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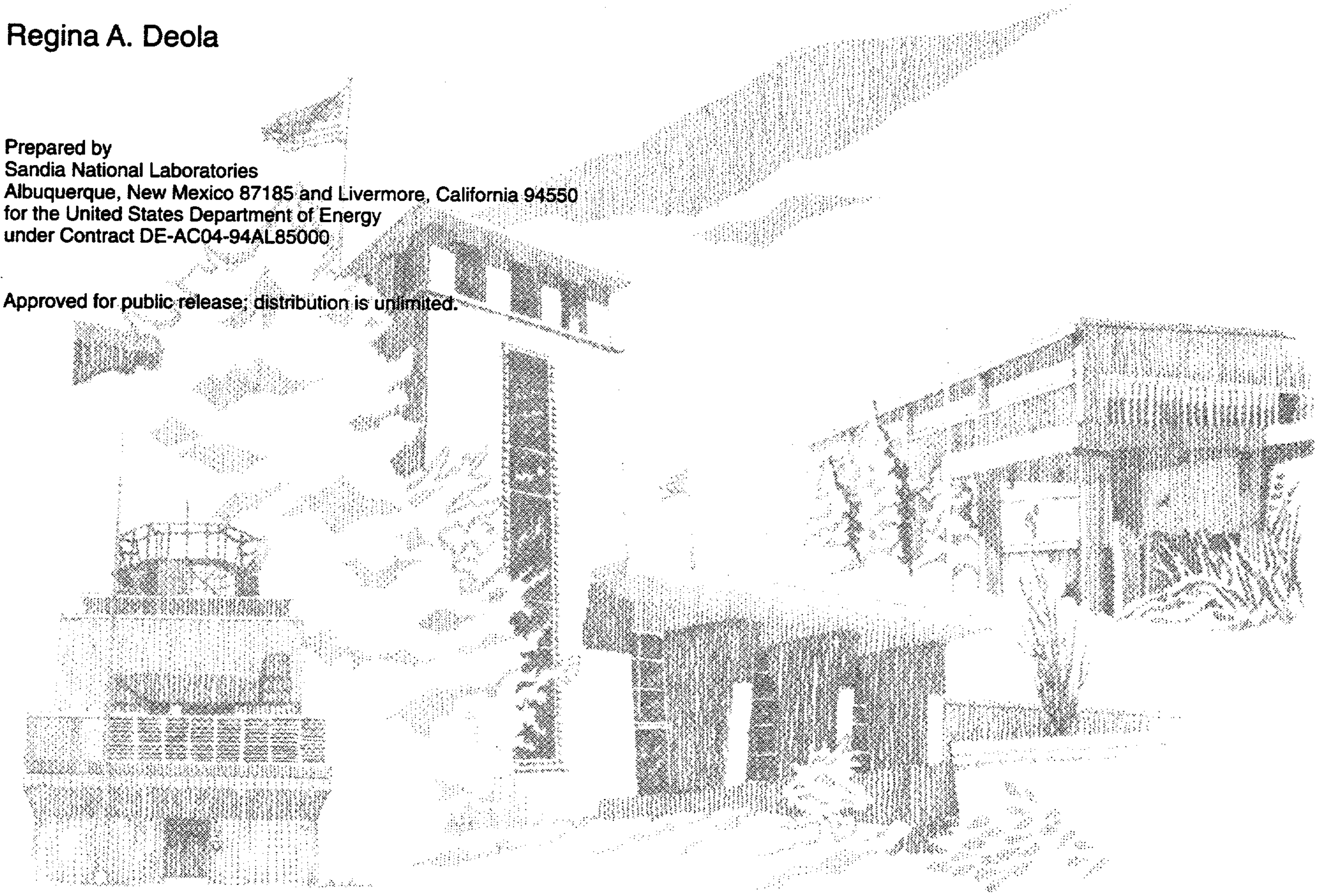
East Mountain Area 1995 Air Sampling Results

Regina A. Deola



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East Mountain Area

1995 Air Sampling Results

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Abstract

Ambient air samples were taken at two locations in the East Mountain Area in conjunction with thermal testing at the Lurance Canyon Burn Site (LCBS). The samples were taken to provide measurements of particulate matter with a diameter less than or equal to 10 micrometers (PM_{10}) and volatile organic compounds (VOCs). This report summarizes the results of the sampling performed in 1995. The results from small-scale testing performed to determine the potentially produced air pollutants in the thermal tests are included in this report. Analytical results indicate few samples produced measurable concentrations of pollutants believed to be produced by thermal testing. Recommendations for future air sampling in the East Mountain Area are also noted.

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DISCLAIMER

1.0 INTRODUCTION

This is the second of two documents detailing Sandia National Laboratories/New Mexico (SNL/NM) sampling activities in the East Mountain Area. The first document, entitled *"East Mountain Air Sampling Project"* (Deola 1995), describes the background air concentrations measured in 1994 and methodologies used in the sampling activities.

The East Mountain Air Sampling Project was implemented in association with thermal testing at the Lurance Canyon Burn Site (LCBS) to provide measurements of respirable particulate matter (PM_{10}) and volatile organic compounds (VOCs) in the event that these elements are generated in measurable concentrations downwind from the burn area. Thermal testing involves subjecting materials to fire in order to measure the integrity of the test object. This document describes the ambient air quality results from samples taken in 1995. In addition to ambient air sampling during thermal tests, a study was conducted in 1995 in an effort to characterize pollutants produced and emitted by the combustion of jet fuel. A summary of the main constituents found in that work is also presented.

2.0 TEST ACTIVITY AT THE LCBS

Sandia National Laboratories (SNL), owned by the United States Department of Energy (DOE), conducts various types of fire tests at the Lurance Canyon Burn Site (LCBS). The majority of these tests are safety tests for shipping containers, transportation systems, or weapon components mock-ups. The thermal tests are used to address the performance of these materials when exposed to fire to simulate potential conditions of a transportation accident. Requirements to perform thermal tests are specified in laws and regulations including Department of Defense (DOD) specification TB700-2 "Explosives Hazard Classification Procedures" (DoD 1989), Nuclear Regulatory Commission (NRC) regulations found in 10 CFR 72, and Federal Railroad Administration (FRA) regulations found in 49 CFR 179. In addition, some thermal testing is done in conjunction with Cooperative Research and Development Agreements (CRADAs) the DOE and SNL maintains with industries.

2.1 Test Facilities

The LCBS is located in Lurance Canyon on land permitted to the DOE (Figure 2.1). Three main facilities at the burn site are used for thermal tests: the Small WInd SHielded facility (SWISH), the SMoke Emission Reduction Facility (SMERF), and the Open Pool (OPOL). The first two, used for testing smaller objects, are enclosed, and emissions from combustion processes exit through stacks. The OPOL is exposed to the atmosphere and used for testing larger objects.

The type and amount of fuel ignited at the burn site are dependent upon the type of test being conducted. Tests conducted in the SWISH and SMERF facilities use smaller quantities of fuel and processes that maintain more thorough combustion of the fuel. These tests produce smaller smoke plumes that are not as opaque as plumes produced by OPOL tests. Tests in the OPOL are performed using larger quantities of fuel exposed to ambient conditions, which produce large opaque plumes. Approximately 1000 gallons of fuel are burned over 30 minutes for most OPOL tests. Ambient air sampling is performed during OPOL thermal tests. Both jet fuel (JP-8) and wood, which produce black smoke when burned, were the fuels used in OPOL thermal tests in 1995. Table 2.1 lists the dates and quantities of fuel burned in 1995 test activities. All OPOL tests are considered open burns by the Albuquerque Environmental Health Department (AEHD) and are permitted by the city.

The SWISH and SMERF facilities were seldom used in the past due to regulatory interpretation and classification of these facilities as point sources which must comply with visible emission regulations. In January 1996, these facilities were given an exemption from visible emissions regulations and will be used for a greater percentage of thermal tests.

