

Health Consultation

FORMER FORT ORD SITE
(a/k/a FORT ORD)

MARINA, MONTEREY COUNTY, CALIFORNIA

EPA FACILITY ID: CA7210020676

FEBRUARY 3, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

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PUBLIC HEALTH EVALUATION OF OCTOBER 2003 PRESCRIBED BURN

EPA FACILITY ID: CA7210020676

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

**Public Health Consultation
Former Fort Ord, California
Public Health Evaluation of October 2003 Prescribed Burn**

Background and Statement of Problem

As part of the long-term base closure process of the former Fort Ord (fFO) U.S. Army Base, the Army has conducted a prescribed burn of several former firing ranges. These burns were and will be conducted to remove vegetation from the firing ranges, thus allowing subsequent cleanup of unexploded munitions possibly left on the firing ranges. Burning of the vegetation will result in burning and explosion of some munitions and explosives of concern (MEC) as well as the vegetation. Before the scheduled burn in October 2003, concerns about possible adverse health effects from inhalation of the smoke from these prescribed burns prompted the Army to undertake an extensive air monitoring evaluation of the burn to quantify potential air contaminants and concentrations in the surrounding communities. ATSDR has been asked by the Army to evaluate the air monitoring data to determine whether smoke from the prescribed burn represents a potential public health hazard to the surrounding communities.

The fFO is in northwestern Monterey County, California, approximately 80 miles south of San Francisco (Figure 1). The former Army base consists of approximately 28,000 acres directly adjacent to Monterey Bay, with the Cities of Del Rey Oaks, Seaside, Monterey, and Sand City to the west or southwest of the fFO, and the City of Marina to the northwest (Figure 1). The Laguna Seca Recreation Area and Toro Regional Park, as well as the Toro Park and San Benancio communities, are on the southern and southeastern borders of the fFO (Figure 1).

In response to community concerns about the proposed burn operations, the Army developed a comprehensive community notification and relocation plan to mitigate potential community exposures to the smoke (C&C 2003). The Army also developed a prescribed burn plan to manage burn operations and ensure that burns occurred under specific meteorological conditions (Fire Stop 2002) and a sampling plan to monitor the composition and distribution of the smoke plume (MACTEC 2003). The prescribed meteorological conditions for a burn require a temperature between 60°–95° F, and a relative humidity between 15%–35%. Fire ignition would only occur if the weather forecast called for east-to-northeast winds (40° to 140°), wind speeds of 0–15 mph, and an atmospheric mixing height greater than 1,000 ft. These conditions would ensure that the smoke plume would rise rapidly and disperse over Monterey Bay with very little effect on the surrounding communities.

The prescribed meteorological conditions were forecast for the period beginning October 24, 2003. The burn commenced on that date and active burning continued through October 26 (contingency operations continued until November 1, 2004). The prescribed burn area (ranges 43–48) covers approximately 490 acres (Figure 1); an adjacent area of 1000 acres also burned when the fire escaped the original containment area (Parsons 2004). Three reports were produced that documented the burn operations (Parsons 2004), the general air monitoring program (MACTEC 2004), and air monitoring for energetic and explosive compounds (CHPPM 2004). This health consultation evaluates the air monitoring programs and resulting data contained in those reports to determine whether emissions from the burn represented a public health hazard.

Energetic materials and their breakdown products are the primary contaminants of concern predicted from the combustion of MEC (Harding ESE 2001). Examples of these compounds include nitrobenzene, n-nitrotoluene, nitroglycerin, n-dinitrotoluene (and others as listed in CHPPM 2004; Attachment 1). Other potential contaminants of concern include particulate

metals (such as beryllium, chromium, cobalt, lead, mercury, zinc, and others) and dioxins and furans (MACTEC 2004). Most of these potential contaminants of concern are also emitted from burning of vegetation where MEC is not present (Harding ESE 2001). According to Army documents, the source of both the aluminum and acrolein could be the fuel/accelerant "alumina gel" used to start the burn (Fire Stop 2002). Other potential contaminants of concern include constituents of all vegetation fires such as particulate matter (measured as particulate matter less than 10 microns; PM-10), and carbon dioxide (CO₂).

