CLEAR CREEK MANAGEMENT AREA ASBESTOS EXPOSURE AND HUMAN HEALTH RISK ASSESSMENT

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U.S. Environmental Protection Agency
Region 9
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Background

The Clear Creek Management Area (CCMA) covers approximately 75,000 acres in San Benito and Fresno counties in central California. It includes part of the New Idria Formation, a serpentinite rock body which contains a 31,000 acre outcrop of naturally occurring asbestos, the largest asbestos deposit in the United States. The U.S. Department of Interior Bureau of Land Management (BLM) has designated the New Idria portion of the CCMA as the Serpentine Area of Critical Environmental Concern (ACEC). Recreational use of CCMA by hikers, campers, hunters, botanists, rock collectors, and off-highway vehicle (OHV) users disturbs soils of the ACEC, which have high levels of asbestos, creating the potential for asbestos exposure and increased health risk. The BLM is the agency responsible for administering the public lands of CCMA.

In 1991, EPA signed the Record of Decision (ROD) for the Atlas Asbestos Mine Superfund site, which selected the cleanup remedy for the Atlas Mine, an abandoned asbestos mine located within the CCMA. In the ROD, EPA designated the CCMA as one of four geographic areas that comprise the site, but did not propose a cleanup action for the CCMA. Instead, EPA stated that it would evaluate whether the BLM's plans for management of CCMA were adequate to protect public health from exposure to asbestos found in the CCMA's soil and air.

In 2004, as part of the process of evaluating the Atlas site for possible delisting from the federal National Priorities List, EPA Region 9 initiated an asbestos exposure and human health risk assessment for the CCMA. The goal of the assessment was to use current asbestos sampling and analytical techniques to update the 1992 BLM Human Health Risk Assessment and provide more robust information to BLM on the asbestos exposures from typical CCMA recreational activities and the excess lifetime cancer risks associated with those exposures. The assessment was conducted consistent with U.S. EPA policy and guidance, including the Risk Assessment Guidance for Superfund (RAGS) (EPA/540/1-89/002), and with the encouragement of the California Air Resources Board (CARB) and the California Department of Toxic Substances Control (DTSC). Data for the exposure assessment was collected using activity-based sampling, simulating typical CCMA recreational activities and collecting samples from the breathing zone of participants, and the samples were analyzed using transmission electron microscopy (TEM). In addition, as families are frequent visitors to CCMA, the assessment evaluated exposures and risks to children (using adult samplers), as well as adults.

After the exposure data was collected for the various individual activities, the activities were used to calculate risk for seven CCMA use scenarios. The scenarios are designed to reflect the spectrum of activities an individual would participate in during a typical day, weekend, or work year visit to CCMA, e.g., driving in, riding motorcycles, camping, and driving out. The report provides excess lifetime cancer risk estimates for the seven scenarios.

The first five scenarios reflect recreational exposures. The last two scenarios reflect exposures for rangers or other workers.

Major Findings

Exposure Assessment - Most of the asbestos found in the EPA air samples was short fiber (< 5 microns in length) chrysotile asbestos. However, only the fiber size which has been most closely linked to asbestos disease, the longer Phase Contrast Microscopy Equivalent or PCME fibers (> 5 microns long, 0.25 – 3.0 microns wide, ≥ 3:1 aspect ratio) were used in the EPA exposure and risk assessment.

The activity-based sampling showed that activities which disturbed the soil recorded significantly elevated asbestos levels in the breathing zone.

Activity	Mean Concentration (PCME fibers per cubic centimeter)	95% Mean UCL Concentration (PCME fibers per cubic centimeter)
Ambient Air	0.003 f/cc	0.003 f/cc
Motorcycle Riding	0.31 f/cc	0.51 f/cc
ATV Riding	0.32 f/cc	0.61 f/cc
SUV Driving/Riding	0.18 f/cc	0.32 f/cc
Hiking	0.018 f/cc	0.021 f/cc
Overall OHV Riding - Lead	0.07 f/cc	0.10 f/cc
Overall OHV Riding – First Trailing	0.25 f/cc	0.39 f/cc
Overall OHV Riding – Second Trailing	0.56 f/cc	1.08 f/cc

Motorcycle riding, ATV riding, and SUV driving/riding had the highest exposure concentrations, in some cases exceeding even the U.S. Occupational Safety and Health Administration (OSHA) 30-minute Excursion Limit for asbestos. Only hiking was near ambient asbestos concentrations. For Overall OHV Riding, combining motorcycling, ATV driving/riding, and SUV driving/riding, trailing riders had significantly higher exposures than lead riders.