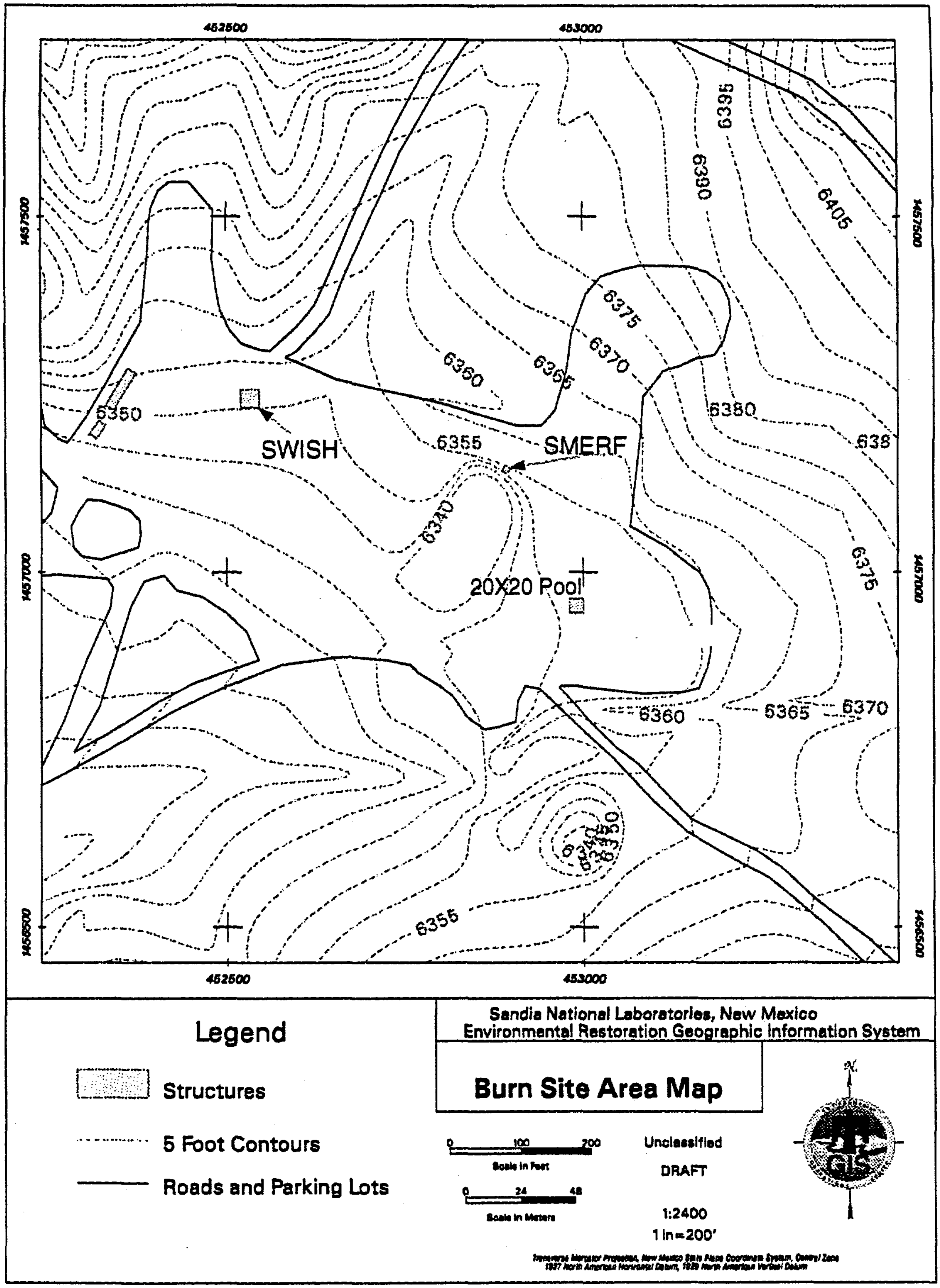

Figure 2.1. Location map of the Lurance Canyon Burn Site (LCBS).

Table 2.1. Thermal test dates and fuel consumption at the OPOL during 1995.

Date of Burn	Quantity & Type of Fuel	Permit Number
4/5/95	950 gal. JP-8	95-003-S
5/18/95	1193 gal. JP-8	95-004-S
7/29/95	900 gal. JP-8	76-OB-4-1995
9/8/95	1100 gal. JP-8	76-OB-5-1995
9/20/95	1100 gal. JP-8	76-OB-5-1995
9/25/95	1100 gal. JP-8	76-OB-5-1995
9/26/95	1100 gal. JP-8	76-OB-5-1995
10/3/95	1100 gal. JP-8	76-OB-5-1995
10/13/95	900 gal. JP-8	76-OB-4-1995
10/19/95	900 gal. JP-8	76-OB-4-1995
10/20/95	14,000 lbs Wood	76-OB-6-1995
12/19/95	900 gal. JP-8	76-OB-4-1995

2.2 Characterization of JP-8 Emissions

Small-scale experiments were conducted in September and October of 1995 to characterize emissions from combustion of JP-8 (Einfeld and Morrison 1996). These experiments were designed to simulate OPOL tests by floating JP-8 fuel on top of a one-half meter diameter water-filled pan and igniting the fuel. All emissions from the burn were trapped in a test chamber and characterized by analyses of the following pollutants: NO, NO_2, CO, SO_2, PM_{10}, and VOCs. The total mass of each pollutant found in the test chamber was then used to calculate emission factors. Emission factors for the largest quantities of pollutants developed through these analyses are shown in Table 2.2. These emission factors represent the total quantity (in pounds) of a compound that would be emitted into the air per gallon of fuel burned.

As shown in Table 2.2, CO, PM_{10}, and total VOCs are the three main constituents generated in appreciable quantities. Based on these emission factors and average quantities of 1000 gallons of JP-8 per OPOL test, the quantity of pollutants generated (and spatially dispersed over time) can be as much as 200 pounds of VOCs, 131 pounds of particulate matter (soot), and 144 pounds of CO. Approximately 13 pounds of benzene, a hazardous air pollutant, is emitted to the atmosphere in burn tests.

The above information may be used to generally compare compounds measured qualitatively in the small-scale experiments and compounds found in air samples taken in the East Mountain area during burn events. Direct qualitative and quantitative comparison of the small pan experiment results and ambient air sample results should not be considered. The

Table 2.2. Emission factors for JP-8 pool fire.

Pollutant	**Emission Factors** ppmv	lb/gal. fuel
NO	166	1.11E-03
NO_2	391	2.61E-03
CO	21600	1.44E-01
SO_2	1044	6.96E-03
PM_{10}	19600	1.31E-01
VOC	31000	2.07E-01
Benzene	2000	1.33E-02
Naphthalene	1200	8.00E-03
n-Undecane	1100	7.34E-03
n-Decane	410	2.73E-03
Indene	380	2.53E-03
Toluene	330	2.20E-03
Isovaleraldehyde	330	2.20E-03
Styrene	290	1.93E-03
1,3-Butadiene	240	1.60E-03
m- & p-Xylene	190	1.27E-03

Note: JP-8 Bulk Density: 6.67 lb/gal.
Factors presented in "*Characterization of Combustion Emissions from JP-8 Pool Fires*" by W. Einfeld and D. J. Morrison, January 1996.
ppmv = parts per million by volume.

thermodynamics of the large fire will create hotter temperatures with potentially more complete fuel combustion (generating less organic pollutants), and oxidation will be greater in the larger fire which could potentially increase NO_x emissions. NO_x concentrations measured in the pan experiments are very small, as shown in Table 2.2; therefore, despite the potential increase in NO_x, the net effect should be an overall reduction in the amount of hazardous pollutants.

The emissions generated by the average thermal test at SNL/NM may be compared to emissions generated by various activities. The following comparisons are used to gain perspective on the amount of pollutants generated during thermal tests. For example, a wildfire can be used to compare emissions since the organic pollutants are somewhat similar. A typical one-acre wildfire in the Southwest will produce approximately 170 pounds of particulates, 1400 pounds of CO, and 240 pounds of VOCs (EPA 1995). Fifty household fireplaces being used for one night will produce a total of 250 pounds of CO and 229 pounds of VOCs. Another element common to the Southwest is dirt or gravel roads; three dozen cars traveling one mile over a dirt road will result in the same quantity of particulate matter that is produced by a 1000-gallon thermal test. The chemical composition of the particulate matter is different for road dust and organic soot, but the particulate matter itself is the criteria pollutant that may produce harmful effects in large concentrations.

2.3 Screening Model Concentrations

The emission factors shown in Table 2.2 can be used in air dispersion modeling to predict concentrations that may occur downwind of the emission source. Air dispersion models used as screening techniques for estimation of downwind concentrations are generally conservative in that they tend to overestimate ambient air concentrations produced by pollutant sources. This safeguard is used to protect the public and the environment in the vicinity of pollutant sources. An air dispersion screening model (SCREEN3) was used by personnel at SNL/NM to estimate concentrations downwind of the burn site using the emission factors produced by the Einfield and Morrison study (1996).

The screen model was run for various terrain scenarios, using 1000 and 1200 gallons of fuel. Worse-case meteorological data (ws[*] = 2.5, F stability class) is used for complex terrain while full meteorology (all ws and stability classes) is used for flat terrain cases. Table 2.3 portrays the maximum ground level concentrations predicted by the model using Table 2.2 emission factors. Maximum concentrations are presented for the simple or flat terrain cases. The downwind locations where these maximum concentrations were found in this scenario were less than one mile from the emission source. Concentration values for complex terrain are shown for three distances since this scenario produced the highest calculated results. The DOE-permitted area property line is approximately two miles from the LCBS at the closest point to public lands. Maximum modeled concentrations occurred within a one-mile radius of the LCBS. Table 2.3 also presents the Ambient Air Quality Standard (AAQS) or the Threshold Limit Value-Time Weighted Average as a reference for violation of any standard. As can be seen from the table, particulate matter concentrations are the highest of any pollutant downwind of the thermal test area. This soot, which is composed of unburned or partially burned carbon compounds, gives the plume its characteristic black color seen by many area residents during a thermal test.

The values in Table 2.3 represent one-hour average concentrations. Almost all concentrations are well below the standards in the table except for the one-mile complex terrain case of PM_{10}. To compare a 1-hr concentration to a 24-hour standard, it is recommended that the modeled concentration be multiplied by a factor of 0.3 (AEHD 1995) for the stability conditions used in this complex screening scenario (F stability). PM_{10} screening model concentrations when multiplied by 0.3 are also below the standards. Actually, since the boundary fence line is two miles from the LCBS, concentrations at two miles would be used in the event of a regulatory permit application, and the 1-mile concentration would not be considered. This exercise was performed to demonstrate through the use of simple screening techniques that activities at the LCBS comply with all applicable standards. The concentrations listed here should not be directly compared to sampling results presented in Section 4.0 since limitations to air dispersion screening models can grossly overestimate ambient concentrations.

