APPENDIX E

AIR QUALITY TERMINOLOGY AND BACKGROUND

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BACKGROUND INFORMATION ON AIR QUALITY

Air Pollution Terminology

The discussion of air pollution issues requires an understanding of terms that have a technical meaning. It is especially important to understand the distinction between air pollutant emissions and ambient air quality. Other important terminology includes: primary pollutants, secondary pollutants, and pollutant precursors; aerosols and particulate matter; and ozone precursor emissions terminology.

Emissions and Ambient Air Quality. The term "pollutant emissions" refers to the amount (usually stated as a weight) of one or more specific compounds introduced into the atmosphere by a source or group of sources. In practice, most pollutant emissions data are presented as "emission rates": the amount of pollutants emitted during a specified increment of time or during a specified increment of emission source activity. Typical measurement units for emission rates on a time basis include pounds per hour, pounds per day, or tons per year. Typical measurement units for emission rates on a source activity basis include pounds per thousand gallons of fuel burned, pounds per ton of material processed, and grams per vehicle mile of travel.

The term "ambient air quality" refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) actually experienced at a particular geographic location that may be some distance from the source of the relevant pollutant emissions. The ambient air quality levels actually measured at a particular location are determined by the interactions among three groups of factors:

- emissions: the types, amounts, and locations of pollutants emitted into the atmosphere;
- meteorology: the physical processes affecting the distribution, dilution, and removal of these pollutants; and
- chemistry: any chemical reactions that transform pollutant emissions into other chemical substances.

Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million by volume).

Primary Pollutants, Secondary Pollutants, and Pollutant Precursors. Air pollutants are often characterized as being "primary" or "secondary" pollutants. Primary pollutants are those emitted directly into the atmosphere (such as carbon monoxide, sulfur dioxide, lead particulates, and hydrogen sulfide). Secondary pollutants are those (such as ozone, nitrogen dioxide, and sulfate particles) formed through chemical reactions in the atmosphere; these chemical reactions usually involve primary pollutants, normal constituents of the atmosphere, and other secondary pollutants.

Those compounds which react to form secondary pollutants are referred to as reactive pollutants, pollutant precursors, or precursor emission products. Some air pollutants (such as many organic gases and suspended particulate matter) are a combination of primary and secondary pollutants.

The distinction between primary and secondary pollutants is more than a matter of semantics; important air quality management implications are also involved. The ambient concentration of primary pollutants depends on the spatial concentration of the emission sources, the rate of pollutant emissions, and the degree to which the emitted pollutants are dispersed or removed from the atmosphere between the emission source and the location of interest. Air quality problems involving primary pollutants (such as carbon monoxide) often can be traced to a single pollutant source or a concentrated group of sources emitting large quantities of the pollutant. Additionally, the responsible emission source will be relatively close to the location of the air quality problem. The distance between the emission source and the location of a ground-level air quality problem depends largely on the height at which the emissions are released into the atmosphere.

When an air quality problem involves a secondary pollutant (such as ozone), the spatial relationship between emission sources and ambient air quality problems becomes much more complicated. Because secondary pollutants are not emitted directly into the atmosphere, observed ambient concentrations may not show a clear correlation with the spatial distribution of sources emitting the pollutant precursors. The time factor involved in the chemical reactions producing secondary pollutants allows emissions from numerous sources to become dispersed and mixed together. As a result, the observed ambient pollutant concentrations are due as much to the cumulative areawide emissions of precursors as to the spatial concentration of emission sources.

Aerosols and Particulate Matter. Most people would interpret the term "aerosol" as indicating some type of liquid droplet or mist sprayed into the air. Similarly, most people would interpret the term "particulate matter" as implying a solid particle (such as dust or fly ash). In the air pollution field, however, the terms "aerosol" and "particulate matter" are used interchangeably; both terms can refer to either liquid or solid material suspended in the air.

Ozone Precursor Emissions. Ozone, a major component of photochemical smog, is the secondary pollutant of greatest concern in most portions of California. The pollutant emissions generally categorized as ozone precursors fall into two broad groups of chemicals: nitrogen oxides and organic compounds. Many different terms are used to refer to these groups of ozone precursors. As indicated below, the various terms are seldom used in a rigorous chemical sense.

The terms "nitrogen oxides" and "oxides of nitrogen" are used interchangeably to refer to the combination of nitric oxide (designated by the chemical symbol NO) and nitrogen dioxide (designated by the chemical symbol NO_2). This combination of nitrogen oxides often is designated by the symbol NOx. Although there are five different oxides of nitrogen, the terms "nitrogen oxides", "oxides of nitrogen", and "NOx" generally refer only to the combination of NO and NO_2. NO_2 is itself a secondary pollutant formed primarily from nitric oxide.

Organic compound precursors of ozone are routinely described by a number of variations on three terms: hydrocarbons (HC), organic gases (OG), and organic compounds (OC). These three basic terms are often modified by adjectives such as total, reactive, or volatile. The result is a rather

confusing array of acronyms: HC (hydrocarbons), THC (total hydrocarbons), RHC (reactive hydrocarbons), TOG (total organic gases), ROG (reactive organic gases), TOC (total organic compounds), ROC (reactive organic compounds), and VOC (volatile organic compounds). An additional term, NMHC (nonmethane hydrocarbons), is also used on occasion.

To a chemist, most of these terms differ from each other in some significant way. In the air pollution control field, however, they are used as two groups of interchangeable terms. THC, TOG, and TOC imply a comprehensive grouping of chemicals including some (such as methane and many chlorinated organic compounds) that have no significant role in photochemical reactions in the lower atmosphere. The other terms (HC, RHC, ROG, ROC, VOC, and NMHC) imply a grouping of chemicals limited to those that play a meaningful role in photochemical reactions in the lower atmosphere.

From a purely chemical standpoint, the "hydrocarbon" terminology (HC, THC, RHC, and NMHC) often is inappropriate; many of the compounds of concern are organic compounds, but not hydrocarbons. The "reactive organic gases" (ROG) terminology incorrectly implies that compounds which condense into an aerosol droplet cease to play a role in smog photochemistry. The "volatile organic compound" (VOC) terminology incorrectly implies that emissions occur only through an evaporation process. The phrase "reactive organic compounds" (ROC) usually is the most accurate ozone precursor terminology, but the ROC acronym is not in widespread use. Since there already are too many acronyms for ozone precursors, the ROG acronym is the most reasonable one to use, and will be used in this document.

Air Quality Standards

Air quality management programs have evolved using two distinct management approaches: one approach based on setting and achieving ambient air quality standards, and a parallel approach of setting emission limits for individual sources of air pollutants considered to be hazardous.

The ambient standards approach to air quality management typically entails:

- setting ambient air quality standards for acceptable exposure to selected air pollutants;
- conducting monitoring programs to identify locations exposed to air pollutant concentrations exceeding the standards; and
- developing programs and regulations designed to reduce or eliminate the identified high exposure conditions in a timely manner.

The hazardous air pollutant emission limits approach to air quality management typically entails:

- identifying specific chemical substances that are potentially hazardous to human health, and then
- setting emission limits to regulate the amount of those substances that can be released by individual commercial or industrial facilities or by specific types of equipment.

Ambient Air Quality Standards for Criteria Pollutants. Air quality programs based on ambient air quality standards typically address air pollutants that are produced in large quantities by widespread types of emission sources and which are of public health concern because of their toxic

properties. The U.S. Environmental Protection Agency (EPA) has established ambient air quality standards for several different pollutants, which often are referred to as criteria pollutants (ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, suspended particulate matter, and lead). Standards for suspended particulate matter have been set for two size fractions: inhalable particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$). Federal ambient air quality standards are based primarily on evidence of acute and chronic health effects. Federal ambient air quality standards apply to outdoor locations to which the general public has access.

Some states have adopted ambient air quality standards that are more stringent than the comparable federal standards or address pollutants that are not covered by federal ambient air quality standards. Most state ambient air quality standards are based primarily on health effects data, but can reflect other considerations such as protection of crops, protection of materials, or avoidance of nuisance conditions (such as objectionable odors). Table 1 summarizes federal and state ambient air quality standards applicable in Hawai'i.