Evaluation of Air Monitoring Data from October 2003 Prescribed Burn

Figure 1 shows the locations of the air monitoring stations as well as a wind rose illustrating the direction and speed of the wind during the prescribed burn period (October 24–26, 2003). Samples collected on October 24 are considered active burn phase samples; samples collected on October 25 are considered smolder phase samples. Baseline samples were collected on October 23 or on November 12 or 18. Detailed information on the air monitoring analytical procedures (including sampling procedures and quality control information) is presented in the Sampling and Analysis Plan (MACTEC 2003) and the previously referenced data reports (MACTEC 2004; CHPPM 2004).

The vast majority of all measured contaminant concentrations are non-detections. A non-detection indicates that a contaminant, if present, is below the analytical sensitivity of the laboratory instrument and sampling procedure. Non-detections indicate that the contaminants of concern are not a public health hazard, providing that 1) the detection limit is greater than the applicable health comparison value (or screening limit) for a contaminant, and 2) the sampling stations are appropriately located and operated to capture the contaminant emissions.

Attachment 1 contains a list of the contaminants analyzed and the respective health screening levels (Table 2 from MACTEC 2004). Analytical detection or reporting limits for each contaminant are less than the health screening levels (MACTEC 2003). Air monitoring station locations and sampling procedures were appropriately sited and operated to capture emissions from the prescribed burn (Figure 1; MACTEC 2004; CHPPM 2004). Consequently, non-detections from these air monitoring programs indicate that non-detected contaminants were not a public health hazard.

Although the majority of analytical measurements were non-detections, several contaminants were detected at both on-site and off-site locations.¹ These contaminants did not include any MEC components and are consistent with materials released from the burning of vegetation. Of the 13 contaminants detected at either on-site or off-site locations, only PM-10, aluminum, and acrolein were found above their respective health comparison values at off-site locations (Table 1).² It is important to point out, however, that exposure to contaminants at concentrations above their health comparison value does not necessarily indicate that adverse health effects will result from those exposures. The health comparison values are health-protective screening levels that indicate further exposure evaluation should be conducted. Those substance-specific evaluations are as follows.

¹ Note that off-site locations include several on-base sites (PS-1, PS-2) that have been transferred to alternate ownership and control and have unlimited public access.

² Note that time-averaged contaminant concentrations were estimated by multiplying a peak to mean ratio, derived from hourly particulate matter measurements, by the total sampling period contaminant concentrations (MACTEC 2004).

PM-10

The only off-site PM-10 sample above its appropriate health comparison value ($150 \mu\text{g}/\text{m}^3$, or, micrograms per cubic meter, equivalent to parts per billion, 24-hour average (EPA 2004a) was measured at PS-3 (Manzanita School; Figure 1) during the active ignition phase of the burn (October 24). The PM-10 (24-hour) measurement of $248 \mu\text{g}/\text{m}^3$ at PS-3 (Manzanita School) corresponds with an (AQI) air quality index of 147, which is considered “unhealthy for sensitive groups” (http://www.epa.gov/airnow/aqi/conc_aqi_calc.html — last accessed 30 September 2004).

This AQI category includes the following health and cautionary statements:

“Increasing likelihood of respiratory symptoms and aggravation of lung disease, such as asthma. People with respiratory disease, such as asthma, should limit outdoor exertion.”

Consequently, at this location, people with respiratory disease undertaking strenuous outdoor exertion could have been subject to temporary respiratory irritation. People remaining indoors and not undertaking strenuous outdoor activities on October 24 were unlikely to have had any adverse health effects. As subsequent PM-10 measurements at all off-site locations were below the 24-hour standard of $150 \mu\text{g}/\text{m}^3$, such conditions were likely to be short-term, with no continuing adverse health effects.

Aluminum

Only one off-site aluminum measurement was detected above its respective health comparison value ($23.8 \mu\text{g}/\text{m}^3$; Table 1). This measurement occurred during the active ignition phase at PS-2 (Fitch Middle School). The estimated maximum hourly aluminum concentration of $31 \mu\text{g}/\text{m}^3$, while greater than the health comparison value, is about 100 times lower than the air concentration in a study where no harmful health effects were seen in animals breathing $3000 \mu\text{g}/\text{m}^3$ aluminum for 3 days, a time period roughly equivalent to the fFO burn duration (ATSDR 1999, Table 2-1).