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[*] ws = windspeed

Table 2.3. Maximum ground-level concentrations in ppm predicted by Screen Model.

Pollutant (Mw)	1000 Gallons Fuel						1200 Gallons Fuel					
	Emission Rates (lb/hr.)		Flat Terrain	Complex Terrain (PM$_{10}$ in µg/m3)			Flat Terrain	Complex Terrain			Min. Standard	
	1000 gal.	1200 gal.	Max.	1 mi.	2 mi.	3 mi.	Max.	1 mi.	2 mi.	3 mi.	ppm	Time avg.
NO (30)	1.11	1.33	1.74-04	1.5E-03	6.6E-04	4.1E-04	1.8E-04	1.7E-03	7.6E-04	4.7E-04	0.1	24-hr
NO$_2$ (46)	2.62	3.14	2.6-04	2.3E-03	1.0E-03	6.2E-04	2.7E-04	2.6E-03	1.2E-03	7.3E-04	0.1	24-hr
CO (28)	144.72	173.66	2.4E-02	2.1E-01	9.2E-02	5.7E-02	2.5E-02	2.4E-01	1.1E-01	6.6E-02	13.1	1-hr
SO$_2$ (64)	6.99	8.39	5.0E-04	4.4E-03	1.9E-03	1.2E-03	5.2E-04	5.0E-03	2.3E-03	1.4E-03	0.5	3-hr
PM$_{10}$	131.32	157.58	2.0E+01	1.7E+02	7.7E-01	4.7E+01	2.1E+01	2.0E+02	8.9E+01	5.5E+01	150	24-hr
VOC (109)	207.70	249.24	8.7E-03	7.6E-02	3.4E-02	2.1E-02	9.1E-03	8.7E-02	3.9E-02	2.4E-02		
Benzene (78)	13.40	16.08	7.8E-04	6.9E-03	3.1E-03	1.9E-03	8.2E-04	7.9E-03	3.5E-03	2.2E-03	10	8-hr
Naphthalene (128)	8.04	9.65	2.9E-04	2.5E-03	1.1E-03	6.9E-04	3.0E-04	2.9E-03	1.3E-03	8.0E-04	10	8-hr
n-Undecane (156)	7.37	8.84	2.2E-04	1.9E-03	8.4E-04	5.2E-04	2.3E-04	2.2E-03	9.7E-04	6.0E-04	400	8-hr
n-Decane (142)	2.75	3.30	8.8E-05	7.7E-04	3.4E-04	2.1E-04	9.2E-05	8.9E-04	4.0E-04	2.5E-04	400	8-hr
Indene (116)	2.55	3.06	1.0E-04	8.8E-04	3.9E-04	2.4E-04	1.0E-04	1.0E-03	4.5E-04	2.8E-04	10	8-hr
Toluene (92)	2.21	2.65	1.1E-04	9.6E-04	4.3E-04	2.6E-04	1.1E-04	1.1E-03	5.0E-04	3.1E-04	50	8-hr
Isovaleraldehyde (86)	2.21	2.65	1.2E-04	1.0E-03	4.6E-04	2.8E-04	1.2E-04	1.2E-04	5.3E-04	3.3E-04	50	8-hr
Styrene (104)	1.94	2.33	8.5E-05	7.5E-04	3.3E-04	2.0E-04	8.9E-05	8.6E-04	3.9E-04	2.4E-04	50	8-hr
1, 3-Butadiene (54)	1.61	1.93	1.4E-04	1.2E-03	5.3E-04	3.3E-04	1.4E-04	1.4E-03	6.1E-04	3.8E-04	2	8-hr
m- & p-Xylene (106)	1.27	1.53	5.5E-05	4.8E-04	2.1E-04	1.3E-04	5.7E-05	5.5E-04	2.5E-04	1.5E-04	100	8-hr

Note: Mw = molecular weight of compound

3.0 AMBIENT AIR SAMPLING

The East Mountain Air Sampling Project was implemented to quantify concentrations of pollutants that may be generated by OPOL thermal testing at the burn site. Under most conditions there should be minimal or no ambient pollutant impacts at ground level since the burn is designed to prevent these impacts. SNL and DOE are committed to document the physical evidence if pollutants from the thermal tests are impacting the environment.

Air samples were taken over a four-hour period commencing with the start of the burn. This sample period allowed for transport and deposition time over the test area. Thermal tests in 1995 were completed in one-half hour. The VOC samples were analyzed for approximately 150 compounds while the PM_{10} samples were analyzed for 20 different metals and total uranium. Uranium has not been involved with the test objects since the late 1980s, but analysis of the samples for uranium was performed to provide data on fugitive or residual sources. It should be noted that uranium is naturally present in the soils and underlying bedrock of the East Mountain area (NCRP 1987).

3.1 Meteorology

Due to the location of Lurance Canyon in the foothills of the Manzanita Mountains, diurnal upslope-downslope wind patterns which are common around mountainous areas are prevalent at the burn site. This type of topographically induced wind pattern produces an east wind that blows downslope toward the Rio Grande Valley (west) at night and west wind that blows upslope toward the higher terrain (east) during the day. In addition to this general wind pattern, the surrounding terrain provides canyons which tend to channel windflow. The wind patterns at the burn site are channeled due to the canyon's east-west orientation in the vicinity of the burn area. This orientation increases the frequency of daytime winds blowing toward the east in the vicinity of the burn.

Generally, windflow in mountainous terrain follows the terrain, channeling into valleys or canyons, and moving around or over hills. The pollutants carried by the wind will also behave in a similar fashion until dispersed or deposited. There are two main channels east of the test site that may influence the transport of pollutants from the burn site. One channel diverts air towards the northeast while the other channel diverts air towards the southeast within a mile of the test site. The complexity of the terrain does not facilitate easy prediction of a plume originating at the LCBS after the initial diversion. Visual observations recorded during some of the thermal tests and sampling events are included in Section 4.0.

Conditions that may produce pollutant impacts at the ground level include tests that do not produce enough heat (to assist plume rise) or atmospheric conditions different from the burn site producing an inversion layer that may be too strong for the plume to penetrate. Occasionally, the early morning thermal structure of the atmosphere develops so that there is little to no wind through a lower layer of the atmosphere, only to have stronger winds (comparatively) towards the hilltops or nocturnal flows still present in some of the elevated valleys. This may produce concentrations of pollutants close to ground level.

SNL attempts to conduct burn tests under weather conditions that will best disperse the smoke plume. A mild sunny day that dissipates the overnight inversion and quickly increases the mixing height creates an atmospheric environment that assists in rapid diffusion and dispersion of the smoke produced by the burn. In a different scenario, a deep cool layer of air that extends above the hilltops around the LCBS assists plume rise as the heat from the burn makes the plume warmer than the surrounding environment. Under average burn conditions, the heat from the burning fuel increases the plume lift and allows the plume to be carried higher into the atmosphere, increasing the dispersion of the plume.

3.2 Sampling Sites

The East Mountain Air Sampling Project includes monitoring the ambient air at two locations downwind from the LCBS. The 1995 sampling sites were approximately one and three miles east of the burn site. The sampling sites were selected to: sample at the ridge of Lurance Canyon in proximity to the test site where the smoke may impact (East Mountain Site); and sample at a potentially impacted residence in the East Mountain community (Private Residence Site).

Figure 3.1 shows the location of each of these sites. The East Mountain Site was selected because of its proximity to the LCBS, it is directly in-line between the LCBS and the private residence, and it had road access. The sampling equipment was placed in a clearing at the end of an existing road. The Private Residence Site is on the east side of the mountains, directly in the path of the east bound smoke plumes from the burn site. The Private Residence Site prevents disturbance of the equipment and unwanted traffic in the area. The samplers were placed atop an existing cistern because of the forested property and the scarcity of open areas which meet Environmental Protection Agency (EPA) siting criteria.

3.3 Sampling Equipment & Analytical Techniques

3.3.1 VOCs

Evacuated 15-liter SUMMA stainless steel canisters were used to collect air samples for the determination of VOCs. The canisters were fitted with particulate filters to control particulates from entering the canister, and 1.5-meter sampling canes to assist in sampling air closer to the breathing zone. Flow regulators were used to set the volume of air entering the canisters over the sample duration to assure some vacuum remained in the canister at the conclusion of the sampling. Flow rates were set to approximately 40 milliliters per minute for the 4-hour samples.

The VOC samples were analyzed by gas chromatography coupled to multiple detectors (GC/MD) by an analytical laboratory vendor not associated with SNL. The GC/MD systems consist of three detectors that have different detection capabilities. Each system is equipped with a flame ionization detector (FID), a photoionization detector (PID), and a Hall electrolytic conductivity detector (HECD or ELCD). The Hall detector is preferred over electron capture detectors (ECD) because of its larger linear response range, higher sensitivity to monohalogenated compounds, and increased selectivity. The Hall detector also has the ability to not become saturated by highly halogenated compounds such as chlorofluorocarbons (CFCs), which are common in ambient samples.