Air pollutants covered by federal and state ambient air quality standards can be categorized by the nature of their toxic effects as:

- irritants (such as ozone, particulate matter, nitrogen dioxide, sulfur dioxide, and hydrogen sulfide) that affect the respiratory system, eyes, mucous membranes, or the skin;
- asphyxiants (such as carbon monoxide and nitric oxide) that displace oxygen or interfere with oxygen transfer in the circulatory system, affecting the cardiovascular and central nervous systems;
- necrotic agents (such as ozone, nitrogen dioxide, and sulfur dioxide) that directly cause cell death; or
- systemic poisons (such as lead particles) that affect a range of tissues, organs, and metabolic processes.

Ozone, suspended particulate matter, and carbon monoxide are the air pollutants of greatest concern in most parts of the country. Ozone is a strong oxidizing agent that reacts with a wide range of materials and biological tissues. Ozone is a respiratory irritant that can cause acute and chronic effects on the respiratory system. Recognized effects include reduced pulmonary function, pulmonary inflammation, increased airway reactivity, aggravation of existing respiratory diseases (such as asthma, bronchitis, and emphysema), physical damage to lung tissue, decreased exercise performance, and increased susceptibility to respiratory infections. In addition, ozone is a necrotic agent that causes significant damage to leaf tissues of crops and natural vegetation. Ozone also damages many materials by acting as a chemical oxidizing agent. Because of its chemical activity, indoor ozone levels are usually much lower than outdoor levels.

Suspended particulate matter represents a diverse mixture of solid and liquid material having size, shape, and density characteristics that allow the material to remain suspended in the air for meaningful time periods. The physical and chemical composition of suspended particulate matter is highly variable, resulting in a wide range of public health concerns.

Many components of suspended particulate matter are respiratory irritants. Some components (such as crystalline or fibrous minerals) are primarily physical irritants. Other components are chemical irritants (such as sulfates, nitrates, and various organic chemicals). Suspended particulate

matter also can contain compounds (such as heavy metals and various organic compounds) that are systemic toxins or necrotic agents. Suspended particulate matter or compounds adsorbed on the surface of particles can also be carcinogenic or mutagenic chemicals.

TABLE 1. AMBIENT AIR QUALITY STANDARDS APPLICABLE IN HAWAII

POLLUTANT	SYMBOL	AVERAGING TIME	STANDARD AS PARTS PER MILLION BY VOLUME		STANDARD AS MICROGRAMS PER CUBIC METER		VIOLATION CRITERIA	
			HAWAII	NATIONAL	HAWAII	NATIONAL	HAWAII	NATIONAL
Ozone	O_3	8 Hours	0.08	0.08	157	157	If exceeded on more than 1 day per year	If exceeded by the mean of annual 4th highest daily values for a 3-year period
Carbon Monoxide	CO	8 Hours	4.5	9	5,000	10,000	If exceeded on more than 1 day per year	If exceeded on more than 1 day per year
		1 Hour	9	35	10,000	40,000	If exceeded on more than 1 day per year	If exceeded on more than 1 day per year
Inhalable Particulate Matter	PM_{10}	Annual Arithmetic Mean	---	---	50	50	If exceeded	If exceeded as a 3-year single station average
		24 Hours	---	---	150	150	If exceeded on more than 1 day per year	If exceeded by the mean of annual 99th percentile values over 3 years

TABLE 1 (continued). AMBIENT AIR QUALITY STANDARDS APPLICABLE IN HAWAII

POLLUTANT	SYMBOL	AVERAGING TIME	STANDARD AS PARTS PER MILLION BY VOLUME		STANDARD AS MICROGRAMS PER CUBIC METER		VIOLATION CRITERIA	
			HAWAII	NATIONAL	HAWAII	NATIONAL	HAWAII	NATIONAL
Fine Particulate Matter	$PM_{2.5}$	Annual Arithmetic Mean	---	---	---	15.0	---	If exceeded as a 3-year spatial average of data from designated stations
		24 Hours	---	---	---	65	---	If exceeded by the mean of annual 98th percentile values over 3 years
Nitrogen Dioxide	NO_2	Annual Average	0.037	0.053	70	100	If exceeded	If exceeded
Sulfur Dioxide	SO_2	Annual Average	0.03	0.03	80	80	If exceeded	If exceeded
		24 Hours	0.14	0.14	365	365	If exceeded on more than 1 day per year	If exceeded on more than 1 day per year
		3 Hours	0.5	0.5	1,300	1,300	If exceeded on more than 1 day per year	If exceeded on more than 1 day per year

TABLE 1 (continued). AMBIENT AIR QUALITY STANDARDS APPLICABLE IN HAWAII

POLLUTANT	SYMBOL	AVERAGING TIME	STANDARD AS PARTS PER MILLION BY VOLUME		STANDARD AS MICROGRAMS PER CUBIC METER		VIOLATION CRITERIA	
			HAWAII	NATIONAL	HAWAII	NATIONAL	HAWAII	NATIONAL
Lead Particles (TSP Sampler)	Pb	Calendar Quarter	---	---	1.5	1.5	If exceeded	If exceeded
Hydrogen Sulfide	H_2S	1 Hour	0.025	---	35	---	If exceeded on more than 1 day per year	---

Notes:

All standards except the national PM10 and PM2.5 standards are based on measurements corrected to 25 degrees C and 1 atmosphere pressure.

The national PM10 and PM2.5 standards are based on direct flow volume data without correction to standard temperature and pressure.

Decimal places shown for standards reflect the rounding precision used for evaluating compliance.

Gaseous pollutant concentration equivlencies (parts per million by volume versus micrograms per cubic meter) are nominal values accounting for rounding conventions; exact equivalencies may be different.

Except for the 3-hour sulfur dioxide standard, the national standards shown are the primary (health effects) standards.

The national 3-hour sulfur dioxide standard is a secondary (welfare effects) standard.

The national PM10 standards were adopted in 1987; revised violation criteria were adopted for attainment areas in 1997.

The original violation criteria for the national PM10 standards will remain in effect for PM10 nonattainment areas until EPA takes actions required by Section 172(e) of the Clean Air Act or approves emission control programs for the relevant PM10 state implementation plan.

TABLE 1 (continued). AMBIENT AIR QUALITY STANDARDS APPLICABLE IN HAWAII

Notes (continued):

Violation criteria for all standards except the national annual standard for PM2.5 are applied to data from individual monitoring sites.

Violation criteria for the national annual standard for PM2.5 are applied to a spatial average of data from one or more community-oriented monitoring sites representative of exposures at neighborhood or larger spatial scales (40 CFR Part 58).

The "10" in PM10 and the "2.5" in PM2.5 are not particle size limits; these numbers identify the particle size class (aerodynamic equivalent diameters in microns) collected with 50% mass efficiency by certified sampling equipment. The maximum particle size collected by PM10 samplers is about 50 microns aerodynamic equivalent diameter; the maximum particle size collected by PM2.5 samplers is about 6 microns aerodynamic equivalent diameter. (40 CFR Part 53).

Data Sources:

40 CFR Parts 50, 53, and 58.

Hawaii Administrative Rules Chapter 11-59 (August 28, 2001).

Public health concerns for suspended particulate matter focus on the particle size ranges likely to reach the lower respiratory tract or the lungs. Inhalable particulate matter (PM_{10}) represents particle size categories that are likely to reach either the lower respiratory tract or the lungs after being inhaled. Fine particulate matter ($PM_{2.5}$) represents particle size categories likely to penetrate to the lungs after being inhaled. The "10" in PM_{10} and the "2.5" in $PM_{2.5}$ are not upper size limits. These numbers refer to the particle size range collected with 50% mass efficiency by certified sampling devices; larger particles are collected with lower efficiencies and smaller particles are collected with higher efficiencies.

In addition to public health impacts, suspended particulate matter causes a variety of material damage and nuisance effects: abrasion; corrosion, pitting, and other chemical reactions on material surfaces; soiling; and transportation hazards due to visibility impairment.

Carbon monoxide is a public health concern because it combines readily with hemoglobin in the blood, and thus reduces the amount of oxygen transported to body tissues. Relatively low concentrations of carbon monoxide can significantly affect the amount of oxygen in the blood stream since carbon monoxide binds to hemoglobin 200-250 times more strongly than oxygen. Both the cardiovascular system and the central nervous system can be affected when 2.5-4.0 percent of the hemoglobin in the blood is bound to carbon monoxide rather than to oxygen. Because of its low chemical reactivity and low solubility, indoor carbon monoxide levels usually are similar to outdoor levels.

