consider all electrical equipment and sources at all voltages dangerous. ▪ Do not work with power supply lines or electrical equipment until existing conditions are determined during an inspection or test by qualified personnel. ▪ Do not operate machinery within 3 feet of buried electrical lines.	**L**
	▪ Inclement weather	▪ Monitor weather conditions. ▪ Stop work and seek shelter during severe weather events such as lightning storms, heavy rain, and high wind. ▪ If isolated from the shelter during close-in lightning, adopt a low crouching position, with feet together (up on toes, if possible) and hands-on ears. ▪ Avoid open fields and use hard-wired telephones and headsets when lightning is in the area. ▪ Do not resume outdoor activities until at least 30 minutes after the last bolt of lightning is observed and the last clap of thunder is heard.	**L**
	▪ Fatigue	▪ Monitor for signs of fatigue. ▪ Do not operate heavy equipment when tired. ▪ Stick to a regular bedtime. Ensure quality and quantity of sleep. ▪ Stay hydrated but avoid alcohol consumption and stimulants like coffee and tea before rest periods. ▪ Seek medical attention for sleep disorders.	**L**
	▪ Altitude Sickness	▪ Ascend and descend elevations gradually. ▪ Do not drink alcohol or do heavy exercise for at least the first 48 hours prior to ascent. ▪ Utilize supplemental oxygen if necessary.	**L**

ACTIVITY HAZARD ANALYSIS

ACTIVITY Heavy Equipment and Earth Moving Machinery Operations

Job Steps	Hazards	Controls	RAC
Heavy Equipment and Earth Moving Machinery Operations (continued)	▪ Heat Stress	▪ Monitor for signs of heat stress. ▪ Maintain adequate fluid intake. ▪ Take rest breaks in a shaded area. ▪ Lightweight, light-colored, loose-fitting clothing. Remove excess layers as necessary. ▪ If utilizing commercial electrolyte mixes, double the amount of water called for in the package directions.	L
	▪ Cold Stress	▪ Monitor for signs of cold stress. ▪ Wear appropriate layers of insulating and wind-and-moisture-resistant clothing. ▪ Cover all exposed skin. Wear a hat and gloves to help retain body heat. ▪ Seek shelter in a warm protected area when the signs and symptoms of cold stress are evident.	L
	▪ Noise	▪ Wear hearing protection when operating or working around heavy equipment, powered hand tools, drilling equipment, and/or whenever regular conversation cannot be carried out at arms' length. ▪ Maintain hearing protection in a clean and reliable condition, ▪ Inspect hearing protection prior to and after use. Repair or discard damaged or deteriorated hearing protection.	L
	▪ Fire	▪ Refrain from smoking outside of the designated smoking area. ▪ Do not fill generators or gas cans in truck beds or areas where combustibles are present. ▪ Ensure the fill spout remains in contact with the fill port during refueling.	L

Equipment to be Used	PPE	Training Requirements	Inspection Requirements
▪ Trucks/Vehicles ▪ Heavy equipment ▪ Fire extinguisher(s) ▪ First aid kit(s)	Level D: ▪ Long sleeve pants and shirts, class two high-visibility safety vest or shirt ▪ F2413-compliant safety boots extending to ankle or higher ▪ Gloves ▪ ANSI Z87.1-compliant safety glasses or googles	***Site-Specific:*** ▪ 40 hr-OSHA HAZWOPER ▪ 8-hr HAZWOPER refresher ▪ Adult first aid and CPR ▪ Bloodborne Pathogen competency training within the past 12 months	***Site Inspection:*** ▪ All equipment will be properly stored, inspected, and/or maintained according to the manufacturer's requirements. ▪ Equipment will be inspected by a qualified person daily, prior to use. ▪ Records of inspections will be maintained by the SSHO.

ACTIVITY HAZARD ANALYSIS

ACTIVITY Heavy Equipment and Earth Moving Machinery Operations

Job Steps	Hazards	Controls	RAC
	▪ Hard hat ▪ NRR30 (or better) hearing protection	***Motor Vehicles:*** ▪ Operators will hold a valid license for the type and class of vehicle they are operating	

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Appendix C
Forms

ATTACHMENT CONTENT REDACTED

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List of forms included in this attachment:

Safety Forms:

- Daily Safety Briefing;
- Safety and Health Deficiency Tracking Log;
- Mishap Notification and Investigation (ENG Form 3394);
- Site Specific Training;
- Visitor Sign-In Log;
- Heavy Equipment Insepction; and
- Vehicle Insepction.

Note, the forms provided in the Attachment are the formats planned for use, but these forms may need to be altered to accommodate project specific elements during project execution.

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Appendix F
Environmental Protection Plan

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FINAL
ENVIRONMENTAL PROTECTION PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawaiʻi

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

Prepared by:

GSI North America Inc.
181 South Kukui St., First Floor
Honolulu, HI 96813

January 2025

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Acronyms and Abbreviations

AOI	Area of Interest
CZM	Coastal Zone Management
DAF	Department of the Air Force
DLNR	Department of Land and Natural Resources
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ft	Foot/Feet
GSINA	GSI North America Inc.
HHAOS	Haleakalā High Altitude Observatory Site
HSP	Health and Safety Plan
IAW	In Accordance With
IfA	Institute for Astronomy
MSSC	Maui Space Surveillance Complex
O&M	Operations and Maintenance
PID	Photoionization Detector
RAWP	Remedial Action Work Plan
SAP	Sampling and Analysis Plan
UH	University of Hawai‘i
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WMP	Waste Management Plan

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Section 1 Introduction

This Environmental Protection Plan (EPP) has been prepared for the Remedial Action (RA) to be performed at the Generator Fuel Spill Site (SS014) located at the Maui Space Surveillance Complex (MSSC), Haleakalā, Hawaiʻi. The EPP was prepared under the requirements specified in the Performance Work Statement under the United States (U.S.) Department of the Air Force (DAF) contract number FA8903-24-C-0008.

The purpose of this EPP is to describe the approach, methods, and procedures to be employed by GSI North America Inc. (GSINA) and its subcontractors to protect the natural and cultural resources during the performance of tasks associated with the project. Specifically, this EPP describes the procedures and methods that will be implemented during RA activities at Site SS014 to minimize pollution, protect and conserve sacred natural and cultural resources, and control noise and dust within reasonable limits.

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Section 2 Installation Background and Land Use

The Generator Fuel Spill Site (SS014) is located on Pu‘u Kolekole, a promontory, at the western edge of the summit caldera of the Haleakalā volcano on the island of Maui. Site SS014 is located within the MSSC which is located at approximately 10,000 feet (ft) in elevation on the southwestern edge of the crater rim of the dormant volcano Haleakalā in east Maui. The area was used by the National Park Service in the 1920s until the 1940s when the War Department utilized the area. Grading of the area occurred during this time and remnants of solid waste disposal (World War II burn pits) are mapped in the area. In 1961, by State Executive Order, the area was classified as conservation lands and given to the University of Hawai‘i (UH) to manage for the study of astronomy. UH developed plans for the MSSC which were used by the U.S. Army Corps of Engineers to begin construction in 1963, and the complex began operation in 1965 under the Air Force Systems Command.

The MSSC has been an essential site for space surveillance and electro-optical research for over 60 years. The primary use of the MSSC is to perform 24/7 deep space surveillance and satellite tracking, while also supporting research and development projects and collaborating with outside organizations for space-monitoring efforts. Due to year-round excellent viewing conditions and a relatively stable climate, the facility routinely performs deep space observational operations and has the capability of projecting lasers into the atmosphere. MSSC hosts small, medium, and large-aperture tracking optics, including the Department of Defense’s largest optical telescope designed for tracking and imaging satellites, with visible and infrared sensors to collect data on near-Earth and deep-space objects (Space Base Delta I, 2023).

The MSSC is a tenant on the Haleakalā High Altitude Observatory Site (HHAOS) and leases the land from the State of Hawai‘i Department of Land and Natural Resources (DLNR). HHAOS is managed by the UH Institute for Astronomy (IfA) on behalf of the landowner, the DLNR. As part of the lease agreement, any MSSC actions involving ground disturbance or major construction activities must obtain a permit from the Hawai‘i State Office of Conservation and Coastal Lands within the DLNR through a representative from the IfA to include complying with all federal law and regulations.

The 15 Space Surveillance Squadron is headquartered on Maui, operating out of multiple sea level facilities and the MSSC. The 15 Space Surveillance Squadron was activated on 26 May 2022 after the deactivation of the Air Force Research Lab Detachment 15, and reports to the Space Delta 2, Space Operations Command.

The future land use of the MSSC site will likely be to continue to host astronomical research and space surveillance facilities for the foreseeable future. Continued DAF use of the MSSC is contingent on renewals of leases with the Department of Land and Natural Resources and the Federal Aviation Administration in 2031 and 2027, respectively (DAF, 2024). In January 2023, a lightning strike at the MSSC caused a diesel generator to malfunction and spill over 700 gallons of a Jet A-Diesel fuel mixture onto the generator pad and surrounding ground surface. The area of interest (AOI) for this project is approximately 8,490[1] square ft in the vicinity of the MSSC generator release. The site is further defined by the City and County of Honolulu Real Property

[1] *Does not include landfarm area(s).*

Tax Office as tax map key (2) 2-2-007: 008. The AOI is designated as Release Identification 3239 by the State of Hawaiʻi Department of Health Hazard Evaluation and Emergency Response Office.

2.1 Threatened and Endangered Species

The ʻahinahina (Haleakalā silversword, *Argyroxiphium sandwicense subsp. Macrocephalum*) is the only federally listed threatened species with habitat found within MSSC. A 2014 inventory identified 127 individuals throughout the installation, including in landscaped planter boxes, around utility access points, and around the north and south slope boundaries. The species' habitat range is highly restricted and only occurs above 6,900 ft within and around the Haleakalā Crater (Air Force Research Laboratory, 2023). There are no ʻahinahina located within the AOI or the estimated project area of impact, however, the nearest ʻahinahina to the estimated area of impact is approximately 25 ft southeast (Figure 2-1).

Other federally listed threatened or endangered species listed under the Endangered Species Act that are known to fly over or forage within the MSSC include the ʻuaʻu (Hawaiian dark-rumped petrel, *Pterodroma phaeopygia sandwichensis*), nēnē (Hawaiian goose; *Branta sandvicensis*), ʻōpeʻapeʻa (Hawaiian hoary bat; *Lasiurus cinereus semotus*), Blackburn's sphinx moth (*Manduca blackburni*), and yellow-faced bee (*Hylaeus* sp.) (Air Force Research Laboratory, 2023).

The ʻua'u, nēnē, and ʻōpeʻapeʻa are known to fly over the MSSC installation, but they nest and burrow at lower altitudes. ʻUa'u burrows are at elevations lower than MSSC, ranging from about 7,000 to about 9,500 ft. Nēnē live on the slopes of Haleakalā below the MSSC facilities, at elevations of approximately 5,000 to 6,900 ft. The endangered ʻōpeʻapeʻa has been observed across Hawaiʻi at elevations up to 13,000 ft. On Haleakalā, an ʻōpeʻapeʻa was found in the south Haleakalā park boundary fence, another was found near the Kalahaku Overlook at an elevation of 9,200 ft, and several other deceased individuals have been found at about the same elevation. However, the ʻōpeʻapeʻa is not suited to the cold temperatures that often occur at the MSSC. Thus, suitable habitat for nēnē, ʻua'u, and ʻōpeʻapeʻa does not occur in the vicinity of the MSSC and the AOI (KC Environmental Inc., 2010).

Four endangered species of yellow-faced bee (*Hyleaus anthracinus*, *H. assimulans*, *H. facilis*, and *H. longiceps*) are currently found on the island of Maui. The U.S. Fish and Wildlife Service (USFWS) observed yellow-faced bees within the MSSC in recent surveys, though they are more often found on mountain dubautia and pukiawe (*Styphelia tameiameiae*) and other native shrubs throughout Haleakalā National Park (Air Force Research Laboratory, 2023). The endangered Blackburn's sphinx moth (*Manduca blackburni*) is found throughout the eastern Hawaiian Islands, although it is most common on the coastal areas of Maui. The species prefers coastal or lowland dry forest environments up to an elevation of 5,000 feet. The preferred host plants for this species are the native Aiea (*Nothocestrum* sp.), though this species is known to use a variety of nonnative species, including tobacco (*Nicotiana tabacum*), eggplant (*Solanum melongena*), garden tomato (*Solanum lycopersicum*), and jimsonweed (*Datura stramonium*). Although these environments and plant species are not found within or immediately around the MSSC, this species is known to fly and lay eggs near the western summit of Haleakalā Park (Air Force Research Laboratory, 2023).

Refer to Table 2-1 for Federally Listed Threatened and Endangered species known to occur at or near the MSSC.

Table 2-1: Occurrences of Federally Listed Species at MSSC

Species	Federally Listed	MSSC Occurrence
ʻUaʻu (Dark-rumped Petrel, *Pterodroma phaeopygia sandwichensis)*	Endangered	Known to fly over the MSSC
Nēnē (Hawaiian Goose, *Nesochem sandvicensis)*	Threatened	Known to fly over the MSSC
ʻŌpeʻapeʻa (Hawaiian Hoary Bat, *Lasiurus cinereus semotus*)	Endangered	Known to fly over the MSSC
ʻahinahina (Haleakala silversword; *Argyroxiphium sandwicense subsp. Macrocephalum*)	Threatened	There are many on the MSSC, but none within the AOI. The nearest to the AOI is approximately 25 ft southeast (Figure 2-1).
Blackburn's sphinx moth (*Manduca blackburni*)	Endangered	Not found within or immediately around the MSSC, but species is known to fly and lay eggs near the western summit of Haleakalā Park
Yellow-faced bee (*Hyleaus anthracinus*, *H. assimulans*, *H. facilis*, and *H. longiceps*)	Endangered	Observed within the MSSC, though they are more often found on other native shrubs throughout Haleakalā National Park

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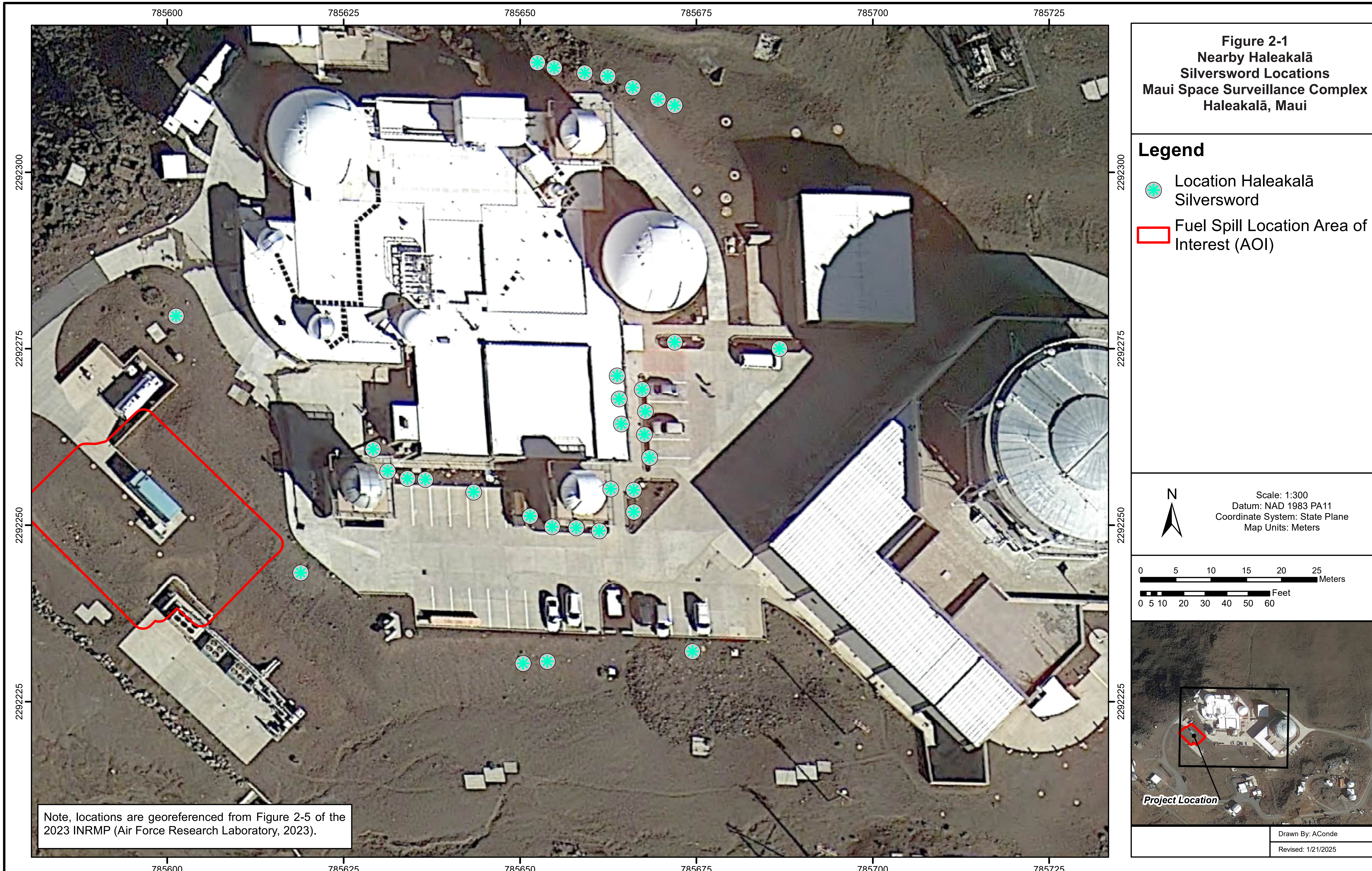

785600
785625
785650
785675
785700
785725
2292300
2292275
2292250
2292225
Figure 2-1
Nearby Haleakalā Silversword Locations
Maui Space Surveillance Complex
Haleakalā, Maui
Legend
Location Haleakalā Silversword
Fuel Spill Location Area of Interest (AOI)
N
Scale: 1:300
Datum: NAD 1983 PA11
Coordinate System: State Plane
Map Units: Meters
0 5 10 15 20 25 Meters
0 5 10 20 30 40 50 60 Feet
Project Location
Drawn By: AConde
Revised: 1/21/2025
Note, locations are georeferenced from Figure 2-5 of the 2023 INRMP (Air Force Research Laboratory, 2023).

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2.2 Hydrological Resources

2.2.1 Surface Water

The nearest surface water body is an intermittent stream approximately 1.9 miles downslope of the MSSC (KC Environmental Inc., 2010). No surface water features were observed within or near the AOI.

The HHAOS is built squarely on Haleakalā’s southwestern rift zone, and surface drainage at the facility is influenced by which side of Haleakalā’s western rift zone water initially drains to. Water draining to the north of the rift zone is likely to continue draining in a westerly direction, while water that initially drains to the south of the rift zone will continue to drain south, with both eventually terminating in the Pacific Ocean.

Stormwater at the MSSC is generated from the surfaces encountered at the facility, including the existing buildings, roads, and parking areas. The HHAOS also has stormwater engineering features such as paved gutters, an asphalt berm, and several culverts that run into an infiltration basin located on the western portion of the facility, acting as a natural sink for the stormwater (UH IfA, 2006). According to the HHAOS Stormwater Management Plan, stormwater at the AOI is primarily controlled via natural drainage paths due to the site’s topography and the native soils can infiltrate the stormwater. Engineered drainage is not present at or near the AOI.

Based on GSINA’s onsite observations and topographic maps reviewed, the topographic gradient and presumed hydraulic gradient is to the west-southwest, towards the Pacific Ocean.

2.2.2 Groundwater

Groundwater resources below the HHAOS are characterized as part of the Kamaole and Makawao systems of the Central sector and the Lualailua and Nakula systems of the Kahikinui sector (Mink and Lau, 1990). Two high-level, unconfined, perched aquifers exist, one on top of the other, in dike compartments. Groundwater in both the upper and lower aquifers are identified as freshwater (containing less than 250 milligrams per liter of chloride) that have the potential for future use as drinking water, but the water was not in use when the aquifer was classified. The upper aquifer is classified as being replaceable and highly vulnerable to contamination while the lower dike aquifers are classified as being irreplaceable and moderately vulnerable to contamination. The AOI is located above the Lualailua Aquifer.

2.2.3 Wetlands

No wetlands are located within or immediately adjacent to the MSSC.

2.3 Wilderness Area

The MSSC is located near but not within the Haleakalā National Park designated wilderness area (i.e., Haleakalā Wilderness Area) or any other designated Wilderness Areas (Wilderness Connect, 2024).

2.4 Cultural, Archaeological, and Historical Resources

The MSSC is situated within the Papaʻanui ahupuaʻa in the traditional moku of Honuaʻula. Haleakalā, especially the summit (including the area on which MSSC resides), is considered sacred to the Hawaiian people and their ancestors. It is a Puʻu Honua (sacred refuge or place of peace), which both Hawaiian ancestors and modern-day Hawaiians believe is a Wao Akua, or place where gods and spirits walk. The sacred class of na poāo kāhuna (priest) used the summit area as a learning center, and in ancient times, commoners could not even walk on the summit because it belonged to the gods. Traditional cultural practices have taken place on Haleakalā for thousands of years and continue to be conducted by Hawaiian people.

Two ahu (altar; shrine) are located at the HHAOS, built in 2005 and 2006, named Hinalaʻanui and Pāʻele Kū Ai I Ka Moku, respectively. These sites are available for use by Native Hawaiians for traditional and cultural purposes (KC Environmental, 2010).

Previous archaeological surveys completed near the Haleakalā summit included the identification of platforms, trails, markers, petroglyphs, and burials, however, no archaeological sites were identified within the AOI. Nonetheless, the summit itself is considered a cultural resource and is eligible for inclusion on the National Register of Historic Places as a traditional cultural property by the State Historic Preservation Division under criterion "a," for its association with the cultural landscape of Maui, reflected in the mele (songs) and legends surrounding Haleakalā, and criterion "c," as a natural summit and location of traditional sacred use.

2.5 Coastal Zones Within Project Site

The AOI is within a designated Coastal Zone Management (CZM) area which encompasses the entire State of Hawaiʻi, as no point of land is more than 29 miles from the ocean. Thus, the site is protected under the Federal CZM program (State of Hawaiʻi Office of Planning, 2011). No specific requirements apply to this project.

2.6 Vegetation Reduction

Vegetation reduction will not be required or implemented during the project as there is no vegetation located within the AOI.

2.7 Waste Disposal

Waste generated during the project will be disposed of as described in the Waste Management Plan (WMP), located in Attachment C of the project Sampling and Analysis Plan (SAP) (Remedial Action Work Plan [RAWP] Appendix D).

Section 3 Proposed Mitigation Measures

The following sections detail proposed environmental protection mitigation measures to be implemented during the project.

3.1 Manifesting, Transportation and Disposal of Waste

No hazardous wastes are expected to be generated as a result of site activities; however, site preparation and sampling activities may require the use of hazardous substances and petroleum products such as diesel fuel, gasoline, motor oil, methanol, or other regulated liquids. These substances may be present in contained conditions as part of internal combustion engines or in designated containers (e.g., labeled gas cans and sample containers). Disposal of diesel fuel or gasoline is not anticipated as most will be consumed during equipment use. However, if the need to dispose of these materials should arise, the Field Manager will coordinate with the Project Manager and ensure that the waste is handled, stored, treated, packaged, and/or transported in accordance with (IAW) Federal, state, and local laws, policies, and regulations.

Appropriate onsite housekeeping practices (e.g., rubbish disposal) will be managed during the course of the project. All generated waste will be collected and disposed of properly off site. Refer to the WMP, located in Attachment C of the project SAP (Appendix D of the RAWP) for details.

3.2 Burning Activities

Open fires will not be permitted during the performance of this project due to the biological and cultural sensitivity of the area. Smoking will not be allowed outside of designated smoking areas and any activities that could potentially produce a spark will be carefully monitored. Fire prevention measures and emergency response plans for fire control are discussed in the Health and Safety Plan (HSP), located in Appendix E of RAWP.

3.3 Dust and Emission Control

Equipment combustion emission sources will include automobiles and heavy equipment. All potential emission sources will be maintained properly and will meet applicable vehicle emissions standards.

Permits for air pollution control are not anticipated to be required for this project.

Any soil moving activities will be limited during high wind events to mitigate dust generation. If dust control measures are required, dust suppression will consist of water application to exposed surface soils from an approved water source. If fugitive dust is observed, water will be applied to minimize worker exposure and migration away from the work area.

3.4 Noise Control **and** *Prevention*

It is expected that this project will generate one primary source of noise: noise from mechanical equipment (e.g., heavy equipment, drill rig, and trucks). To minimize noise resulting from mechanical equipment, the equipment will be powered off when not in use and GSINA will ensure that the manufacturer's engineering controls are in place and functioning as intended.

As noise generated by project activities will be limited to infrequent pulses that are short in duration, GSINA does not anticipate adverse impacts to resident fauna, if any. It is expected that fauna will temporarily avoid the areas where noise is being generated until the activities have ceased.

3.5 Spill Control and Prevention

Refueling of smaller support vehicles (e.g., pickup trucks) will occur at offsite commercial filling stations except in emergency conditions when onsite fueling is required (e.g., to recover a malfunctioning vehicle that would not be able to be relocated otherwise). Gasoline and diesel fuel for equipment fueling may be stored in vehicles or in U.S. Environmental Protection Agency (EPA)-approved portable fuel containers of less than five gallons. As a precaution, spill containment equipment will be stored on site and will be on hand during all phases of the field work in locations where petroleum, oil, and lubricants are present. If a spill occurs, containment and preventive measures will be implemented immediately IAW the HSP (Appendix E of the RAWP).