Chrysotile asbestos was the predominant asbestos type found in the air samples, but almost 8% of the PCME asbestos fibers detected belonged to the amphibole asbestos group. When the sampling results were evaluated by the general meteorological conditions of the dates sampling was conducted, “dry”, “moist”, and “wet”, it was observed that asbestos air concentrations were only reduced when it was actively raining. Additionally, comparison of samples collected at the same time by the same individual wearing sampling cassettes set at different heights to simulate adult and child breathing zones, showed that the child exposure concentrations exceeded that of the adult sample approximately 64% of the time.

Risk Characterization – Importing the mean and 95% upper confidence level of the mean (UCL) exposure data into the scenarios, excess lifetime cancer risk was estimated using both the U.S. EPA Integrated Risk Information System (IRIS) and the California EPA Office of

Environmental Health Hazard Assessment (OEHHA) cancer toxicity values for asbestos. Calculations were prepared for 30-year adult exposures, as recommended by the Superfund risk assessment guidance. In addition, 30-year combined child and adult exposures (12 years as a child and then 18 years as an adult) and 12-year child exposures (a population which recreates with families from ages 6 to 18) were also evaluated. Risks were calculated for 1 visit per year, 5 visits per year (Reasonable Maximum Exposure), and 12 visits per year (High Estimate) for the recreational scenarios, and 1 visit per year, 60 visits per year, and 120 visits per year for the worker scenarios. For two of the recreational scenarios, one visit is a two-day or weekend trip to CCMA.

Figure ES-1 below shows estimated Adult Cancer Risk for the seven scenarios using the IRIS unit risk. Figure ES-2 shows the estimated risks for the same scenarios using the California OEHHA toxicity value. The risks are compared to the EPA Superfund program acceptable risk range for exposure to a carcinogen, like asbestos, of 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000) excess lifetime cancer risk. Exposures which are estimated to cause more than 1 in 10,000 excess cancers are considered by EPA to be of concern and may require action to reduce the exposure and resulting risk.

There was no combination of scenario, toxicity value, or visits per year that was below the lower end of EPA's acceptable risk range, i.e. risks less than 1 in 1,000,000. Only Scenario 3 (Day Use Hiking) had risk calculations within the acceptable range. Using the IRIS toxicity value, as shown in Figure ES-1, EPA's risk estimations found that making five or more visits to CCMA per year over a 30-year period to participate in recreational Scenarios 1 (Weekend Rider), 2 (Day Use Rider), 4 (Weekend Hunter), or 5 (Combined Rider/Workday) could put recreational users at an excess lifetime cancer risk above EPA's acceptable risk range of 1x 10^{-4} (1 in 10,000) to 1 in 10^{-6} (1 in 1,000,000). The highest IRIS risk estimations, 2 in 1,000 (2 x 10^{-3}), were based on the 95% UCL exposure concentration for 12 visits per year for recreational Scenario 1 (Weekend Rider) and 120 visits per year for worker Scenario 7 (SUV Patrol).

Using the OEHHA toxicity value, even one visit per year for recreational scenarios 1, 2, 4, and 5, put users above EPA's acceptable risk range. The higher risks reflect the fact that the OEHHA asbestos toxicity value is 8 times larger than the value in IRIS. At the high end of the risk range, excess lifetime cancer risk estimations using the OEHHA toxicity value and the 95% UCL concentration indicate that recreational users riding motorcycles 12 weekends per year could have as much as a 1 in 100 (1 x 10^{-2}) lifetime chance of developing asbestos-related cancer. Worker populations performing SUV patrol duties at CCMA (Scenario 7) for 120 days per year are estimated to have the same risk. It should be noted that neither the IRIS nor OEHHA values are designed for very high exposure levels, so the number calculated for the high-end risk has a higher degree of uncertainty than the numbers calculated for the lower exposure scenarios. However, the risks are still extremely high.