Hazardous Air Pollutants. Air quality programs based on regulation of other hazardous substances typically address chemicals used or produced by limited categories of industrial facilities. Programs regulating hazardous air pollutants focus on: substances that alter or damage the genes and chromosomes in cells (mutagens); substances that affect cells in ways that can lead to uncontrolled cancerous cell growth (carcinogens); substances that can cause birth defects or other developmental abnormalities (teratogens); substances with serious acute toxicity effects; and substances that undergo radioactive decay processes, resulting in the release of ionizing radiation. Federal air quality management programs for hazardous air pollutants focus on setting emission limits for particular industrial processes rather than setting ambient exposure standards. Some states have established ambient exposure guidelines for various hazardous air pollutants, and use those guidelines to as part of the permit review process for industrial emission sources.

The State of Hawai'i has adopted ambient concentration guidelines for hazardous air pollutants. Those guidelines are used as part of the permit review process for emission sources that require state or federal air quality permits. The Hawai'i ambient exposure guidelines for hazardous air pollutants (Hawai'i Administrative Rules Title 11 Chapter 60.1, Section 179) include the following:

- for non-carcinogenic compounds, an 8-hour average concentration equal to 1 percent of the corresponding 8-hour threshold level value (TLV) value adopted by the Occupational Safety and Health Administration (OSHA);
- for non-carcinogenic compounds, an annual average concentration equal to 1/420 (0.238 percent) of the 8-hour TLV value adopted by OSHA;
- for non-carcinogenic compounds for which there is no OSHA-adopted TLV, the Director of

Health is authorized to set ambient air concentration standards on a case-by-case basis so as to avoid unreasonable endangerment of public health with an adequate margin of safety; and

- for carcinogenic compounds, any ambient air concentration that produces an individual lifetime excess cancer risk of more than 10 in 1 million assuming continuous exposure for 70 years.

Air Quality Planning Programs

The federal Clean Air Act requires each state to identify areas which have ambient air quality in violation of federal standards. States are required to develop, adopt, and implement a State Implementation Plan (SIP) to achieve, maintain, and enforce federal ambient air quality standards in these nonattainment areas. Deadlines for achieving the federal air quality standards vary according to air pollutant and the severity of existing air quality problems. The SIP must be submitted to and approved by EPA. SIP elements are developed on a pollutant-by-pollutant basis whenever one or more air quality standards are being violated.

The status of areas with respect to federal ambient air quality standards is categorized as nonattainment, attainment (better than national standards), unclassifiable, or attainment/cannot be classified. For most air pollutants, initial federal status designations are made using only two categories (either nonattainment and unclassifiable/attainment, or nonattainment and attainment/cannot be classified). For simplicity and clarity, the federal unclassifiable and attainment/cannot be classified designations will be called unclassified in this document. The unclassified designation includes attainment areas that comply with federal standards as well as areas for which monitoring data are lacking. Unclassified areas are treated as attainment areas for most regulatory purposes. Areas that have been reclassified from nonattainment to attainment of federal air quality standards are automatically considered "maintenance areas", although this designation is seldom noted in status listings. The entire state of Hawai'i is categorized as attainment or unclassified for each of the federal ambient air quality standards.

Regulatory Considerations

The original 1963 Clean Air Act limited federal involvement in air quality programs to research, education, and advisory functions plus a mediation role for interstate disputes. The federal role was expanded in 1965 with Congressional authorization for uniform federal emission standards for motor vehicles. The 1970 amendments to the Clean Air Act established several regulatory programs, including:

- adoption of emission standards for motor vehicles and other types of mobile sources;
- adoption of emission standards for major new industrial facilities as new source performance standards (NSPS);
- adoption of national emission standards for hazardous air pollutants (NESHAP); and
- requirements for pre-construction review of major new industrial facilities or major modifications to existing facilities through a new source review (NSR) program for

nonattainment areas, and through a prevention of significant deterioration (PSD) program for attainment areas.

The 1977 amendments to the Clean Air Act revised and expanded some of the regulatory programs established by the 1970 amendments, but did not create any new programs. The 1990 amendments to the Clean Air Act made further revisions to the established regulatory programs and added some new regulatory programs:

- operating permits for major industrial facilities (Title V permits);
- additional programs to regulate an extensive list of hazardous air pollutants;
- emissions allocation programs to regulate sulfur emissions from electrical power generation facilities;
- programs to reduce emissions of compounds that deplete stratospheric ozone levels; and
- requirements for federal agencies to demonstrate that actions they undertake are consistent with federally mandated state implementation plans (SIPs).

In general, states have assumed primary responsibility for enforcing most industrial source emission standards and industrial source review requirements; EPA exercises formal review and oversight responsibilities. Most states have implemented the NSR, PSD, and Title V requirements as formalized air quality permit programs. Many states have air quality permit programs that extend to emission sources not covered by federal NSR or PSD requirements. State air quality permit requirements generally are integrated with federal NSR and PSD requirements, resulting in a consolidated permit program. Under most consolidated permit programs, basic state permit requirements apply to all sources that are not specifically exempted. Additional NSR and/or PSD program requirements (including EPA review of the permit) become applicable if sources exceed various size or emission thresholds.

Clean Air Act Conformity

Section 176(c) of the Clean Air Act requires federal agencies to ensure that actions undertaken in nonattainment or maintenance areas are consistent with the Clean Air Act and with federally enforceable air quality management plans. EPA has promulgated separate rules that establish conformity analysis procedures for highway/mass-transit projects (40 CFR Part 93, Subpart A) and for other (general) federal agency actions (40 CFR Part 93, Subpart B). General conformity requirements are potentially applicable to most other federal agency actions, but apply only to those aspects of an action that involve on-going federal agency responsibility and control over direct or indirect sources of air pollutant emissions.

The EPA conformity rule establishes a process that is intended to demonstrate that the proposed federal action:

- would not cause or contribute to new violations of federal air quality standards;
- would not increase the frequency or severity of existing violations of federal air quality standards; and
- would not delay the timely attainment of federal air quality standards.

The EPA general conformity rule applies to federal actions occurring in nonattainment or

maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emission thresholds that trigger requirements of the conformity rule are called *de minimis* levels. Emissions associated with stationary sources that are subject to permit programs incorporated into the SIP are not counted against the *de minimis* threshold. No portions of the State of Hawai‘i are classified as nonattainment or maintenance areas. Consequently, Clean Air Act conformity analysis procedures do not apply to Army actions in Hawai‘i.

Existing Air Quality Conditions

The State of Hawai‘i currently operates 9 ambient air quality monitoring stations on the Island of O‘ahu, 1 station on the Island of Kaua‘i, 2 stations on the Island of Maui, and 5 stations on the Island of Hawai‘i. All of the monitoring stations are located in coastal regions, with many of the monitoring stations located in or near urbanized areas. None of the monitoring stations are located at or near Army training areas. The monitoring stations on Maui are located to monitor the air quality impacts of sugar cane burning. The monitoring stations on the Island of Hawai‘i have been located primarily to monitor the impacts of emissions from volcanic eruptions and geothermal development. Based on available monitoring data and the locations of recognized emission sources, EPA has determined that no locations in Hawai‘i exceed federal ambient air quality standards.

Almost all of the monitoring data collected in recent years shows that ambient air quality levels are well below the values of the relevant state and federal ambient air quality standards. Only the state and federal 24-hour PM_{10} standards (150 micrograms per cubic meter) have ever been approached. Maximum 24-hour PM_{10} concentrations often exceed 100 micrograms per cubic meter at one or both monitoring stations on Maui, and sometimes exceed 100 micrograms per cubic meter at the Pearl City and Kapolei monitoring stations on O‘ahu. The high PM_{10} concentrations at monitoring stations on Maui are associated with agricultural burning activities. The high PM_{10} concentrations at Pearl City and Kapolei have been attributed to the use of fireworks during New Year’s Day celebrations. Two episodes of 24-hour PM_{10} concentrations over 150 micrograms per cubic meter were recorded at Pearl City in 2000. Those two episodes represent a violation of the state 24-hour PM_{10} standard, but did not constitute a violation of the federal 24-hour PM_{10} standard.

Climate and Meteorology Conditions

The most prominent feature of the circulation of air across the tropical Pacific is the persistent trade-wind flow in a general east-to-west direction. The trade winds blow across Hawai‘i from the northeast quadrant about 80 to 95 percent of the time from May through September and about 50 to 80 percent of the time from October through April. In addition to the trade winds, wind patterns are influenced by major storm systems and by topographic features that alter or channel prevailing wind directions. Topographic features have additional influences on local wind patterns in coastal areas, with up slope/down slope flow patterns often reinforcing sea breeze/land breeze patterns. Local winds tend to move inland from the coast during mid-morning to early evening periods, then reverse direction and flow off-shore during night and

early morning hours. The on-shore sea breeze component tends to be stronger than the off-shore land breeze component. Sea breeze/land breeze patterns are most common on the south and west coasts of the Hawaiian Islands.