3.6 Spill Response

Due to the nature of the operations, the potential for a spill of chemicals during operations is low. The highest probability would occur in the event that a vehicle would need to be fueled on site. If this occurs, a catchment pan will be placed under the vehicle. Spill kits will be available on site for immediate cleanup of any oil or hazardous substance release (including fuel and hydraulic fluid from heavy equipment). Refer to the HSP (Appendix E of the RAWP) for spill response measures.

3.7 Storage Areas and Temporary Facilities

Temporary facilities, such as temporary sampling tents and temporary waste staging areas will be established in ways that minimize soil disturbance. GSINA will store temporary sampling tents and associated sampling equipment in the Butler Building at the conclusion of each day of work. All temporary storage and facilities will be removed upon completion of project activities.

3.8 Access Routes

Field operations will not require the construction of new access roads, as there are several previously existing access roads at the MSSC and in the vicinity of the AOI.

3.9 Equipment Decontamination and Disposal

Decontamination fluids (water, light detergent, and residual soil) will be generated during equipment decontamination; however, the volume and concentration of the decontamination fluid will be sufficiently low to allow onsite evaporation in the landfarm. This eliminates the need for offsite disposal and further reduces the amount of soil leaving the summit region.

Any used, disposable equipment (such as Terra Cores®) and used personnel protective equipment (such as gloves) will be placed in contractor trash bags in the Butler Building pending accumulation of suitable quantities, and will be disposed of as municipal waste in an appropriate manner. Refer to the WMP (Attachment C of the project SAP [Appendix D of the RAWP]) for details.

3.10 Minimization of Disturbed Area

To minimize the impacts of vehicles and other equipment within the MSSC, vehicles will remain on existing roads to the extent practicable.

3.11 Post-Activity Cleanup

At the completion of fieldwork, each worksite or sampling location shall be restored to its original condition when possible IAW the project SAP and RAWP. Waste containers, trash, and other waste will be removed. If applicable, investigation-derived waste will be disposed of according to WMP requirements (Attachment C of the project SAP [Appendix D of the RAWP]). Unused or surplus materials and supplies, stakes, flagging, and waste material will be removed as the work is completed.

3.12 Air Monitoring

Air monitoring will be utilized during field activities and as part of sampling activities and ongoing operation and maintenance (O&M) of the bioventing well system. A photoionization detector (PID) will be utilized for field monitoring purposes during the boring and installation of bioventing wells and sampling of soil from borings, to verify the level of personal protective equipment is high enough to protect project personnel. During O&M of the bioventing system, a PID and a multi-gas meter will be used to monitor the presence of appropriate gases to measure trends over time and aid in optimizing remediation. Refer to the project O&M Plan (Appendix G of the RAWP) and SAP (Appendix D of the RAWP) for further details.

3.13 Cultural Resources Management

3.13.1 Archaeological Monitoring

Although previous archaeological research indicates a low probability for encountering archaeological resources within the AOI during the Phase 3 RA activities, out of an abundance of caution and due to the culturally sensitive and sacred significance of the area, archaeological monitoring will be conducted during all ground-disturbing activities performed during the project.

A qualified archaeological monitor will be present during all ground disturbing activities (e.g., soil sampling) associated with the project. If an archaeological site or burial site is inadvertently discovered, all work in the immediate area shall cease and the area will be protected and the DAF Contracting Officer’s Representative as well as appropriate agencies such as the Hawai‘i State Historic Preservation Division will be contacted. If a cultural artifact is identified, it will be inspected by the archaeological monitor and handled IAW the Archaeological Monitoring Plan (Appendix C of the RAWP). Refer to the Archaeological Monitoring Plan for details on archaeological monitoring procedures. Additionally, a cultural advisor/monitor will inspect all soil samples prior to removal from the summit as described in Section 3.13.2.

Prior to mobilization and annually throughout the project, all project personnel (both on site and in office) will also watch the film, "Haleakalā: A Sense of Place" which aims to educate and foster a sense of stewardship for the cultural significance and natural diversity found on Haleakalā (https://amostech.com/haleakala-sense-of-place/). The pre-mobilization and annual review of the video will be documented on a training log form.

3.13.2 Haleakalā Soil Management

The project team recognizes and appreciates the cultural significance and sacredness of the soil on Haleakalā and the concerns of the Native Hawaiian community regarding soil disturbance at the summit and the removal of soil from Haleakalā. No soil will be removed from the MSSC without written permission from the Government. Additionally, before any soil leaves the MSSC, the site cultural advisor will be notified and given adequate time and opportunity to bless the soil before it is packed and shipped to the appropriate laboratory. All soil from a sample not consumed by the laboratory during preparation and analysis will be returned to the MSSC and added to the landfarm for remediation and reuse within the summit region.

To further limit the amount of soil leaving the MSSC, GSINA will perform additional sample preparation in the field as described in the project SAP.

GSINA staff and subcontractors will utilize brushes to brush soil from their work boots before leaving the MSSC each day to prevent soil and soil dust from leaving the Haleakalā summit.

3.14 Ecological Resources Management

Although nēnē, ‘ua’u, ‘ōpe‘ape‘a, yellow-faced bee, and Blackburn's sphinx moth may potentially fly over or forage within the MSSC, they are likely to nest or borrow at lower altitudes and suitable habitat does not occur in the immediate vicinity of the MSSC and the AOI. Therefore, the primary constraints for sampling efforts at the MSSC relate to the conservation and protection of the threatened ‘ahinahina (Haleakalā silversword) which can be found on site, and preventing the introduction of non-native species which could negatively affect native species on site.

3.14.1 Ecological Mitigation Measures

Prior to the commencement of field activities, field personnel will be provided awareness training on all threatened and endangered species in and around MSSC. The briefing will also identify geographic areas of concern (e.g., location of the ‘ahinahina plant located near the AOI [Figure 2-1]). ‘Ahinahina plants will be avoided and will not be disturbed during the RA field activities. If any species are identified within the immediate project work area, the location of the identified species will be avoided and GSINA will notify the DAF, who may consult with the USFWS and DLNR, as necessary.

IAW the MSSC *Integrated Natural Resources Management Plan* (Air Force Research Laboratory, 2023), the following procedures will be utilized to minimize impacts to ‘ahinahina:

- Avoid conducting ground disturbing activities (e.g., any activity having an impact deeper than the 462 soil's surface layer) within 6 feet of individual plants to minimize effects to their shallow, fibrous 463 root system; and
- If ground disturbing activities must occur within 6 feet of individual plants (although not anticipated for this project), GSINA will notify the DAF and the DAF will implement mitigation as required by consultation with the USFWS and DLNR.

3.14.2 Preventing the Spread of Invasive Species to and from the Site

The MSSC site is biologically sensitive. To minimize environmental impacts, the following special protection measures will be implemented:

- Clothing, equipment, tools, and other items brought to the MSSC will be inspected for presence of foreign items that could impact the site (e.g., exotic plants and seeds);
- Equipment and tools will be cleaned prior to being used at the site;
- Equipment and tools will be decontaminated between borings/decision units and before demobilizing from the site, as necessary; and
- Work boots will be brushed before and after each day of work outside of the Butler building to remove any seeds/plants from entering or leaving the site.

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Section 4 References

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Appendix G
Operations and Maintenance Plan

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FINAL
OPERATIONS AND MAINTENANCE PLAN

Environmental Remediation Services to Conduct a Remedial Action at Generator Spill Site (SS014)
Maui Space Surveillance Complex, Haleakalā, Hawaiʻi

Contract No. FA8903-24-C-0008

Prepared for:

Department of the Air Force

Prepared by:

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January 2025

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Acronyms and Abbreviations

%	Percent
AOI	Area of Interest
CH_4	Methane
CO_2	Carbon Dioxide
COPC	Contaminant of Potential Concern
DAF	Department of the Air Force
EAL	Environmental Action Level
ft	Foot/Feet
GSINA	GSI North America Inc.
HDOH	State of Hawaiʻi Department of Health
HEER	Hazard Evaluation and Emergency Response
IAW	In Accordance With
LEL	Lower Explosive Limit
mph	Miles per Hour
MSSC	Maui Space Surveillance Complex
O_2	Oxygen
O&M	Operations and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PG	Professional Geologist
PID	Photoionization Detector
RAO	Remedial Action Objective
RAM	Remedial Action Memorandum
RAWP	Remedial Action Work Plan
SAP	Sampling and Analysis Plan
SWE	Significant Weather Event
U.S.	United States
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

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Section 1 Introduction

This Operations & Maintenance (O&M) Plan was prepared on behalf of the United States (U.S.) Department of the Air Force (DAF), under contract number FA8903-24-C-0008, to document planned O&M activities for the active bioventing system and landfarm at the Generator Spill Site (SS014), Maui Space Surveillance Complex (MSSC), Haleakalā, Hawaiʻi. This O&M Plan also documents annual monitoring to include soil gas testing of bioventing wells and landfarm confirmation soil sampling.

1.1 Background

Site SS014 is located in Pu'u Kolekole, a promontory at the western edge of the summit caldera of the Haleakalā volcano on the island of Maui, roughly 10,000 feet (ft) above mean sea level. Site SS014 is located within the Maui County-owned 4.4-acre MSSC which is located within the 18.2-acre property of the Haleakalā High Altitude Observatory Site. The specific area of interest (AOI) for this project is limited to approximately 5,500[1] square feet in the immediate vicinity of the MSSC generator release. The project site is further defined by the Maui County Real Property Assessment Division as tax map key (2) 2-2-007: 008. The AOI is designated as Release Identification 3239 by the State of Hawaiʻi Department of Health (HDOH) Hazard Evaluation and Emergency Response (HEER) Office, and as Generator Spill Site (SS014) by the DAF.

On 29 January 2023, a fuel storage tank for an emergency generator released approximately 700 gallons of fuel onto the generator pad and the surrounding soil at the MSSC, on the summit of Haleakalā. This spill consisted of a roughly 80/20 mixture of diesel and Jet A (ultra-refined kerosene and is predominantly C9-C16 hydrocarbons) fuel, respectively. Due to the elapsed time since the spill, the lower molecular weight Jet A components have largely evaporated, with the heavier diesel fuel remaining in the soil at the site.

The active bioventing system, specifically designed for Site SS014, constitutes a crucial component of the overall remediation strategy. This system is designed to address the specific characteristics of the site's contamination profile and geological features. The implementation of this bioventing system is anticipated to expedite the biodegradation of target contaminants, thereby accelerating the site's return to unrestricted conditions. The active bioventing system will be comprised of the FALCO 300 (catalytic oxidizer), a 10-horsepower blower system, unit housing (a storage container), and a network of 10 individual bioventing wells. Refer to Section 5.7 of the project Remedial Action Work Plan (RAWP) for additional information.

1.2 Purpose

The purpose of this O&M Plan is to provide a detailed guide for the optimal O&M of the Site SS014 active bioventing system. The plan aims to equip site operators with the necessary information for routine operations and system upkeep. The plan is also designed to ensure that the system operates within the bounds of safety requirements and environmental compliance, thereby

[1] *Does not include landfarm area(s).*

maximizing its effectiveness in remediating the site. Lastly, this plan provides a schedule for ongoing monitoring and confirmation sampling at Site SS014.

1.3 Objectives

The overall Remedial Action Objectives (RAOs) established for the site and presented in the Remedial Action Memorandum (RAM) are developed to be protective of human health and the environment and prevent exposure to diesel range organics and associated contaminants of potential concern (COPCs) (identified in Table 3-1 of the RAWP) at the site via the ingestion, dermal contact, and inhalation of particulates exposure pathways at concentrations above Environmental Action Levels (EALs). The RAOs include the following:

- Achieve cleanup of in-situ soil to below site-specific (restricted) EALs (shown in Table 2 of the RAM or Table 3-2 of the RAWP) and below Tier 1 EALs (shown in Table 3 of the RAM or Table 3-2 of the RAWP) for supersacked soil; and
- Minimize potential adverse impacts to the community and the environment during implementation of the remedial action (DAF, 2024).

The objectives of this O&M Plan are to:

- Provide clear procedures for system use;
- Outline regular maintenance tasks to maintain system integrity and reliability;
- Document sampling schedules; and
- Establish protocols for monitoring system performance.

1.4 Performance Metrics

To meet bioventing remediation objective (i.e., decrease the diesel fuel/Jet A concentrations in the underlaying soil and rock to assist in achieving the RAO) and evaluate the effectiveness of the active bioventing system, this plan identifies key performance metrics. These include:

- Measuring the reduction and/or stabilization of target contaminants in site soil gas;
- Monitoring the rate of airflow and oxygen concentration to ensure they are at optimal levels for microbial degradation[2]. Active bioventing will promote aerobic degradation of hydrocarbons, but it should be noted that anaerobic degradation (which is a slower process) is likely currently occurring as well, especially in the subsurface where anaerobic conditions may exist; and
- Maintaining operational stability. Refer to Section 2.2 for stability metrics.

Regular assessment against these performance metrics is crucial for understanding the system's impact and guiding any necessary adjustments.

[2] *Optimal levels will be determined after baseline data is collected.*

1.5 Baseline Data

The foundation of this O&M Plan is site baseline data, which is data collected prior to the active bioventing system start-up. Baseline data includes initial contaminant concentrations in soil and soil gas (via both handheld meters and passive sampling), soil characteristics, and the status of indigenous microbial populations, all of which will be collected during the Phase 3 Remedial Action and O&M activities. Refer to the RAWP for details on the Phase 3 Remedial Action activities. Additionally, historical environmental conditions at the site are evaluated to provide a comprehensive backdrop against which the active bioventing system's performance will be measured. This baseline data is essential for ongoing evaluation, enabling the identification of trends and the effectiveness of the bioventing process over time. Regular updates and evaluation of the biweekly (i.e., every other week) field instrument data and annual passive sampling data are key to the continuous improvement of the system's O&M strategies.

Baseline soil samples will be collected from the landfarm after landfarm construction. Thereafter, confirmation soil samples will be collected from the landfarm annually as discussed in Section 3.3. Also, refer to the RAWP and Sampling and Analysis Plan (SAP) (Appendix D of the RAWP) for details on landfarm soil sampling.

The ground surface of the region where the MSSC is located is composed mainly of post-shield stage cinders and lava eruptions of the preceding eruptive phase, termed the Kula series (Kolekole cinder cone). The substrate beneath the facility consists of about 100 ft of alkalic pyroclastic cinders originating from a vent roughly 300 ft west of the MSSC (Figure 3 in Appendix A of the RAWP). Inter-bedded ankaramite basalt lava flows are present deeper beneath the MSSC (National Response Corporation/US Ecology, 2023). The U.S. Department of Agriculture (USDA) Soil Conservation Service and University of Hawai‘i Agricultural Experiment Station classifies the site as 100 percent (%) cinder land, referring to a ground surface with a presence of cinders, or small fragments of erupted basaltic rock that contains numerous vesicles and is typically composed of excessively drained paragravel from 0 to 60 inches (USDA, 2023). Soil within the AOI comprises native material used as fill following site gradings. Vegetation at the site is extremely limited, due to high altitude, low humidity, and young age.

Screening samples collected during the Phase 2 Site Characterization and Alternatives Evaluation indicated the COPCs referenced in Table 1-1 were present in AOI soil. No known contamination was present within the AOI prior to the January 2023 fuel release.

Table 1-1: Soil COPCs

Contaminants	USEPA Testing Method[1]	Analytes	Contaminant Sources/Rationale
Total Petroleum Hydrocarbons	8015D	Diesel Range Organics	Approximately 700 gallons of fuel was released from the generator onto the generator pad and surrounding soil.
Benzene, Toluene, ethylbenzene, and xylenes	8260D	Benzene, ethylbenzene, toluene, xylenes	

Contaminants	**USEPA Testing Method[1]**	**Analytes**	**Contaminant Sources/Rationale**
PAHs	8270E	1-Methylnaphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene	PAHs such as naphthalene and alkylbenzenes make up approximately 25% of diesel fuel. Jet A fuel is ultra-refined kerosene and is predominantly C9-C16 hydrocarbons.

Notes:
[1] U.S. Environmental Protection Agency (USEPA) methods listed follow the current Department of Defense Quality Systems Manual
PAH - Polycyclic Aromatic Hydrocarbon

Site SS014 is expected to have an established microbial population due to the time elapsed since deposition (Hadland et al., 2024). Bacteria and fungi within the soil will metabolize the hydrocarbons as their food source, provided sufficient oxygen is available to use as the electron acceptor. The metabolic status of the subsurface will be evaluated in the initial collection of soil vapor samples from the well screen intervals prior to venting of the wells (refer to the project SAP for additional details).

Section 2 Initial Operations and Maintenance

This section presents details of initial data collection, system start-up, and vacuum testing.

Installation and start-up of the active bioventing system will follow the general steps below:

1. Boring and installation of bioventing wells (refer to Section 5.4 of the RAWP);
2. Allow wells to passively vent;
3. Close the well caps, then complete an initial round of soil gas sampling to gather data on site conditions prior to operating the active bioventing system (Section 2.1);
4. The FALCO 300 system will be built off site (in normal, stable conditions) in a piece-wise fashion, and transported to the site, where the system will be installed;
5. System start-up (Section 2.2);
6. Conduct a system test according to the vendor-supplied manual (Attachment A). This test will measure stable operation of the system (Section 2.2);
7. Run 70-80% bleed air through the system. The bleed air is used to dampen the flow (Section 2.2);
8. Conduct vacuum testing to gauge the area of influence (Section 2.2.1); and
9. Biweekly (i.e., every other week) field monitoring of bioventing wells (Section 3.2).

Adjustments may be made based on field observations.

Landfarm holding cell construction and establishment is described in Section 5.5 of the project RAWP.

2.1 Data Collection

The following information will be collected from the site ambient air and wells’ headspace during both passive venting and active bioventing system operation:

1. Weather information including temperature, windspeed and direction, barometric pressure, and barometric pressure trends;
2. Field instrument readings from each well for:
    a. Temperature and barometric pressure, to better understand in-ground conditions, using a handheld precision digital barometer/thermometer;
    b. Volatile organic compounds (VOCs), as an approximation of the mass of volatile hydrocarbons being mobilized into the vapor phase and transported to the well, using a combination photoionization detector (PID) /lower explosive limit (LEL) meter;
    c. LEL (Pentane) to monitor the emission of hydrocarbon vapors from the petroleum material remaining in the site subsurface. This measurement will be used to monitor potential explosive hazards and an indication of the presence

of the volatile fraction remaining in the subsurface when combined with the PID and methane (CH_4) monitoring results;

d. Oxygen (O_2), as an indicator of the amount of O_2 circulating through the subsurface and to the well, using a multi-gas meter;

e. Carbon dioxide (CO_2), for information regarding hydrocarbon metabolism rates (used to adjust the venting rates to optimize the system), using a multi-gas meter;

f. CH_4 as a percentage of LEL, for information regarding hydrocarbon metabolism rates and particularly the reduction of CO_2 to CH_4, using a multi-gas meter;

g. Vacuum pressure, using a manometer;

h. Field instrument readings from active bioventing system influent main line for pressure differential, temperature, and flow rate; and

i. Field instrument readings from active bioventing system discharge main line for the same parameters listed in (h) above.

3. Initial and annual soil vapor passive sampling of bioventing wells using passive soil vapor samplers provided from the laboratory (refer to the RAWP Section 5.8 and SAP for details on soil vapor sampling); and
4. Initial baseline landfarm soil samples (including microbial deoxyribonucleic acid samples) and annual confirmation soil samples of landfarms will be collected (refer to Section 3.3).

The data described above will be recorded on the appropriate field forms (Attachment B).

2.2 System Start-Up

Initial, short-term operation will utilize passive bioventing until the FALCO 300 system is installed and the electrical service is active. Active bioventing system start-up at the site will commence following FALCO 300 installation.

System start-up will follow the general steps provided below. The specific active bioventing system start-up, shutdown, operation, maintenance, and troubleshooting procedures are provided in the vendor-supplied manual (Attachment A).

1. The venting well valves will be fully closed and the air bleed line fully opened;
2. The FALCO 300 will be started and run through a warm-up sequence according to the manufacturer’s procedures (Attachment A). Start-up needs to be slow and dilute to avoid overloading the system; and
3. The active bioventing system will be allowed to run for a minimum of 48 hours during a system test to confirm the system will operate stably. Stable operation includes electrical stability (no power surges or brownouts), stable operation of the blower, stable operation of the FALCO 300 oxidizer unit, and ensuring the system can run without automatically turning off due to some malfunction or overload (of power, vacuum, or temperature).

Once system stability is achieved, GSI North America Inc. (GSINA) will conduct a vacuum test of the active bioventing system as described in Section 2.2.1.

2.2.1 Vacuum Test

A vacuum test will be conducted following baseline soil vapor sample collection and completion of the FALCO 300 installation and system test.

The vacuum test includes vacuum pulling on every well screen interval for the eight venting and extraction wells (the four well groups upslope, near the generator), and measuring the effect of applied vacuum (using a manometer) on all other well screen intervals (not under vacuum) to understand the radius of influence for each well screen interval. The two venting wells downslope will only be monitored for inlet effects and will not be placed under system vacuum. An example data sheet for the testing of each well screen interval is provided in Attachment B.

The FALCO 300 system will be either shut down or placed on full bypass mode overnight during this testing phase. The daily conditions at the site and in the wells will be monitored according to Section 2.1.

Once the vapor concentrations in each well screen interval and the vacuum testing results for all nested well screen intervals are determined, an operating venting sequence plan can be determined, if needed. It may be necessary to sequence venting from the wells to flow more air through the unavailable parts of the subsurface. This would possibly include adding a venting cap to an extraction segment to allow air down well and through the subsurface as needed. By doing so, the flow through the subsurface can be altered to control the locations and move air in the desired direction to get the desired effects.

The maximum flow capacity of the system will be calculated using the blower curve for the system. The estimated operating flow from the subsurface will be estimated using the vacuum measurements for each of the well segments and the vacuum measurement of the bleed/dilution air valve to reach a total for the system with the bleed/dilution air proportion used to account for the amount of flow that is not coming from the ground. The system flow estimates may need to be revised during the project as the flow from the outlet wells is adjusted during the project. The system flow estimates will be utilized in the estimation of volatile and semi-volatile compound mass removal from the subsurface due to advection by the venting system (Section 3.6).

Completion of the vacuum test marks the end of the system start-up phase. Following the vacuum test, the active bioventing system will be run continuously as described in Section 3.

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Section 3 Long-Term Operations and Maintenance

This section details active bioventing system long-term O&M activities, though the vendor-supplied manual (Attachment A) shall be used as the primary reference source for maintenance procedures. General long-term monitoring activities are also summarized below.

3.1 Schedule

The active bioventing system is expected to be operated for three to five years to meet the project RAOs (Section 1.3). Analytical samples (e.g., soil vapor and landfarm soil) will be collected annually to track contaminant reduction trends. O&M inspections and field monitoring will be conducted on a biweekly (i.e., every other week) basis by GSINA’s Maui-based subcontractor upon completion of the vacuum test. General monthly and annual O&M tasks will be conducted in conjunction with biweekly inspections as described in the following subsections.

GSINA’s Professional Geologist (PG) will conduct quarterly site visits during remediation activities. A summary of planned O&M activities and field monitoring is provided in Table 3-1.

Table 3-1: O&M Schedule Summary

Activity	Conducted By	Biweekly[2]	Monthly	Quarterly	Semiannual	Annual
Soil Vapor Sampling	GSINA					X
System Inspection	Local subcontractor[1]	X				
Collection of PID/ Multi-Gas Meter, LEL, Manometer, Barometer/Temperature Meter Readings	Local subcontractor[1]	X				
System Adjustment (as needed for optimization)	Local subcontractor[1]	X				
Prepare and Submit O&M Reports	GSINA		X			
Landfarm Turning	Local subcontractor[1]				X	
Landfarm Confirmation Sampling	GSINA					X
Inspection for Damage to Holding Cells	Local subcontractor[1]	X				
Ensure Covers on Landfarm are Properly Attached	Local subcontractor[1]	X				
Maintenance and Repairs on Landfarm	Local subcontractor[1]					X[3]
Site Visits	GSINA PG			X		

Notes:
[1] Subcontracted by GSINA as the prime contractor. GSINA will ensure that the local Maui-based subcontractor is qualified and properly trained to perform the O&M activities.
[2] Every other week
[3] Maintenance and repairs of the landfarm will also occur on an as needed basis.

Furthermore, GSINA will monitor the site remotely via an online weather service for significant weather events (SWEs). An SWE is defined as meeting one or more of the following criteria, as predicted by a reputable weather service at least 24 hours prior to rain commencement:

- Precipitation exceeding 0.40 inches per hour or 1.0 inches within a 24-hour period; and/or
- Sustained wind greater than 40 miles per hour (mph) and/or gusts greater than 58 mph.

When an SWE is predicted, GSINA's Maui-based subcontractor will conduct additional O&M inspections within 24 hours (weather and safety-permitting) both prior to and following SWEs. Field monitoring of remediation progress using a PID/LEL combined meter and multi-gas meter will not be conducted in conjunction with additional SWE O&M inspections.

Active bioventing system and landfarming operations will be monitored in accordance with (IAW) the schedule provided in Table 3-1 to ensure the system is operating as designed and within the appropriate operating ranges, and to optimize the system to expedite site clean-up. Additionally, GSINA or its Maui-based subcontractor will inspect holding cell integrity both before and after SWEs.