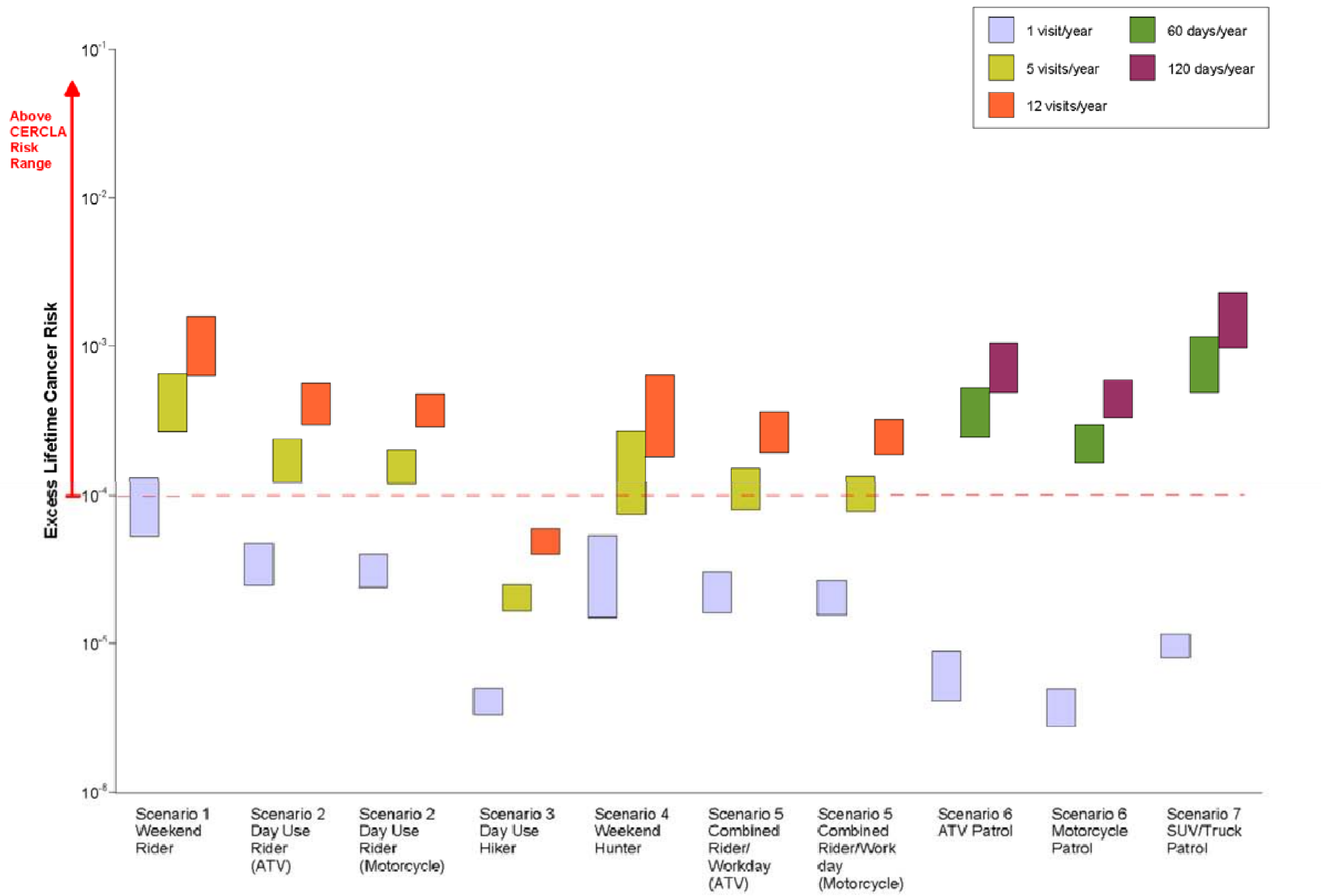

FIGURE ES-1

Adult Cancer Risk, Scenarios 1 – 7 Mean and 95% UCL Exposures Using IRIS Unit Risk