Short-term inhalation exposure to aluminum is usually not harmful. Factory workers who breathe large amounts of aluminum dusts ($>1,000 \mu\text{g}/\text{m}^3$) over long periods can have lung problems, such as coughing or changes that show up in chest x-rays. Some workers who breathe aluminum dusts or aluminum fumes have decreased performance in some tests that measure functions of the nervous system. Acute aluminum inhalation studies of laboratory animals have documented several respiratory effects, such as alveolar wall thickening, increased lung weight, and an increased number of macrophages and broncopneumonia (reviewed by ATSDR 1999). However, all of these adverse health effects occurred at air concentrations several thousand times higher than the measured aluminum air concentrations at the Fitch Middle School.

Considering that aluminum air concentrations inside the school or other nearby buildings will be much lower than outside air concentrations (ATSDR 1992), and that the maximum estimated aluminum concentrations are much lower than any concentrations for which adverse health effects have been documented, the maximum estimated hourly off-site aluminum concentration of $31 \mu\text{g}/\text{m}^3$ is not a public health hazard. No adverse health effects are likely to occur from short term exposure to air aluminum concentrations of $31 \mu\text{g}/\text{m}^3$.

Acrolein

Acrolein was measured at several off-site stations at concentrations above its health comparison value of $0.02 \mu\text{g}/\text{m}^3$ (Table 1). Acrolein was also measured at concentrations above the

comparison value in baseline samples at both on-site and off-site locations. The following review of acrolein and its potential health effects are from the ATSDR Toxicological Profile on Acrolein (ATSDR 1990). Acrolein is a clear or yellow liquid with a disagreeable odor. It burns easily. It changes into a vapor much faster than water when heated to high temperatures, it can change into a vapor very quickly. Acrolein is used to make other chemicals and pesticides and is found in some livestock feeds and pesticides. Small amounts of acrolein can be formed and can enter the air when organic matter such as trees, other plants, including tobacco, are burned and also when fuels such as gasoline and oil are burned.

Exposure to acrolein results in irritation of the eyes, nose and throat at levels around 170 parts acrolein in one billion parts air (i.e., 170 ppb or 396 $\mu\text{g}/\text{m}^3$; ATSDR 1990). If you are exposed to low levels (396 $\mu\text{g}/\text{m}^3$) of acrolein for a short time, your eyes might water and your nose and throat might become sore. Most likely the symptoms would be relatively mild and similar to a cold, including scratchy throat, cough, irritated sinuses, headaches, running nose and stinging eyes. People with lung diseases such as asthma or bronchitis could find it more difficult to breathe, and could cough or feel short of breath. Asthmatics could be at an increased risk of an adverse reaction. Symptoms of exposure would be temporary and disappear rapidly after exposure ceased. Exposure would most likely have been intermittent and short duration. The public announcement of the proscribed burn would have served to reduce the potential for exposure, and increase the likelihood that someone would take precautions to avoid breathing smoke from the burn. Weather patterns at the time would carry most of the contamination toward Monterey Bay, further reducing exposure.

Acrolein has a sharp, unpleasant odor. Maximum concentrations in air were 424 $\mu\text{g}/\text{m}^3$, above the odor threshold of 360 $\mu\text{g}/\text{m}^3$. Considering the pungent smell combined with its irritant effect on the eyes and nose, it is likely that someone breathing acrolein would make an effort to avoid further exposure to smoke from the prescribed burn.

At the maximum estimated hourly acrolein air concentration of 424 $\mu\text{g}/\text{m}^3$, temporary minor respiratory and eye irritation could have occurred in some sensitive individuals. This sample was taken during the smolder phase of the burn (October 25) at the PS-9 station (Monterey Aquarium). The acrolein measurement at this station also exceeded the health comparison value for the baseline sample taken on November 12, 2003 (16 days after all fire suppression was completed; MACTEC 2004), however, it was not detected during the active ignition phase at this location. Because acrolein can come from a number of sources, such as engine emissions, cigarette smoke, or restaurant grills, it is likely that the prescribed burn was only one of several sources contributing to the measured acrolein air concentration at the Monterey Aquarium.