The combination of a dominant trade wind pattern and limited seasonal changes in the length of day and night combine to limit seasonal variations in weather conditions in Hawai‘i. Weather conditions in Hawai‘i show a two season pattern, with a winter season of seven months (October through April) and a summer season of five months (May through September). The summer months generally are warmer and drier than the winter months. Most major storms occur during the winter season. Seasonal variations in temperature conditions are mild at lower elevations, with daytime temperatures commonly in the 70s to 80s and nighttime temperatures in the 60s to 70s. Topographic features exert a strong influence on rainfall amounts, and also influence temperature patterns at higher elevations. Rainfall amounts range from less than 20 inches per year on the southern and western coastal areas to over 300 inches per year on the windward slopes of the high mountains or near the summits of lower mountains on Kaua‘i, O‘ahu, and Maui.

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KEY ACRONYMS

CO: carbon monoxide
EPA: U.S. Environmental Protection Agency
NESHAP: national emission standards for hazardous air pollutants
NO: nitric oxide
NO_2: nitrogen dioxide
NOx: oxides of nitrogen (nitric oxide plus nitrogen dioxide)
NSPS: new source performance standards
NSR: new source review
ODC: ozone depleting chemicals
OSHA: Occupational Health and Safety Administration
PM_{10}: inhalable particulate matter
$PM_{2.5}$: fine particulate matter
PSD: prevention of significant deterioration
ROG: reactive organic gases or reactive organic compounds
SIP: State Implementation Plan
SOx: sulfur oxides
TLV: threshold level value (an 8-hour time weighted average concentration value)

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"BACKGROUND SAMPLING EVENT" (8 APRIL 2003)
(Page 1 of 1)

POI Category	Analytical Method (Laboratory; Instrument)	Field Results Background Sampling Event		Health-Based Guidance & State Regulatory 8-Hour TWAs	
		Individual POI Concentrations	Corresponding POI Results Expressed as 8-Hour TWA	ACGIH Health-Based Exposure Guidelines	State of Hawai'i "Hazardous Air Pollutants" Guidelines
VOCs	USEPA TO-15 (AIR TOXICS; GC/MS)	Chloromethane: 1.3 ppbV	Chloromethane: 0.9 ppbV (TWA)	Chloromethane: 50,000 ppbV	Chloromethane: 1,000 ppbV
SVOCs	USEPA TO-13 (AIR TOXICS; GC/MS)	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*
Energetic Compounds	USEPA 8330mod (SWL Lab; HPLC)	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*
Chlorinated Herbicides	USEPA 8151Amod (APPL; GC/ECD)	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*
PCDDs/ PCDFs	USEPA TO-9A (ALTA; HR-GC/MS)	OCDD: 27.2 pg/m³ (*NOTE: compound also detected in associated laboratory Method Blank at a higher level*)	*(NOTE: OCDD was detected in the associated Method Blank at a higher level than the background field sample and is considered to be a laboratory contaminant; therefore, TWA calculations are not applicable.)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*
Particulate Metals	NIOSH 7300 (CHESTER; ICP)	Barium: 0.03 µg/m³ Chromium: 0.71 µg/m³ Magnesium: 0.54 µg/m³ Nickel: 0.11 µg/m³ Lead: 0.27 µg/m³ Zinc: 0.12 µg/m³	Barium: 0.02 µg/m³ (TWA) Chromium: 0.46 µg/m³ (TWA) Magnesium: 0.35 µg/m³ (TWA) Nickel: 0.07 µg/m³ (TWA) Lead: 0.18 µg/m³ (TWA) Zinc: 0.08 µg/m³ (TWA)	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³
Cyanides	NIOSH 7904 (EAS; ISE)	*(no detected hydrogen cyanide)*	*(no detected hydrogen cyanide)*	*(no detected hydrogen cyanide)*	*(no detected hydrogen cyanide)*
Sulfur Gases	ASTM D-5504 (AIR TOXICS; GC/SCD)	*(no detected sulfur gases)*	*(no detected sulfur gases)*	*(no detected sulfur gases)*	*(no detected sulfur gases)*
Particulate Matter – 2.5 microns	USEPA IP-10A (CHESTER; gravimetric)	PM-2.5: 12.9 µg/m³	PM-2.5: 8.3 µg/m³ (TWA) PM-2.5: 12.9 µg/m³ (24-hr)	PM-2.5: 3,000 µg/m³ (TWA - respirable) PM-2.5: 65 µg/m³ (24-hr Federal Air Quality Standard)	*(not established)*
Particulate Matter – 10.0 microns	USEPA IP-10A (CHESTER; gravimetric)	PM-10: 14.5 µg/m³	PM-10: 9.3 µg/m³ (TWA) PM-10: 14.5 µg/m³ (24-hr)	PM-10: 10,000 µg/m³ (TWA - inhalable) PM-10: 150 µg/m³ (24-hr Federal Air Quality Standard.)	*(not established)*

Notes:
1. Background sampling location: Kahanahaiki Valley, northern side of MMR.
2. Background sampling conditions: non-CALFEX date (i.e., no troop or helicopter activities at MMR during sample collection).
3. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
4. 24-hour PM-2.5 and PM-10 background values equivalent to the recorded particulate concentrations for the respective background monitoring duration.
5. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
6. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
7. Acronyms and abbreviations used in this table:

µg/m³: micrograms of substance per cubic meter of air
ACGIH: American Conference of Governmental Industrial Hygienists
AIR TOXICS: Air Toxics, Ltd. (Folsom, CA)
ALTA: Alta Analytical Laboratory, Inc. (El Dorado Hills, CA)
APPL: Agricultural & Priority Pollutants Laboratory, Inc. (Fresno, CA)
ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
GC/ECD: gas chromatography/electron capture detection
GC/MS: gas chromatography/mass spectrometry
GC/SCD: gas chromatography/sulfur chemiluminescence detection
HAR: Hawai'i Administrative Rules
HPLC: high performance liquid chromatography
hr: hour
HR: high resolution (GC/MS)
ICP: inductively coupled plasma (atomic emission spectroscopy)
ISE: ion specific electrode
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OCDD: octachlorodibenzodioxin
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
pg/m³: picograms of substance per cubic meter of air
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
POI: pollutant of interest
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TLV: threshold limit value (ACGIH)
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #1 SAMPLING EVENT" (31 JANUARY 2003)
(Page 1 of 3)

AIR SAMPLING STATION (LOCATION)	VOCs (USEPA TO-13; (AIR TOXICS)				SVOCs (USEPA TO-13; AIR TOXICS)	ENERGETICS (USEPA 8330mod; SWL Lab)	CHLOR. HERBICIDES (USEPA 8151Amod; APPL)	PCDDs/PCDFs (USEPA TO-9A; ALTA)
	FIELD RESULT	**FIELD TWA**	**ACGIH TWA**	**HAWAII TWA**	**FIELD RESULT**	**FIELD RESULT**	**FIELD RESULT**	**FIELD RESULT**
STATION 1 (On-site; just west of OBJ Deer, downwind air station)	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	1,4-Dioxane: 3.7 ppbV	1,4-Dioxane: 3.0 ppbV	1,4-Dioxane: 20,000 ppbV	1,4-Dioxane: 1,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	Acetone: 3.5 ppbV	Acetone: 3.3 ppbV	Acetone: 500,000 ppbV	Acetone: 10,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	DCM: 1.5 ppbV Benzene: 5.2 ppbV Toluene: 9.6 ppbV Ethylbenzene: 1.4 ppbV m,p-Xylenes: 3.2 ppbV o-Xylene: 1.4 ppbV 1,2,4-TMB: 1.0 ppbV Ethanol: 5.7 ppbV	DCM: 1.1 ppbV Benzene: 3.9 ppbV Toluene: 7.1 ppbV Ethylbenzene: 1.0 ppbV m,p-Xylenes: 2.4 ppbV o-Xylene: 1.0 ppbV 1,2,4-TMB: 0.7 ppbV Ethanol: 4.2 ppbV	DCM: 50,000 ppbV Benzene: 500 ppbV Toluene: 50,000 ppbV Ethylbenzene: 100,000 ppbV m,p-Xylenes: 100,000 ppbV o-Xylene: 100,000 ppbV 1,2,4-TMB: 25,000 ppbV Ethanol: 1,000,000 ppbV	DCM: 250 ppbV Benzene: 10 ppbV Toluene: 2,000 ppbV Ethylbenzene: 1,000 ppbV m,p-Xylenes: 1,000 ppbV o-Xylene: 1,000 ppbV 1,2,4-TMB: *(not established)* Ethanol: 10,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	DCM: 1.2 ppbV Acetone: 4.8 ppbV	DCM: 1.0 ppbV Acetone: 4.0 ppbV	DCM: 50,000 ppbV Acetone: 500,000 ppbV	DCM: 250 ppbV Acetone: 1,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 7 (On-site; just south of OBJ Deer, crosswind air station)	Acetone: 5.1 ppbV	Acetone: 4.2 ppbV	Acetone: 500,000 ppbV	Acetone: 1,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 8 (Background air station in Kahana-haiki Valley; northern side of MMR)	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 9 <FIELD DUPLICATE OF STATION 3> (On-site; near administration area at MMR's west-end, downwind)	DCM: 2.2 ppbV PCE: 2.4 ppbV	DCM: 1.5 ppbV PCE: 1.6 ppbV	DCM: 50,000 ppbV PCE: 25,000 ppbV	DCM: 250 ppbV PCE: 1,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*
STATION 10 (Trip blank; QA/QC sample**)**	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 2.2 µg/m^3 for PM-2.5 and 4.5 µg/m^3 for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
4. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
5. Acronyms and abbreviations used in this table:

µg/m^3: micrograms of substance per cubic meter of air
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APPL: Agricultural & Priority Pollutants Laboratory, Inc. (Fresno, CA)
ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
HAR: Hawai'i Administrative Rules
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
PCE: tetrachloroethene
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TMB: trimethylbenzene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #1 SAMPLING EVENT" (31 JANUARY 2003)
(Page 2 of 3)

AIR SAMPLING STATION (LOCATION)	PARTICULATE METALS (NIOSH 7300; CHESTER)				CYANIDES (NIOSH 7904; EAS LAB)	SULFUR GASES (ASTM D-5504; AIR TOXICS)			
	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA	FIELD RESULT	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA
STATION 1 (On-site; just west of OBJ Deer, downwind air station)	Aluminum: 0.65 µg/m³ Barium: 0.02 µg/m³ Chromium: 0.69 µg/m³ Magnesium: 0.50 µg/m³ Nickel: 0.13 µg/m³ Zinc: 0.16 µg/m³	Aluminum: 0.54 µg/m³ Barium: 0.02 µg/m³ Chromium: 0.56 µg/m³ Magnesium: 0.41 µg/m³ Nickel: 0.10 µg/m³ Zinc: 0.13 µg/m³	Aluminum: 10,000 µg/m³ Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Aluminum: 150 µg/m³ Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 10 ppbV	Carbonyl sulfide: 8.2 ppbV	*(not established)*	*(not established)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	Barium: 0.02 µg/m³ Chromium: 0.62 µg/m³ Magnesium: 0.36 µg/m³ Nickel: 0.13 µg/m³ Zinc: 0.10 µg/m³	Barium: 0.01 µg/m³ Chromium: 0.52 µg/m³ Magnesium: 0.31 µg/m³ Nickel: 0.11 µg/m³ Zinc: 0.09 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 11 ppbV	Carbonyl sulfide: 9.5 ppbV	*(not established)*	*(not established)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	Barium: 0.02 µg/m³ Chromium: 0.80 µg/m³ Magnesium: 0.49 µg/m³ Nickel: 0.10 µg/m³ Lead: 0.28 µg/m³ Zinc: 0.15 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.53 µg/m³ Magnesium: 0.32 µg/m³ Nickel: 0.07 µg/m³ Lead: 0.18 µg/m³ Zinc: 0.10 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 11 ppbV	Carbonyl sulfide: 7.2 ppbV	*(not established)*	*(not established)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	Barium: 0.02 µg/m³ Chromium: 0.55 µg/m³ Magnesium: 0.44 µg/m³ Nickel: 0.09 µg/m³ Lead: 0.19 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.51 µg/m³ Magnesium: 0.41 µg/m³ Nickel: 0.08 µg/m³ Lead: 0.18 µg/m³ Zinc: 0.10 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	Barium: 0.02 µg/m³ Chromium: 0.33 µg/m³ Magnesium: 2.26 µg/m³ Nickel: 0.13 µg/m³ Zinc: 0.12 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.24 µg/m³ Magnesium: 1.65 µg/m³ Nickel: 0.10 µg/m³ Zinc: 0.09 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 15 ppbV	Carbonyl sulfide: 11.1 ppbV	*(not established)*	*(not established)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	Barium: 0.02 µg/m³ Chromium: 0.73 µg/m³ Magnesium: 0.43 µg/m³ Nickel: 0.14 µg/m³ Zinc: 0.21 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.61 µg/m³ Magnesium: 0.36 µg/m³ Nickel: 0.11 µg/m³ Zinc: 0.18 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 10 ppbV	Carbonyl sulfide: 8.4 ppbV	*(not established)*	*(not established)*
STATION 7 (On-site; just south of OBJ Deer, crosswind air station)	Barium: 0.02 µg/m³ Chromium: 0.73 µg/m³ Magnesium: 0.41 µg/m³ Nickel: 0.16 µg/m³ Lead 0.23 µg/m³ Zinc: 0.17 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.61 µg/m³ Magnesium: 0.34 µg/m³ Nickel: 0.13 µg/m³ Lead: 0.19 µg/m³ Zinc: 0.14 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 9.6 ppbV	Carbonyl sulfide: 8.0 ppbV	*(not established)*	*(not established)*
STATION 8 (Background air station in Kahana-haiki Valley; northern side of MMR)	Barium: 0.02 µg/m³ Chromium: 0.43 µg/m³ Magnesium 0.52 µg/m³ Nickel: 0.13 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.34 µg/m³ Magnesium: 0.41 µg/m³ Nickel: 0.10 µg/m³ Zinc: 0.08 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 14 ppbV	Carbonyl sulfide: 9.4 ppbV	*(not established)*	*(not established)*
STATION 9 **<FIELD DUPLICATE OF STATION 3>** (On-site; near administration area at MMR's west-end, downwind)	Barium: 0.02 µg/m³ Chromium: 0.46 µg/m³ Magnesium: 0.52 µg/m³ Nickel: 0.17 µg/m³ Zinc: 0.16 µg/m³	Barium: 0.01 µg/m³ Chromium: 0.30 µg/m³ Magnesium: 0.35 µg/m³ Nickel: 0.11 µg/m³ Zinc: 0.11 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 10 (Trip blank; QA/QC sample**)**	Barium: 0.03 µg/filter Chromium: 0.81 µg/filter Magnesium: 0.29 µg/filter Nickel: 0.15 µg/filter Zinc: 0.13 µg/filter	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Zinc: *(not applicable)*	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Zinc: *(not applicable)*	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Zinc: *(not applicable)*	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 2.2 µg/m³ for PM-2.5 and 4.5 µg/m³ for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
4. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
5. Acronyms and abbreviations used in this table:

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ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
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HAR: Hawai'i Administrative Rules
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
PCE: tetrachloroethene
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TMB: trimethylbenzene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #1 SAMPLING EVENT" (31 JANUARY 2003)
(Page 3 of 3)