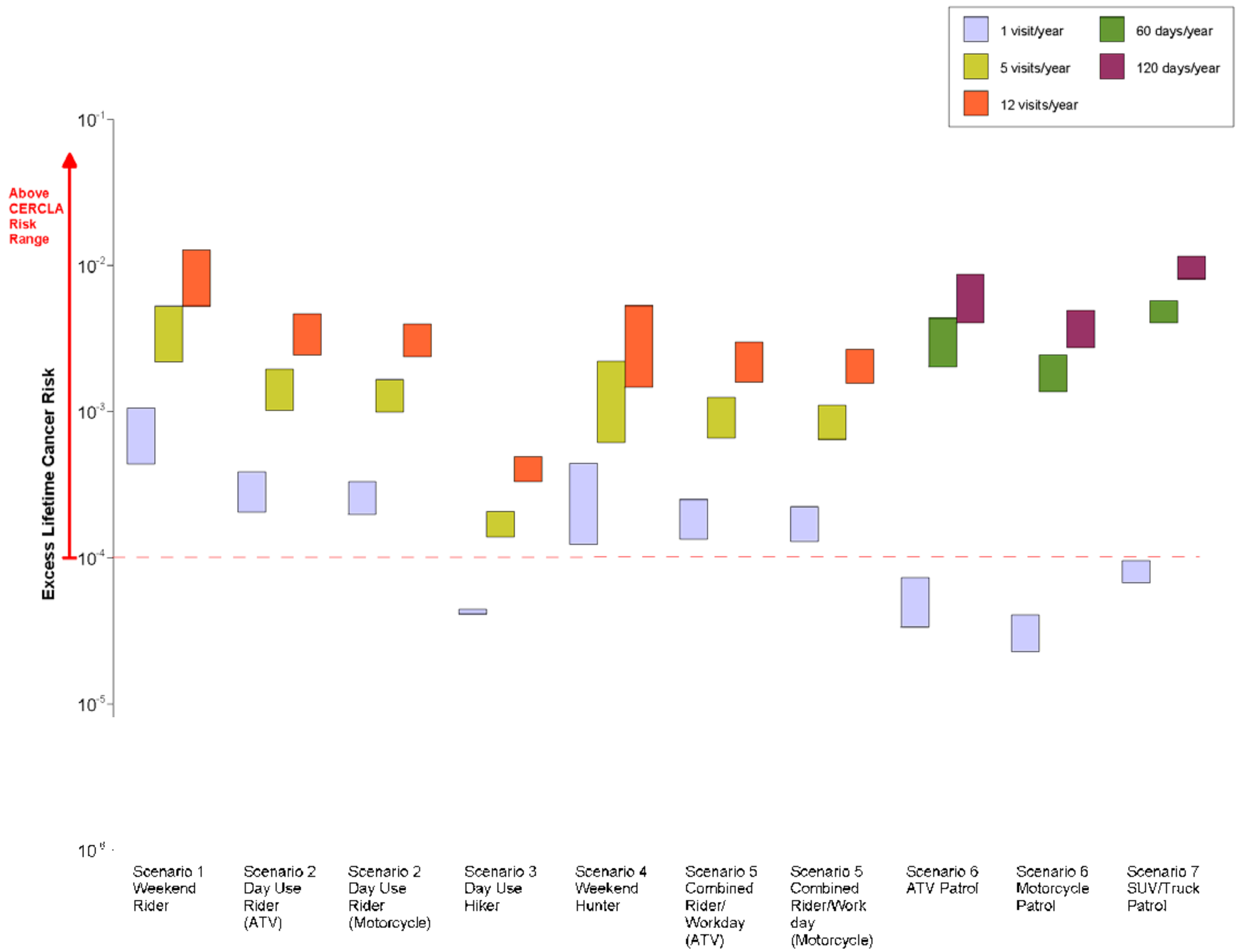

FIGURE ES-2

Adult Cancer Risk, Scenarios 1 – 7 Mean and 95% UCL Exposures Using OEHHA Unit Risk

Exposure and Risk Uncertainties

The assessment of risk as a probability of an outcome always has unknown values that are estimated in health protective ways to ensure that the risks are neither underestimated nor grossly overestimated. The largest uncertainty in the assessment of risk to users of CCMA is that the risk evaluation only assesses excess lifetime cancer risk. It is known that asbestos causes debilitating and fatal diseases other than cancer, such as respiratory and pleural disease. The non-cancer effects are not quantitatively taken into account in the assessment because there is no asbestos toxicity value for non-cancer health effects, even though non-cancer effects could actually be more significant to total disease outcome from CCMA asbestos exposure. Therefore, the general probability of developing disease from exposure related to activities at Clear Creek may be significantly underestimated in the report.

Uncertainties related to the exposure parameters in the CCMA assessment that could cause the estimated risk to be less or greater than the actual risk include: the frequency of exposure and the time actually engaged in dust-generating activities; the effect of the exposures on children; and the representativeness of the areas used for the sampling as accurate models of typical CCMA conditions. One exposure that was not measured, and which could cause the exposure and risk to be higher, is the continued exposure that results when asbestos fibers from CCMA are taken home in vehicles and on equipment.