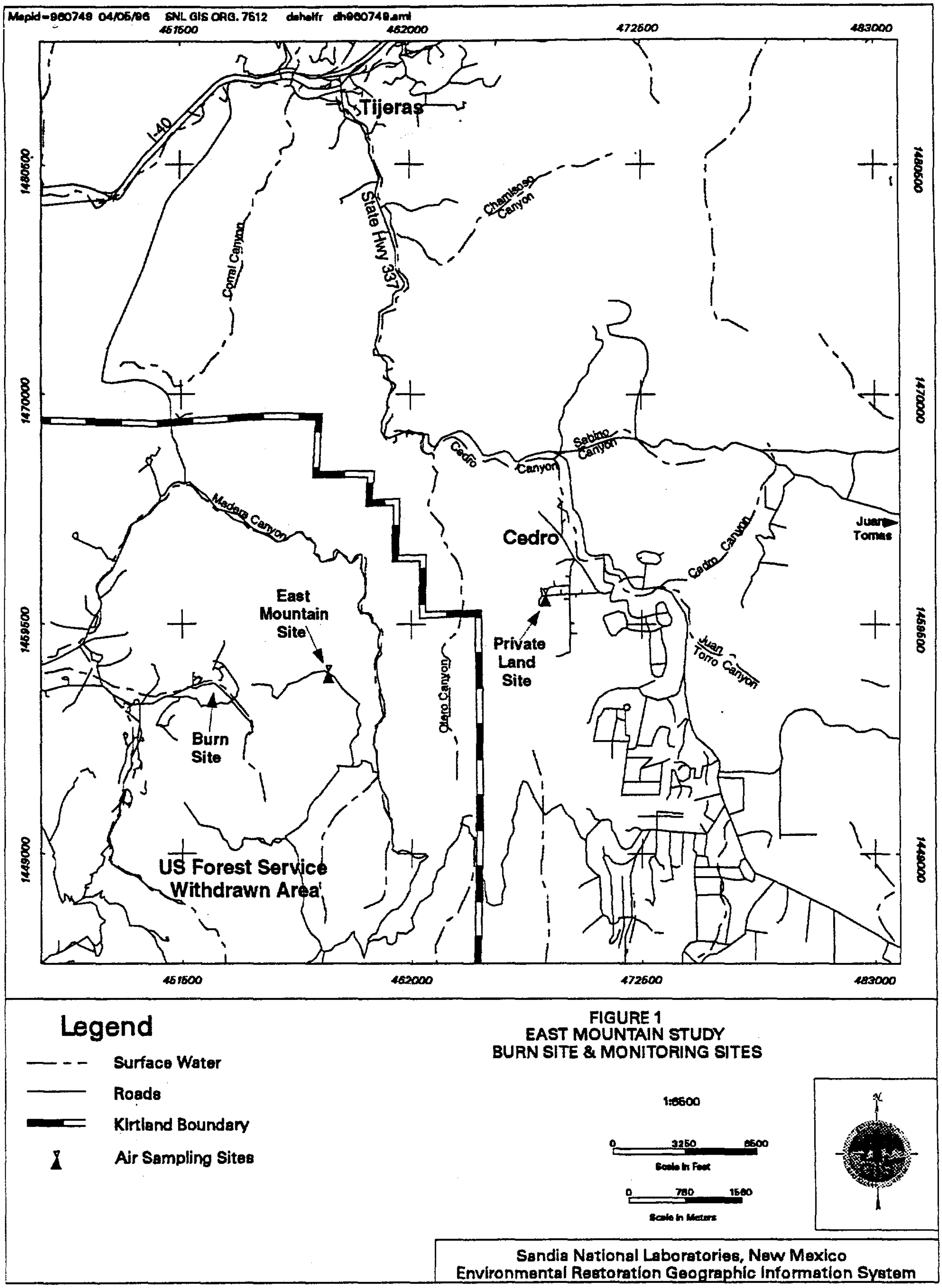

Figure 3.1. Location map for sampling sites in the vicinity of the LCBS.

An asset of the GC/MD systems is the capability to quantify over 150 compounds. The analysis of the VOC samples included all the compounds listed in Appendix A. While the samples were analyzed for all these chemicals, Section 4.0 includes just the compounds that were found in the samples.

3.3.2 Particulate Matter (PM_{10})

Wedding and Associates high-volume PM_{10} air samplers were used to collect particulate samples. The Wedding sampler is accepted by the EPA as a method for sampling PM_{10}. Desiccated glass-fiber filters were used to collect the particulate matter during sampling. A critical flow device regulated the flow of air into the samplers. The nominal flow rate for this instrumentation was one cubic meter per minute. Filters were weighed before and after sampling for the determination of particulate loading and calculation of particulate concentrations.

The filters were sent to an outside analytical laboratory for metal and uranium analyses. The filters were cut into strips and digested using a hot extraction procedure (HEP) in nitric acid. The solubilized metals were ready for analysis by either Inductively Coupled Argon Plasma Emission Spectroscopy (ICAPES) or Graphite Furnace Atomic Absorption Spectroscopy (GFAAS). Lead (Pb) and arsenic (As) require a separate aliquot to measure concentrations.

4.0 ANALYTICAL RESULTS

This section includes summarized data taken over the one-year sampling period. For specific results of each sampling event, refer to Appendix B for PM_{10}, and Appendix C for VOCs. All analytical results are included in the appendices, even if the compound is not a product from fuel combustion and represents pollutants from another source, or if results were at the analytical detection limit. All filters collected in this project were sent to the analytical laboratory regardless of the particulate loading, with the exception of the December 19, 1995, sample for which filter weight could not be determined. Table 4.1 lists the dates, comments, and observations for the East Mountain sampling events in 1995.

The last two samples in the table are background samples which were taken to show ambient air concentrations without burn tests. Initially, several background samples were planned at each location but due to resource constraints, only two background samples were taken in 1995. Background samples were taken over conditions and time periods similar to when burn tests take place. Actual average ambient conditions in the East Mountain area may differ from results outlined in this report due to the conditions and duration of samples used to describe background in this report.

Appendix D lists threshold limit values that are published by the American Conference of Governmental Industrial Hygienists (ACGIH). They are not legal regulatory standards, but are used as a reference to what individuals may be exposed to in a work environment, to assist in the control of health hazards. They are presented in this report as a reference to scale concentrations of chemicals found in the East Mountain area against what is generally considered acceptable by ACGIH for most individuals over certain time intervals.

4.1 Particulate Matter

The relatively short sampling time and low wind conditions needed for thermal testing influenced the low particulate filter loading seen in Table 4.1. As a comparison, PM_{10} monitoring across SNL/NM, reduced to a 4-hour time frame, averages 2916 μg of loading and a concentration of 12.1 $\mu g/m^3$. The accuracy of particulate matter weighing is to the tenths of milligrams and the filter weight is in grams. For sampling events that accumulate small amounts of particulate matter, results of the sample may be lost in the accuracy of the analytical method for elements that occur in both the filter substrate and the sample.

PM_{10} analytical results for 1995 are portrayed as averages in Figure 4.1. These values are average results based on all the sampling events listed in Appendix B, with the five main filter constituents (aluminum, calcium, potassium, magnesium, and sodium) removed. Typically, blank results are subtracted from the exposed filter results to eliminate the filter substrate and analytical artifacts. Due to the small number of filter blanks sent to the analytical laboratory for the East Mountain Project and the analytical results for those blanks, blank results are listed in Appendix B. For the East Mountain sampling, blank results were not used to correct analytical results. Concentrations presented in this report will be somewhat higher without this correction factor.

Table 4.1. East Mountain sampling events.

Date	Location	Field Remarks/Comments	Filter Loading (μg)	PM_{10} ($\mu g/m^3$) Concentrations NA
4/5/95	EMPM	Road not passable/no sample.		
	RDPM	No plume impact. Plume moved from Burn Site then up Tijeras Canyon.	300	1
5/18/95	EMPM	7:50 a.m. - Plume overhead, 300 ft. aboveground. Plume moving slightly NE, and SE, but still overhead. Last of plume NE of Burn Site at 8:15.	300	1
	RDPM	8:15 a.m - Observed signs of smoke 200 yds. S.		
9/8/95	EMPM	Plume moving N before reaching site, plume moving NNE.	900	4
	RDPM	Smoke plume at 1 mile N of site, 100 ft. above ridge, moving slowly east.	2100	9
9/26/95	EMPM	8:15 a.m. - Plume overhead and toward NE. 8:20 - Site is in southern edge of plume. 8:30 - Plume moving NNE.	1600	7
	RDPM	Smoke plume at 1 mile N of site, in the trees.	0	0
10/3/95	EMPM	8:05 a.m. - Plume SSE from burn site. 8:15 - Plume slowly moving ESE, sampling site near north edge of plume. 8:20 - Plume in lower areas (valley) E of sampling site.	1400	6
	RDPM discontinued	The RDPM site was decomissioned 9/28/95	--	--
10/19/95	EMPM	8:48 a.m. - Plume moving ESE. 8:58 - Plume S of sampling site and 300 ft AGL. 9:08 - Plume moving ESE.	2000	8
12/19/95	EMPM	8:45 a.m. - Plume overhead. Most of plume stationary over burn site at 9:00. Overhead smoke dissipated by 9:20.	--	NA
2/3/95	RDPM	Background samples.	300	1
10/17/95	EMPM	Background samples.	1200	5