3.2 Bioventing System

3.2.1 System Inspections

Biweekly (i.e., every other week) system inspections will be conducted to verify the active bioventing system is in working order and functioning as intended, collect PID and multi-gas readings from each well to monitor the remediation process by measurement of the hydrocarbon and metabolic gases, and adjust the system as needed for optimization per Section 3.4. Biweekly (i.e., every other week) inspections will comprise the following activities:

- Verify and document internal blower gauge readings are within operating parameters;
- At each wellhead, measure:
  - Vacuum using a manometer;
  - Temperature/pressure using a handheld barometer/thermometer;
  - O_2/CH_4/CO_2 using a multi-gas meter; and
  - VOCs and LEL using a PID/LEL combined meter (LEL calibrated with pentane).
- Adjust the system as directed by GSINA's technical lead, as needed;
- Walk above-ground electrical conduits and check for signs of damage;
- Inspect system components for indications of corrosion and/or damage and repair as needed. The blower filter will be checked and changed as necessary;
- Check condensate accumulation and empty drum into cuttings landfarm, as necessary. A 55-gallon drum (knockout drum) will be used to collect water/condensate from the extraction wells. Water is expected to be minimal and will be emptied as needed into the cuttings landfarm for onsite evaporation. Note, the knockout drum will have a high level

shutdown switch that will shut down the bioventing system if water in the drum reaches a specified level to prevent any water from entering the blower system and into the catalyst;

- Collect operational data from the system control panel (e.g., temperature stability);
- Collect field instrument readings from active bioventing system influent main line for pressure differential, temperature, and flow rate; and
- Collect field instrument readings from active bioventing system discharge main line for the same parameters listed above for the influent main line.

Specific monthly O&M activities include:

- Preparing and submitting O&M reports; and
- Biweekly activities as listed above.

Specific quarterly O&M activities include the following:

- Site visit by GSINA PG during remediation; and
- Biweekly activities as listed above.

Specific annual O&M activities include the following in addition to the biweekly, monthly, and quarterly activities:

- Collect passive soil gas samples as described in the project SAP; and
- Biweekly activities as listed above.

The following conditions are cause for reporting to the Project Manager, Engineers, and System Operators:

- Active bioventing system or Heat Exchanger Variable Frequency Drive failure/motor overload;
- Active bioventing system high condensate drum level;
- Active bioventing system line high vacuum; and
- System shut-down.

Routine maintenance will be performed as needed IAW manufacturer recommendations. Routine maintenance includes:

- Checking for physical damage to the wellheads and venting lateral;
- Checking that the temperature control is functioning properly and that the system is in a safe temperature range;
- Ensuring the venting valves are still set on their previously marked settings;
- Checking for storm damage or rockslides;
- Inspecting the control panel; and
- Draining the knockout tank.

Specific active bioventing system O&M procedures and start-up, shutdown, and troubleshooting procedures will be documented in the vendor-supplied active bioventing system O&M Manual, to be provided with the turn-key system upon final completion (Attachment A).

3.2.2 System Configuration Changes

Upon request and written approval by the DAF, a bypass around the oxidizer can be accomplished as long as the untreated vapor stream is diverted and not run through the cold oxidizer. To utilize the bypass it would be necessary to confirm that hydrocarbons or any regulated vapors are not being exhausted directly to the atmosphere rather than through the oxidizer. Therefore, potential use of the bypass can likely only occur either in the very late stage of the project or to test the blower after a repair using full bleed air instead of the feed from the wells. Any changes to the system will need to be documented (in writing and the system vendor must be notified) and a warning label will need to be posted to the FALCO control panel not to operate the blower package. The purpose of implementing the bypass would be for energy management/conservation purposes so that the oxidizer is not used. If the oxidizer needs to be run again, all system components can be put back into the original configuration. The return to the original system configuration will also be documented.

The steps to obtain the bypass (i.e., using the 10-horsepower blower package for venting through carbon) are presented below[3]:

- Follow all lock out and tag out procedures;
- Disconnect the 3-inch steel union between the blower discharge and the oxidizer inlet and cap the inlet piping to the oxidizer to prevent animals or debris from entering. Connect piping between blower discharge and carbon. If the FALCO 300 discharge stack is removed, make sure the top of the heat exchanger is capped to prevent rain/debris from entering;
- Turn the heater and VCV switches to the OFF position. Turn the heater breaker OFF;
- Disconnect the two red wires from the bottom of terminal blocks 52 and 53 in the FALCO 300 control box enclosure and protect wire ends with wire nuts. Install a jumper wire across these same terminal blocks (52 and 53);
- Remove the knob on the Vapor Control Valve and remove VCV guards. Remove VCV belt, reattach knob, and turn knob counter-clockwise until beam starts to move toward box. Reinstall guards. In this position the valve will be open to process (wells), and closed to dilution air;
- With the jumper installed, the VCV closed position interlock is bypassed and the blower will start when the FALCO 300 power switch is turned ON; and
- The FALCO control panel must have a WARNING label affixed to the front panel stating that the oxidizer CANNOT be operated with the blower package until the jumper is removed and all modifications have been changed back to original configuration.

[3] *Note, Falmouth Products does not recommend running untreated/unheated vapor through the oxidizer*

3.3 Landfarm

GSINA or its Maui-based subcontractor will inspect holding cell integrity both before and after SWEs. Repairs to holding cells will be made on an as-needed basis to maintain landfarm integrity. Every six months, GSINA's Maui-based subcontractor will draw back the cover sheeting on each landfarm and turn the soil within each holding cell, starting six months following initial construction.

Specific annual O&M activities include the following:

- Collect landfarm confirmation samples:
  - One year after construction, GSINA will collect confirmation samples IAW with the project SAP.
- Any necessary maintenance and repairs.

Specific semiannual O&M activities include the following:

- Draw back the cover sheeting on the landfarm and turn the soil within each holding cell, every six months, starting six months after initial construction.

Specific biweekly (i.e., every other week) O&M activities include the following:

- Inspecting for damage to holding cells; and
- Ensuring covers are properly attached.

3.4 Active Bioventing System Data Analysis and System Adjustments

Physical and chemical field data will be used to verify that each well is performing as designed, gauge progress toward achieving the project RAO, and optimize system performance. GSINA's technical lead will compare field data to that from previous biweekly (i.e., every other week) checks to identify any trends that may suggest a well's performance is decreasing and whether a corrective measure is required.

Field monitoring results will be examined for trends, including the amount of vacuum being pulled, the approximate area of influence that a particular well segment is treating, and whether there are anaerobic zones in the subsurface. Based on data trends, GSINA's technical lead will determine if system adjustments or operational changes are needed to improve efficiency and to maintain performance towards the RAO. Additionally, vapor headspace readings should remain below 10% of their LEL before wells are put under vacuum (applies to non-venting wells only).

Field monitoring results from individual wells will be used to recommend system adjustments to optimize mass recovery. System effectiveness will also be evaluated based on soil gas analytical data, which will be available on an annual basis. Refer to Section 5.5.2 of the project SAP for more information. Field monitoring should indicate rapidly decreasing PID readings and analytical concentrations following a first order decay rate.

Routine monitoring will be performed on the concentrations of oxygen, carbon dioxide, and methane in the venting wells along with the PID/Explosimeter during the bi-weekly servicing and measuring the hydrocarbon concentrations with the passive vapor testing conducted per the intervals specified in this plan. There will be continuous information received regarding the metabolic state of the subterranean microbial ecosystem so adjustments of the system can be made, if needed.

The cumulative monitoring results will indicate what the subsurface conditions are within each well segment. The optimum flows will need to be determined for the ecosystem using the in well progress monitoring results of oxygen, methane, carbon dioxide, and humidity.

The categories to manage the system to keep it in balance will generally be:

1. Is the metabolic system aerobic and in equilibrium (just right)?;
2. Is over venting and desiccating the subsurface environment and inhibiting the metabolism occurring?; and/or
3. Is underventing with the system being metabolically inhibited due to anoxia occurring?

The carbon dioxide is used as the respiration tracer. The methane is used as the anaerobic conditions tracer to indicate underventing. oxygen is used as the basis for comparison of the carbon dioxide and methane vs the ambient air. humidity will be used to monitor for overventing.

The carbon dioxide measurements vs. oxygen are expected to decline over time as the hydrocarbons are consumed and at some point become non-detectable using the meters. The observed carbon dioxide measurements will need to be compared to the passive soil vapor monitoring results over time.

Adjustments may include:

- Vacuum adjustments to individual active bioventing system wells through manual valve adjustments. This will provide flow rate adjustments in the screened intervals to increase or decrease mass flow through selected subsurface regions;
- Changes to the system extraction rate of the blower through adjustment of the dilution valve or bleed air valve; and
- Flow rate adjustments to groups of wells (if possible) through manual valve adjustments, based on monitoring results.

Specific corrective measures, system adjustments, and operational changes will need to be decided upon by GSINA's technical lead, based on field observations by GSINA or GSINA's local Maui-based subcontractor and monitoring results.

3.5 Landfarm Data Analysis

Confirmation soil samples will be collected from the landfarm annually to monitor remediation progress towards achieving the project RAO. For statistical analysis, field replicates will be collected. Treated soil that has reached the project RAO will be spread elsewhere at the MSSC per the direction of DAF. Refer to the RAWP and SAP for details on landfarm sampling/analysis and decision logic.

3.6 Reporting

GSINA's Maui-based subcontractor will complete field forms during each site visit to document O&M activities and observations (Attachment B). GSINA will provide a monthly O&M report to the DAF within 14 days of site activity, documenting field activities and conditions for the most recently completed biweekly (i.e., every other week) site visit, ensuring each biweekly event is captured in an O&M report.

The cumulative site soil investigation and vapor monitoring results will be used to estimate the subsurface hydrocarbon mass present prior to initiating the bioventing and at quarterly and annual intervals using the cumulative field gas meter readings of oxygen, methane, and carbon dioxide combined with the passive vapor testing results of volatile and semi-volatile hydrocarbon and constituent concentrations in each of the wells for the monitoring interval. The results will be used to estimate the bioventing treatment progress and to estimate the mass removal of volatile and semi-volatile hydrocarbons and constituents by the venting system.

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Attachment A
FALCO 300 Manual

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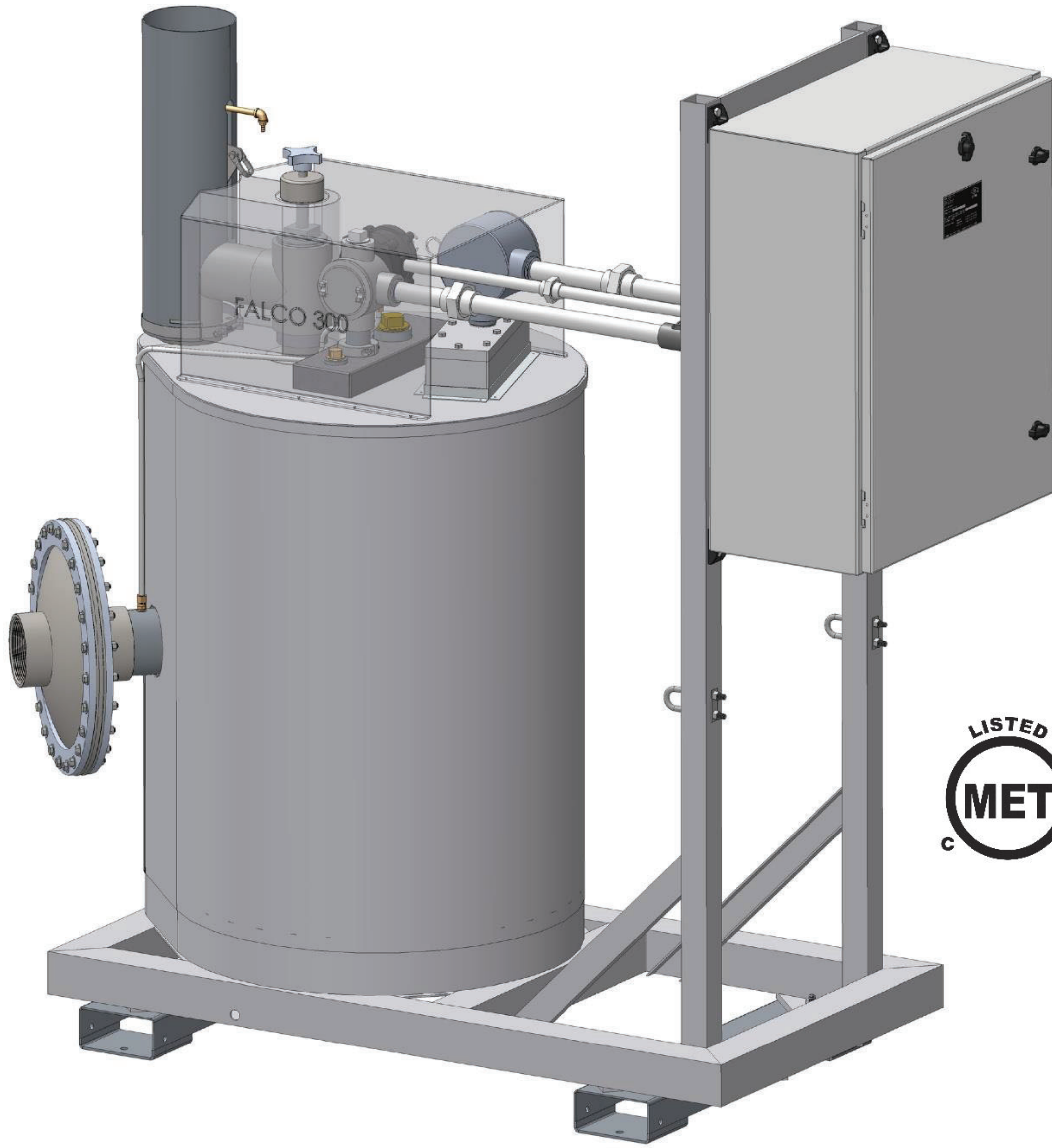
FALMOUTH PRODUCTS CATALYTIC OXIDIZER

FALCO 300

Installation and Operations Manual



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Technical Assistance: 508-548-6686

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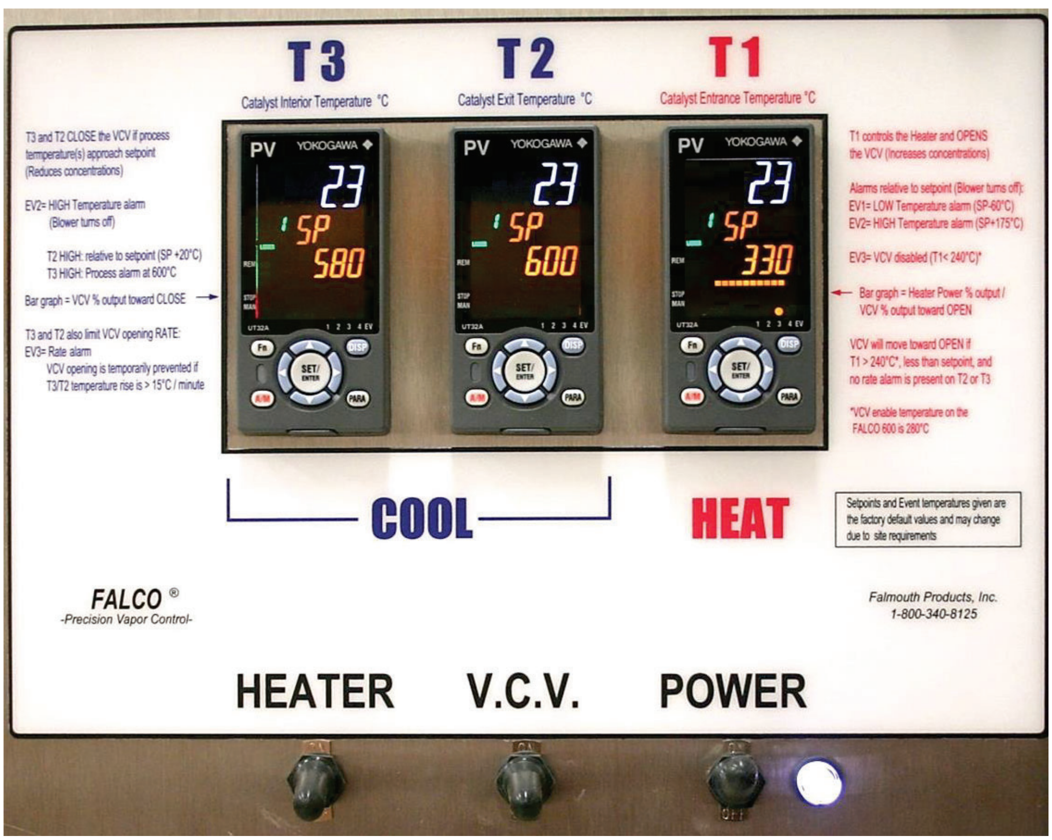
FALMOUTH PRODUCTS FALCO 300 CATALYTIC OXIDIZER

INSTALLATION AND OPERATIONS MANUAL

FALMOUTH PRODUCTS CATALYTIC OXIDIZER (FALCO) converts hydrocarbon contaminates in an air stream to carbon dioxide and water vapor. Combustion occurs in the temperature range 300°C-620°C.
Heat is transferred from the hot exhaust stream to the incoming contaminated air, heating it to the catalytic oxidation temperature. This manual covers models delivered after 7-1-22.

FALCO is equipped with three programmable controllers. One controller (T1) monitors and responds to a thermocouple sensing the temperature at the upstream end of the catalyst. The second controller (T2) monitors and responds to a thermocouple sensing temperature downstream from the catalyst. The third controller (T3) senses the temperature at an intermediate position inside the catalyst. The T3 controller provides a rapid response to increasing vapor concentration by increasing dilution air and shutting the system down if necessary. (See figure 3)

The three controllers regulate the temperature of vapor entering the catalyst. The T1 controller regulates an electric heater, which adds heat to the incoming flow when required. The controllers are programmed to shut down the system if selected temperature limits are exceeded, and also cooperate in the regulation of a *Vapor Control Valve* (VCV) that controls the input vapor concentrations to the FALCO 300.



Auxiliary relays in the T1, T2, and T3 controllers shut down the system if the thermocouple temperatures move above or below the setpoints by selected amounts. If the Vapor Control Valve (VCV) does not respond rapidly enough to an increase in vapor line concentration, T2 and T3 will increase to their alarm settings and turn off the system.
FALCO is also equipped with a pressure switch, which interrupts the heater circuit if flow is interrupted.

Safety Messages

Read this manual and all the warning labels. Follow instructions carefully.
Safety instructions include hazard alert symbols and words (**Warning** or **Caution**).
The symbols have the following meanings:

Lisez ce manuel et toutes les étiquettes d'avertissement. Suivez attentivement les instructions.
Les consignes de sécurité incluent des symboles et des mots d'alerte (Avertissement ou Attention).
Les symboles ont les significations suivantes:

This symbol indicates **HIGH VOLTAGE**. When you see this symbol it means that items or operations could be dangerous to you or others using this equipment. Read the message and follow instructions.

*Ce symbole indique ia **HAUTE TENSION**. Lorsque vous voyez ce symbole, cela signifie que des choses ou des opérations peuvent être dangereuses pour vous ou d'autres utilisateurs de cet équipement. Lisez le message et suivez les instructions.*

This symbol is the "Safety Alert Symbol".
It will occur with the two signal words **WARNING** and **CAUTION** as described below:

Ce symbole est le « symbole de danger ».
*Cela se produira avec les deux mots-indicateurs **WARNING** et **CAUTION** décrits ci-dessous:*

WARNING:
Indicates a potentially hazardous situation, which, if not avoided can result in serious injury or death.

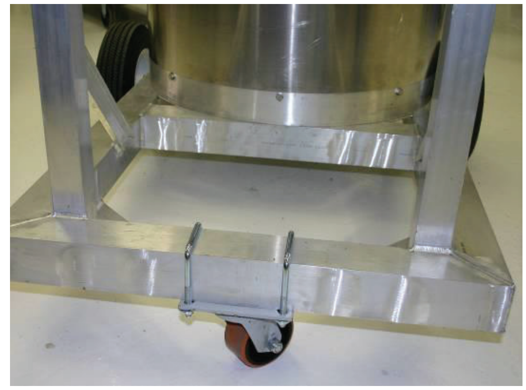
Indication d'une situation potentiellement dangereuse qui, si elle n'est pas évitée, puisse conduire aux blessures graves, ou mortelles.

CAUTION:
Indicates a potentially hazardous situation, which, if not avoided can result in minor to moderate injury or equipment damage.

Indication d'une situation potentiellement dangereuse qui, si elle n'est pas évitée, puisse conduire aux blessures mineures à modérées ou des dommages matériels.

TRANSPORTATION & STORAGE

The FALCO 300 weighs approximately 875 pounds with the flame arrestor. FALCO is weatherproof while in operation. When FALCO is in storage it should be kept dry. The unit should be transported and moved around on site carefully. FALCO 300 may be supplied with tires mounted on steel axles and a front castor wheel.
The axles may be inserted into holes in the frame to ease in **manual** transportation around the site.



WHEN FALCO IS NOT OPERATING, ALL OPENINGS MUST BE COVERED.

INSTALLATION

Operating Environment (-10ºF to 110ºF)

The FALCO 300 is approved by MET Labs for installation in Class I, Division 2, Group D, (Temp Code T2C) hazardous locations extending up to 41 inches from the bottom of the frame. Portions of the oxidizer located outside of this area are only suitable for unclassified / non-hazardous locations.

The FALCO 300 must be installed in a well-ventilated area. The FALCO 300 heater uses an SCR power control to switch the heaters. A heat sink on the back of the control box dissipates heat away from this power control. Airflow through the heat sink must not be restricted. If the FALCO 300 will be installed where ambient temperatures exceed 110ºF, contact Falmouth Products to discuss strategies for cooling this heat sink to prevent failure of the power control. Installation in hot locations with high sun load requires a sun shield above the control box.
Do not insulate the control box.

The VCV is MET Labs approved for use in Class I, Division 2, Group D Hazardous Locations (indoor or outdoor).

Place FALCO on a level surface in a **secure** area. Figure 4 illustrates a view of a typical installation.
In cold climates all vapor lines should be protected from freezing by heating cable and insulation.

Additional ratings:
- Altitude up to 2000m
- %RH 80% up to 31°C (88°F), derated to 50% at 40°C (104°F)
- Overvoltage Category II
- Pollution Degree 2

Stack Installation (Figure 18)

The FALCO 300 is supplied with a 5 foot section of 6" Type B gas vent pipe (Hart and Cooley 6RP5) and rain cap (Hart and Cooley 6RHW) for installation on the exhaust stack. Attach cap to top of vent pipe, then insert bottom of pipe (end with T-bolt) over the exhaust stack until fully engaged. Tighten T-bolt clamp until vent pipe is fully secured. Stack should not be installed directly adjacent to combustible materials or power lines. Stack discharge temperature may be as high as 330°C (626°F).

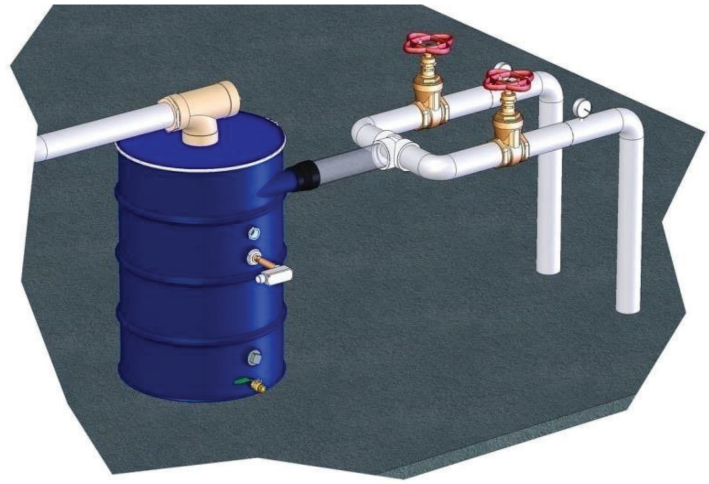
PVC Piping to Vacuum Side of Blower

Beginning at the vapor lines, the **PVC** piping should be installed as follows:

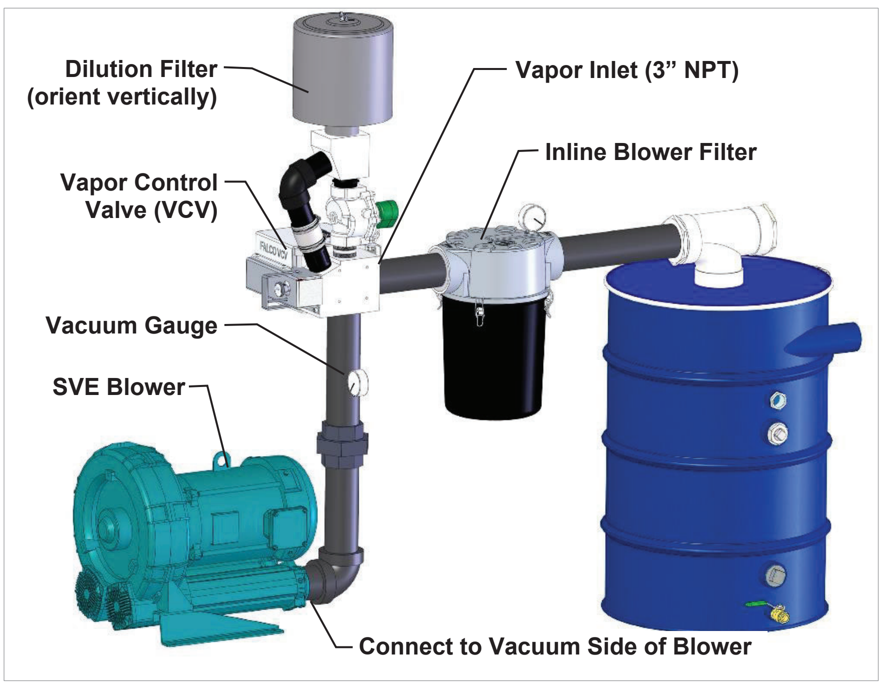
1. Install valves on each separate vapor line. These lines should each be equipped with sample and vacuum ports.