Uncertainty related to the toxicity parameters of the risk characterization includes the application of the IRIS and OEHHA asbestos toxicity values, which were developed from epidemiological studies of occupational exposures, to infrequent and episodic recreational exposures. This uncertainty could mean that the actual risks could be much lower than those estimated in the CCMA assessment. Another uncertainty, adjustments for early-lifetime childhood exposures, could mean that the actual risks are higher than those estimated in the report.

Conclusions

Asbestos is a known human carcinogen. Despite the uncertainties inherent in risk assessment, the EPA evaluation of asbestos exposures and risks at the Clear Creek Management Area has led to some important conclusions.

- The Activity Causes the Exposure – The concentration of asbestos in the breathing zone is directly related to the degree that an activity disturbs the soil and creates dust.
- Children Are of Special Concern – In a majority of the samples, the concentration of asbestos measured in the child’s breathing zone exceeded the asbestos concentration in the companion adult sample. Further, a child’s life expectancy exceeds the latency period for asbestos-related disease.
- The Higher the Exposure, the Higher the Risk – The activities with the highest exposure - motorcycling, ATV riding, and SUV driving/riding - had the highest corresponding excess lifetime cancer risk.
- Reducing the Exposure Will Reduce the Risk – The risk of developing asbestos-related disease is dependent on the level of exposure, the duration of exposure, and the time

since first exposure. Reducing exposure will reduce the risk of developing asbestos-related cancers and debilitating and potentially fatal non-cancer disease.

In summary, the asbestos exposures that EPA measured at CCMA are high and the resulting health risks are of concern.

1.0 Introduction

The Clear Creek Management Area (CCMA) covers approximately 75,000 acres in San Benito and Fresno counties in central California. It includes part of the New Idria Formation, a serpentinite rock body which contains a 31,000 acre outcrop of naturally occurring asbestos, the largest asbestos deposit in the United States. The U.S. Department of Interior Bureau of Land Management (BLM) has designated the New Idria portion of the CCMA as the Serpentine Area of Critical Environmental Concern (ACEC). Recreational use of the CCMA by hikers, campers, hunters, botanists, rock collectors, and off-highway vehicle (OHV) users disturbs soils of the ACEC, which have high levels of asbestos, creating the potential for asbestos exposure and increased health risk. The BLM is the agency responsible for administering the public lands of the CCMA.

In 1991, EPA signed the Record of Decision (ROD) for the Atlas Asbestos Mine Superfund site, which selected the cleanup remedy for the Atlas Mine, an abandoned asbestos mine located within the CCMA. In the ROD, EPA designated the CCMA as one of four geographic areas that comprise the site, but did not propose a cleanup action for the CCMA. Instead, EPA stated that it would evaluate whether the BLM's plans for management of the CCMA were adequate to protect public health from exposure to asbestos found in the CCMA's soil and air. EPA, California EPA, and other federal, state, and international organizations classify asbestos as a known human carcinogen.

BLM's current management direction for CCMA is contained in the 1984 Hollister Resource Management Plan (RMP) and the Record of Decision (ROD) for the CCMA RMP Amendment and Route Designation (2006). The Hollister RMP was updated in 2007 to re-establish goals, objectives, and management actions for BLM public lands that address current issues, knowledge, and conditions. However, the CCMA was not addressed in that document because EPA was preparing this risk assessment to provide further information on airborne asbestos emissions and the associated health risks from various types of activities in the CCMA.

If the results of the EPA risk assessment were significant, BLM agreed to expeditiously initiate a National Environmental Policy Act (NEPA) review to consider the new information and potential management responses at the CCMA. BLM and EPA agreed that this subsequent NEPA review would address general public access and recreation at the CCMA. Therefore, BLM published the "Notice of Intent to Prepare the CCMA RMP/EIS" on September 6, 2007. The purpose and need for the CCMA RMP/EIS is to incorporate the results of this risk assessment and analyze a full range of alternatives to minimize and reduce the human health risk from exposure to asbestos at CCMA. BLM will complete public scoping for the CCMA RMP/EIS approximately 45 days after the public release of this risk assessment and expects to complete the RMP/EIS process in 2009.