Note:
EMPM = East Mountain Site
RDPM = Private Residence Site

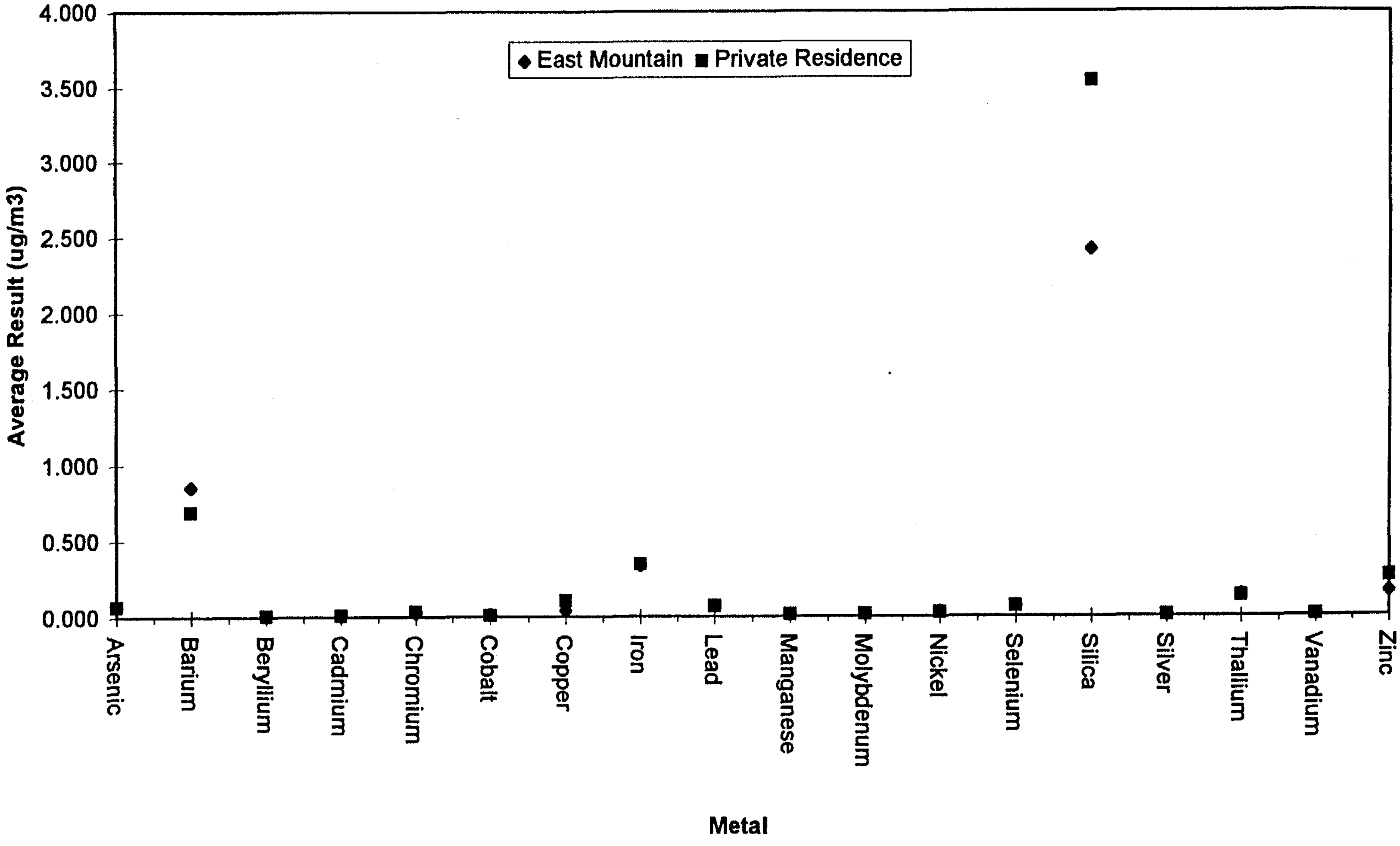

Figure 4.1. East Mountain PM_{10} results.

Two trace metals found in the filter substrate that are still reported in Figure 4.1 are silicon and iron. These are also common elements found in soils in the East Mountain vicinity. Other elements commonly found in soils are barium, copper, and zinc, all of which appear at small concentrations in the samples. The thallium in Figure 4.1 is an analytical artifact as can be seen when comparing the blank concentration to exposed samples (Appendix B). The detection limit of the analytical method divided by the small volume of air sampled produced this value.

Radiochemistry screening of the particulate matter included gross alpha and gross beta analysis, total uranium, and gamma spectroscopy. The minimum detectable activity (MDA) for each analyte in every sample is important for the low levels of radionuclides that may be present in environmental samples. The MDA is the minimum amount of activity that must be in the sample in order to be successfully detected with any degree of certainty. Sample results less than the MDA contain less than this minimum amount. Table 4.2 includes concentrations that were calculated for results greater than or equal to the MDA. Individual radiological results are presented in Appendix B2. Only gross beta and total uranium were detected above the MDA in the samples. As can be seen by comparing the sample results with the background results, the exposed sample concentrations were within the normal range of background concentrations for gross beta. For uranium, the results vary more, but are still representative of normal variation in ambient uranium in air. The average of all concentrations is 0.00578 ug/m^3 and the average plus two standard deviations is 0.01312 ug/m^3. The value of 0.01312 represents the upper limit of the expected natural variation. Since the maximum concentration found is below this value, all results are within the natural variation of background.

In summary, the particulate matter captured on the filters appears to be resuspended soil particles. This is especially true for the Private Residence Site where field observations in Table 4.1 detail only one event where the plume was close to the site (May 18, 1995). At the East Mountain sampling location, there were several occasions where the plume may have been sampled. An analysis of variance was performed to see if analytical results from these three tests were statistically different than the rest of the samples taken at both sites. There was no statistical difference in the results.

Organic carbon analysis was not performed on the particulate matter samples. Logistics, costs, and the additional special requirements necessary for particulate organics analysis prohibited the analysis. An alternative method that may be used to verify organic particulate matter is the analysis of total carbon. However, the specific source of carbon may only be inferred from carbon analysis since organics are also present in background concentrations. This recommendation is discussed in Section 5.0.

4.2 VOC Analytical Results

Average analytical results for the gaseous samples taken during 1995 are portrayed in Figure 4.2. Due to the range of analytical results, which was primarily a function of one sample contaminated with alkane alcohols, the natural logarithms of the average results are shown. Appendix C lists the actual values for each sampling event. To normalize the graph, 10 was added to the average of each result before the natural logarithm was taken, which is why most values are

Table 4.2. East Mountain radiological results.

Site	Sample Day	Radionuclide	Result pCi/filter	Error	MDA pCi/filter	Concentration pCi/m^3
East Mountain	5/18/95	Uranium, total	2.4		0.12	0.01072
East Mountain	9/8/95	Uranium, total	1.6		0.04	0.00711
East Mountain	9/26/95	Gross Beta, total	56	±27	41	0.24845
	9/26/95	Uranium, total	1.8		0.06	0.00799
East Mountain	10/3/95	Uranium, total	0.24		0.02	0.00105
East Mountain	10/19/95	Gross Beta, total	43	±27	42	0.18918
	10/19/95	Uranium, total	0.18		0.02	0.00079
Private Residence	4/5/95	Uranium, total	1.2		0.26	0.00536
Private Residence	5/18/95	Uranium, total	2.5		0.12	0.01096
Private Residence	9/8/95	Uranium, total	1.6		0.02	0.00703
Private Residence	9/26/95	Gross Beta, total	49	±24	37	0.21520
	9/26/95	Uranium, total	1.6		0.06	0.00703
East Mountain	10/17/95	Gross Beta, total	24	±25	40	0.10615
(Background)	10/17/95	Uranium, total	0.17		0.02	0.00075
Private Residence	2/3/95	Gross Beta, total	51	±24	37	0.22280
(Background)	2/3/95	Uranium, total	1.1		0.11	0.00481

Note: Concentrations are calculated for results greater than or equal to the MDA.
MDA = Minimum detectable amount

centered around a value of 2.3. Averages are calculated based on the number of occurrences (or number of times the analyte appeared in the samples), not the total number of samples taken. This is a conservative way of presenting the results since samples that did not contain the analyte (concentration of zero) will not be included in the averages. The sample that was contaminated with the three compounds that skewed results was taken on September 8, 1995. Table 4.3 shows the compound, possible sources, and the Threshold Limit Value (TLV) for the compound. These alcohol compounds are not used in jet fuel, nor were they found in the characterization of JP-8 emissions. It is believed that the compounds were actually present in the vicinity of the residence, and the rest of the results for that sample are considered valid.