Estimated hourly acrolein concentrations at several other off-site stations were also above the health comparison value. However, concentrations at these stations (PS-2, PS-3, PS-5, PS-6, and PS-7) were much lower than the PS-9 sample. Estimated hourly concentrations at these stations, which ranged from 1 to 45 $\mu\text{g}/\text{m}^3$, are not expected to produce any adverse health effects.

Conclusions and Recommendations

Using the measured concentrations or non-detections of 29 different components of MEC and vegetation combustion, exposure to smoke from the October 24–26, 2003 prescribed burn at the former Fort Ord, California Army Base is considered to be “*no apparent public health hazard.*” This conclusion means that while some exposure to burn-related contaminants might have occurred, no adverse health effects are expected from those exposures. We base this conclusion on the following factors:

- Symptoms are reversible and temporary symptoms and would stop when exposure ceases. The scientific and biomedical literature indicates no lasting, adverse health effect at maximum detected air concentrations of acrolein.
- The likely exposure would be intermittent and of short duration, given likely avoidance behavior (i.e., due to exceeding the odor threshold) in the potentially exposed population, and
- The atmospheric conditions at the time of the burn (i.e., timing of the burn was designed to minimize smoke exposure to surrounding community).

Some uncertainty surrounds whether exposure to acrolein and PM-10 at specific locations by especially sensitive members of the community might have caused temporary adverse health effects. Short-term exposure to estimated maximum concentrations of airborne acrolein and PM-10 could cause minor respiratory and eye irritation in sensitive individuals. These adverse health effects would have been temporary, and would have dissipated shortly after exposures ceased. In addition, as described above, as further mitigation against possible exposure to members of the community, the Army has implemented a community notification and relocation program.

The respiratory irritation to PM-10 exposure is likely to occur only in those persons with a respiratory disease who participated in strenuous outdoor activities adjacent to the Manzanita School location on October 24, 2003. Exposure to acrolein at the maximum estimated concentration in the vicinity of the Monterey Aquarium on October 25, 2003, could cause minor eye irritation. Due to the numerous potential sources of airborne acrolein and its presence at this location several weeks after the prescribed burn, the maximum estimated acrolein concentration could have emanated from sources other than and in addition to the smoke from the prescribed burn.

These minor, short-term adverse health effects would not be likely if residents relocated or stayed indoors during the period of highest smoke concentrations. In that regard, the contaminant monitoring data reviewed in this report are adequate for evaluating potential exposures.

If future prescribed burns are required at the former Fort Ord, it is recommended that the U.S. Army continue their program of community notification and their best fire management practices. Community members who have respiratory illnesses or who could be especially susceptible to smoke should participate in the voluntary relocation program or stay indoors during future burn events.