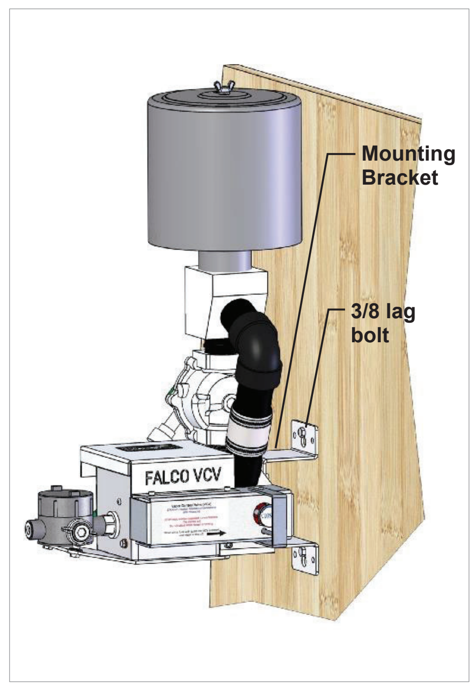
2. Combine the vapor lines together into a single line and install a piece of clear PVC so water may be seen entering the knockout.

3. Run this main vapor line through a large capacity water knockout (30 gallons minimum).



4. Install the Vapor Control Valve (VCV) in series with the vapor line **after** the water knockout. The VCV should be mounted so it can be easily removed for service and will not be damaged. **Install the VCV with its filter vertical, vapor inlet horizontal, and the vapor discharge on the bottom of the valve**.





CAUTION: If the VCV is installed inside a building with a ventilation system, the VCV dilution air filter must be piped to the outside of the building to prevent the ventilation system from pulling vapors out the dilution air filter and into the building when the FALCO shuts down.

5. Install a vacuum gauge between the VCV and the blower. Install a filter on the vacuum side of the blower. For operation in cold climates, all piping on the vacuum side of the blower, including the water knockout, must be insulated and heating cable installed.

Steel Piping On Pressure Side of Blower and Flame Arrestor Installation

Note: Minimize the use of galvanized pipe and Teflon based pipe thread sealant. They may damage the catalyst. Use Rectorseal™ #5 pipe thread sealant on all pipe threads.

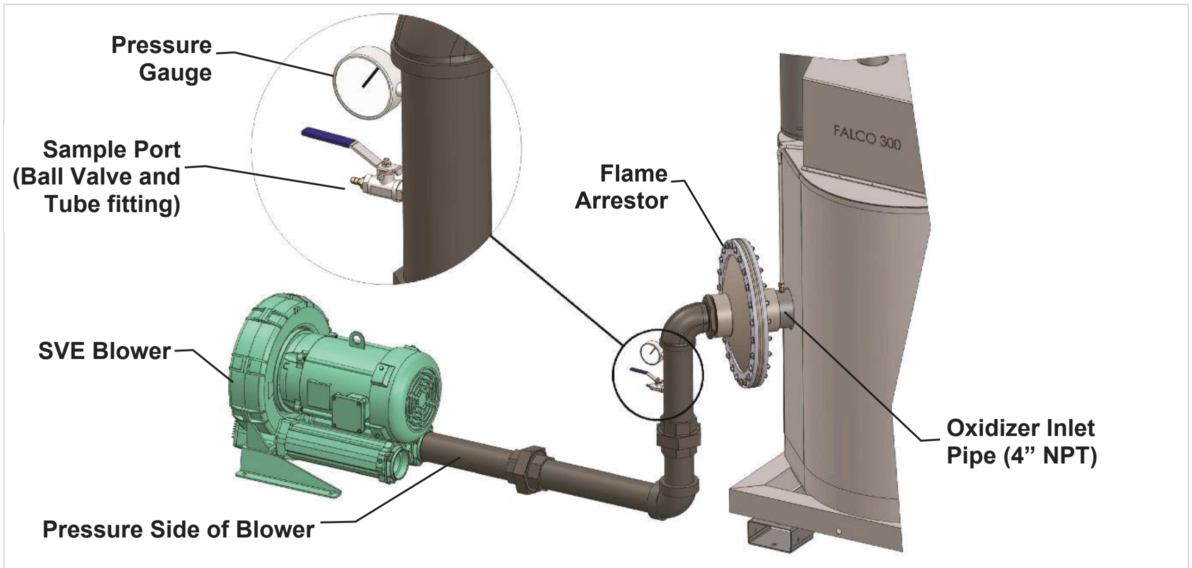
Apply sealant to threads of 4" oxidizer inlet pipe then screw flame arrestor onto inlet. Screw a 4" x 3" reducer bushing into the flame arrestor inlet.

Adapt the discharge piping from the blower up to 3-inch pipe. For ease of installation and reduced time it is advantageous to locate the blower parallel to and next to the catalytic unit. (See figure 4).

When the oxidizer is mounted close to the blower use 3" steel **non-galvanized** piping**.**

If the oxidizer is mounted more than 10' (total pipe length) away from a regenerative blower, use *at least* 5' of steel pipe for blower heat dissipation. If blower discharge temperature is not expected to be high, the piping may be finished with schedule 80 PVC pipe to the oxidizer. If a PD blower or other type of blower is used, steel pipe is recommended for the full distance.

Include in this steel piping (schedule 80 PVC piping in some cases as mentioned earlier) an influent sample port and a pressure gauge.



Water (Soil Vapor Extraction applications)

Most vapor recovery operations produce some water. While water vapor is not a problem, **liquid water can damage the catalyst. If water is left in the equipment for long periods it may cause damage.**
If water is run into the equipment contact Falmouth Products to discuss removal.
The following strategies minimize the transportation of water.

1. Slant vapor lines downhill toward the vapor wells.
2. Avoid low points that might accumulate slugs of water. If low points cannot be avoided, provide a means for draining accumulations.
3. In cold climates, install heating cable and insulate pipe that is not buried.
4. Install a water knockout upstream from the blower. Install a vacuum gauge. A bouncing vacuum gauge often means there is a slug of water in a vapor line. Install a high level switch in the knockout drum.
5. Site check intervals should not exceed the time for water to fill the knockout.

ELECTRICAL POWER CONNECTIONS

WARNING: Hazardous voltage can cause severe or fatal injury. This equipment must be installed and grounded by qualified personnel per the National Electric Code and local codes.

WARNING: This equipment should not be modified either physically or electrically. Do not drill holes in the top or sides of the control box. This allows water to enter the control box. Temperature controllers are fragile! Do NOT get them wet or allow metal chips to enter their cases or they will be damaged.

Control Box to Breaker Box

FALCO control box is connected by rigid metal conduit to the breaker box (not supplied). Two hubs are supplied on the bottom of the control box. Explosion proof seal fittings must be installed in line with the conduit just below the control box and the breaker box.

Three circuits feed power to FALCO 300 through the rigid conduit.
All wires used should be stranded copper wire. Do not secure feed wires to yellow thermocouple wires.
Note: Wire sizes are provided as a reference only. All wiring should be in accordance with the National Electrical Code.

1. A *70 amp, three pole* (208-240 volts three phase) breaker supplies power to the electric heaters (20,300-27,000 watts) through three #6 wires. (Optionally the heater can be wired for operation at lower power levels). The heater load is **56 amps @ 208 volts** and **65 amps @ 240 volts**.

2. A second three-pole breaker (size depends on blower horsepower) supplies power to the blower.

3. A third 15-amp single pole 120-volt breaker supplies power to the controllers and relays through two #12 wires.

4. A # 6 grounding wire is run from the FALCO control box grounding bar through the conduit and attached to a ground in the breaker box.

Feed Conduit

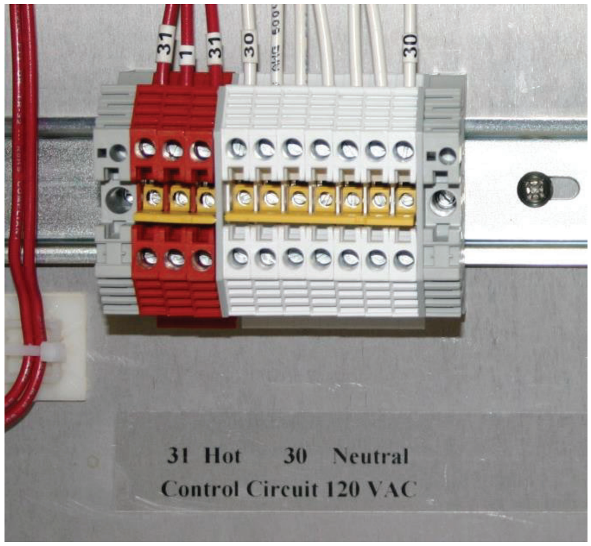
Install rigid conduit with seals between the breaker box and the control box.

Pull the following nine wires through the conduit:

- Three #6 wires for the heaters.
- Three wires appropriately sized for the blower.
- One pair of #12 wires for the controls.
- One #6 ground wire.

Control Circuit

The (120-volt) control circuit is wired as follows: Locate the power distribution block on the rear control panel (terminals 30 and 31). The Neutral lead (white) is attached to the bottom of terminal #30 and the Hot lead (colored) is attached to the bottom of terminal #31.

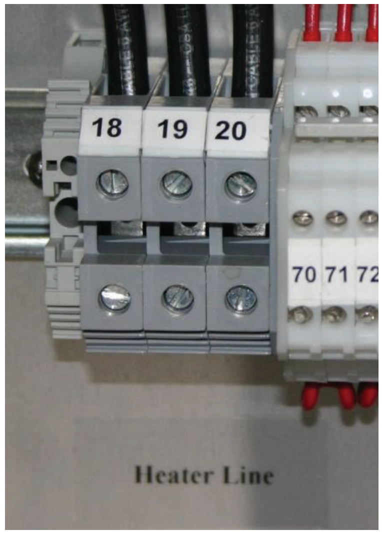


Ground

FALCO is grounded as follows: Locate the grounding bar on the bottom of the FALCO control box.
Install a grounding wire (Green # 6) from the bar, through the conduit to a ground inside the breaker box.

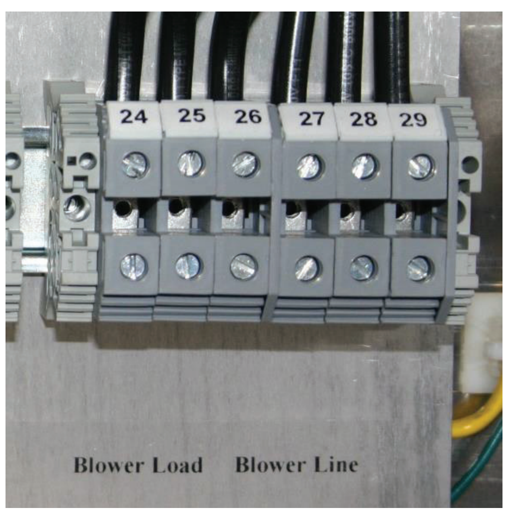
WARNING: Hazardous voltage can cause severe or fatal injury.
This equipment and interconnected parts must be properly grounded per the National Electric Code and local codes.

Heater
Wire the heater feed wires as follows: Attach three #6 gauge wires to terminals **18**, **19**, and **20** located on the lower left side of the rear panel in the FALCO control box.



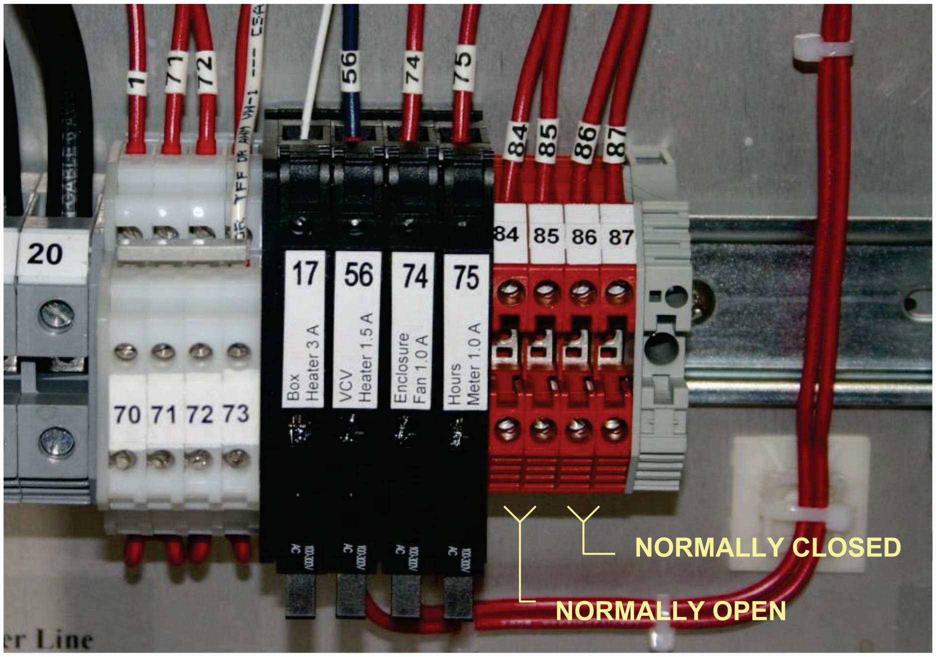
Blower
The following presents two methods for wiring the extraction blower: In the first case, the line voltage for the blower is switched directly by the blower contactor in the FALCO control panel. In the second case, the blower contactor auxiliary contacts (84 and 85) control a remotely mounted motor contactor, which controls the line voltage to the blower. Blower thermostat wires may be connected to terminals 72, and 73 (remove the jumper if installed).

Case #1 Locate terminals **27**, **28**, and **29** on the lower right side of the rear control panel in the FALCO control box. For three phase power, these three terminals should be supplied with power from the breaker box.
The blower load is attached to the corresponding load terminals **24**, **25**, and **26**.



Note: The standard FALCO 300 is supplied with a motor starter with a **three-phase** overload relay.
If a single-phase blower is used, and the line and load are run through the motor starter,
a single-phase starter and overload relay must be installed.

Case #2 If a separate, remotely mounted blower contactor is used, it must be interlocked with the blower contactor in the FALCO control panel. A pair of normally open dry contacts (terminals 84 and 85) is provided on the bottom of the rear panel. These contacts are closed when the FALCO is running, and open when an alarm is tripped (FALCO blower contactor opens). Interlock the remotely mounted starter by connecting its coil wires in series with terminals 84 and 85.



Caution: The Blower contactor in the FALCO control box MUST control the vapor extraction blower! Failure to properly interlock the vapor extraction blower with the FALCO Blower contactor may result in catastrophic equipment damage and possible release of untreated vapors.

Blower Conduit

Install conduit with seals between the blower and the control box. Install an explosion proof union at the blower so it may be removed for service.

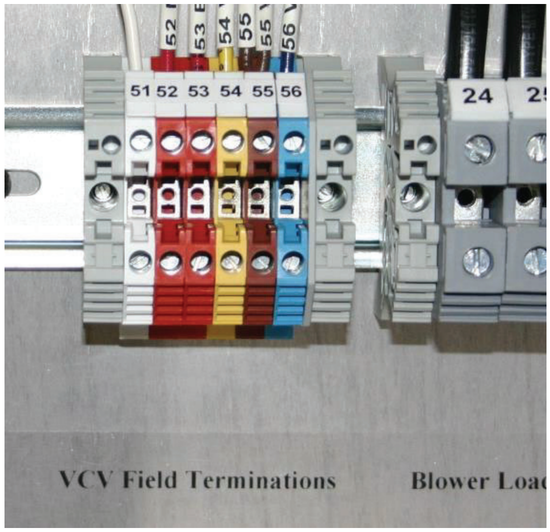
Blower Ground

Ground the blower as follows: Install a ground wire (green) from the case of the blower through the conduit and attach it to the grounding bar inside the control box.

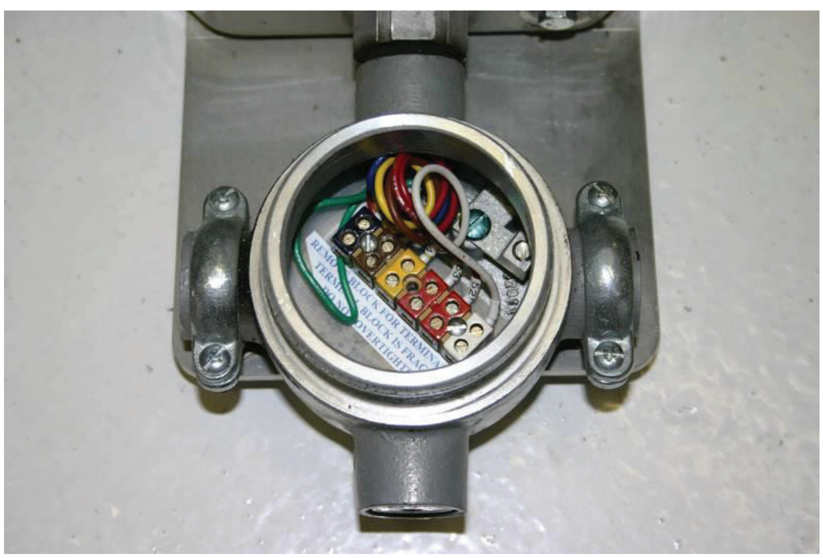
Vapor Control Valve (VCV)

1. Install 1/2" rigid conduit with a seal fitting between the FALCO control box and the VCV conduit body.

2. Pull seven # 16 gauge wires (two red, one white, one yellow, one brown, one blue, and one green) through the 1/2" rigid conduit. In the FALCO control box (lower right hand side), make the following terminations: Connect the six wires (two red, white, yellow, brown, and blue) to the corresponding terminal blocks # 51, 52, 53, 54, 55, and 56). Connect the ground wire to the grounding bar in the FALCO control box.



3. Unscrew the round VCV conduit body cover and locate the white, reds, yellow, brown, blue and green wires that were previously pulled into the box through the 1/2" conduit. Connect these wires to the corresponding terminal blocks inside the VCV conduit body. Connect the green wire to the grounding lug. Do not open the PVC VCV enclosure.



4. Verify correct VCV operation as outlined in the ***Startup*** procedure (see page 17).

Water Knockout High-Level Switch (optional wiring)
The FALCO control panel has a pair of terminal blocks (70 and 71) that may be used to wire a high-level switch. These terminals are factory wired in series with the control wiring (31) so that if the switch is activated, the FALCO and the extraction blower will shut down (temperature controllers will not be illuminated). When this happens, the VCV returns to its closed position before the extraction blower is allowed to start.

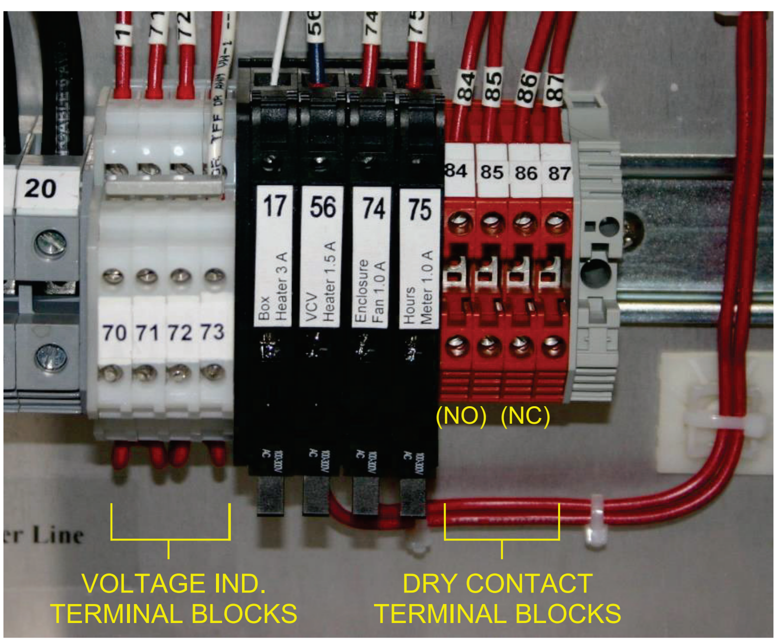
To integrate a high level switch, a conduit (and seal) must be installed between the switch and FALCO control panel. Feed a pair of wires through the conduit and connect them to the bottom of terminal blocks 70 and 71 (remove the jumper).

Emergency Stop and Other Shutdown Devices (Optional wiring)
The FALCO control panel has another pair of terminal blocks (72 -73) that may be used to wire an emergency stop switch, blower thermal wires or other shutdown device (see picture below). These terminals are factory wired in series with the control wiring (31) such that if the switch is activated, the FALCO and the extraction blower will shut down. When power is returned, the VCV returns to its closed position before the extraction blower is allowed to start.

To integrate a remote shutdown device, a conduit should be installed between the switch and FALCO control panel. Feed a pair of wires through the conduit and connect them to terminal blocks 72 and 73 (remove the bottom jumper). NOTE: A panel mounted E-Stop switch is factory wired into the top of terminals 71 and 72.

An indicator light is present on terminal blocks 70-73 to indicate voltage. If power is interrupted by any device connected to these terminals, the light will go out on all terminals numbered before that device. (For example, if the E-stop switch connected to blocks 71 and 72 opens, the lights on terminals 70 and 71 will go out.)

Auxiliary Contacts (optional wiring)
Auxiliary dry contacts are provided 84, 85 (NO) and 86, 87 (NC) that change state when the contactor is activated. These contacts (10 A @ 120 VAC) may be used to signal a PLC, sparge compressor or other remotely mounted device.



Temperature Controller Retransmit Wiring (optional wiring)

Each temperature controller utilizes its own internal 15V DC power supply to create a **4-20 mA** DC retransmit signal.

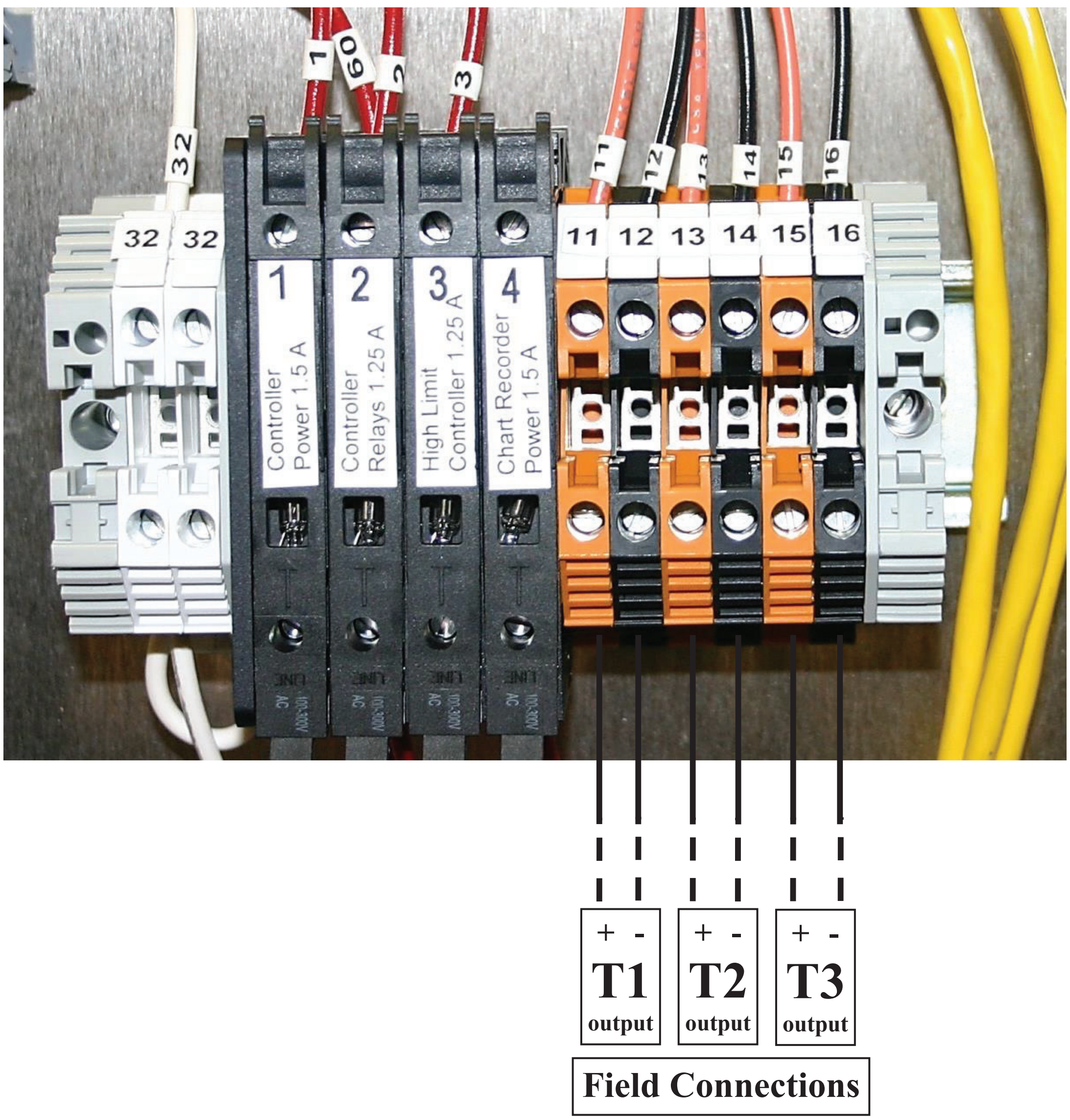
Do not attach an external power supply!

This 4-20 mA signal may be used to retransmit the displayed temperature reading from the temperature controller to a remote device (current loop load resistance of 600 Ω or less) with a scale of **0 to 700 °C**.