2.0 Goal of the EPA Exposure and Risk Assessment

The goal of EPA's exposure and human health risk assessment is to use current asbestos sampling and analytical techniques to update the 1992 PTI Human Health Risk Assessment (section 6.8) and provide information to BLM on the asbestos exposures from typical CCMA recreational activities and the excess lifetime cancer risks associated with those exposures. This assessment was conducted consistent with U.S. EPA policy and guidance, including the Risk Assessment Guidance for Superfund (RAGS) (EPA/540/1-89/002), and with the encouragement of the California Air Resources Board (CARB) and the California Department of Toxic Substances Control (DTSC). The assessment consists of two parts: 1) an exposure assessment, which measures asbestos levels in air associated with various activities, and 2) a risk characterization, which estimates the excess lifetime cancer risk associated with the exposures. The conceptual site model for the EPA assessment is essentially the same as the model employed in the 1992 PTI HRA and is presented in Appendix A. For the current assessment, representatives of EPA, DTSC, and BLM collaborated to develop an approach for generating a more robust data set on asbestos exposures of recreational users, using a more accurate analytical method, Transmission Electron Microscopy (TEM), to identify asbestos structures. In addition, the assessment evaluates exposures and risks to children, as well as adults.

After the exposure data was collected for the various individual activities (motorcycling, ATV (all-terrain vehicle) riding, SUV (sport utility vehicle) riding, hiking, camping, and vehicle washing and vacuuming, etc.), the activities were used to calculate risk for seven scenarios for risk estimation purposes. The seven scenarios are designed to reflect the spectrum of activities an individual would participate in during a typical day, weekend, or work year visit to CCMA, for example, driving in, riding motorcycles, camping, and driving out. This report presents excess lifetime cancer risk estimates for the seven scenarios. The first five scenarios reflect recreational exposures. The last two scenarios reflect exposures for rangers or other workers.

3.0 Background

The Clear Creek Management Area is a highly mineralized district which has been mined for mercury, asbestos, and gems. Over 300 mining claims have been recorded for the area, and the CCMA is crossed by numerous roads built to extract metals and timber. From the 1850's to the 1970's the area was mined for cinnabar, which was processed to extract liquid mercury. In the early 1960's, three asbestos mines opened in the area. The Atlas Asbestos mine operated from 1963 to 1979; the Coalinga Mine from 1962 to 1977. The KCAC mine, which opened in 1963, was the last remaining active asbestos mine in the United States when it closed in 2002.

The CCMA is generally rugged with steep topography. Elevations range from approximately 2,200 feet to 5,241 feet on San Benito Mountain. The large New Idria serpentinite deposit is the most unique of the CCMA features. Almost 9,000 acres of the CCMA is barren hills due to the highly mineralized nature of serpentinite soils, which are nutrient poor and limit plant growth. Logging in the 19th century and fires in the mid-20th century have also contributed to the barren landscape. The naturally barren areas, the steep terrain, and the many logging and mining roads which traverse the landscape make soil erosion a major problem. OHV use is a contributing factor. Activities which disturb the soil can generate large amounts of dust, and have the potential to release asbestos into the air.

While serpentine soils limit the growth of many plant species, they provide habitat for some unique plants and plant communities adapted to these conditions. There are seven different special status plant species within CCMA. The serpentine deposits within the vicinity of CCMA are the only known habitat for of the San Benito evening primrose, a federally listed threatened plant species. In an effort to preserve and expand the range of the primrose, BLM has built fences and barriers and, in 2007, designated routes and barrens open for OHV use to protect public land resources. Some areas of CCMA are closed to OHV use.

Current multi-use activities at CCMA include hiking, hunting, camping, rock collecting, botanical research, and OHV use. Many weekend visitors include families with children. CCMA averages approximately 35,000 visitors per year, primarily in the cooler, winter months when rainfall tends to reduce dust production. The 242 miles of public trails offer a wide variety of riding opportunities and challenges, and are particularly popular with OHV users from the San Jose/San Francisco metropolitan areas. Also, the Area is the site for several annual motorcycle races, some of which draw national participation.

4.0 Exposure Assessment

4.1 Exposure Assessment Methods

4.1.1 Activity-Based Air Sampling (ABS)

Exposure data for this assessment were collected using activity-based sampling (ABS). Personal breathing zone air samples were obtained by individuals performing typical CCMA recreational activities, such as motorcycling, ATV riding, SUV riding, hiking, camping, and vehicle washing and vacuuming. These activities were identified as typical for CCMA based on discussions with CCMA managers, the enforcement officer, and casual interviews of some CCMA users. Information on activity scenarios and sampling techniques is presented below and in Appendices B and C.