The values in parentheses in Figure 4.2 are recalculated averages with the three contaminated compounds removed. Average concentrations without this sample are similar to concentrations found at the East Mountain Site. The trace concentrations of compounds at both locations, except for ethanol and methanol, show a relatively clean environment. The trace compounds are common in gasolines, cleaning fluids or solvents, surface coatings, and various

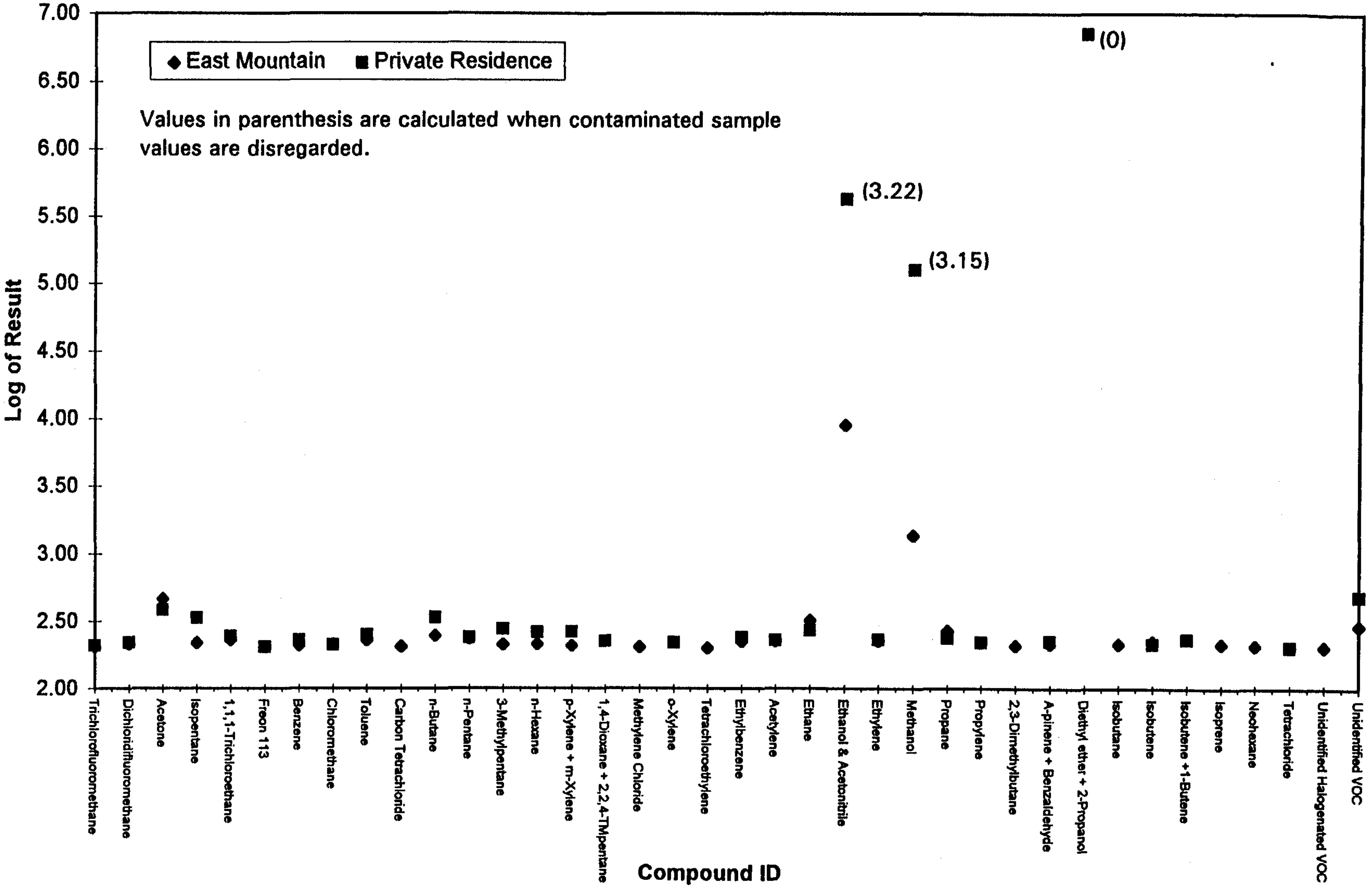

Figure 4.2. Log of VOC results.

Table 4.3. Compounds found in September 8, 1995, Private Residence sample.

Compound	Sources or Processes	TLV-TWA*	Concentration
Ethyl Alcohol	paints, agricultural wastes, solvents	1000 ppm	33.90 ppm
Isopropyl Alcohol	paints, solvents, preservatives	400 ppm	0.90 ppm
Methyl Alcohol	paints, agricultural wastes, solvents	200 ppm	1.14 ppm

* TLV is an American Conference of Governmental Industrial Hygienists guideline. It is not a legal regulatory standard. The TLV-TWA is the time-weighted average concentration for an 8-hour day, 40-hour week, to which nearly all workers may be repeatedly exposed, without adverse effect. It is used here as a reference to scale the ambient concentration measured to what is generally considered not harmful to average individuals.

products available to the general consumer population. The frequency of finding methanol and ethanol was low (the number of times a sample contained the analyte), but the concentrations for the samples that contained the compound were higher than other analytes, which produced the high averages. These chemicals are quite common; in fact, methanol is the 22nd highest volume chemical produced in the United States (Sax and Lewis 1987). Total Non-Methane Hydrocarbons (TNMHC) is a total count of all the carbon that was present in the samples. It includes both the analytes that were identified (non-methane) and those that were not. The presence of the three chemicals listed in Table 4.3 skewed the average TNMHC to the value in Figure 4.2. A comparison of the TNMHC is a quick, cursory way to compare the results of the East Mountain Air Sampling Project with results from SNL/NM. Direct comparison cannot be made since the analysis of VOC samples at SNL/NM is limited to 25 chemicals and TNMHC, while the full scan was performed for the East Mountain Project. Before comparing TNMHC results, a new, more accurate TNMHC result should be calculated to omit the contribution of the alkane alcohols contaminated sample. Also, for the sake of comparison, the highest and the lowest site averages of TNMHC at SNL/NM were used. The results are listed in Table 4.4. Actual concentrations are used in the table instead of logarithms.

The ethanol contribution to the TNMHC is significant for both locations in the East Mountain Project (Appendix C) for several samples. Ethanol is not quantified for SNL/NM samples. Even with this difference, the average TNMHC found in the East Mountains is lower than that found at SNL/NM Technical Area 1 (TA-I).

In summary, the VOC samples taken in 1995 reveal trace concentrations of chemicals that are present in many products generally available to consumers. Periodic occurrence of organic alcohols influenced TNMHC values, but these alcohols were not harmful in the concentrations found.

Table 4.4. Comparison of TNMHC concentrations in East Mountain Area at SNL/NM.

Location	TNMHC Concentrations
Technical Area I (TA-I)	13.67 ppb
Technical Area III (TA-III)	5.00 ppb
East Mountain Location	12.86 ppb
Private Residence	11.56 ppb (with 9/8/95 TNMHC disregarded)

5.0 RECOMMENDATIONS

The recommendations in this section are based on the work to characterize JP-8 emissions and address questions that are unanswered by the 1995 air sampling results. The recommendations may be contingent on future funding levels. All recommendations listed here have drawbacks of either increasing costs or needed manpower. Additionally, funding of many programs in the environmental arena depend on legal requirements; to keep costs of programs down, generally, a project will not be funded if there is not a legal requirement to perform the task. In the end, funding may drive the decision to perform the recommendations listed below.

- Since one of the goals of SNL/NM is to prevent environmental impacts from laboratory operations, meteorology could be used to evaluate the potential of ground level impacts of smoke plumes. By measuring wind and turbulence parameters at various levels in the atmosphere, a meteorologist may be able to determine how the plume will move in and around the LCBS. A sound detection and ranging instrument (SODAR), which measures wind and turbulence data up to 1000 meters above ground, can be used to characterize morning mixing heights. In this way, data from the SODAR could help improve predictability of local conditions the morning of the burn. Mixing height information could be included in test decisions if there is potential for smoke plume impact in residential areas. However, there is no guarantee that the atmosphere in the next air basin is behaving exactly like the one in the basin being measured during the early morning hours. Meteorological measurements alone are not the solution to thermal testing impacts.

- If East Mountain ambient sampling is performed in the future, particulate matter analysis should, at a minimum, include total carbon. While quantifying carbon will not give definitive particulate matter results, ambient background carbon and carbon found during plume impact sampling could be evaluated on a ratio basis. In addition, the most likely location for plume sampling is at the East Mountain location, the sampling site closest to the LCBS. Particulate matter sample analysis for speciated organic compounds at this location would provide additional information.

- For radiochemistry screening, arrangements could be made with the analytical laboratory to increase sample count times, resulting in lowering detection limits. This effectively increases the sensitivity of the radiochemistry data, so that general comparisons of the East Mountain radiochemistry data could then be made with other data where large volumes of air are sampled. This would only be used to prove that the testing at the LCBS does not emit radioactive compounds.

- The East Mountain sampling results were all lower than applicable ambient standards or fell within regulatory guidelines. Over half of the samples were of ambient air not affected by the smoke plume. While some questions remain unanswered, the sampling of a smoke plume generated by a thermal test remains difficult, and alternatives to "point sampling" are expensive. The results from the characterization of JP-8 emissions probably present the most cost-effective way to identify compounds that are produced by combustion of JP-8 in the environment.

The above recommendations are not necessary based on the outcome of the 1995 sampling results since all results were within legal limits. They are suggested to provide a complete picture if ambient air samples taken do indeed contain plume compounds. If additional work cannot be performed, results of the JP-8 study and atmospheric dispersion modeling should be used to inform East Mountain residents of the compounds emitted during thermal testing.

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49 CFR 179, *Code of Federal Regulations*, Title 49, Part 179, "Specifications for Tank Cars," U.S. Environmental Protection Agency, Washington D.C., 1995.