The retransmit terminals (11-16) are provided for field connections on the FALCO front panel:

- Terminals **11** and **12** (T1) Catalyst Entrance Temperature
- Terminals **13** and **14** (T2) Catalyst Exit Temperature
- Terminals **15** and **16** (T3) Catalyst Internal Temperature

For conversion to a 1-5 Volt DC signal, a 250 Ω precision resistor must be wired across each set of terminals.



CONTROLLER OPERATION (Figure 9)

The control parameters have been set by FALMOUTH PRODUCTS before delivery. With the exception of the temperature setpoints, control settings will normally not be changed by the operator. If circumstances indicate a need to change controller programming, consult with Falmouth Products.

The setpoints are adjusted on the controllers by first pressing the SET/ENTER button. This will cause the setpoint to flash. Adjust the setpoint with the arrow buttons, then press the SET/ENTER button again to lock in the new setpoint.

Alarms on the temperature controllers turn off the system (blower and heater) if the temperature limits are exceeded.

Alarm limits and setpoints

If the process temperatures exceed the following limits the system shuts down (blower turns off).

On the T1 controller the alarm settings are **+175°** and **-60° C**, relative to the T1 setpoint (deviation alarms). Blower shutdown occurs if the T1 process temperature exceeds the T1 setpoint by 175°C (EV2 light), or drops below by 60°C (EV1 light).

T1 setpoint 330°C **High alarm SP+175, shutdown 505°** **Low alarm SP-60, shutdown 270°**

On the T2 controller the alarm setting is **+20°** relative to the T2 setpoint (deviation alarm). Blower shutdown occurs (EV2 light) if the T2 process temperature exceeds the T2 setpoint by 20°C.

T2 setpoint 600°C **High alarm SP+20** **shutdown 620°**

Blower shutdown occurs (EV2 light) if the T3 process temperature exceeds 600°C (process alarm).

T3 setpoint 580°C **High alarm 600°** **shutdown 600°**

Alarms causing a shutdown will change the display color from white to red. Also, a message describing the cause of the alarm will scroll across the upper display and alternate with the process temperature.
For example, if the T1 setpoint is 330° and the temperature drops to below 270°, the blower will shut down, the upper display will turn red, and the message "BLOWER OFF-LO TEMP" will scroll across the upper display.

Note: On initial startup, FALCO enters a ramp mode and the T1 low alarm is bypassed until the shutdown temperature is reached.

To clear alarms, change the setpoint to be within the alarm limit and press the **Fn** button. If a high alarm is tripped, and the T2 or T3 temperatures exceed their setpoints, restart the system by cycling the power switch (turn the POWER switch to the OFF position for a minimum of 5 seconds). On power up, the VCV will return to its closed position before the blower will operate.

Heater High Limit Control

A high limit controller is provided to protect the heater from over temperature. This controller is located behind the front panel in the upper right corner.

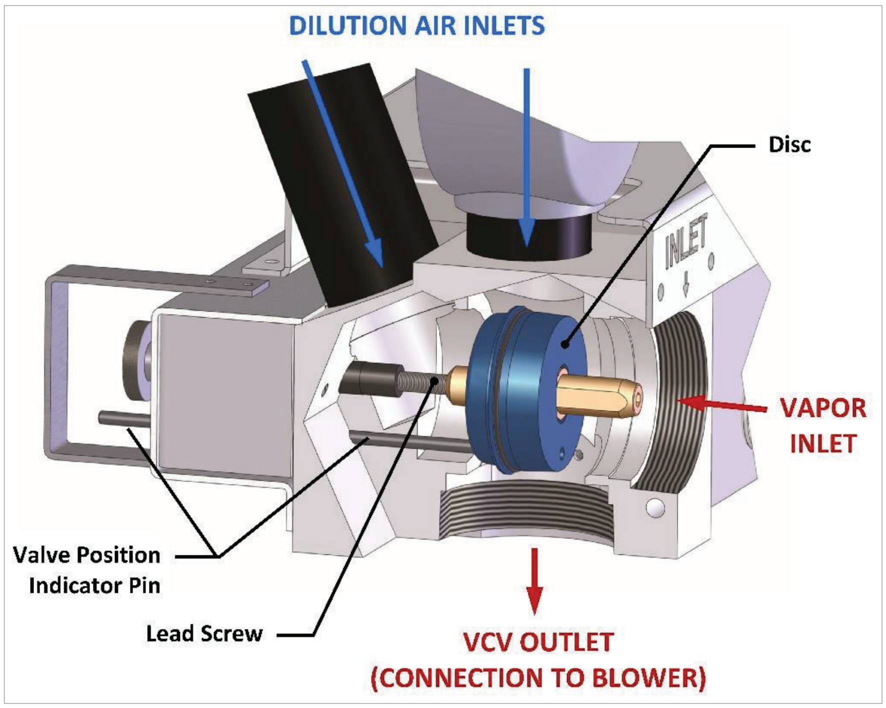
The high limit setpoint is factory set at **480°C**. If the heater exceeds this temperature, the alarm will open the limit contactor and disable the heater. The limit controller display will also change from green to red. If this alarm trips, contact Falmouth Products before resetting.

DISCUSSION OF UNIT OPERATION

Vapor Control Valve (VCV)

The Vapor Control Valve (VCV) regulates inlet vapor concentrations to the oxidizer. It is an essential part of the control system and **must** be operational for safe operation of the oxidizer. A sprocket on the VCV motor drives a chain, which adjusts the valve toward open or close.

The VCV (figure 5) consists of a valve body which includes a valve disc, two valve seats and a motor. The motor opens and closes the valve in response to input from the three temperature controllers. The valve simultaneously regulates dilution air and source vapors by moving the valve disc. A solenoid valve is supplied for rapid introduction of dilution air, regardless of valve position.



Note: An indicator pin on the side of the valve shows valve position. When the pin is fully extended, the vapor line is conductive and dilution air is closed off. When the pin is flush with the guard, the vapor line is closed and full dilution flow is available.

Operation of the VCV is automatic. The VCV is integrated with the temperature control system to automatically control system warm up, introduction of vapors, and temperature modulation.

The T1 controller regulates the electric heater and increases vapor concentrations by opening the VCV (HEAT). The T2 and T3 controllers decrease vapor concentrations by closing the VCV (COOL). Rate alarms (EV3 light) on the T2 and T3 controllers limit the rate of temperature increase. If the T1 controller calls for heat and the catalyst bed has reached the temperature where vapors can be introduced (240°C), the VCV will open, and increase vapor concentrations (HEAT). If the T2 or T3 process temperatures approach their setpoint, the VCV will close to reduce concentrations (COOL). When the T2 or T3 controllers close the VCV, the solenoid on the VCV will simultaneously open.

Vapor introduction

Prior to the introduction of vapors, the catalyst is heated to a reactive temperature. Once the catalyst is hot, concentrations are gradually introduced by the VCV. Vapor oxidation results in a temperature rise across the catalyst. Catalyst temperature takes several minutes to reach equilibrium after a change in concentration. The higher the concentration of vapor, the greater the temperature rise (ΔT) or T2-T1. During start up, the control system and the VCV regulate this temperature rise. Alarms on the controllers turn off the blower and heaters if set temperature limits are exceeded. Temperatures exceeding 650ºC damage the catalyst. Vapors must be fed in gradually.

CAUTION: On initial startup when concentrations are unknown restrict individual vapor line valves before starting FALCO. Valves can be further opened (after shutdown) once control stability and concentrations are confirmed.

CAUTION: Manual adjustment of the VCV is not recommended. If a vapor line is opened too quickly the automatic controls may not respond fast enough to prevent overheating and damage to the catalyst. Vapor sources or SVE wells must not be switched or adjusted while the blower is running!

Switching vapor sources

Vapor sources or SVE wells must not be switched while the blower is running!
If this is done, a lean well may be closed, or a rich one opened, resulting in a dramatic change in concentration. The new vapor level may exceed the ability of the control system to protect the oxidizer. This can result in permanent damage to the equipment.

When switching vapor wells, first turn off the power switch. Next, configure the wells as required, and then turn the power back on. Automatic switching can be accomplished this same way by turning off the unit control power at terminals 70 and 71, switching vapor wells, and then turning power back on. The VCV returns to the full dilution (vapors closed) position before the blower restarts.

STARTUP

1. Configure supply vapor lines as desired. (Supply valves should not be adjusted while system is in operation).

If this is the first time the system has been started, the VCV must be tested (see below). Close the vapor supply lines (or disconnect piping to the inlet of the VCV) before turning on the power switch.

2. Close the heat exchanger bypass valve (see figure 6).

3. Turn the Power switch on (Cycle switch if controller(s) flash alarms).
   EV3 will be lit on the T1 controller until T1 reaches 241ºC (this is normal and indicates that the unit has not reached the temperature required for the introduction of vapors).

4. Adjust the setpoints to: T1=330ºC, T2=600ºC, and T3=580ºC
5. Turn the VCV and Heater switches on.
6. Verify the VCV is closing (knob turning clockwise and indicator pin moves in). If the VCV is fully open, automatic closure will take 8 minutes. If the VCV is already closed, the pin is flush with the guard and the blower will start without delay.

CAUTION: When the VCV valve reaches its closed position, the blower starts automatically.

Confirm blower direction and airflow through the oxidizer. Verify flow by opening the influent sample port. A pressure gauge prior to the flame arrestor is useful for estimating flow rate (When the FALCO 300 is cold **19" H_2O** inlet pressure equals approximately 300 scfm).

7. FALCO enters a ramp mode on initial start up and the T1 low alarm is bypassed.

8. Once the blower is running, warm-up is automatic. EV3 (rate alarms) may flash on T3 and T2 intermittently.

9. When T1 temperature reaches 241ºC, the VCV starts opening (introducing vapors).

VCV OPERATION TEST

Close supply vapor lines or temporarily disconnect piping to inlet of VCV.

Test 1: Verify the VCV begins opening (knob turns counterclockwise and pin moves out) once the T1 process temperature reaches 241ºC.

Test 2: Temporarily lower the T1 setpoint to 220ºC (press SET/ENTER button, use arrow keys, and press SET/ENTER again). Temporarily lower the T3 setpoint 20º below the T3 process temperature. After 10 seconds the VCV will close (knob turns clockwise and pin moves in). The VCV solenoid should also open (a snap will be heard). After verifying this, adjust the T3 setpoint back to 580ºC. Adjust the T1 setpoint back to 330ºC (this may trip a low alarm on T1).

Test 3: Turn the power switch on the FALCO control panel to the off position and open supply vapor lines. Turn power back on. Verify that the VCV is returning to its closed position. Blower should start when VCV is closed.

If VCV operation is incorrect, check the wiring between the FALCO control box and the VCV.

CAUTION: Correct VCV operation is essential! Do not operate with an incorrectly installed VCV. If you have a problem call Falmouth Products **508-548-6686**.

10. Observe temperature rise on the T3 controller. Ascent is limited by rate alarms (EV3) on the T2 and T3 controllers. Temperatures may oscillate slightly before steady state operation is achieved. Time is required to reach new equilibrium temperatures after the VCV valve changes position. T3 provides early indication of increased concentrations, and responds by preventing the VCV from opening, and if necessary closing it.

    Several minutes are required after an adjustment in concentrations to see an effect on T2.

11. When T1 temperature reaches or exceeds its setpoint, startup is complete.

System operation is automatic. The vapor extraction blower is prevented from starting until the VCV fully closes. Each time power is cycled, or an alarm is tripped, the VCV valve automatically returns to its closed position and the startup sequence repeats.

After the VCV reaches the closed position, a proximity switch enables the motor starter and the blower starts. When the blower starts, the unit heats up to the minimum temperature for the introduction of hydrocarbons. When the electric heater is on, the bar graph on the T1 controller will display the % power output (each bar represents 10%). Also, the HEATER INDICATOR light located below the SCR controller is lit. During warm up, the EV3 light is lit on the T1 controller. This indicates the unit has not yet reached the temperature required for the introduction of vapors.

When the T1 process temperature reaches 241°C the EV3 light goes out, and the VCV begins to introduce vapors. The rate at which vapors are introduced is controlled by rate alarms on the T2 and T3 controllers. Temperature ascent greater than 15 degrees/minute interrupts the VCV opening adjustments. When the ascent rate declines to below 15 degrees/minute, the rate alarm self-clears and vapor introduction resumes.

Once up to operating temperature, the unit regulates input concentrations based on heater demand. Each time the T1 controller demands heat to maintain the T1 setpoint (330°C) the heater/VCV output % increases (displayed on bar graph) and the VCV will open to increase concentrations. As source concentrations decline over time, the VCV will eventually open completely (dilution air closed and vapor line open). A proximity switch disables the open circuit once the VCV is fully open.

CAUTION: Manual adjustment of the VCV is not recommended. If a vapor line is opened too quickly the automatic controls may not respond fast enough to prevent overheating and damage to the catalyst. Vapor sources or SVE wells must not be switched or adjusted while the blower is running!

As the T3 or T2 temperatures approach their setpoints, the VCV may close slightly. When this occurs, a section of the bar graph on the T2 or T3 controllers will light up. The VCV solenoid activates each time the VCV closes.

The T1 setpoint should still be at 330°, but the T1 process temperature may be above the setpoint.

After temperature equilibrium is established, observe the value of ΔT (temperature difference between T1 and T2). If for example, T1 = 340°C and T2 = 540°C then ΔT is 540-340 or 200°C. Input concentration (for Gasoline) may be estimated by multiplying ΔT by 8. Therefore, the input concentration is approximately 200 * 8 or 1,600 PPMV. This computation becomes less accurate at lower concentrations.

When vapor line concentration is high, (at the start of a vapor recovery operation, concentrations over 30,000 ppmv are common) the vapor stream must be diluted to below 2,200 ppmv. The oxidizer may reach full operating temperature, and maximum loading, without fully opening the VCV at sites with high vapor line concentration and low flow resistance. High dilution ratios (VCV toward close) will result in low vapor line vacuum.

As the vapor line concentrations decrease, the VCV reduces dilution airflow and vapor line vacuum increases. This may effect water production at soil vapor extraction sites. A vacuum relief valve or manual dilution valve may be required on the vacuum side of the blower to limit vacuum applied to the vapor extraction piping. A vacuum gauge is recommended.

CONTROLLING INPUT CONCENTRATIONS

High concentrations

When the vapor line concentration is relatively high, the VCV controls the vapor concentration fed to the oxidizer.
The input concentration maintained by the VCV is a function of heat recovery efficiency.
When heat recovery efficiency is decreased, the input concentration maintained by the VCV increases.

Heat exchanger bypass valve

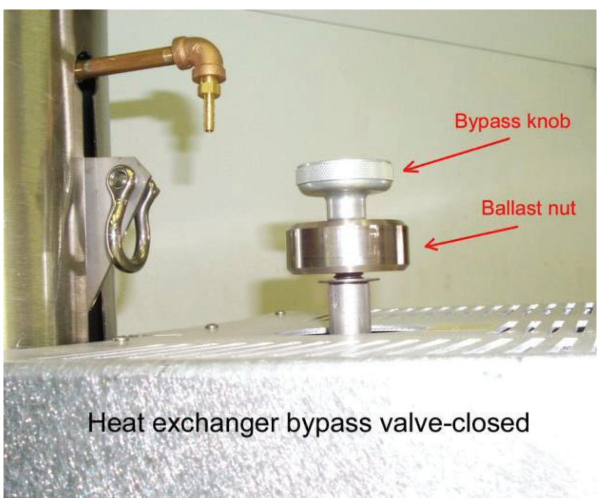
On the FALCO 300, heat recovery may be adjusted with the heat exchanger bypass valve.

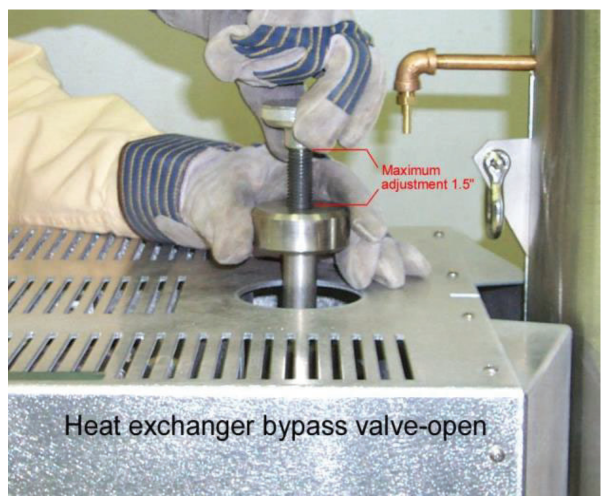
The heat exchanger bypass is an adjustable valve in the passage connecting the discharge side of the catalyst to the exhaust stack. Flow of hot exhaust gas through the bypass provides a corresponding reduction in flow through the heat exchanger. In this way, the heat exchanger bypass regulates heating of the inlet vapor stream.

In order to **maximize** vapor input during operation at high concentrations, the valve must be manually opened.
As the heat exchanger bypass is adjusted toward open, the flow of hot exhaust gas through the heat exchanger is reduced, thus reducing heat recovery. During operation with low vapor line concentration, when electric heat is needed to help preheat the vapor being treated, the heat exchanger bypass should be closed to minimize energy use.
The heat exchanger bypass valve should also be closed during warm-up.

Bypass Valve adjustment **(See figure 6)**

The top portion of the bypass valve assembly projects through the top of the heat shield.
When the bypass valve is in the **closed** position, the ballast nut has been screwed upward so threads are visible below it. The internal valve weight is fully seated and all treated flow passes through the heat exchanger.





When the bypass valve is adjusted to an **open** position, the ballast nut supports the valve off its seat.
The distance between the bypass knob and the ballast nut represents the amount of heat exchanger bypass. **The maximum recommended adjustment of the bypass knob is approximately <u>1.5"</u> higher than the top of the ballast nut**. Further adjustment is possible, but may lead to system instability.

CAUTION: The heat exchanger bypass valve will be hot! Wear gloves to make adjustments.

After an adjustment to the heat exchanger bypass valve toward open, observe the T1 controller and the VCV.
The heater may begin to cycle after a short time, and the VCV will commence making small adjustments of the valve toward open. Allow 15 minutes for a new equilibrium to be established, and observe T1 and T2.
A larger ΔT (T2-T1) indicates an increase in input concentration.

The closing force on the bypass valve is the weight of the valve assembly. Therefore, the bypass valve also serves as a pressure relief valve, limiting pressure in the catalyst chamber.

Examples of control response to bypass adjustments.

Case 1:

Initial conditions: VCV partially open, and vapor concentration is relatively high.
The objective is to increase input concentrations.

Adjusting the bypass valve toward open reduces heat recovery**.**
Control system responds by **increasing** inlet vapor concentration.
The control mechanism is as follows:

1. Reduction in heat recovery results in a drop in the temperature of vapors entering the catalyst. The T1 thermocouple senses the new temperature, at or below the T1 set point.

2. The T1 controller responds to the drop in temperature by signaling the VCV to make adjustments toward open. As a result, the inlet vapor concentration is increased.

3. The increased inlet vapor concentration makes more heat available. In this way, the temperature of the inlet vapor is raised to, or above, the T1 set point (despite the lower heat recovery efficiency).

Increases in inlet vapor concentration result in temperature increases at T3 and T2. The maximum allowable inlet vapor concentration is reached when the temperature rise through the catalyst results in T2 approaching its setpoint temperature of 600°C.

Case 2:

Initial conditions: Concentrations have dropped over time and the heater has started to cycle.
Objective is to increase heat recovery to reduce heater load.

Adjusting the bypass valve toward close increases heat recovery**.**
The control mechanism is as follows:

1. The increase in heat recovery results in an increase in the temperature of vapors entering the catalyst. This temperature increase propagates through the catalyst as a temperature wave, increasing the temperatures at T2 and T3.

2. After approximately five minutes the T1 temperature will increase and the heater load will be reduced. The T1 temperature may drift above its setpoint.

3. If the effect of the adjustment is great enough, all three temperatures will drift upward after about ten minutes. The T2 or T3 controller may respond by signaling the VCV to start making small adjustments toward close.

Low concentrations

Declining input concentrations are accompanied by decreasing temperatures. After the end of the dilution phase, if input concentrations have continued to decline, the heater will be on more. After concentrations drop below 1,000 ppmv and the heater is on more, the heat exchanger bypass valve should be closed. If these adjustments are not made, power consumption will be significantly increased during operation at low concentrations. Closing the bypass valve will be accompanied by an increase in T1, T2 and T3. Temperatures may increase until the VCV closes slightly.

As the input concentration declines below 1,000 ppm, the T1 setpoint may need to be increased in order to maintain high conversion efficiency. At 1,400 ppm a T1 setpoint of 330°C is a good choice. At 400 ppm and lower, a setpoint of 340°C may be required to maintain conversion efficiency. If the catalyst is damaged, a higher T1 setpoint may be required. To maximize heater life, when operating at low vapor concentrations, operate at the lowest temperature that will yield satisfactory destruction efficiency, but not below 330 °C or above 370°.
This limitation refers to the T1 setpoint, not the actual temperature, which can substantially exceed the T1 setpoint under certain conditions.

TROUBLESHOOTING

WARNING: Hazardous voltage can cause severe or fatal injury.
This equipment must be installed and grounded by qualified personnel per the National Electric Code and local codes.
Electrical work should be performed by qualified personnel only.
This equipment has multiple sources of electric supply.
Follow lock out / tag out safety procedures.

WARNING: Equipment that is damaged should not be used. If you are unsure of the condition of this equipment it should be returned to Falmouth Products for inspection and testing.

Blower Problems

1. Problem**:** FALCO controls turn on, alarm message scrolls across display, and blower will not start.

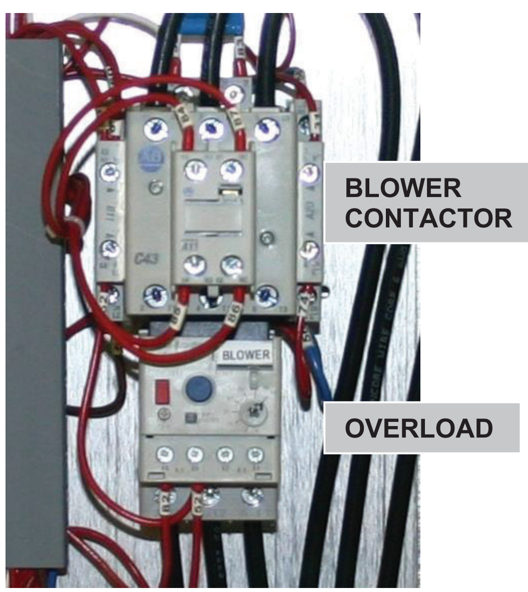
   Possible cause: *An alarm limit has been exceeded*, opening the blower contactor. An alarm message will scroll across the upper display describing the alarm condition and alternate with the temperature. Bring setpoint to within alarm limits and clear alarms (See CONTROLLER OPERATION section on page 13). Wait 10 seconds after clearing alarms and cycle power or press the **Fn** key on the affected controller. An initial *thump* will be heard when the heater contactor closes. When the blower starts, a second *thump* will be heard in the FALCO enclosure. This is the blower contactor closing.

2. Problem: FALCO controls turn on, no alarms present, blower will not start.

   Possible cause: *VCV is not closed*. The VCV prevents blower operation until the VCV is closed. Blower should start when the VCV position-indicating pin is flush with the belt guard. If VCV is not closed (or closing on power up) check VCV input wiring.

   Possible cause: *Circuit breaker for blower has tripped.*

   Possible cause: *Thermal protection on the blower or on a motor starter* has interrupted the blower relay and stopped blower. Investigate blower contactor overload relay adjustment inside FALCO control box.



3. Problem: FALCO controls will not turn on, blower will not start.

   Possible cause: *A float switch on the water knockout, if present, may have interrupted panel power.* High-level switch should be interlocked at terminals 70 and 71 on the rear control panel.

   Possible cause: *E-stop switch may be engaged.* Check voltage indicating terminal blocks 70-73 on the rear control panel. All indicators should be lit.

   Possible cause: *Thermal cutout on a blower may trip due to a high vacuum.* If the blower trips its thermal overload, flow is stopped to FALCO and the heater turns off. Verify the blower is not exceeding its maximum vacuum and pressure ratings. Cooling air must circulate freely across the blower motor.

   Check amperage draw on the blower motor. If a motor starter has been used, check the adjustment of the overload relay on the contactor and adjust appropriately for motor horsepower.

4. Problem: FALCO controls turn on, no alarms present, blower will not start and blower circuit breaker has tripped.

   Possible cause: *Does blower spin over freely?* Blowers that have been outside for long periods without operating, may freeze up. Ice or corrosion may have accumulated preventing a restart and tripping the circuit breaker.

5. Problem: Blower starts but no flow gets to FALCO.

   Possible causes:
   Blower filter clogged
   Flame arrestor on FALCO is clogged with debris.
   VCV valve plugged with debris.
   Restricted vapor lines.
   Improper blower rotation.
   Piping from blower discharge to FALCO is broken or plugged.
   Broken drive belt or couplings on blower.

Heater problems

1. Problem**:** Controller turn on but FALCO will not warm up at all.
   Possible causes:
   VCV has not returned to closed position and blower is not running. (See below under VCV)
   Heater switch in off position.
   Breaker for heater in off position.
   Improperly adjusted controller setpoints. If controller setpoints are not adjusted properly, FALCO will not warm up.

   Little or no airflow to unit / Incorrect blower rotation.
   Check for airflow at sample port. FALCO is equipped with a pressure switch that disables the heater circuit, protecting the heater from low flow conditions. This switch disables the heater circuit at approximately 30 CFM or less. A pressure gauge before the flame arrestor will allow the operator to estimate flow rate.

   Clogged flame arrestor is reducing flow to the oxidizer to below 30 CFM so the pressure switch interrupts the heater circuit. Remove flame arrestor for inspection. Remove and pressure wash screen if necessary. Contact Falmouth Products for new gaskets.