ABS utilizes personal air monitoring, which is a well-established approach that has been used for decades by industrial hygienists for exposure assessment in occupational environments. It is well-suited for environmental asbestos exposure measurements, because it captures the asbestos structures in the personal dust cloud that is generated by activities which disturb asbestos- containing soils. ABS directly measures the asbestos levels in the breathing zone of an individual, making it a more accurate predictor of exposure than static, stationary monitors. ABS is being used by EPA to evaluate asbestos exposure at a variety of sites across the country, and was also used in earlier investigations at the CCMA (BLM, 1992, Cooper & Popendorf, et al 1979, Popendorf & Wenk, 1983). In this study, ABS was primarily used to evaluate recreational activities, because exposures of BLM rangers and employees are governed by the regulations of the federal Occupational Safety and Health Administration (OSHA). The OSHA methods for evaluating asbestos exposure are prescribed by federal regulations, and are different than the EPA methods used in this study. However, at BLM's request, risks were calculated for a BLM employee engaged in typical worker activities, using EPA methods. These calculations are for informational purposes only, and are not intended for regulatory use.

4.1.1.1 Air Collection Methods

ABS sampling was performed by adult EPA contractors with 40-hour hazardous waste training, and/or by members of the U.S. Coast Guard's Pacific/Atlantic Strike Teams, trained in hazardous waste emergency response. Samplers were outfitted in disposable Tyvek suits and wore full or half-face air-purifying respirators equipped with filters, as well as other protective gear (e.g., helmets, boots) depending on the specific hazards associated with each activity.

For all activity-based sampling events, except as noted otherwise, asbestos samples were collected from the breathing zones of the event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual is actually breathing.

Air filter cassettes were mounted on the shoulder strap of a backpack, near the breathing zone of the person conducting the sampling. For many activities, both adult and child exposure samples were simulated by mounting the cassettes at different locations on the shoulder strap to simulate taller adult and shorter child heights (Photo 1). In the case of SUV riding, the child simulation consisted of mounting the air cassette on the back seat of the vehicle, behind the driver.

PHOTO 1

For many sampling events, participants carried two pumps which ran simultaneously, scheduled to turn off after different pumping intervals. The two pumps collected a high-flow or volume and a low-flow or volume sample. The reason for this was to provide a back-up sample in case the longer pumping interval resulted in an overloaded filter that could not be read using the direct analytical method. The most appropriate pumping intervals for each activity were determined during a one-day pilot study in September 2004. More detailed information on sampling pump operation is contained in Appendix C.

4.1.1.2 Activities

Activity-based asbestos sampling was conducted for a variety of activities, most of which are typical for users of the CCMA. Fence building was included, even though it is not a common recreational activity, because users sometimes volunteer to assist BLM in fence building/maintenance activities.

The list of specific activities for which EPA collected activity-based samples is below. For activities which normally have multiple participants, both lead and trailing samples were collected. The (A) designation means that adult simulations were performed and the (C) designation means that child simulations were conducted.

- Motorcycle riding - lead (A/C); trailing (A/C)
- ATV (all-terrain vehicle) riding - lead (A/C); trailing (A/C)
- SUV (sport utility vehicle) riding with windows open - lead (A/C); trailing (A/C)

- SUV riding with windows closed – lead (A/C); trailing (A/C)
- hiking – lead (A/C); trailing(A/C)
- camping (A/C)
- sleeping in tent (A)
- vehicle washing (decontamination activity) (A)
- vehicle vacuuming (decontamination activity) (A)
- fence building (A)

The simulations conducted for each of the above activities are described in Appendix B.

4.1.1.3 Activity Based Sampling (ABS) Schedule

EPA conducted five sampling events during 2004-2005:

- September 15, 2004
- November 2004 (3 days)
- February 11, 2005
- February 20, 2005
- September 2005 (3 days).

The sample events were not always identical in purpose or design, so each event generated a different number of samples of different types. Table 1 summarizes the types of air samples taken during each sampling event.