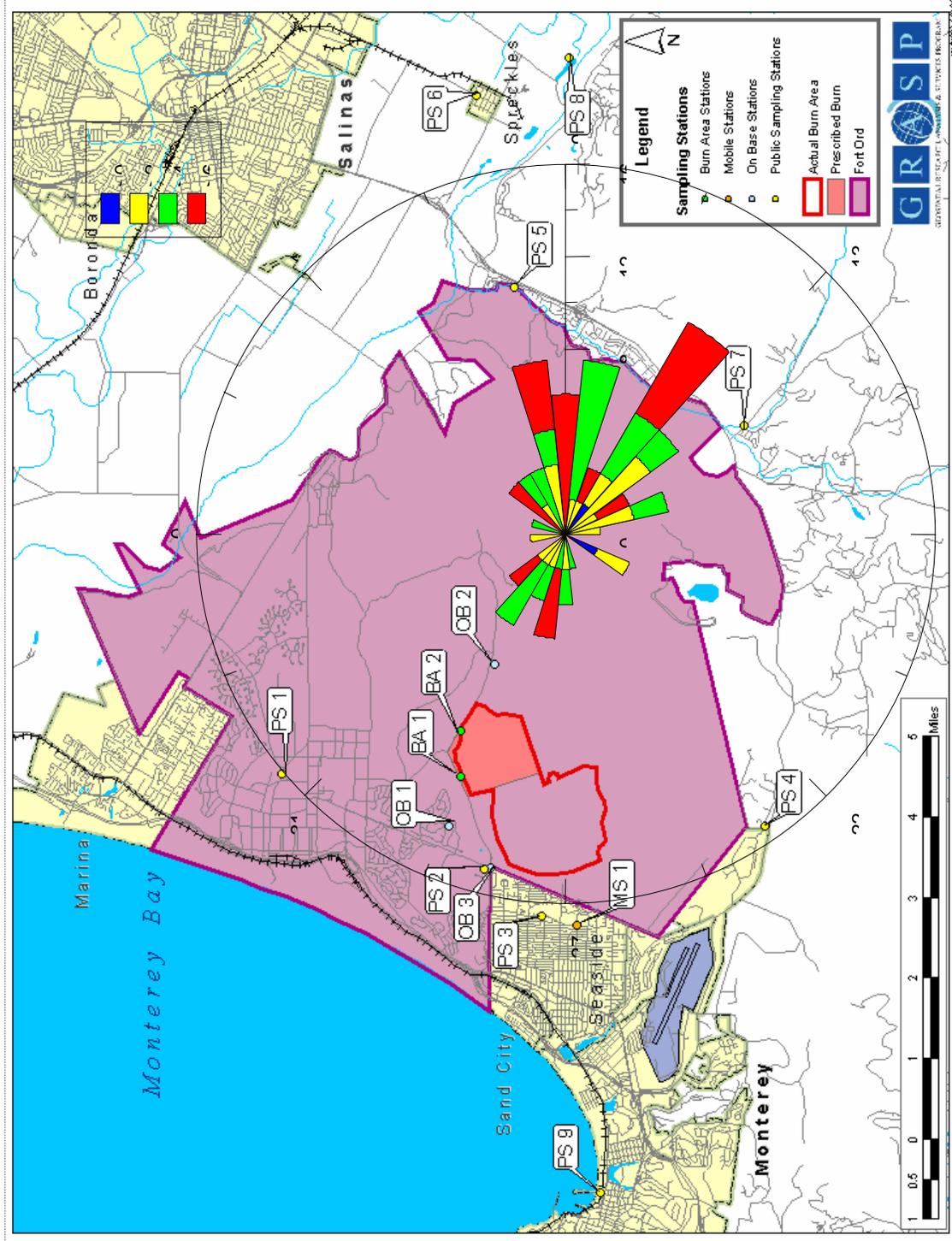


Figure 1. Location map of former Fort Ord, adjacent communities, and air monitoring stations. The wind rose represents the frequency, direction, and speed (in mph) that the wind is blowing from during the burn period (Oct. 24–26, 2003).

Table 1. Airborne Contaminants Detected at On-or Off-Site Monitoring Stations during the October 24–26, 2003 Prescribed Burn, Former Fort Ord, California

<i>Contaminant</i>	<i>On-site Concentrations $\mu\text{g}/\text{m}^3$</i>	<i>Off-site Concentrations $\mu\text{g}/\text{m}^3$</i>	<i>Health Comparison Value $\mu\text{g}/\text{m}^3$</i>
PM-10 (24 hr avg.)	34 – 2256*	42 – 248	150 (NAAQS 24 hr)
Aluminum	0 – 56	ND – 31	23.8 (1 hour)**
Antimony	0 – 39	ND	1.2 (1 hour)**
Barium	0 – 8	ND	1.2 (1 hour)**
Copper	0 – 1.6	ND	100 (1 hour)+
Lead	ND – 2.6	ND	1.5 (3 month)#
Manganese	0 – 30.6	ND	0.5 (1 hour)**
Mercury	0 – 0.0053	ND	1.8 (1 hour)+
Zinc	0 – 14	ND	11.9 (1 hour)**
Acetaldehyde	2.7 – 230	1.4 – 4	9 (long term)++
Acrolein	0 – 373	0.3 – 424	0.2 (1 hour)+
Formaldehyde	0 – 586	0.2 – 36.4	94 (1 hour)+
TEQ (dioxin/furans)	5.6E-06	ND (only sampled at MS-1)	4.0e-5 (long term)++
ND Non-detect NAAQS National Ambient Air Quality Standard (24 hour PM-10) TEQ Total dioxin and furan toxicity equivalent * Sampling period average (approximately 8 hours) ** Monterey Bay Unified Air Pollution Control District Rule 1000 + Office Environmental Health Hazard Assessment Acute Reference Exposure Level # California Ambient Air Quality Standard ++ Office Environmental Health Hazard Assessment Chronic Reference Exposure Level			

Notes:

Air concentration averaging times are commensurate with health comparison times with the exception of lead, acetaldehyde, and TEQ, which are averaged over the sampling period of 9 hours (MACTEC 2004).