APPENDIX A

VOC Analytes

Appendix A. VOC Analytes

1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethylene
1,2,3-Trimethylbenzene
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dibromoethane
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Butadiene
1,4-Dioxane
1-Butanol
1-Butyne
1-Decene
1-Heptene
1-Hexene
1-Methylcyclohexene
1-Nonene
1-Octene
1-Pentene
1-Propanol
1-Undecene
2,2,3-Trimethylpentane
2,2,4-Trimethylpentane
2,2,5-Trimethylhexane
2,3,4-Trimethylpentane
2,3-Dimethylbutane
2,4,4-Trimethyl-1-Pentene
2,4-4-Trimethyl-2-Pentene
2,4-Dimethylpentane
2,5-Dimethylhexane
2,5-Dimethylthiophene
2-Butanone
2-Butyne
2-Chloroethylvinyl Ether
2-Ethyl-1-Butene
2-Methyl-1,3-Dioxolane
2-Methyl-1-Butene
2-Methyl-1-Pentene
2-Methyl-2-Butene
2-Methyl-2-Pentene
2-Methylthiophene
2-Pentanone
2-Propanol
3,5,5-Trimethylhexene
3-Methyl-1-Butene
3-Methylheptane
3-Methylhexane
3-Methylpentane
3-Methylthiophene
3-Octanone
3-Pentanone
4-Methyl-1-Pentene
4-Nonene
a-Pinene
Acetaldehyde
Acetone (+)
Acetonitrile
Acetylene
Acrylonitrile
b-Pinene
Benzaldehyde
Benzene
Benzyl Chloride
bis-Chloroethyl Ether
bis-Chloromethyl Ether
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Butyl Acrylate
Butyl Mercaptan
Butyraldehyde
c-1,2-Dichloroethylene
c-1,3-Dichloropropene
c-2-Butene
c-2-Hexene
c-2-Octene
c-2-Pentene
c-3-Heptene
c-3-Hexene

Appendix A. VOC Analytes (Continued)

c-3-Methyl-2-Pentene
c-4-Methyl-2-Pentene
Carbon Tetrachloride
Chlorobenzene
Chlorodifluoromethane
Chloroethane
Chloroform
Chloromethane
Chloroprene
Cumene
Cyclohexane
Cyclohexanone
Cyclohexene
Cyclopentane
Cyclopentene
Dibromochloromethane
Dichlorodifluoromethane
Dichlorofluoromethane
Dichlorotoluene
Diethyl Ether
Dimethyl Acetal
Dimethyl Ether
Dimethylsulfide
Ethane
Ethanol
Ethyl Mercaptan
Ethylbenzene
Ethylene
Fluorobenzene
Freon 113
Freon 114
Freon 23
Heptanal
Hexachloro-1,3-Butadiene
Hexanal
Indan
Indene
Iodomethane
Isobutane
Isobutene + 1-Butene
Isobutylbenzene
Isobutyraldehyde
Isoheptane + 2,3-Dimethylpentane
Isohexane
Isopentane
Isopentyl Mercaptan
Isoprene
Isovaleraldehyde
Limonene
m-Chlorotoluene
m-Dichlorobenzene
m-Diethylbenzene
m-Ethyltoluene
Methanol (+)
Methyl Acrylate
Methyl Formate
Methyl Mercaptan
Methyl t-Butylether
Methylcyclohexane
Methylcyclopentane
Methylcyclopentene
Methylene Chloride
Methylisobutylketone
n-Butane
n-Butylbenzene
n-Decane
n-Heptane
n-Hexane
n-Nonane
n-Octane
n-Pentane
n-Propylbenzene
n-Undecane
Naphthalene
Neohexane
Neopentane
o-Chlorotoluene
o-Dichlorobenzene
o-Ethyltoluene
o-Xylene
p-Chlorotoluene
p-Dichlorobenzene
p-Diethylbenzene
p-Ethyltoluene

Appendix A. VOC Analytes (Concluded)

p-Isopropyltoluene
p-Xylene + m-Xylene
Propane
Propionaldehyde
Propylene
Propyne
Styrene
t-1,2-Dichloroethylene
t-1,3-Dichloropropene
t-2-Butene
t-2-Heptene
t-2-Hexene
t-2-Pentene
t-3-Heptene
t-4-Methyl-2-Pentene
t-Butylbenzene
Tetrachloroethylene
Tetrahydrothiophene
Thiophene
Toluene
Trichloroethylene + BCM
Trichlorofluoromethane
Unidentified Halogenated VOC
Unidentified VOC
Valeraldehyde
Vinyl Acetate
Vinyl Bromide
Vinyl Chloride
TNMHC

APPENDIX B-1

Metal Analysis

Table B-1. Individual particulate matter metal analysis results.

		East Mountain							
	Blank	Background	Routine					Average	Std
Metal (µg/m^3)	5/18/95	10/17/95	5/18/95	9/8/95	9/26/95	10/3/95	10/19/95	Result	Dev
Aluminum, total	7.504	5.307	5.806	2.846	3.017	4.835	5.279	4.357	1.347
Arsenic, total	0.088	0.088	0.089	0.089	0.000	0.088	0.088	0.071	0.040
Barium, total	0.088	1.194	0.107	0.978	0.932	1.099	1.144	0.852	0.425
Beryllium, total	0.009	0.009	0.009	0.009	0.000	0.009	0.009	0.007	0.004
Cadmium, total	0.009	0.009	0.009	0.009	0.000	0.009	0.009	0.007	0.004
Calcium, total	22.953	16.807	17.865	10.227	11.535	14.945	15.838	14.082	3.142
Chromium, total	0.022	0.021	0.016	0.032	0.027	0.025	0.026	0.025	0.006
Cobalt, total	0.009	0.009	0.023	0.009	0.000	0.009	0.009	0.010	0.008
Copper, total	0.009	0.062	0.024	0.089	0.053	0.019	0.025	0.042	0.029
Iron, total	0.313	0.407	0.339	0.302	0.337	0.334	0.370	0.337	0.024
Lead, total	0.088	0.088	0.089	0.089	0.000	0.088	0.088	0.071	0.040
Magnesium, total	7.504	4.865	5.806	2.490	2.484	4.220	4.399	3.880	1.412
Manganese, total	0.016	0.009	0.018	0.009	0.009	0.009	0.009	0.011	0.004
Molybdenum, total	0.018	0.018	0.018	0.018	0.000	0.018	0.018	0.014	0.008
Nickel, total	0.035	0.035	0.036	0.036	0.000	0.035	0.035	0.028	0.016
Potassium, total	10.152	6.634	6.253	5.336	4.880	6.154	6.159	5.756	0.615
Selenium, total	0.088	0.088	0.089	0.089	0.000	0.088	0.088	0.071	0.040
Silica, total	2.913	2.123	3.305	3.379	1.508	1.934	1.936	2.413	0.867
Silver, total	0.009	0.009	0.009	0.009	0.000	0.009	0.009	0.007	0.004
Sodium, total	194.218	159.222	178.651	133.393	133.097	158.242	158.381	152.353	19.319
Thallium, total	0.177	0.177	0.179	0.178	0.000	0.176	0.176	0.142	0.079
Vanadium, total	0.009	0.009	0.009	0.009	0.000	0.009	0.009	0.007	0.004
Zinc, total	0.026	0.057	0.067	0.285	0.319	0.062	0.062	0.159	0.131

Table B-1. Individual particulate matter metal analysis results (Concluded).

	Private Residence							
	Blank	Background	Routine				Average	Std
Metal ($\mu g/m^3$)	5/18/95	2/3/95	4/5/95	5/18/95	9/8/95	9/26/95	Result	Dev
Aluminum, total	7.504	10.922	11.612	5.699	2.811	5.270	6.348	3.733
Arsenic, total	0.088	0.087	0.089	0.088	0.088	0.000	0.066	0.044
Barium, total	0.088	0.655	0.625	0.105	0.878	1.142	0.688	0.442
Beryllium, total	0.009	0.009	0.009	0.009	0.009	0.000	0.007	0.004
Cadmium, total	0.009	0.009	0.009	0.009	0.009	0.000	0.007	0.004
Calcium, total	22.953	27.960	32.157	18.413	10.979	15.371	19.230	9.142
Chromium, total	0.022	0.052	0.063	0.018	0.026	0.026	0.033	0.020
Cobalt, total	0.009	0.009	0.009	0.009	0.009	0.000	0.007	0.004
Copper, total	0.009	0.105	0.089	0.105	0.141	0.083	0.105	0.026
Iron, total	0.313	0.402	0.393	0.359	0.264	0.351	0.342	0.055
Lead, total	0.088	0.087	0.089	0.088	0.088	0.000	0.066	0.044
Magnesium, total	7.504	8.301	9.379	5.699	2.284	4.392	5.438	2.980
Manganese, total	0.016	0.016	0.013	0.018	0.009	0.011	0.012	0.004
Molybdenum, total	0.018	0.010	0.018	0.018	0.018	0.000	0.013	0.009
Nickel, total	0.035	0.035	0.036	0.035	0.035	0.000	0.026	0.018
Potassium, total	10.152	9.611	11.612	7.014	4.392	5.709	7.182	3.142
Selenium, total	0.088	0.087	0.089	0.088	0.088	0.000	0.066	0.044
Silica, total	2.913	1.398	3.216	3.288	5.709	1.932	3.536	1.577
Silver, total	0.009	0.009	0.009	0.009	0.009	0.000	0.007	0.004
Sodium, total	194.218	205.330	232.247	175.362	118.577	144.928	167.778	48.842
Thallium, total	0.177	0.175	0.179	0.175	0.176	0.000	0.132	0.088
Vanadium, total	0.009	0.009	0.009	0.009	0.009	0.000	0.007	0.004
Zinc, total	0.026	0.612	0.581	0.096	0.281	0.079	0.259	0.233

APPENDIX B-2

Radionuclide Analysis

Table B.2a. Radiological results for East Mountain Site.