   Fuses on SCR power control open. Turn off all power and check resistance across fuses.
   Damaged SCR power control (call Falmouth Products).

   High limit control alarm. A high limit control located inside the control box protects the heaters from over temperature. The high limit is factory set at 480 ºC. If this alarm trips and prevents the limit contactor from closing, contact Falmouth Products before resetting.

2. Problem: FALCO warms up but not all the way to the 241° C enable temperature on T1 (System needs to be up to this temperature before VCV feeds in vapors).

   Possible causes:
   Improper adjustment of controller setpoints (See 'Cold Startup' section).
   Heat exchanger bypass must be closed prior to cold start (See figure 6).
   Low voltage to the heater circuit. Voltage should be between 208-240 Volts.
   Phase loss.
   Bad circuit breaker or wiring.

   High flow entering FALCO. Flows exceeding 350 CFM will make warm up difficult.
   It may be necessary to **partially** restrict the source vapor lines to achieve temperatures beyond 241°C.
   Inlet pressure to FALCO 300 is 19" H20 @ 300 CFM (cold).
   Single-phase heater power reduces heater output.
   A blower flow control (recirculation valve) may need to be installed.

   Fuses on SCR power control open. Turn off power and check resistance across fuses.
   Damaged SCR power control. Call Falmouth Products.

3. Problem: FALCO warms up on T1 (entrance temperature) but T2 and T3 do not warm up.

   Possible cause:
   Low flow can result in long warm up times. The entrance of the catalyst (T1) warms up first, then the midpoint (T3), and then the discharge (T2). Low flow causes the heat transfer through the catalyst to take longer.

Vapor Control Valve (VCV) problems

CAUTION: Correct VCV operation is essential!
Do not run this equipment if the VCV is not operating correctly!

Note: The VCV should be returned to Falmouth Products every three years for cleaning, inspection, and adjustment.

1. Problem: FALCO warms up to 241ºC on T1 but VCV does not open.
   Possible causes:
   VCV switch is not turned on.

   VCV wiring is not connected. Check the Yellow terminal block 54 (VCV open circuit) in the VCV conduit body. It should be energized (120 volts) when the T1 controller process temperature is above 241ºC, the heater indicator light located below the SCR controller on the rear panel is illuminated, and there are no rate alarms present on T2 or T3.

2. Problem: VCV does not close.
   Possible causes:
   VCV wiring is not connected. Brown terminal block 55 (VCV close circuit) in the VCV conduit body should be energized (120 volts) when the T2 or T3 controller process temperature is above setpoint and part of the bar graph on either controller is lit (power should cycle every 3-5 seconds). The setpoint may be temporarily lowered to activate the close output (solenoid clicks) Terminal block 55 is also energized when the controller power is cycled and the VCV is closed prior to blower restart.

   Please contact Falmouth Products for VCV problems not related to field wiring.

Controller problems

The temperature controllers may exhibit unusual behavior if they are too cold, or get wet. The control box has a thermostatically controlled heater inside that keeps the controllers at the appropriate temperatures (above 30° F). Do not insulate the control box.

1. Problem: Alarm cannot be cleared with the **Fn** key.
   Possible cause: *Process temperatures are not within alarm limits.*

2. Problem: Controllers will not turn on.
   Possible cause: *Circuit breakers are not turned on at the breaker box.*

   Possible cause*: E-stop or other shutdown device is activated:* If a high level switch or other shutdown device is interlocked with terminals 70-71 or 72-73, it may prevent the control system from turning on. Make sure all voltage indicating terminal blocks located on the rear panel are illuminated.

   Possible cause: *Blown fuses on control panel.* If the controllers still will not turn on, turn **off** the main circuit breaker and check the two fuses on the front control panel (tip - out fuse holders #1and #2.).

System instability-

Problem**:** FALCO does not operate in a stable manner.
Possible causes:

1. *Excessive heat exchange bypass causes instability*. Do not open the bypass more than 1.5 inches.

2. *Low flow and high concentrations.* Flow less than 100 scfm causes slow thermocouple response, which results in slow response by the temperature controllers, and may cause system instability.

3. *Unstable vapor flow*. Water in vapor lines (or dual phase systems) can cause system instability. Stability may be improved with SVE systems by bringing more wells on line or clearing accumulations in low spots. Dual phase systems can be tuned to improve stability by raising drop tubes to the top of the water table to increase air velocity up the tube.

4. *Extremely high concentrations.* Extremely high concentrations can result in high alarm shutdowns on T3 or T2. Opening lean vapor wells, restricting hot vapor wells, and opening a manual dilution valve will reduce concentrations. Opening the heat exchanger bypass valve allows FALCO to accept higher concentrations.

5. *Oil or water carryover from liquid ring pumps.* Liquid ring vacuum pumps that use oil or water can cause unstable operation and/or damage the equipment.

Problems with conversion efficiency
FALCO does not destroy methane completely at its normal operating temperatures. When using a Flame Ionization Detector, methane may show up in the output emissions. By taking two output samples (one with an activated carbon tip, and one without) the non-methane emissions may be determined.

At low input concentrations, destruction efficiency is generally lower then the destruction at high input concentrations. This is due to the lower average treatment temperature. However, the absolute emission while operating at low input concentration is normally lower than while operating at high input concentrations. For example: assume the input concentrations are 2,000 PPM and emissions are 10 PPM. Then conversion is 10/2000=. 005 or 99.5% conversion. However, if the input concentration is 100 PPM and the emissions are 10 PPM, then the conversion is 10/100= .1 or 90% conversion. The conversion efficiency is lower but the overall emissions are the same.

Problem: High output emissions

Possible causes:

1. *High methane concentrations in the influent stream.*
   Check for methane with a carbon tip if using a flame ionization detector.

2. *Improperly calibrated test instrument*.
   Dirty sampling pump or tubing (check on ambient air).

3. *Organic material may have entered the top of the unit and is being burned*.
   For example, if leaves fall down the stack they may cause high emissions.
   Clean the effluent sample port. Inspect the stack.

4. *Low influent temperature*.
   Check T1 setpoint if you are operating at low concentrations with the heater on. Normal setpoint is 330°. This setpoint may be increased in increments of 5°C to a maximum of 420°C. Check emissions after FALCO has reached equilibrium after each increase in setpoint. Increasing input temperatures generally increases conversion efficiency.

5. *High influent flow rate*
   Check flow rate in CFM going into FALCO. The FALCO 300 is designed for flow rates up to 350 CFM. Higher flow rates decrease residence time in the catalyst reducing destruction efficiency. At high input concentrations, slightly higher flow rates may yield acceptable conversion because of higher operating temperatures. At low input concentrations and high flow rate, the electric heater may have trouble maintaining adequate input temperatures for good conversion. Lowering flow rate generally increases conversion efficiency.

6. *Catalyst settling*.
   The packed bed catalyst in the FALCO 300 is comprised of platinum and palladium deposited on 1/8” ceramic spheres. The catalyst is contained in a chamber that is screened on two sides to allow the vapors to flow through horizontally. Over time the catalyst bed may settle. Excessive settling may reduce conversion efficiency. The catalyst fill level should be maintained to the bottom of the 2” fill port. There is a horizontal divider plate located in the top of the catalyst chamber that prevents bypass if the catalyst settles. If the catalyst settles more than four inches below the top of the 2” fill port then untreated vapors may bypass the catalyst.

The fill level may be checked and topped off through the fill plugs (see figures 1 and 2).

Caution: Before opening fill plugs verify that all flow through FALCO has stopped (Blower is not moving at all). Lockout circuit breaker box. The catalyst will be hot. Wear gloves, dust mask, protective clothing, and safety glasses.

Remove the rectangular heat guard on the top of the unit.
Remove the brass fill plugs on the top of the catalyst chamber. The plugs are under the pressure switch and thermocouple conduit body. Pour new catalyst into the catalyst chamber. A **clean** flathead screwdriver may be used to gently distribute catalyst toward the ends of the chamber.

7. *Catalyst poisoning, masking, and overheating*.
   Certain poisons and contaminants can deactivate the catalyst. Vapor streams should be analyzed before operation. If poisoning is suspected, a catalyst sample may be removed from the fill tubes discussed in section 4 for analysis. Avoid running water into the oxidizer. Water can transport solids and mineral salts that may mask or poison the catalyst. Always install a filter on the vapor line prior to the blower to capture particulate. Certain compounds can poison the platinum catalyst used on the FALCO 300. Poisons such as Lead, Phosphorus and Silicone coat the catalyst. Halogens such as chlorine will attack the platinum deposited on the catalyst converting it to an inactive form. Sulfur may mask the catalyst. Operation of the unit at temperatures lower than 300°C may cause incomplete combustion. Deposits of carbon on the catalyst may reduce its efficiency.

   Overheating must be prevented. Temperatures exceeding 650°C will reduce catalyst activity by reducing active surface area.

   If necessary, the catalyst may be changed by vacuuming the old catalyst out through the fill tubes, and pouring in new catalyst (contact Falmouth Products for complete instructions).

FALMOUTH PRODUCTS TECHNICIANS ARE AVAILABLE TO ANSWER YOUR QUESTIONS!
8am-5pm EASTERN STANDARD TIME
PHONE 508-548-6686

MAINTENANCE

WARNING: Hazardous voltage can cause severe or fatal injury. Electrical work should be performed by qualified personnel only. This equipment has multiple sources of electric supply. Follow lock out / tag out safety procedures.

Catalyst level check — **1 WK AFTER INITIAL STARTUP / YEARLY**
Follow instructions in previous section for checking catalyst level and topping off.
Level must be checked several times following replacement.

VCV filter — **EVERY 6 MONTHS**
Turn the unit off before inspecting the filter. Element should be checked if the unit is operated in dusty conditions more frequently. The filter has a replacement element (Solberg part #231P). The filter is washable with mild detergent. Rinse well.

VCV — **EVERY 3 YEARS**
The VCV should be returned to Falmouth Products every three years for cleaning, inspection, and adjustment.

Gauges — **WEEKLY**
Check vacuum and pressure gauges frequently for unusual readings.
Obstructions on the vacuum or pressure sides of the blower result in high vacuum and/or pressure readings. For example: a clogged blower filter will result in high vacuum readings.

Flame Arrestor Inlet Pressure — **MONTHLY**
Inlet pressure should be monitored monthly. High inlet pressure may indicate an obstructed flame arrestor or excessive flow. Inspect flame arrestor for obstructions. Contact Falmouth Products for cleaning procedure.

Cold weather — **WINTER**
In cold climates heat tape and insulate all exposed inlet vapor lines and water knockout tank. The VCV has its own heater, and it is not necessary to insulate it.

Electrical Ground bar and grounding connections — **YEARLY**
Ground bar and connections should be inspected and replaced if corroded or damaged.
Check grounds in the following locations:

- Circuit breaker box or service panel
- FALCO main electrical enclosure ground bars (two)
- Ground lugs (Heater conduit body, VCV conduit body, and pressure switch)
- Ancillary or optional equipment enclosure grounds (various)

Heater and Blower electrical connection (control panel) — **YEARLY**
All Line/Load electrical connections should be inspected and tightened.

Heater electrical connection (distribution block in heater conduit body) — **EVERY 3 YEARS**
All electrical connections in heater conduit body should be inspected and tightened.

Pressure switch low pressure port — **QUARTERLY**
Verify that there is no other debris in port (Mud Dauber wasp nest). Clean out as required.
Note: port has a sintered metal filter inside it (this is normal).

Water knockout — **WEEKLY**
Water knockouts can be purchased separately from Falmouth Products. The system should be shut down and water accumulations drained during every site visit. Do not run water into the oxidizer. Site check intervals should not exceed the time it takes to fill the water knockout unless some provision is made to shut down the system automatically (high level switch).

FALCO 300 SPECIFICATIONS

CAPACITY	100-350 CFM
MAXIMUM INPUT LOADING	250 lb/day petroleum hydrocarbons @ 350 cfm
DESTRUCTION EFFICIENCY	Up to 99.5%
CATALYST TEMPERATURE RANGE	330-620ºC (626-1148ºF)
CATALYST	Packed bed 2.5 cubic feet. Platinum on 1/8" ceramic beads is standard. Other catalysts are available
HEAT EXCHANGER	304 stainless steel spiral plate. 73% efficient at 300 scfm. Manually adjusted heat exchanger bypass valve (hot side).
HEATER (Electric)	Nine 3,000 watt cartridge heaters arranged in Delta. 56 amp @ 208 volts (20.3 kW) / 65 amp @ 240 volts (27 kW) Optional: 38 amp @ 415 volts (27 kW), heaters in Wye configuration Optional: 32.5 amp @ 480 volts (27 kW) *(US only)* Optional: Single Phase, 56.3 amp @ 240 volts (13.5 kW)
HEATER CONTROL	Yokogawa UT32A temperature controller cycles 80 amp SCR power control All three legs switched. Zero cross. 80 amp semiconductor fuses. High limit control with contactor to break all three phases.
VAPOR CONTROL	Vapor Control Valve (VCV) is proportionally controlled by three temperature controllers. The VCV is installed in series on vacuum side of extraction blower and simultaneously controls both dilution air and vapors based on catalyst temperature. Solenoid valve for rapid introduction of dilution air.
CONTROLS	120 VAC. 3 amp max. Yokogawa series UT32A temperature controllers. Proportional control of SCR power control and Vapor Control Valve.
WEIGHT	850 lb. Without flame arrestor.
STACK	6" stainless steel tube. One five-foot length of 6" Type B Gas vent pipe is supplied.
CONSTRUCTION	Stainless steel and aluminum
APPROXIMATE PRESSURE DROP (HOT) (INCLUDING FLAME ARRESTOR)	34" H2O @ 300 scfm with heat exchanger bypass closed 30" H2O @ 300 scfm with heat exchanger bypass open
FLAME ARRESTOR PRESSURE DROP	2" H20
DIMENSIONS	73" high (excluding 5' stack) X 70" long X 29" wide
POWER REQUIREMENTS	3 phase 208-240 Volt standard, optional 3 phase 480 Volt optional 3 phase 415 Volt, optional 1 phase 240 Volt
ELECTRICAL ENCLOSURE	Aluminum or Stainless Steel (NEMA 4X)
APPROVALS	MET Labs approved (US and Canada) for installation in Class I, Division 2, Group D, (Temp Code T2C) hazardous locations extending up to 41 inches from the bottom of the frame. Portions of the oxidizer located outside of this area are only suitable for unclassified / non-hazardous locations. 480 volt configuration has US approval only

FIGURES

FALCO 300 Major Components.. Figure 1

FALCO 300 Major Components (Top View) .... Figure 2

FALCO 300 Flow and Control .... Figure 3

Installation Plan View.. Figure 4

FALCO 300 VCV……………….. Figure 5

Heat Exchanger Bypass Valve Adjustment….......................... Figure 6

Control Panel …………………... Figure 9

Front Panel Wiring …………….. Figure 11

Subcomponent Wiring ………... Figure 12

Rear Panel Wiring ……………... Figure 13

VCV Wiring …………….. Figure 14

Optional Component Wiring (if supplied)………………………... Figure 15

Stack Installation……………………….……………………….... Figure 18

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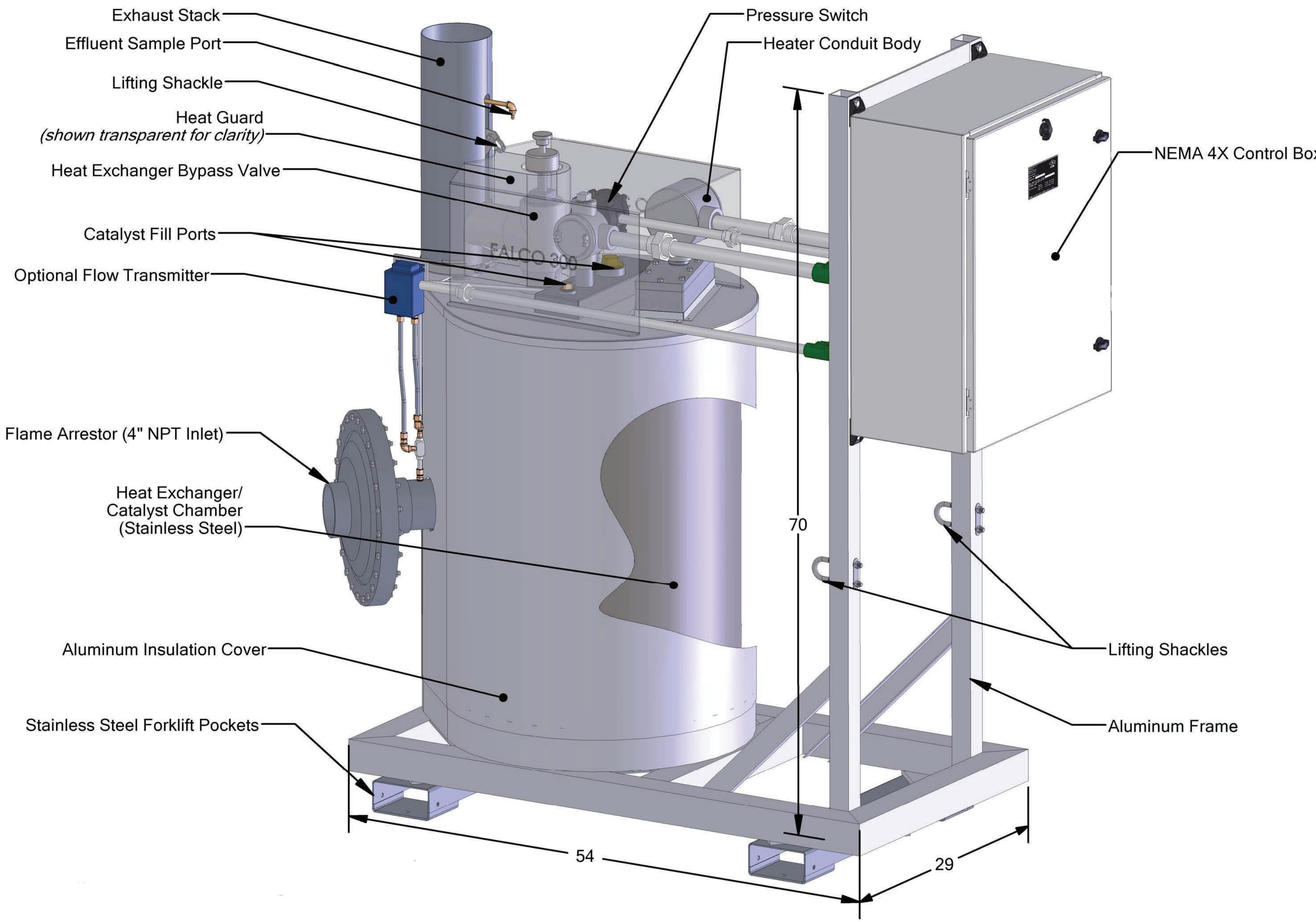

FIGURE 1: FALCO 300 - MAJOR COMPONENTS

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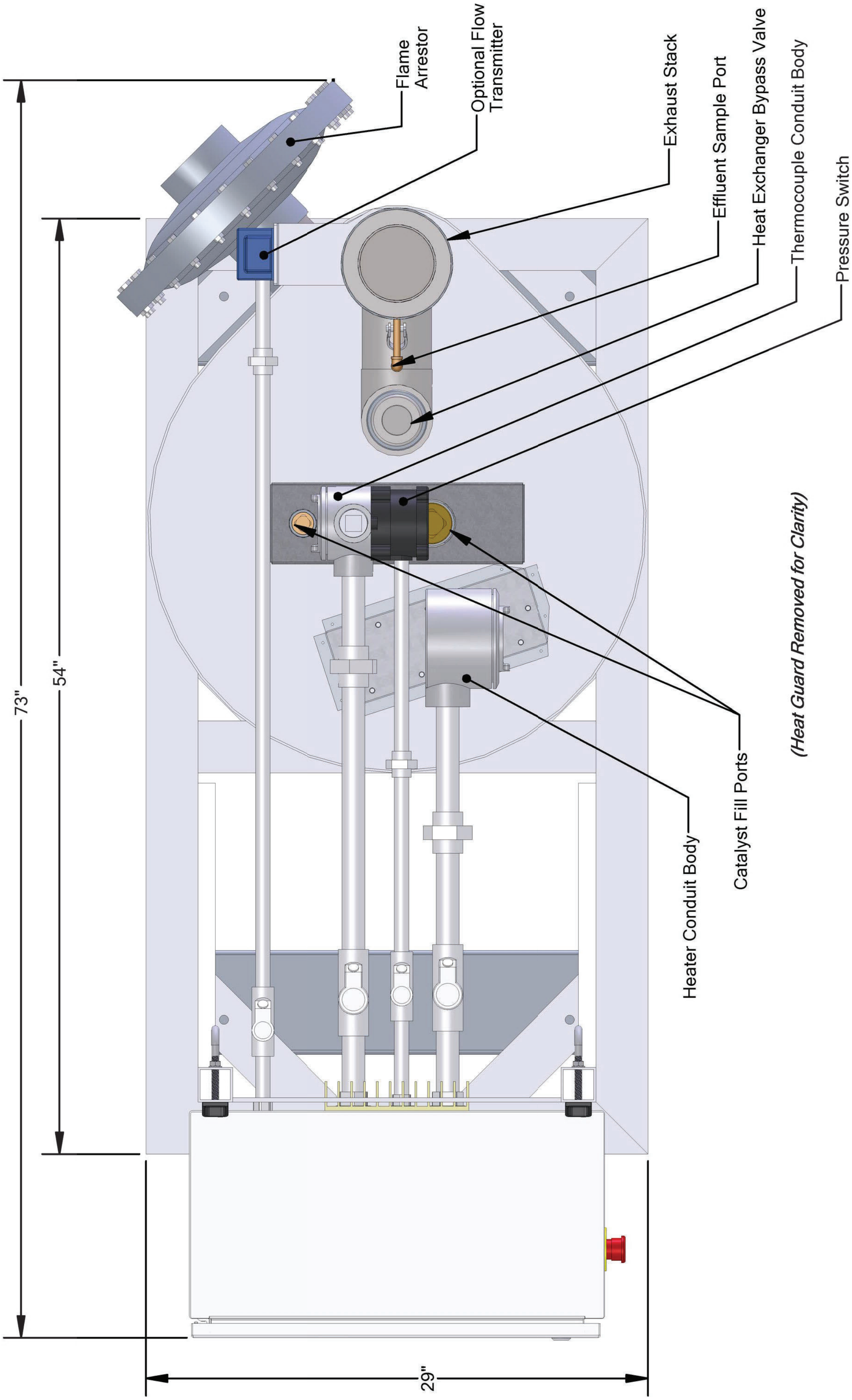