AIR SAMPLING STATION (LOCATION)	NITROGEN GASES (IN-FIELD; DRAEGER TUBES)	PARTICULATES: PM – 2.5 (USEPA IP-10A; CHESTER)				PARTICULATES: PM – 10 (USEPA IP-10A; CHESTER)			
	FIELD RESULT	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA
STATION 1 (On-site; just west of OBJ Deer, downwind air station)	*(station not sampled)*	8.9 µg/m³	7.3 µg/m³ (8-hr TWA) 4.0 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	12.1 µg/m³	9.9 µg/m³ (8-hr TWA) 6.6 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	*(station not sampled)*	4.3 µg/m³	3.7 µg/m³ (8-hr TWA) 2.8 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	12.9 µg/m³	19.9 µg/m³ (8-hr TWA) 6.9 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	*(no detected nitrogen oxides)*	4.8 µg/m³	3.1 µg/m³ (8-hr TWA) 2.7 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	14.3 µg/m³	9.4 µg/m³ (8-hr TWA) 6.6 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	*(no detected nitrogen oxides)*	8.5 µg/m³	7.8 µg/m³ (8-hr TWA) 4.1 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	9.0 µg/m³	8.3 µg/m³ (8-hr TWA) 5.9 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	*(no detected nitrogen oxides)*	7.1 µg/m³	5.2 µg/m³ (8-hr TWA) 3.4 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	50.6 µg/m³	37.0 µg/m³ (8-hr TWA) 15.7 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	*(no detected nitrogen oxides)*	6.3 µg/m³	5.2 µg/m³ (8-hr TWA) 3.3 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	14.5 µg/m³	12.0 µg/m³ (8-hr TWA) 7.3 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 7 (On-site; just south of OBJ Deer, crosswind air station)	*(station not sampled)*	11.5 µg/m³	9.4 µg/m³ (8-hr TWA) 4.7 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	28.6 µg/m³	23.5 µg/m³ (8-hr TWA) 11.1 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 8 (Background air station in Kahana-haiki Valley; northern side of MMR)	*(no detected nitrogen oxides)*	13.1 µg/m³	10.4 µg/m³ (8-hr TWA) 5.1 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	10.5 µg/m³	8.3 µg/m³ (8-hr TWA) 6.1 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 9 <FIELD DUPLICATE OF STATION 3> (On-site; near administration area at MMR's west-end, downwind)	*(no detected nitrogen oxides)*	6.3 µg/m³	4.2 µg/m³ (8-hr TWA) 3.1 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	11.7 µg/m³	7.8 µg/m³ (8-hr TWA) 6.1 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 10 (Trip blank; QA/QC sample)	*(not applicable)*	5 µg/filter	*(not applicable)*	*(not applicable)*	*(not established)*	4 µg/filter	*(not applicable)*	*(not applicable)*	*(not established)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 2.2 µg/m³ for PM-2.5 and 4.5 µg/m³ for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
4. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
5. Acronyms and abbreviations used in this table:

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ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
HAR: Hawai'i Administrative Rules
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
PCE: tetrachloroethene
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TMB: trimethylbenzene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #2 SAMPLING EVENT" (10 APRIL 2003)
(Page 1 of 3)

AIR SAMPLING STATION (LOCATION)	VOCs (USEPA TO-13; (AIR TOXICS)				SVOCs (USEPA TO-13; AIR TOXICS)	ENERGETICS (USEPA 8330mod; SWL Lab)	CHLOR. HERBICIDES (USEPA 8151Amod; APPL)	PCDDs/PCDFs (USEPA TO-9A; ALTA)	
	FIELD RESULT	**FIELD TWA**	**ACGIH TWA**	**HAWAII TWA**	**FIELD RESULT**	**FIELD RESULT**	**FIELD RESULT**	**FIELD RESULT**	**FIELD TWA**
STATION 1 (On-site; just northwest of OBJ Deer, crosswind air station)	Toluene: 1.6 ppbV	Toluene: 1.1 ppbV	Toluene: 50,000 ppbV	Toluene: 2,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 30.9 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	TCE: 1.2 ppbV Toluene: 1.2 ppbV	TCE: 0.9 ppbV Toluene: 0.9 ppbV	TCE: 50,000 ppbV Toluene: 50,000 ppbV	TCE: 1,000 ppbV Toluene: 2,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 21.8 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	Toluene: 1.2 ppbV	Toluene: 0.9 ppbV	Toluene: 50,000 ppbV	Toluene: 2,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 25.9 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	Freon-12: 0.9 ppbV Toluene: 1.5 ppbV Acetone: 8.0 ppbV 2-Propanol: 2.8 ppbV Ethanol: 3.4 ppbV	Freon-12: 0.8 ppbV Toluene: 1.3 ppbV Acetone: 7.1 ppbV 2-Propanol: 2.5 ppbV Ethanol: 3.0 ppbV	Freon-12: 1,000,000 ppbV Toluene: 50,000 ppbV Acetone: 500,000 ppbV 2-Propanol: 200,000 ppbV Ethanol: 1,000,000 ppbV	Freon-12: 10,000 ppbV Toluene: 2,000 ppbV Acetone: 10,000 ppbV 2-Propanol: 4,000 ppbV Ethanol: 10,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 18.9 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	Ethanol: 8.9 ppbV	Ethanol: 7.0 ppbV	Ethanol: 1,000,000 ppbV	Ethanol: 10,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 20.6 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	DCM: 1.1 ppbV Toluene: 1.7 ppbV Acetone: 5.5 ppbV Ethanol: 4.7 ppbV	DCM: 0.7 ppbV Toluene: 1.1 ppbV Acetone: 3.6 ppbV Ethanol: 3.1 ppbV	DCM: 50,000 ppbV Toluene: 50,000 ppbV Acetone: 500,000 ppbV Ethanol: 1,000,000 ppbV	DCM: 250 ppbV Toluene: 2,000 ppbV Acetone: 1,000 ppbV Ethanol: 10,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 65.9 pg/m³ OCDF: 6.9 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 7 (On-site; just northeast of OBJ Deer, crosswind air station)	Acetone: 21 ppbV	Acetone: 15 ppbV	Acetone: 500,000 ppbV	Acetone: 1,000 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*
STATION 9 <FIELD DUPLICATE OF STATION 3> (On-site; near administration area at MMR's west-end, downwind)	Toluene: 1.3 ppbV Acetone: 6.4 ppbV Carbon disulfide: 7.6 ppbV	Toluene: 1.0 ppbV Acetone: 4.7 ppbV Carbon disulfide: 5.5 ppbV	Toluene: 50,000 ppbV Acetone: 500,000 ppbV Carbon disulfide: 10,000 ppbV	Toluene: 2,000 ppbV Acetone: 1,000 ppbV Carbon disulfide: 200 ppbV	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 16.9 pg/m³ (*NOTE: OCDD also detected in associated laboratory Method Blank and field Trip Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*
STATION 10 (Trip blank; QA/QC sample**)**	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected VOCs)*	*(no detected SVOCs)*	*(no detected energetics)*	*(no detected herbicides)*	OCDD: 17.8 pg/sample (*NOTE: OCDD also detected in associated laboratory Method Blank at a comparable level.*)	*(NOTE: both OCDD/OCDF are considered to be laboratory contaminants; therefore, TWA calculations are not applicable.)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 5.3 µg/m³ for PM-2.5 and 8.1 µg/m³ for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
4. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
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ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
HAR: Hawai'i Administrative Rules
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
pg/m³: picograms of substance per cubic meter of air
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TCE: trichloroethene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #2 SAMPLING EVENT" (10 APRIL 2003)
(Page 2 of 3)