Time-averaged air concentrations are estimated using a peak to mean process described in MACTEC (2004).

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Attachment 1. Measured Air Monitoring Analytes for the October 24–26, 2003 Prescribed Burn at the Former Fort Ord (Table 2 from MACTEC 2004). Only 13 of these contaminants were detected at either on-site or off-site locations (Table 1).

Analyte Class	Analyte	Air Screening Level	Screening Level
<i>Vegetation-related Combustion Compounds</i>			
Gaseous species	Carbon dioxide (CO ₂)	N/A	N/A
Particulate matter	PM-10	50 (24-hour)	CA AAQS ¹
Aldehydes	Formaldehyde	94 (1-hour)	OEHHA Acute REL ²
	Acetaldehyde	9 (long-term)	OEHHA Chronic REL ³
	Acrolein	0.19 (1-hour)	OEHHA Acute REL
<i>OE-related Combustion Species</i>			
Energetic Analytes	HMX	180 (long-term)	EPA Region 9 PRG ⁴
	Nitrobenzene	2.10 (1-hour)	EPA Region 9 PRG
	RDX	3.57 (1-hour)	MBUAPCD Rule 1000 ⁵
	PETN	1.19 (1-hour) ⁶	MBUAPCD Rule 1000
	1,3 Dinitrobenzene	0.35 (1-hour)	EPA Region 9 PRG
	1,3,5 Trinitrobenzene	110 (long-term)	EPA Region 9 PRG
	2,4 Dinitrotoluene	7.30 (1-hour)	EPA Region 9 PRG
	2,4,6 Trinitrotoluene	1.10 (1-hour)	MBUAPCD Rule 1000
	2,6 Dinitrotoluene	3.70 (1-hour)	EPA Region 9 PRG
Particulate Metals	Aluminum	23.8 (1-hour)	MBUAPCD Rule 1000
	Antimony	1.19 (1-hour)	MBUAPCD Rule 1000
	Barium	1.19 (1-hour)	MBUAPCD Rule 1000
	Beryllium	0.0047 (1-hour)	MBUAPCD Rule 1000
	Cadmium	0.0119 (1-hour)	MBUAPCD Rule 1000
	Chromium (total)	1.19 (1-hour)	MBUAPCD Rule 1000
	Cobalt	0.047 (1-hour)	MBUAPCD Rule 1000
	Copper	100 (1-hour)	OEHHA Acute REL
	Lead	1.5 (3-month)	CA AAQS
	Manganese	0.47 (1-hour)	MBUAPCD Rule 1000
	Mercury	1.8 (1-hour)	OEHHA Acute REL
	Molybdenum	23.8 (1-hour)	MBUAPCD Rule 1000
	Nickel	6 (1-hour)	OEHHA Acute REL
	Zinc	11.9 (1-hour)	MBUAPCD Rule 1000
Dioxins and Furans	Total Dioxin and Furan Toxicity	4.0E-05 (long-term)	OEHHA Chronic REL

¹ California Ambient Air Quality Standards.

² Office of Environmental Health Hazard Assessment Acute Reference Exposure Levels (http://www.oehha.ca.gov/airacute_rels/allAcRELS.html).

³ Office of Environmental Health Hazard Assessment Chronic Reference Exposure Levels (http://www.oehha.ca.gov/airchronic_rels/allChRELS.html).

⁴ U.S. Environmental Protection Agency, Region 9, Preliminary Remediation Goals.

⁵ Monterey Bay Unified Air Pollution Control District Rule 1000 (screening values shown are 1/420th of the OSHA Permissible Exposure Limit).

⁶ A chemical specific screening level does not exist for PETN, so the most restrictive acute screening level from the other energetic compounds (TNT) was used.