FIGURE 2: FALCO 300 -TOP VIEW

REV 1-28-22

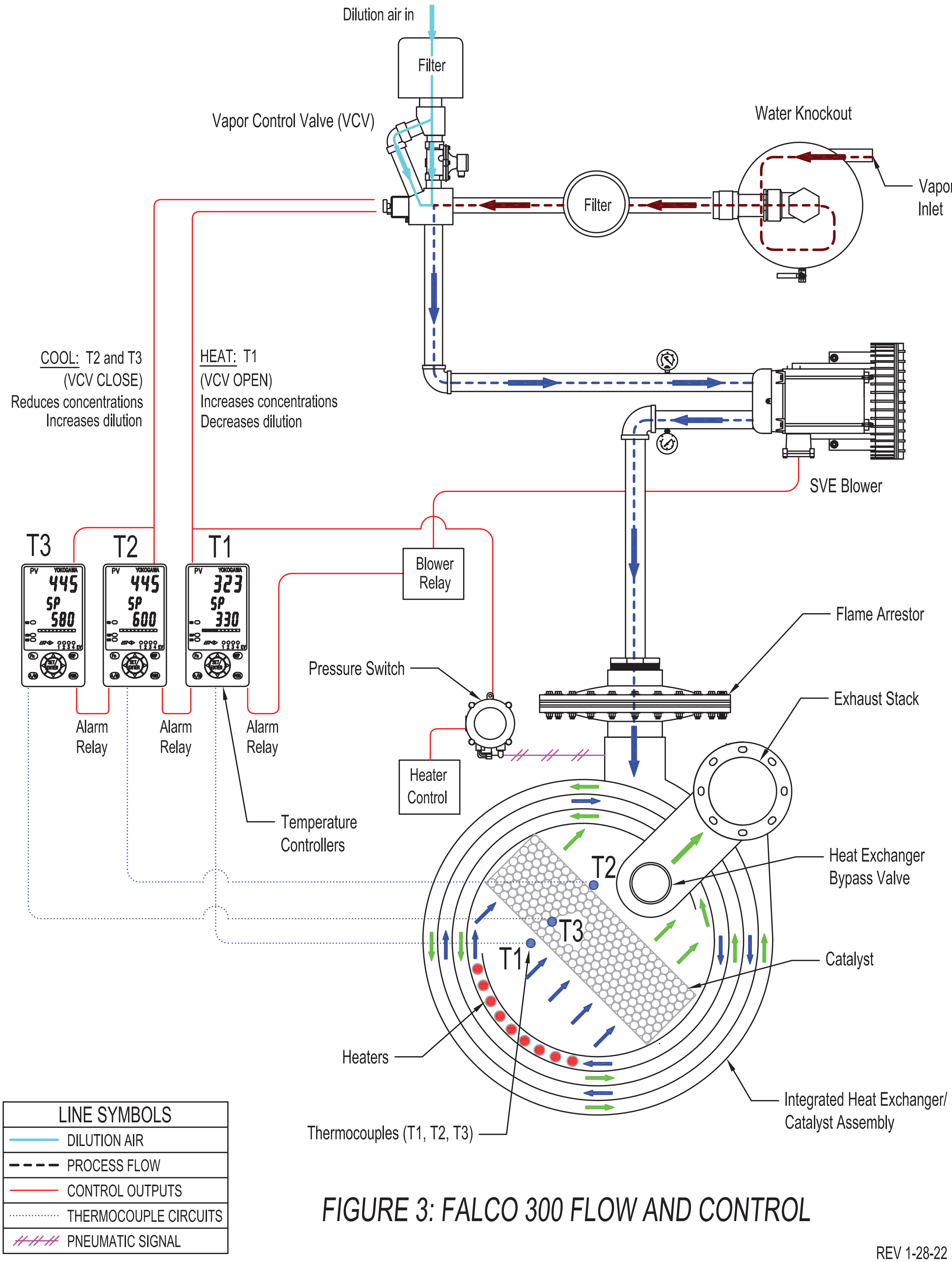

FIGURE 3: FALCO 300 FLOW AND CONTROL

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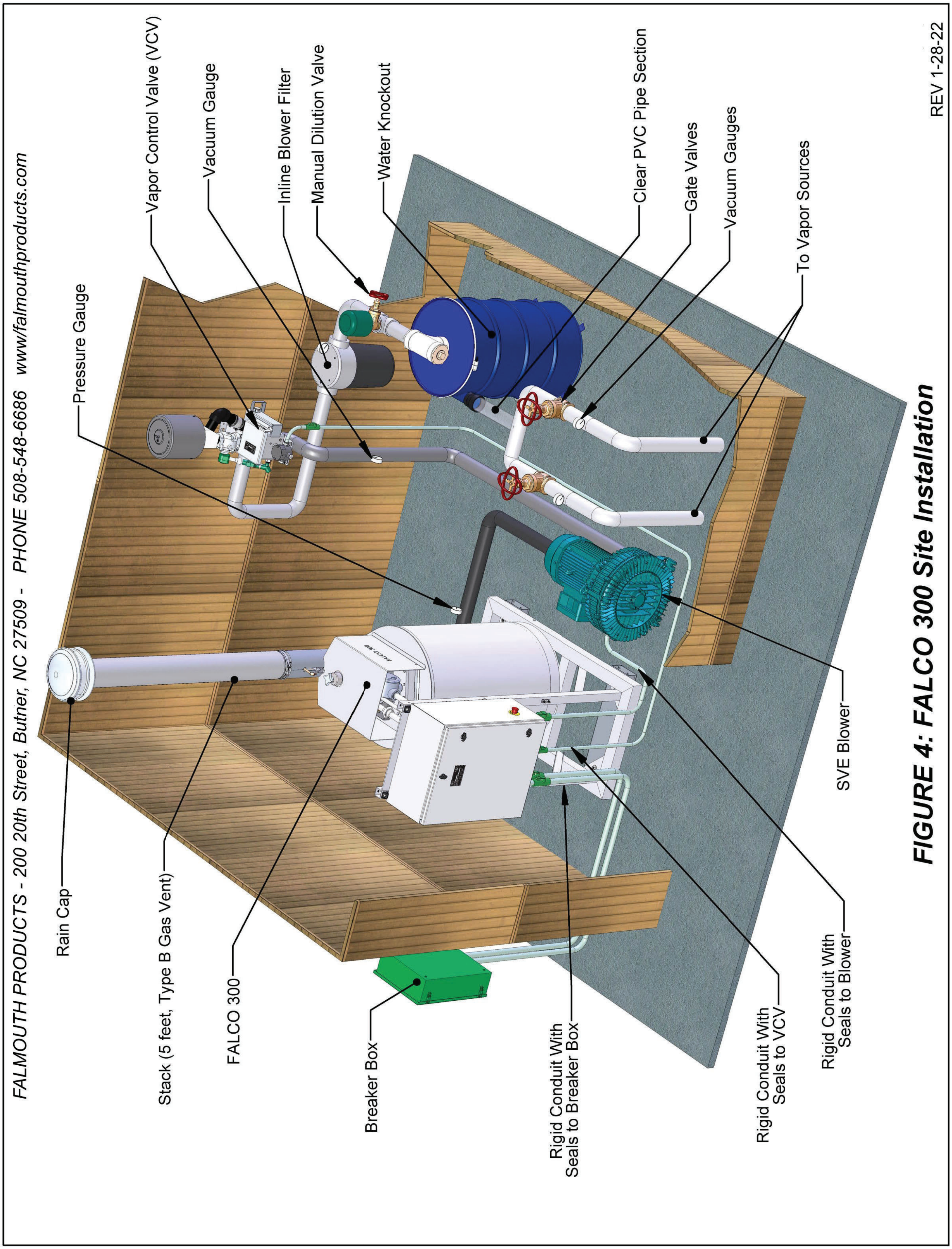

FIGURE 4: FALCO 300 Site Installation

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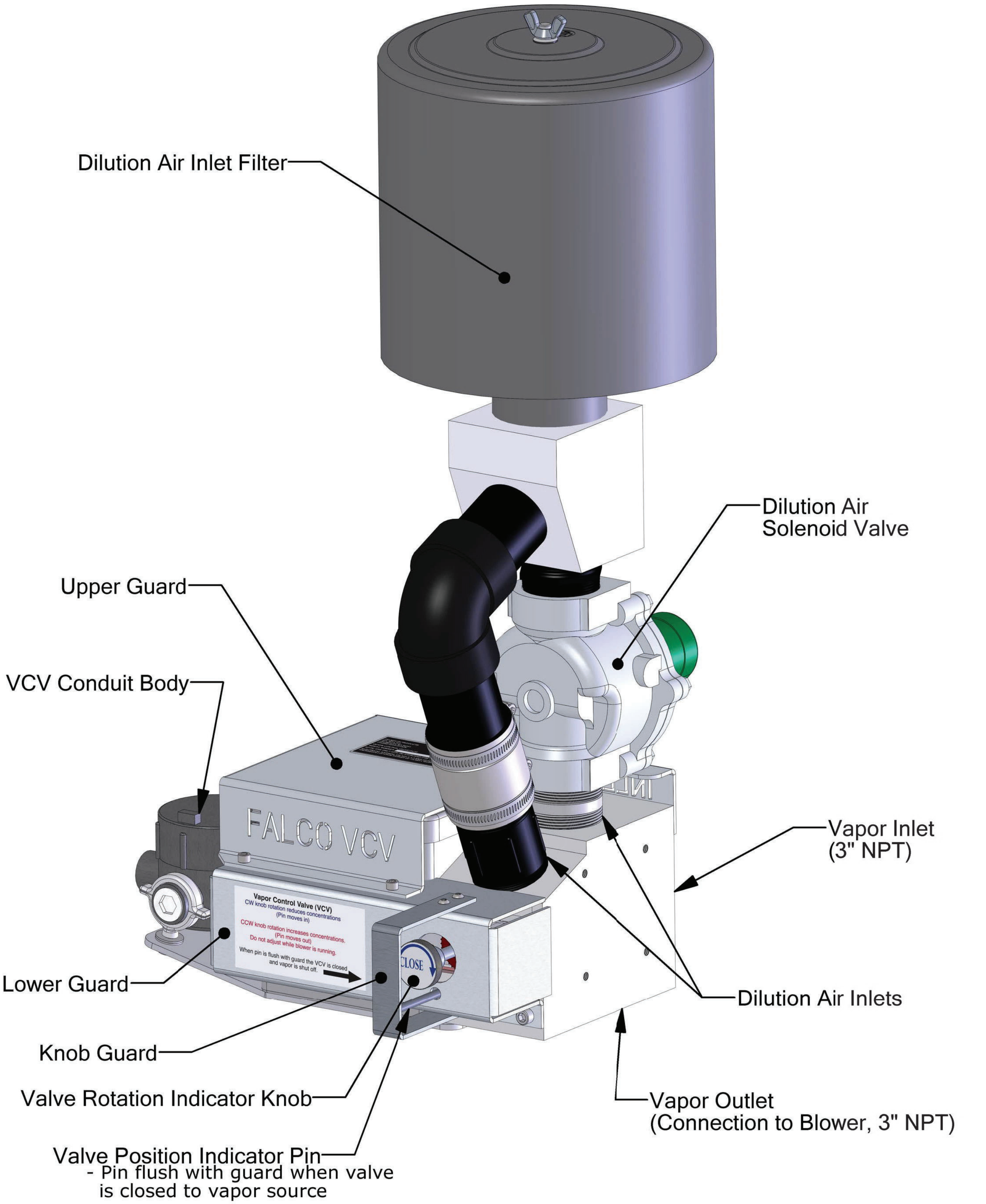

FIGURE 5: VAPOR CONTROL VALVE (VCV)

(VCV mounting bracket not shown)

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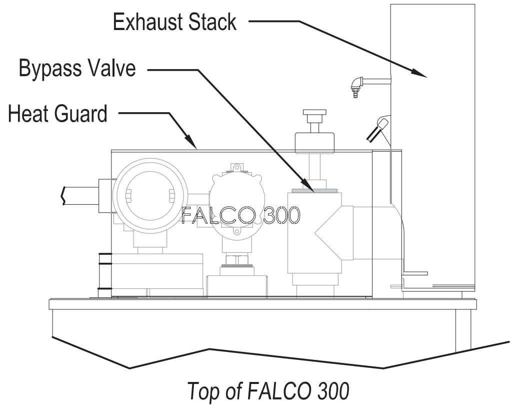


CAUTION! Gloves must be worn when adjusting bypass position. Components will be HOT

1. Grasp BYPASS KNOB and lift assembly upward.
2. Turn BALLAST NUT clockwise to INCREASE bypass, counterclockwise to DECREASE bypass. (Note: Hold knob stationary while turning ballast nut)
3. Lower valve assembly and observe effect of adjustment on catalyst temperatures.

IMPORTANT: Adjustments, either OPEN or CLOSED, should not exceed 1/2" valve movement at a time. Wait at least 15 minutes between adjustments.

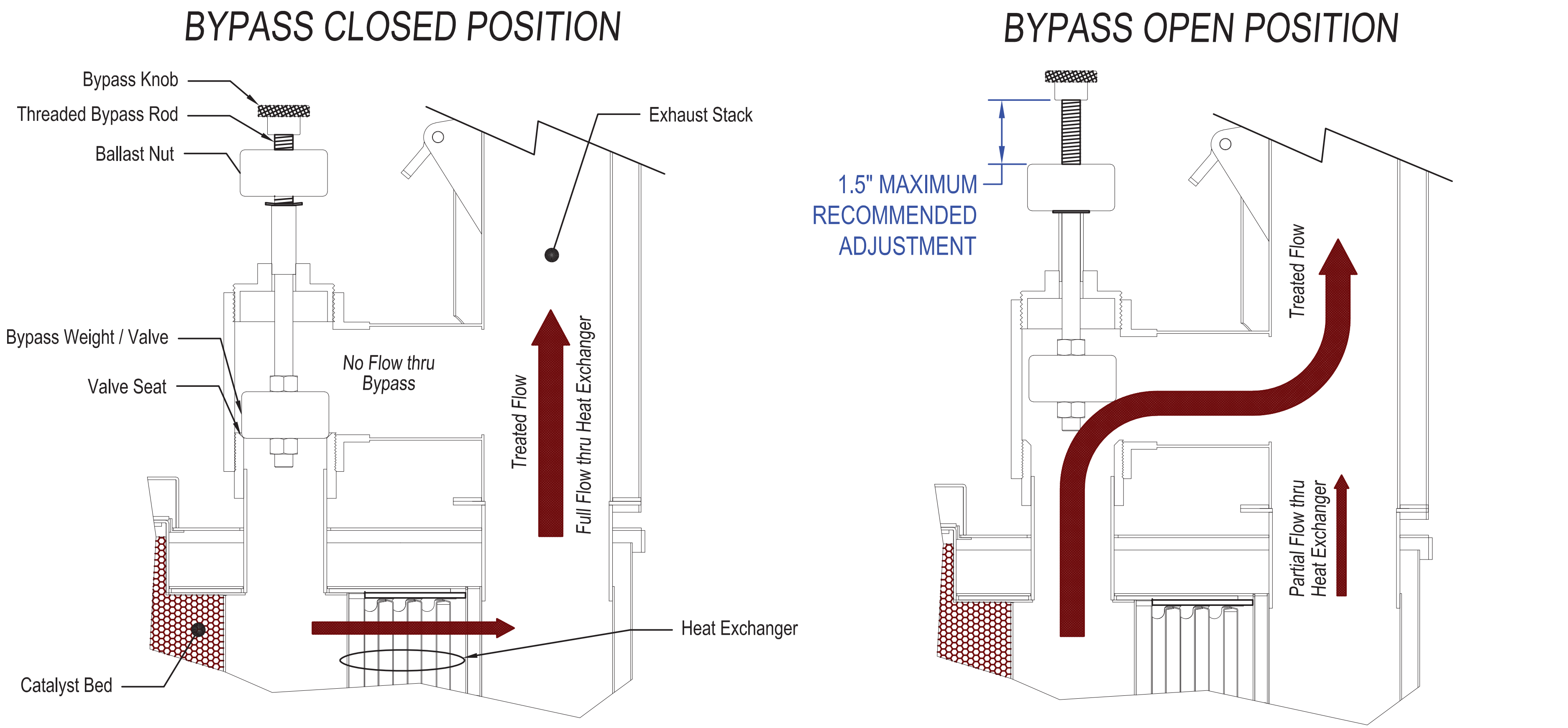
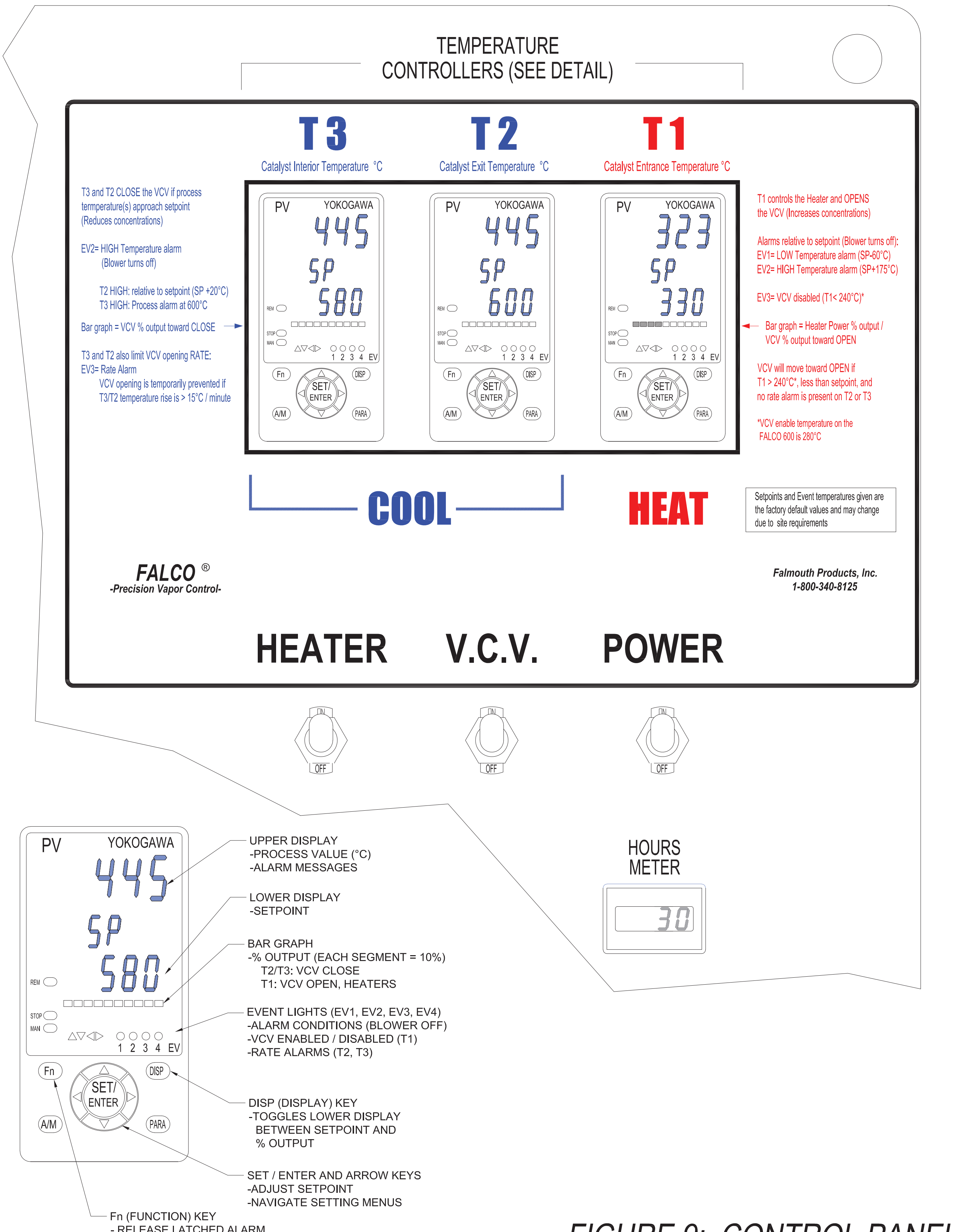


FIGURE 6: HEAT EXCHANGER BYPASS VALVE ADJUSTMENT

(Refer to page 19 in manual)



CONTROLLER DETAIL

FIGURE 9: CONTROL PANEL

REV 1-28-22

HIGH VOLTAGE ELECTRICAL SHOCK HAZARD

WARNING: DISCONNECT POWER BEFORE SERVICING

FUSEHOLDER #2 (CONTROLLER RELAY POWER)
"VERY FAST ACTING" 1.25 AMP FUSE ONLY!
(BUSS GBB-1-1/4-R OR LITTLEFUSE PART #3321.25)

SEE FIGURE 15 FOR OPTIONAL COMPONENTS
INCLUDING: CHART RECORDER, MASS FLOWMETER AND DIFFERENTIAL PRESSURE FLOWMETER

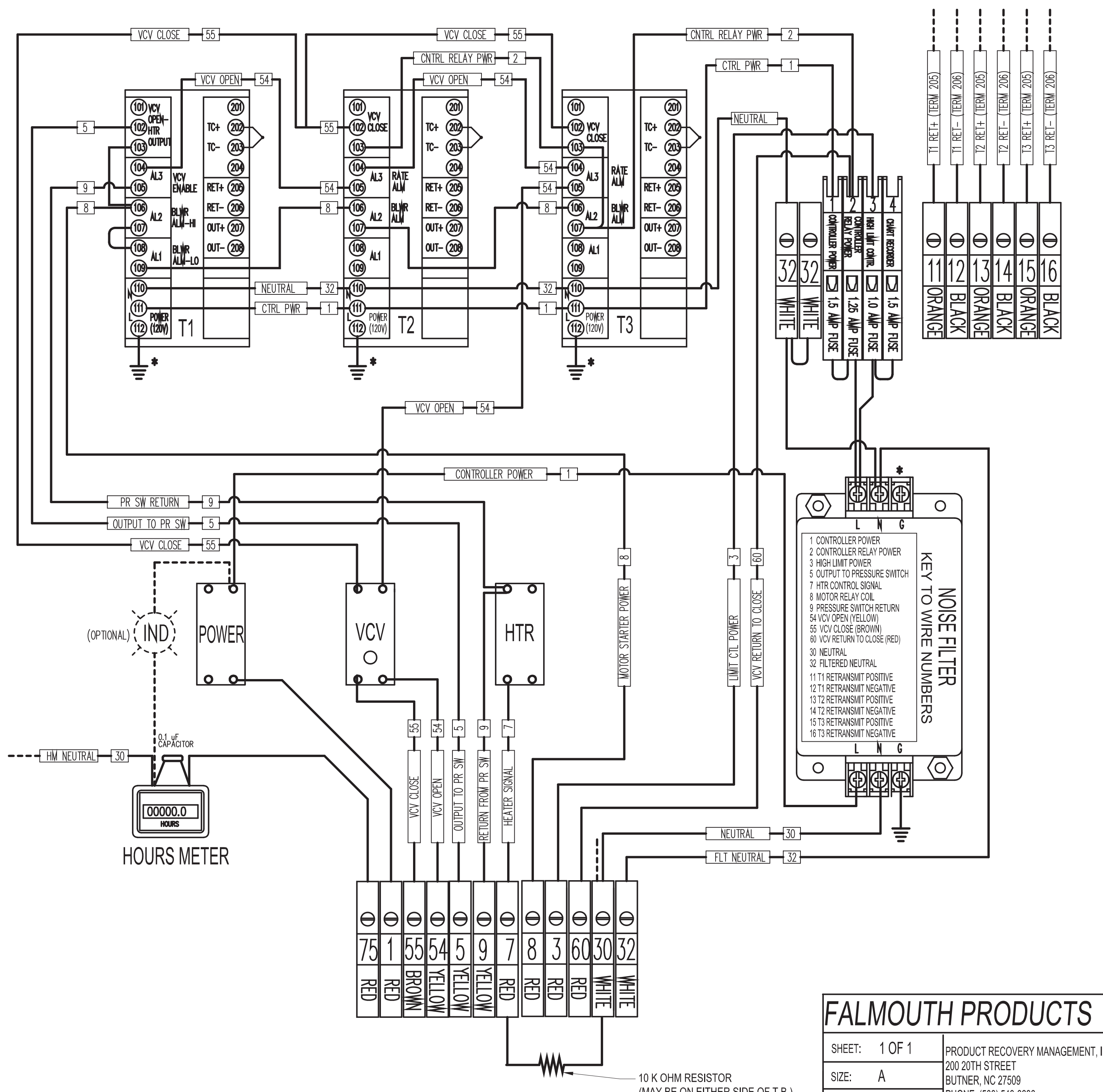


FIGURE 11 - FALCO 300/600 FRONT PANEL WIRING

FALMOUTH PRODUCTS

SHEET: 1 OF 1	PRODUCT RECOVERY MANAGEMENT, INC 200 20TH STREET BUTNER, NC 27509 PHONE: (508) 548-6686		
SIZE: A			
SCALE: -			
DWG: 6506	DRAWN BY: MW	CHECKED BY: --	
ASSY: F300/600	DATE: 12-15-22	REV: D	
DESCRIPTION:	FALCO 300 / 600 FRONT PANEL WIRING		