AIR SAMPLING STATION (LOCATION)	PARTICULATE METALS (NIOSH 7300; CHESTER)				CYANIDES (NIOSH 7904; EAS LAB)	SULFUR GASES (ASTM D-5504; AIR TOXICS)			
	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA	FIELD RESULT	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA
STATION 1 (On-site; just northwest of OBJ Deer, crosswind air station)	Aluminum: 0.63 µg/m³ Barium: 0.03 µg/m³ Chromium: 0.61 µg/m³ Magnesium: 0.49 µg/m³ Nickel: 0.12 µg/m³ Lead: 0.30 µg/m³ Zinc: 0.12 µg/m³	Aluminum: 0.45 µg/m³ Barium: 0.02 µg/m³ Chromium: 0.43 µg/m³ Magnesium: 0.35 µg/m³ Nickel: 0.08 µg/m³ Lead: 0.21 µg/m³ Zinc: 0.08 µg/m³	Aluminum: 10,000 µg/m³ Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Aluminum: 150 µg/m³ Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	Barium: 0.03 µg/m³ Chromium: 0.78 µg/m³ Magnesium: 0.44 µg/m³ Nickel: 0.08 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.58 µg/m³ Magnesium: 0.32 µg/m³ Nickel: 0.06 µg/m³ Zinc: 0.08 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 4.6 ppbV	Carbonyl sulfide: 3.4 ppbV	*(not established)*	*(not established)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	Barium: 0.03 µg/m³ Chromium: 0.19 µg/m³ Magnesium: 0.46 µg/m³ Nickel: 0.08 µg/m³ Zinc: 0.09 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.14 µg/m³ Magnesium: 0.33 µg/m³ Nickel: 0.06 µg/m³ Zinc: 0.07 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 5.1 ppbV	Carbonyl sulfide: 3.7 ppbV	*(not established)*	*(not established)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	Barium: 0.02 µg/m³ Chromium: 0.36 µg/m³ Magnesium: 0.74 µg/m³ Nickel: 0.07 µg/m³ Zinc: 0.12 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.32 µg/m³ Magnesium: 0.66 µg/m³ Nickel: 0.06 µg/m³ Zinc: 0.10 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 4.9 ppbV	Carbonyl sulfide: 4.3 ppbV	*(not established)*	*(not established)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	Barium: 0.02 µg/m³ Chromium: 0.46 µg/m³ Magnesium: 1.08 µg/m³ Nickel: 0.10 µg/m³ Lead: 0.23 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.36 µg/m³ Magnesium: 0.85 µg/m³ Nickel: 0.08 µg/m³ Lead: 0.18 µg/m³ Zinc: 0.09 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	Barium: 0.03 µg/m³ Chromium: 0.77 µg/m³ Magnesium: 0.52 µg/m³ Nickel: 0.11 µg/m³ Lead: 0.29 µg/m³ Zinc: 0.14 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.51 µg/m³ Magnesium: 0.34 µg/m³ Nickel: 0.07 µg/m³ Lead: 0.19 µg/m³ Zinc: 0.09 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 7 (On-site; just northeast of OBJ Deer, crosswind air station)	Barium: 0.03 µg/m³ Chromium: 0.59 µg/m³ Magnesium: 0.46 µg/m³ Nickel: 0.11 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.42 µg/m³ Magnesium: 0.33 µg/m³ Nickel: 0.08 µg/m³ Zinc: 0.07 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*
STATION 9 **<FIELD DUPLICATE OF STATION 3>** (On-site; near administration area at MMR's west-end, downwind)	Barium: 0.03 µg/m³ Chromium: 0.80 µg/m³ Magnesium: 0.52 µg/m³ Nickel: 0.08 µg/m³ Lead: 0.24 µg/m³ Zinc: 0.11 µg/m³	Barium: 0.02 µg/m³ Chromium: 0.58 µg/m³ Magnesium: 0.38 µg/m³ Nickel: 0.06 µg/m³ Lead: 0.17 µg/m³ Zinc: 0.08 µg/m³	Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³	*(no detected hydrogen cyanide)*	Carbonyl sulfide: 4.6 ppbV	Carbonyl sulfide: 3.3 ppbV	*(not established)*	*(not established)*
STATION 10 (Trip blank; QA/QC sample**)**	Barium: 0.02 µg/filter Chromium: 0.81 µg/filter Magnesium: 0.31 µg/filter Nickel: 0.10 µg/filter Lead: 0.27 µg/filter Zinc: 0.13 µg/filter	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Lead: *(not applicable)* Zinc: *(not applicable)*	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Lead: *(not applicable)* Zinc: *(not applicable)*	Barium: *(not applicable)* Chromium: *(not applicable)* Magnesium: *(not applicable)* Nickel: *(not applicable)* Lead: *(not applicable)* Zinc: *(not applicable)*	*(no detected hydrogen cyanide)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*	*(station not sampled)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 5.3 µg/m³ for PM-2.5 and 8.1 µg/m³ for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
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SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TCE: trichloroethene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"CALFEX #2 SAMPLING EVENT" (10 APRIL 2003)
(Page 3 of 3)

AIR SAMPLING STATION (LOCATION)	NITROGEN GASES (IN-FIELD; DRAEGER TUBES)	PARTICULATES: PM – 2.5 (USEPA IP-10A; CHESTER)				PARTICULATES: PM – 10 (USEPA IP-10A; CHESTER)			
	FIELD RESULT	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA	FIELD RESULT	FIELD TWA	ACGIH TWA	HAWAII TWA
STATION 1 (On-site; just northwest of OBJ Deer, crosswind air station)	*(station not sampled)*	12.5 µg/m³	8.9 µg/m³ (8-hr TWA) 7.0 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	16.1 µg/m³	11.5 µg/m³ (8-hr TWA) 10.0 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 2 (On-site; in OB/OD area, eastern-most air station, upwind)	*(no detected nitrogen oxides)*	12.0 µg/m³	8.9 µg/m³ (8-hr TWA) 6.9 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	17.7 µg/m³	13.0 µg/m³ (8-hr TWA) 10.4 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 3 (On-site; near administration/helipad area and MMR's west-end, downwind)	*(no detected nitrogen oxides)*	12.1 µg/m³	8.9 µg/m³ (8-hr TWA) 7.0 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	25.0 µg/m³	18.2 µg/m³ (8-hr TWA) 12.2 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 4 (Off-site; at Makua Beach, recreational area, western-most air station)	*(no detected nitrogen oxides)*	10.6 µg/m³	9.4 µg/m³ (8-hr TWA) 6.9 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	18.3 µg/m³	16.2 µg/m³ (8-hr TWA) 11.1 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 5 (Off-site; at Silva Ranch, residential area, southern-most air station)	*(station not sampled)*	11.3 µg/m³	8.9 µg/m³ (8-hr TWA) 6.9 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	34.0 µg/m³	26.6 µg/m³ (8-hr TWA) 14.8 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 6 (On-site; just north of OBJ Deer, crosswind air station)	*(station not sampled)*	17.4 µg/m³	11.5 µg/m³ (8-hr TWA) 8.0 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	18.2 µg/m³	12.0 µg/m³ (8-hr TWA) 10.3 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 7 (On-site; just northeast of OBJ Deer, crosswind air station)	*(no detected nitrogen oxides)*	19.1 µg/m³	13.5 µg/m³ (8-hr TWA) 8.6 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	16.9 µg/m³	12.0 µg/m³ (8-hr TWA) 10.2 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 9 <FIELD DUPLICATE OF STATION 3> (On-site; near administration area at MMR's west-end, downwind)	*(no detected nitrogen oxides)*	15.8 µg/m³	11.5 µg/m³ (8-hr TWA) 7.8 µg/m³ (24-hr extrapolation)	3,000 µg/m³ (8-hr TWA; respirable) 65 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*	26.5 µg/m³	19.3 µg/m³ (8-hr TWA) 12.5 µg/m³ (24-hr extrapolation)	10,000 µg/m³ (8-hr TWA; inhalable) 150 µg/m³ (24-hr Fed. Air Quality Std.)	*(not established)*
STATION 10 (Trip blank; QA/QC sample)	*(not applicable)*	18 µg/filter	*(not applicable)*	*(not applicable)*	*(not established)*	15 µg/filter	*(not applicable)*	*(not applicable)*	*(not established)*

Notes:
1. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
2. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 5.3 µg/m³ for PM-2.5 and 8.1 µg/m³ for PM-10).
3. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
4. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
5. Acronyms and abbreviations used in this table:

µg/m³: micrograms of substance per cubic meter of air
ACGIH: American Conference of Governmental Industrial Hygienists
AIR TOXICS: Air Toxics, Ltd. (Folsom, CA)
ALTA: Alta Analytical Laboratory, Inc. (El Dorado Hills, CA)
APPL: Agricultural & Priority Pollutants Laboratory, Inc. (Fresno, CA)
ASTM: American Society for Testing and Materials
CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
HAR: Hawai'i Administrative Rules
MMR: Makua Military Reservation
NIOSH: National Institute for Occupational Safety and Health
OCDD: octachlorodibenzodioxin
OCDF: octachlorodibenzofuran
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
pg/m³: picograms of substance per cubic meter of air
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
ppbV: parts per billion by volume
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TCE: trichloroethene
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

DATA SUMMARY TABLE
MAKUA AMBIENT AIR SAMPLING
"OPEN BURN SAMPLING EVENT" (30 OCTOBER 2002)
(Page 1 of 1)