Site	Sample Day	Radionuclide	Result pCi/filter	Error	MDA
East Mountain	5/18/95	Gross Alpha, total	-33	36	64
	5/18/95	Gross Beta, total	26	80	140
	5/18/95	Potassium-40 @ 1460 KeV	-97	180	330
	5/18/95	Uranium, total	2.4		0.12
East Mountain	9/8/95	Gross Alpha, total	12	16	21
	9/8/95	Gross Beta, total	29	26	42
	9/8/95	Potassium-40 @ 1460 KeV	130	190	320
	9/8/95	Uranium, total	1.6		0.04
East Mountain	9/26/95	Gross Alpha, total	4	12	18
	9/26/95	Gross Beta, total	56	27	41
	9/26/95	Potassium-40 @ 1460 KeV	44	190	340
	9/26/95	Uranium, total	1.8		0.06
East Mountain	10/3/95	Gross Alpha, total	10	16	22
	10/3/95	Gross Beta, total	23	29	47
	10/3/95	Potassium-40 @ 1460 KeV	-38	180	320
	10/3/95	Uranium, total	0.24		0.02
East Mountain	10/19/95	Gross Alpha, total	10	12	15
	10/19/95	Gross Beta, total	43	27	42
	10/19/95	Potassium-40 @ 1460 KeV	-69	200	370
	10/19/95	Uranium, total	0.18		0.02

Table B.2b. Radiological results for Private Residence Site.

Site	Sample Day	Radionuclide	Result pCi/filter	Error	MDA
Private Residence	4/5/95	Gross Alpha, total	170	170	210
	4/5/95	Gross Beta, total	270	220	350
	4/5/95	Uranium, total	1.2		0.26
Private Residence	5/18/95	Gross Alpha, total	-17	36	67
	5/18/95	Gross Beta, total	-30	78	130
	5/18/95	Potassium-40 @ 1460 KeV	130	170	300
	5/18/95	Uranium, total	2.5		0.12
Private Residence	9/8/95	Gross Alpha, total	-9	19	37
	9/8/95	Gross Beta, total	23	44	72
	9/8/95	Potassium-40 @ 1460 KeV	14	170	320
	9/8/95	Uranium, total	1.6	0.02	
Private Residence	9/26/95	Gross Alpha, total	4	14	22
	9/26/95	Gross Beta, total	49	24	37
	9/26/95	Potassium-40 @ 1460 KeV	-64	180	330
	9/26/95	Uranium, total	1.6		0.06

Table B.2c. Radiological results for blanks and background.

Site	Sample Day	Radionuclide	Result pCi/filter	Error	MDA
Blank	5/18/95	Gross Alpha, total	0	39	64
	5/18/95	Gross Beta, total	-18	78	130
	5/18/95	Potassium-40 @ 1460 KeV	94	180	330
East Mountain	10/17/95	Gross Alpha, total	0	12	21
	10/17/95	Gross Beta, total	24	25	40
	10/17/95	Potassium-40 @ 1460 KeV	-97	200	360
	10/17/95	Uranium, total	0.17		0.02
Private Residence	2/3/95	Gross Alpha, total	10	20	30
	2/3/95	Gross Beta, total	51	24	37
	2/3/95	Potassium-40 @ 1460 KeV	42	290	500
	2/3/95	Uranium, total	1.1		0.11

APPENDIX C

Individual VOC Analysis Results

Table C-1. Individual VOC analysis results.

	Background		Burn						Burn			
	East Mountain	Private Residence	East Mountain						Private Residence			
Compound	10/17/95	2/3/95	5/18/95	9/8/95	9/26/95	10/3/95	10/19/95	12/19/95	4/5/95	5/18/95	9/8/95	9/26/95
1,1,1-Trichloroethane	0.5	0.07	0.5	1.3	0.6	0.4	0.9	0.2	1.9	0.3	1.2	1
1,4-Dioxane + 2,2,4-TMpentane		0.8										0.2
2,3-Dimethylbutane								0.2				
3-Methylpentane		1.5		0.2				0.3				
A-pinene + Benzaldehyde				0.3							0.5	
Acetone	1.8	5	0.8	18.2		8.2	2.3	1	2.8	2.3		3
Acetylene				0.7				0.4	0.7	0.8		0.3
Benzene		1.7	0.2	0.3				0.1	0.3	0.3		0.2
Carbon Tetrachloride								0.1				
Chloromethane			0.1	0.5	0.2	0.2		0.3		0.3	0.2	0.2
Dichloridifluoromethane	0.1	0.5	0.3	0.4	0.3	0.3	0.1	0.6		0.4	0.4	0.3
Diethyl ether + 2-Propanol											936	
Ethane	3.8		1.2	2.2	1.2	1.3	1.6	5.3	0.9	1.6	1.7	1.4
Ethanol & Acetonitrile				62.3		27.2			23.5	8.7	33900	
Ethylbenzene		0.8				0.5						
Ethylene	0.3			0.7		0.3	0.9	0.5	0.6	0.7		0.6
Freon 113		0.08	0.08	0.07	0.03	0.04		0.1		0.07	0.07	0.04
Isobutane								0.3				
Isobutene				0.5					0.3			
Isobutene +1-Butene		0.7										
Isopentane	0.3	5.8					0.3	0.6	1.3			0.9
Isoprene				0.3								
Methanol						12.9			13.4		1140	
Methylene Chloride				0.06				0.1				
n-Butane	0.5	13.3		1.2				1.2	0.7	0.6	0.3	1.4
n-Hexane		1.3		0.3							1.2	
n-Pentane		2.3		1.2				0.3	0.4	0.3		0.3
Neohexane								0.2				
o-Xylene		0.4										
p-Xylene + m-Xylene		1.3				0.2						
Propane	2.1		0.8	1.2	0.6	0.6	0.9	3.8	0.7	0.8	1	0.6
Propylene	0.2			0.5			0.7	0.4	0.9	0.3	0.2	0.4
Tetrachloride	0.1	0.04	0.1	0.09	0.06	0.05				0.04	0.09	0.07
Tetrachloroethylene								0				
TNMHC	3.9	46.5	1.3	38.2	1.6	24.5	3.6	8	18.4	7.7	12100	8.6
Toluene		4.6		0.6					0.3	0.3	0.2	0.3
Trichlorofluoromethane	0.04	0.2	0.1	0.2	0.1	0.1		0.2		0.2	0.2	0.1
Unidentified Halogenated VOC				0.09		0.03		0.2				
Unidentified VOC	0.3			2	1	7.8	0.5	0.8	3	0.8	15.9	2.8

APPENDIX D

Threshold Limit Values for Chemicals Found in the East Mountain Area

Table D-1. Threshold Limit Values[1] for chemicals found in East Mountain sampling results.

Compound	ppb	Metal ($\mu g/m^3$)	ug/m^3
1,1,1-Trichloroethane	350,000	Aluminum, total	2,000
1,4-Dioxane + 2,2,4-TMpentane	25,000	Arsenic, total	10
2,3-Dimethylbutane	NA	Barium, total	50
3-Methylpentane	NA	Beryllium, total	2
A-pinene + Benzaldehyde	NA	Cadmium, total	10
Acetone	750,000	Calcium, total	1
Acetylene	NA	Chromium, total	10
Benzene	300	Cobalt, total	20
Carbon Tetrachloride	5,000	Copper, total	1,000
Chloromethane	50,000	Iron, total	5,000
Dichloridifluoromethane	1,000,000	Lead, total	150
2-Propanol	400,000	Magnesium, total	10,000
Ethane	NA	Manganese, total	200
Ethanol & Acetonitrile	1,000,000	Molybdenum, total	10,000
Ethylbenzene	100,000	Nickel, total	50
Ethylene	NA	Potassium, total	NA
Freon 113	NA	Selenium, total	2,000
Isobutane	NA	Silica, total	2,000
Isobutene	NA	Silicon, total	10,000
Isobutene +1-Butene	NA	Silver, total	10
Isopentane	0.3	Sodium, total	5,000
Isoprene	NA	Thallium, total	100
Methanol	200,000	Vanadium, total	50
Methylene Chloride	50,000	Zinc, total	10
n-Butane	800,000		
n-Hexane	50,000		
n-Pentane	600,000		
Neohexane	500,000		
o-Xylene	100,000		
Propane	NA		
Propylene	NA		
Tetrachloride	NA		
Toluene	50,000		
Trichlorofluoromethane	1,000,000*		

[1] Values listed are Time-Weighted Averages (TWA) except where marked. TWA is the concentration for a normal 8-hour work day and 40-hour week, to which nearly all workers may be exposed without adverse effect.

Note:*Short-Term Exposure Limit (STEL). The STEL is a 15-minute TWA not to be exceeded at anytime during the work day.

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