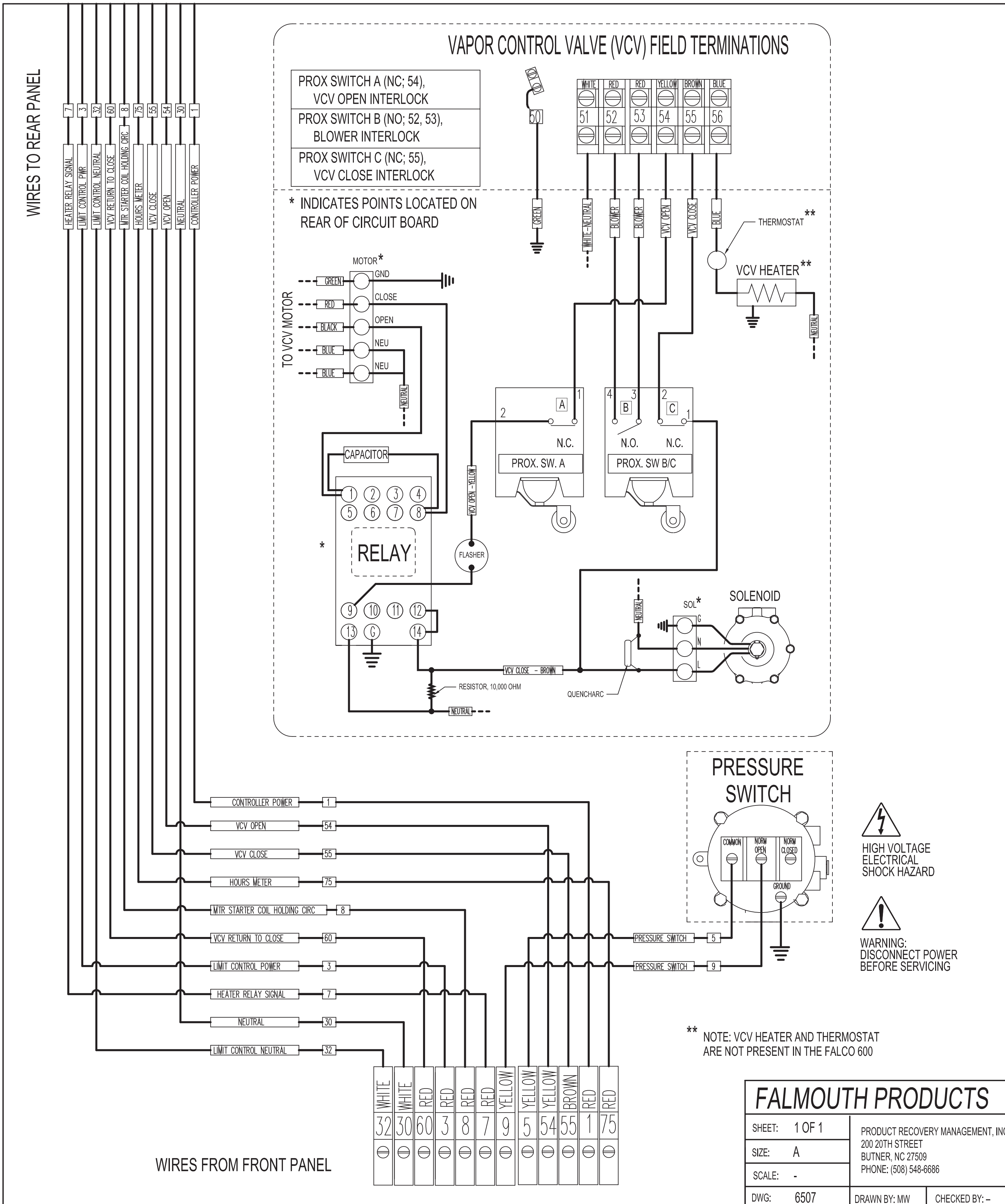
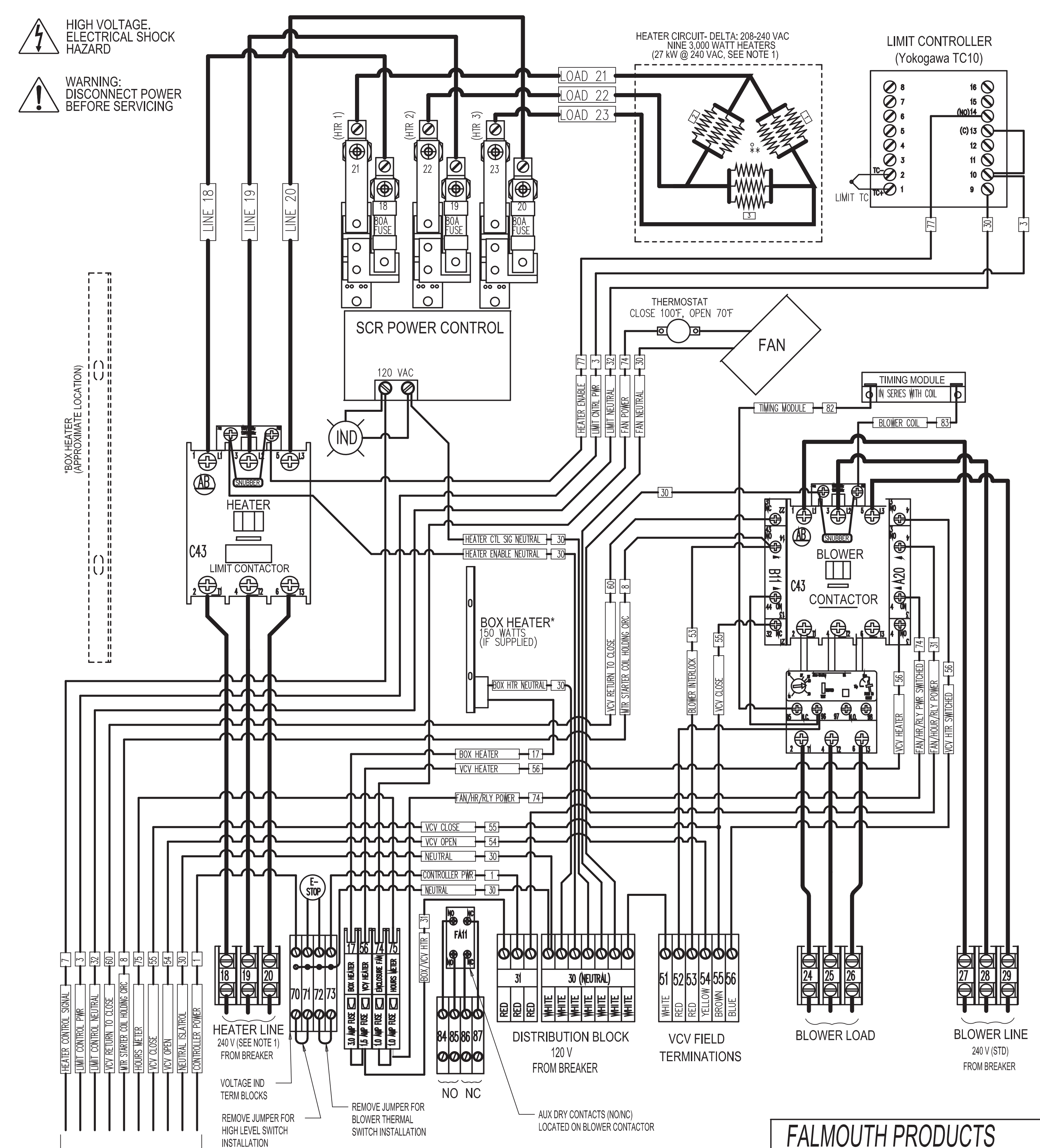


FIGURE 12 - FALCO 300/600 SUBCOMPONENT WIRING

FALMOUTH PRODUCTS			
SHEET: 1 OF 1	PRODUCT RECOVERY MANAGEMENT, INC 200 20TH STREET BUTNER, NC 27509 PHONE: (508) 548-6686		
SIZE: A			
SCALE: -			
DWG: 6507	DRAWN BY: MW	CHECKED BY: –	
ASSY: F600	DATE: 12-15-22	REV: D	
DESCRIPTION:	FALCO 300 / 600: SUBCOMPONENT WIRING		



NOTES:
1. STANDARD HEATERS AND WIRING ARE 240 VOLTS.
-OPTIONAL FACTORY WIRING FOR 480 VOLTS USES THE SAME WIRING CONFIGURATION BUT DIFFERENT HEATERS (3000 WATTS EACH AT 480V, 27000 WATTS TOTAL)
-OPTIONAL FACTORY WIRING FOR 415 VOLTS USES THE 240 VOLT HEATERS CONNECTED IN A WYE CONFIGURATION (3000 WATTS EACH AT 240V, 27000 WATTS TOTAL).

FIGURE 13 - FALCO 300 REAR PANEL WIRING

FALMOUTH PRODUCTS

SHEET: 1 OF 1	PRODUCT RECOVERY MANAGEMENT, INC 200 20TH STREET BUTNER, NC 27509 PHONE: (508) 548-6686		
SIZE: A			
SCALE: -			
DWG: 3530	DRAWN BY: MW	CHECKED BY:	
ASSY: F300	DATE: 12-15-22	REV: C	
DESCRIPTION:	FALCO 300 REAR PANEL WIRING		

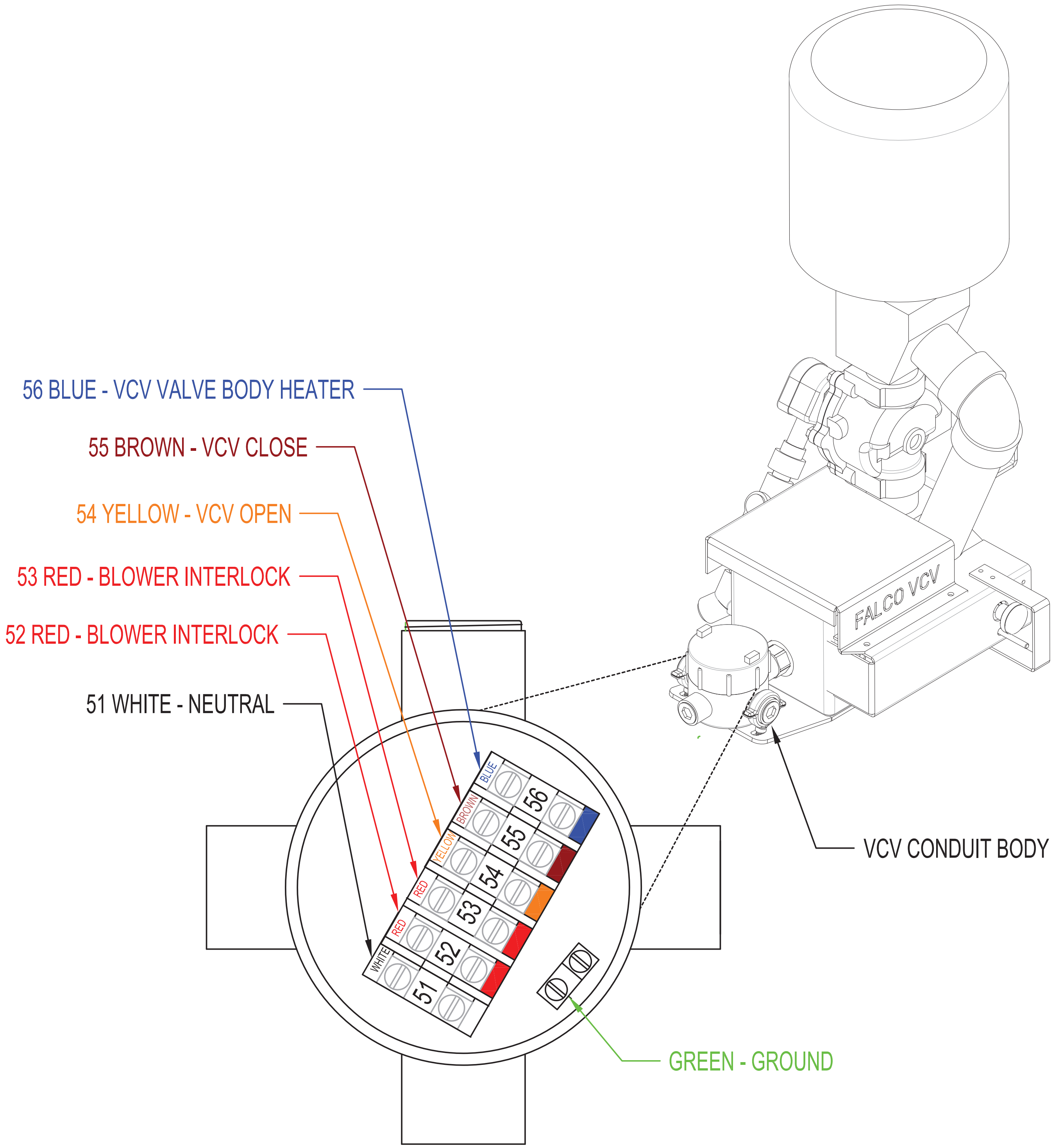
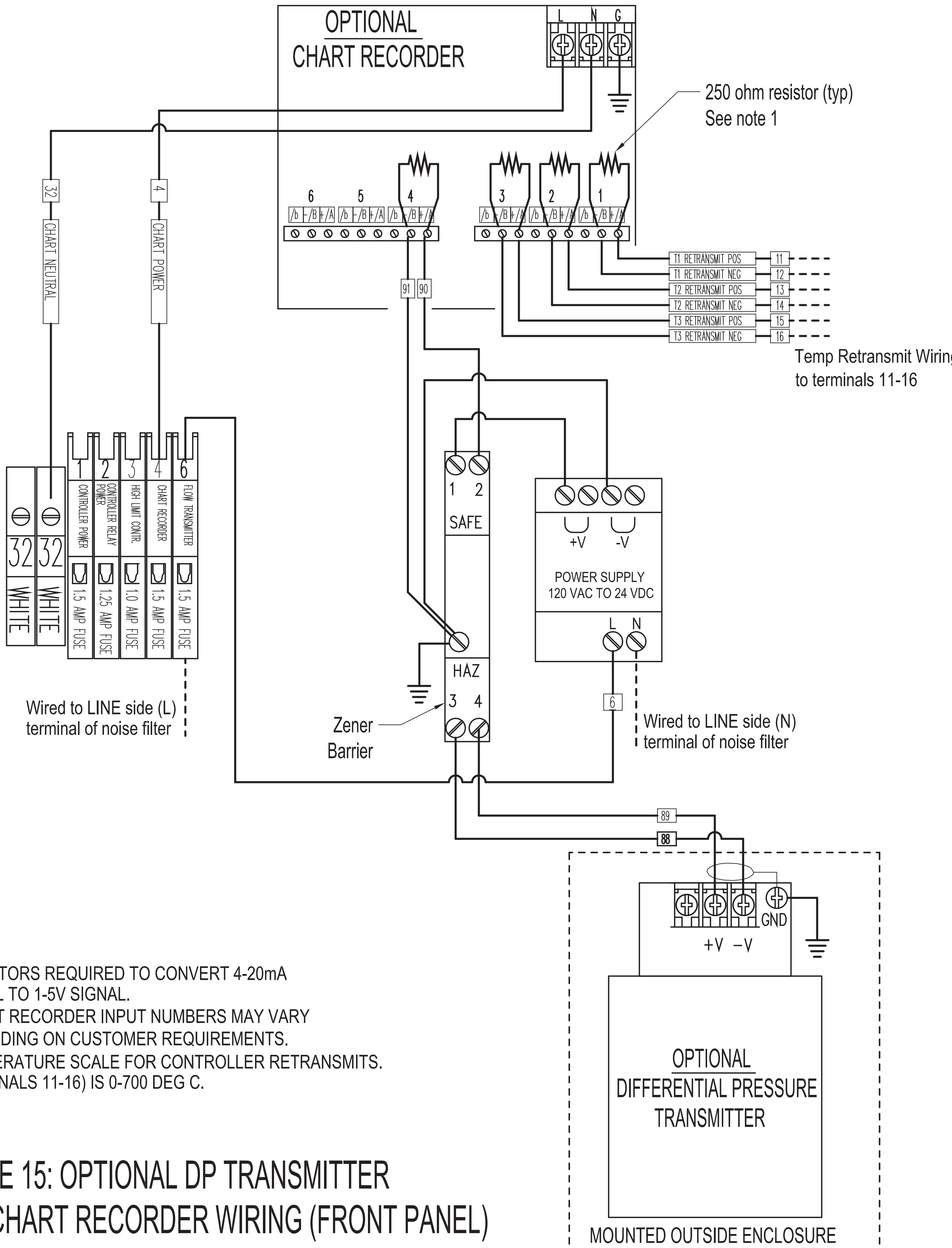


FIGURE 14: VAPOR CONTROL VALVE (VCV)-TERMINAL BLOCKS INPUT WIRING FROM FALCO CONTROL PANEL

REV 1-28-22



NOTES:
1. RESISTORS REQUIRED TO CONVERT 4-20mA SIGNAL TO 1-5V SIGNAL.
2. CHART RECORDER INPUT NUMBERS MAY VARY DEPENDING ON CUSTOMER REQUIREMENTS.
3. TEMPERATURE SCALE FOR CONTROLLER RETRANSMITS. (TERMINALS 11-16) IS 0-700 DEG C.

FIGURE 15: OPTIONAL DP TRANSMITTER AND CHART RECORDER WIRING (FRONT PANEL)

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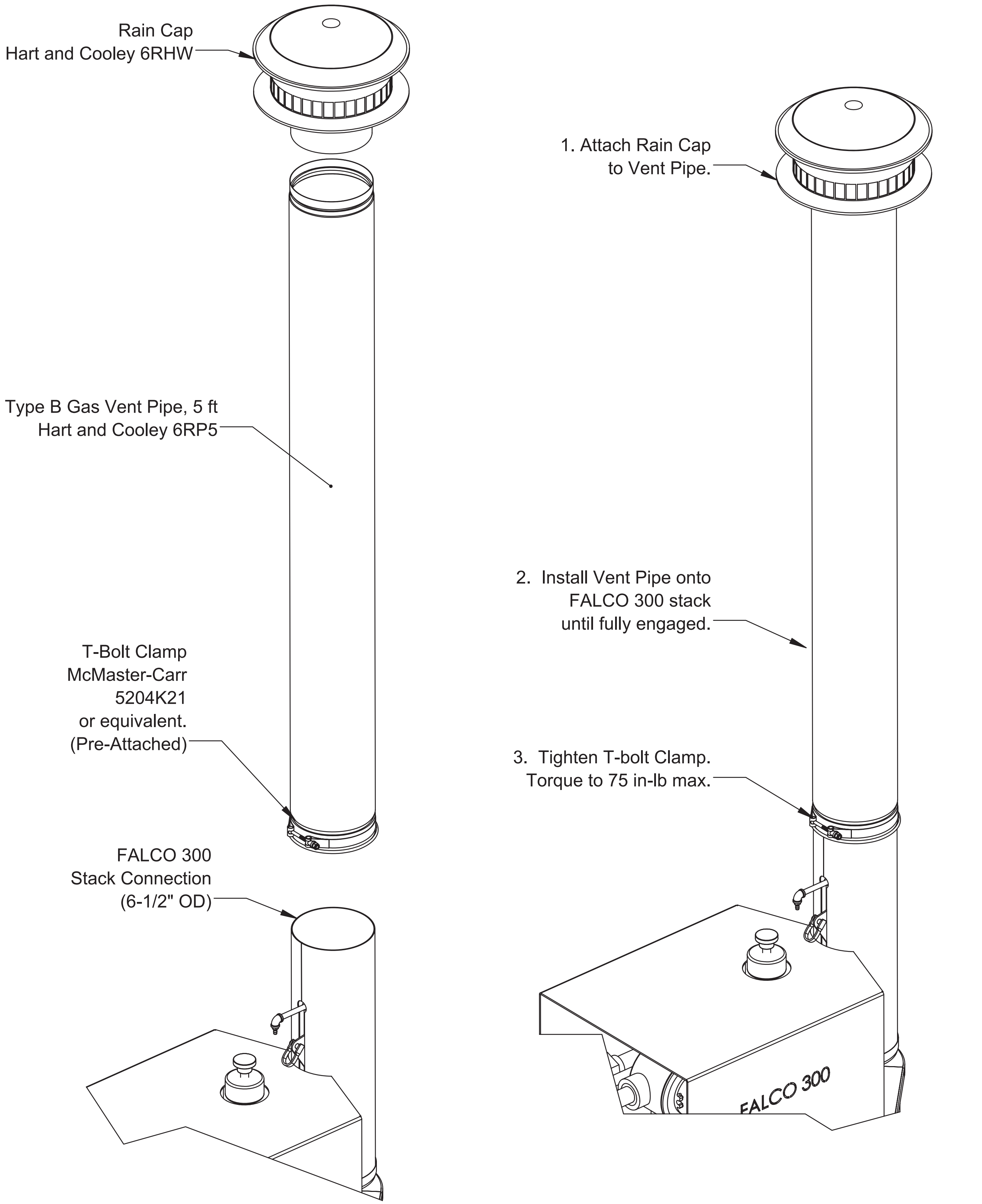

FIGURE 18: FALCO 300 VENT STACK (std) INSTALLATION

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Attachment B
Field Forms

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Long-Term Monitoring Form

Section A: Project Information

Site Name/ Generator Fuel Spill Site (SS014), MSSC, Haleakalā, Hawaiʻi

Date: ____________________

Inspector: ____________________

Section B: General Information

Inspection Type: ☐ Biweekly ☐ Monthly ☐ Quarterly ☐ Semi-Annually ☐ Annually ☐ SWE

Weather:

General: ____________________ Wind speed (mph): ____________________

Temperature (°F): ____________________ Wind direction: ____________________

Humidity (%): ____________________

Barometric Pressure: ____________________ Barometric Pressure Trend: ☐ Increasing ☐ Decreasing

Section C: Inspections

Inspection Item	Observed		
	Yes	**No**	**Comments** (include photograph documentation as attachment)
Conditions to Report to PM/Engineers/System Operators			
Active Bioventing System overload			
Heat Exchanger Variable Frequency Drive failure/motor overload			
Active bioventing system high condensate drum level			
Active bioventing system line high vacuum			
System shut-down			
*If yes to any of the above, report to PM/Engineers/System Operators			
Landfarm			
Structural deficiencies			
Liner in place and in good repair			
Geotextile cover in place and in good repair			
Evidence of fugitive water/dust			
Excess water present in landfarm			
Other (specify in comments)			
Signs/Posted Warnings (Landfarm)			
Present/Secure			
Legible			
Condition: ☐ poor ☐ fair ☐ good ☐ excellent			
Other (specify in comments)			
Active Bioventing System	**Yes**	**No**	**Comments** (include photograph documentation as attachment)
Adjustments made			
Electrical conduit damage			
Corrosion to system components			
Blow filter in good condition			
Condensate drum emptied into landfarm			Quantity:____________
Control Panel Data (catalyst temperature): Inlet:________________ Core:________________ Outlet:________________			
Other (specify in comments)			
IF BIANNUAL (EVERY 6 MONTHS) INSPECTION			
Soil turned within each holding cell			

Active Bioventing System - Well # V1A1	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O2 (GasLab Pro)			
CH4 (GasLab Pro)			
CO2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			
Active Bioventing System - Wellhead # V1B1	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O2 (GasLab Pro)			
CH4 (GasLab Pro)			
CO2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			
Active Bioventing System - Well # V1A2	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O2 (GasLab Pro)			
CH4 (GasLab Pro)			
CO2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			
Active Bioventing System - Well # V1B2	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O2 (GasLab Pro)			
CH4 (GasLab Pro)			
CO2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			

Active Bioventing System - Well # V1A3	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O_2 (GasLab Pro)			
CH_4 (GasLab Pro)			
CO_2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H_2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO_2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			

Active Bioventing System - Well # V1B3	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O_2 (GasLab Pro)			
CH_4 (GasLab Pro)			
CO_2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H_2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO_2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			

Active Bioventing System - Well # V1A4	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O_2 (GasLab Pro)			
CH_4 (GasLab Pro)			
CO_2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H_2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO_2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			

Active Bioventing System - Well # V1B4	**Reading**	**Units**	**Comments** (include photograph documentation as attachment)
Temperature (SperScientific Thermo-Hygrometer)			
Relative Humidity (SperScientific Thermo-Hygrometer)			
O_2 (GasLab Pro)			
CH_4 (GasLab Pro)			
CO_2 (GasLab Pro)			
Oxygen (RAE Systems MultiRAE Lite)			
H_2S (RAE Systems MultiRAE Lite)			
CO (RAE Systems MultiRAE Lite)			
CO_2 (RAE Systems MultiRAE Lite)			
LEL (RAE Systems MultiRAE Lite)			
IF MONTHLY INSPECTION			
Vacuum level (Manometer)			

Other Observations:

Section D: Corrective Actions

Conducted in conjunction with inspection:

Recommended future corrective actions:

Section E: Deviations

Deviations:

Section F: Certification

I certify the information contained in this form is accurate and complete to the best of my knowledge.

Inspector Name: ______________________ Signature: ______________________

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2. Report Information (Subject) 3
3. Upload Report and Supplemental Information 3
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Report Submittal for HEER Office (Assessment and Remediation Related Reports; NOT Written Release Notification Forms; NOT HEPCRA TIER II Forms)

version 1.3

(Submission #: HQA-72TX-QV020, version 1)

Details

Submitted	2/6/2025 (0 days ago) by Shelby Koide
Submission ID	HQA-72TX-QV020
Submission Reason	New
Status	Accepted

Form Input

1. Site Information

Enter the Site Name and iHEER ID if Provided

The Site Name/iHEER ID will appear on all correspondence, and official files.

Site Name and iHEER ID (if provided)
Generator Fuel Spill Site (SS014), Maui Space Surveillance Complex, HEER Release ID 3239

Is this a new Site/Project?
No

Name of Assigned HEER Project Manager
Jennah Oshiro

Contractor/Consultant's Name
Bryan Chinaka on behalf of Jennifer Wehrmann (USAF RPM)

Affiliation of Contractor/Consultant/Person Submitting Report
GSI North America Inc. on behalf of USAF

Address of Submitter

> 181 South Kukui St., First Floor
>
> Honolulu, HI 96813

Phone Number of Submitter
808-551-2396

e-mail Address of Submitter
bchinaka@gsisg.com

Potential Responsible Party's (PRP's) Name
15th Space Surveillance Squadron

PRP Address

> 550 Lipoa Parkway
>
> Kihei, HI 96753

e-mail Address of PRP
phillip.wagenbach.1@spaceforce.mil

Phone Number of PRP
808-891-7701

Provide the Site Address

The site address is the physical address of the facility.

Address of Facility

> Haleakala Observatory
>
> Haleakala
>
> Maui, HI 96790

TMK(s) of the Site (no dashes, no colon). Enter in following Form: DZSPPPppp; D=District, Z=Zone, P=Plat, p=parcel
NONE PROVIDED

Site Project Coordinates - Click on map to show location of contamination
20.7081832,-156.2567542

2. Report Information (Subject)

Subject/Title
Final Remedial Action Work Plan, Revision 01 (REDACTED for public release), Environmental Remediation Services to Conduct a Remedial Action at Generator Fuel Spill Site (SS014), Maui Space Surveillance Complex, Haleakala, Hawai�i

Date of Document
January 2025

Revision or Version Number
Final, Revision 01, 28 January 2025

3. Upload Report and Supplemental Information

Upload Report & Supplemental Information

> Final_RAWP_RA_SS014_MSSC_Revision01_REDACTED.pdf - 02/06/2025 03:33 PM
> **Comment**
> NONE PROVIDED

Attachments

Date	Attachment Name	Context	Confidential?	User
2/6/2025 3:33 PM	Final_RAWP_RA_SS014_MSSC_Revision01_REDACTED.pdf	Attachment	No	Shelby Koide

Status History

	User	Processing Status
2/6/2025 3:28:31 PM	Shelby Koide	Draft
2/6/2025 3:34:26 PM	Shelby Koide	Submitting
2/6/2025 3:34:33 PM	Shelby Koide	Submitted
2/6/2025 4:10:51 PM	Rosa Iu	Accepted

Audit

Event	Event Description	Event By	Event Date
Send Email	Step Completed on Submission HQA-72TX-QV020 in the e-Permitting System email was sent to joslynne.camlin@doh.hawaii.gov.	Shelby Koide	2/6/2025 3:34 PM
Send Email	Step Completed on Submission HQA-72TX-QV020 in the e-Permitting System email was sent to mayara.silva@doh.hawaii.gov.	Shelby Koide	2/6/2025 3:34 PM
Send Email	Step Completed on Submission HQA-72TX-QV020 in the e-Permitting System email was sent to rosa.iu@doh.hawaii.gov.	Shelby Koide	2/6/2025 3:34 PM
Send Email	Step Completed on Submission HQA-72TX-QV020 in the e-Permitting System email was sent to marsha.mealey@doh.hawaii.gov.	Shelby Koide	2/6/2025 3:34 PM

Processing Steps

Step Name	Assigned To/Completed By	Date Completed
Form Submitted	Shelby Koide	2/6/2025 3:34:33 PM

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version 1.3

(Submission #: HQA-72TX-QV020, version 1)

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