POI Category	Analytical Method (Laboratory; Instrument)	Individual POI Concentrations			Corresponding POI Results Expressed as 8-Hour TWA			Health-Based Guidance & State Regulatory 8-Hour TWAs	
		Station 1 South Beach	Station 2 North Beach	Station 3 On-Range	Station 1 South Beach	Station 2 North Beach	Station 3 On-Range	ACGIH Health-Based Exposure Guidelines	State of Hawai'i "Hazardous Air Pollutants" Guidelines
VOCs	USEPA TO-15 (AIR TOXICS; GC/MS)	Chloromethane: 1.9 ppbV DCM: 1.0 ppbV Benzene: 2.4 ppbV Toluene: 2.0 ppbV Acetone: 9.2 ppbV	*(no detected VOCs)*	Chloromethane: 1.7 ppbV DCM: 3.5 ppbV Benzene: ND Toluene: 1.3 ppbV Acetone: 5.6 ppbV	Chloromethane: 1.3 ppbV (TWA) DCM: 0.7 ppbV (TWA) Benzene: 1.6 ppbV (TWA) Toluene: 1.4 ppbV (TWA) Acetone: 6.3 ppbV (TWA)	*(no detected VOCs)*	Chloromethane: 1.0 ppbV (TWA) DCM: 2.0 ppbV (TWA) Benzene: ND (TWA) Toluene: 0.8 ppbV (TWA) Acetone: 3.2 ppbV (TWA)	Chloromethane: 50,000 ppbV DCM: 50,000 ppbV Benzene: 500 ppbV Toluene: 50,000 ppbV Acetone: 500,000 ppbV	Chloromethane: 1,000 ppbV DCM: 250 ppbV Benzene: 10 ppbV Toluene: 2,000 ppbV Acetone: 10,000 ppbV
SVOCs	USEPA TO-13 (AIR TOXICS; GC/MS)	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*	*(no detected SVOCs)*
Energetic Compounds	USEPA 8330mod (SWL Lab; HPLC)	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*	*(no detected energetics)*
Chlorinated Herbicides	USEPA 8151Amod (APPL; GC/ECD)	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*	*(no detected herbicides)*
PCDDs/ PCDFs	USEPA TO-9A (ALTA; HR-GC/MS)	1,2,3,4,7,8-HxCDF: 0.66 pg/m³ *(NOTE: isomer also detected in associated laboratory Method Blank at a higher level)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*	*(NOTE: 1,2,3,4,7,8-HxCDF was detected in the associated Method Blank at a higher level than the South Beach field sample; therefore, no TWA calculation is applicable)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*	*(no detected PCDDs/PCDFs)*
Particulate Metals	NIOSH 7300 (CHESTER; ICP)	Aluminum: 0.76 µg/m³ Barium: 0.04 µg/m³ Chromium: 0.59 µg/m³ Magnesium: 1.32 µg/m³ Nickel: 0.08 µg/m³ Lead: ND Zinc: 0.24 µg/m³	Aluminum: 0.51 µg/m³ Barium: 0.03 µg/m³ Chromium: 0.62 µg/m³ Magnesium: 0.63 µg/m³ Nickel: 0.15 µg/m³ Lead: 0.29 µg/m³ Zinc: 0.22 µg/m³	Aluminum: 0.61 µg/m³ Barium: 0.35 µg/m³ Chromium: 0.51 µg/m³ Magnesium: 0.42 µg/m³ Nickel: 0.08 µg/m³ Lead: 0.19 µg/m³ Zinc: 0.20 µg/m³	Aluminum: 0.44 µg/m³ (TWA) Barium: 0.02 µg/m³ (TWA) Chromium: 0.34 µg/m³ (TWA) Magnesium: 0.76 µg/m³ (TWA) Nickel: 0.05 µg/m³ (TWA) Lead: ND (TWA) Zinc: 0.14 µg/m³ (TWA)	Aluminum: 0.29 µg/m³ (TWA) Barium: 0.02 µg/m³ (TWA) Chromium: 0.36 µg/m³ (TWA) Magnesium: 0.37 µg/m³ (TWA) Nickel: 0.09 µg/m³ (TWA) Lead: 0.17 µg/m³ (TWA) Zinc: 0.13 µg/m³ (TWA)	Aluminum: 0.35 µg/m³ (TWA) Barium: 0.02 µg/m³ (TWA) Chromium: 0.29 µg/m³ (TWA) Magnesium: 0.24 µg/m³ (TWA) Nickel: 0.05 µg/m³ (TWA) Lead: 0.11 µg/m³ (TWA) Zinc: 0.11 µg/m³ (TWA)	Aluminum: 10,000 µg/m³ Barium: 500 µg/m³ Chromium: 500 µg/m³ Magnesium: 10,000 µg/m³ Nickel: 1,500 µg/m³ Lead: 50 µg/m³ Zinc: 10,000 µg/m³	Aluminum: 150 µg/m³ Barium: 5 µg/m³ Chromium: 10 µg/m³ Magnesium: 150 µg/m³ Nickel: 10 µg/m³ Lead: 1 µg/m³ Zinc: 150 µg/m³
Cyanides	NIOSH 7904 (EAS; Spectrophotometry)	HCN: 1.8 µg/m³	HCN: 2.2 µg/m³	HCN: 5.4 µg/m³	HCN: 1.3 µg/m³ (TWA)	HCN: 1.2 µg/m³ (TWA)	HCN: 3.1 µg/m³ (TWA)	HCN: 5,000 µg/m³ (STEL)	HCN: 110 µg/m³ (STEL)
Particulate Matter – 2.5 microns	USEPA IP-10A (CHESTER; gravimetric)	PM-2.5: 212.4 µg/m³	PM-2.5: 26.4 µg/m³	PM-2.5: 138.8 µg/m³	PM-2.5: 150.0 µg/m³ (TWA) PM-2.5: 60.1 µg/m³ (24-hr)	PM-2.5: 18.2 µg/m³ (TWA) PM-2.5: 16.2 µg/m³ (24-hr)	PM-2.5: 94.3 µg/m³ (TWA) PM-2.5: 41.6 µg/m³ (24-hr)	PM-2.5: 3,000 µg/m³ (respirable) PM-2.5: 65 µg/m³ (24-hr Federal Air Quality Standard)	*(not established)*
Particulate Matter – 10.0 microns	USEPA IP-10A (CHESTER; gravimetric)	PM-10: 231.2 µg/m³	PM-10: 42.3 µg/m³	PM-10: 114.1 µg/m³	PM-10: 128.1 µg/m³ (TWA) PM-10: 60.0 µg/m³ (24-hr)	PM-10: 23.4 µg/m³ (TWA) PM-10: 25.1 µg/m³ (24-hr)	PM-10: 51.6 µg/m³ (TWA) PM-10: 35.2 µg/m³ (24-hr)	PM-10: 10,000 µg/m³ (inhalable) PM-10: 150 µg/m³ (24-hr Federal Air Quality Standard.)	*(not established)*

Notes:
1. Station locations: South Beach (off-range, south end of Makua Beach); North Beach (off-range, north end of Makua Beach); On-Range (on-site location at MMR, near Objective Dear).
2. TWA calculations: (sample concentration) x [(sampling time in minutes) / (480 minutes)].
3. 24-hour extrapolations of PM-2.5 and PM-10 used one-half of lowest recorded particulate concentrations for respective background values (i.e., 13.2 µg/m³ for PM-2.5 and 21.2 µg/m³ for PM-10).
4. ACGIH health-based exposure guidelines refer to Threshold Limit Values (ACGIH 2002); Federal 24-hour air quality standards are also cited for PM-2.5 and PM-10 parameters.
5. State of Hawai'i "Hazardous Air Pollutants" 8-hour ambient concentration guidelines refer to Hawai'i Administrative Rules (Title 11, Chapter 60.1, Section 179); these are 8-hour average concentrations equal to 1% of the corresponding Permissible Exposure Limits adopted by OSHA.
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CHESTER: Chester LabNet, Inc. (Tigard, OR)
DCM: dichloromethane (methylene chloride)
EAS: Environmental Analytical Services, Inc. (San Luis Obispo, CA)
GC/ECD: gas chromatography/electron capture detection
GC/MS: gas chromatography/mass spectrometry
HAR: Hawai'i Administrative Rules
HCN: hydrogen cyanide
HPLC: high performance liquid chromatography
hr: hour
HR: high resolution (GC/MS)
HxCDF: hexachlorinated dibenzofuran
ICP: inductively coupled plasma (atomic emission spectroscopy)
MMR: Makua Military Reservation
ND: non-detected
NIOSH: National Institute for Occupational Safety and Health
OSHA: Occupational Health & Safety Administration
PCDD: polychlorinated dibenzodioxin
PCDF: polychlorinated dibenzofuran
PM-2.5: particulate matter – 2.5 microns
PM-10: particulate matter – 10 microns
POI: pollutant of interest
ppbV: parts per billion by volume
STEL: short-term exposure limit
SVOC: semivolatile organic compound
SWL: Southwest Laboratory of Oklahoma, Inc. (Broken Arrow, OK)
TLV: threshold limit value (ACGIH)
TWA: time-weighted average (8-hour)
VOC: volatile organic compound

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