The September 15, 2004 event was a one-day pilot, intended to test and refine field sampling methods and to gain practical experience with the sampling methods. A major concern was that overloading of air filters with excessive dust and/or asbestos might occur if sample volumes were too high. An overloaded sample cannot be analyzed using the designated TEM protocol. Therefore, the data from September 2004 were used to establish pumping durations appropriate to the field conditions. Even so, dual pumps and filters, set to collect different air volumes, were run concurrently during subsequent sampling events, to ensure a back-up sample in the event of over-loading of the high volume sample.

The November 2004, February 11, 2005, and September 2005 sampling events are the most comparable events in terms of their purpose and design. During these events, a full range of activities was sampled with the intention of obtaining as many samples as practicable. For some activities (motorcycle/ATV/SUV/hiking), numerous factors influenced the number of samples that were actually taken during each event, including weather, safety concerns, and equipment malfunctioning.

The February 20 event was conducted during a national OHV racing event. The CCMA was closed before and after this race, as specified by BLM's Resource Management Plan, due to heavy rains that contribute to erosion.

4.1.1.4 Activity-Based Sampling (ABS) Routes/Locations/Conditions

Activity-based sampling was performed along designated routes or in specific locations, shown in Figure 1. Motorcycle and ATV riders followed different routes during morning and afternoon rides. All other activities used the same routes/locations, regardless of the time of day. More information regarding routes/locations and sampling conditions and durations is included in Appendix B.

4.1.2 Ambient Air Sampling

Stationary samplers were used to collect background/reference samples for all sample events. For CCMA, the background or reference samples were collected to provide information on static air levels in areas where activities were being conducted, but the sampling was conducted such that the activities had no or limited influence on the background/reference asbestos levels. The samples were collected concurrent with ABS. More information is available in Appendix C.

Stationary ambient air samplers were placed in four locations, including two within the Serpentine Area of Critical Environmental Concern (ACEC) (Figure 1) and two outside of the ACEC:

- Staging Area 6 within the ACEC
- Staging Area 2 within the ACEC
- Oak Flat Campground, located less than a mile outside the boundary of the ACEC
- BLM de-contamination facility (Section 8), located approximately 8 miles outside the boundary of the ACEC

Staging Area 6 was the terminus of the SUV activity-based sampling route. Staging Area 2 was the location for the camping activity-based sampling, as well as the trailhead for the hiking activity and is frequently used by recreational visitors to CCMA due to its proximity to the ACEC boundary. While the Oak Flat Campground and the BLM decontamination facility (Section 8) are outside the ACEC boundary, the Oak Flat campground is on the route for visitors entering and leaving the ACEC. Sampling at Section 8 conducted by parties other than EPA has shown significant asbestos contamination.

4.1.3 Air Sampling Blanks and QA/QC

Sampling was conducted in accordance with the Quality Assurance and Quality Control procedures of the TEM analytical method, International Organization for Standardization (ISO) Method 10312 (ISO 10312). All data was documented on field data sheets or within site logbooks. Field blanks were collected at a rate of one per twenty samples or one per sampling event, whichever was greater. Lot blanks were collected at a rate of at least two per lot. Co-located samples were collected at a frequency of approximately 5%.

For the ISO 10312 TEM analysis, the following QC procedures were applied:

1. Lot blanks were examined to determine the background asbestos structure concentration.
2. Field blanks were examined to determine whether there was contamination by extraneous asbestos structures during specimen preparation or handling.
3. Laboratory blanks were examined per ISO 10312 to determine if contamination was being introduced during critical phases of the laboratory analysis.

More information on laboratory QC and on data management related to the CCMA samples is contained in Appendix D.

4.1.4 Meteorological Monitoring

An onsite, portable, 3-meter MetOne meteorological station was deployed at the Oak Flat Campground for each sampling event. Wind speed, wind direction, temperature, humidity and station pressure were recorded on the meteorological station data logger and real-time data was available for review on the station display panel. Meteorological data can be referenced in Appendix E. Because much of the sampling took place over varying terrains, hills and canyons, wind speed and direction data may be of limited use for particular sampling events. Rainfall information for the sampling events was derived from California Department of Water Resources weather stations near the sampling area (Santa Rita Peak (SRI), Idria (IDR), and Hernandez (HDZ)), and is displayed in Figure 2.

4.1.5 Air Sample Analysis

Laboratory analysis was performed to identify and determine asbestos fiber concentrations using Transmission Electron Microscopy (TEM) methodology based on International Organization for Standardization (ISO) Method 10312 (1995(E)), Ambient air – Determination of asbestos fibres – Direct-transfer transmission electron microscopy method, including Annex E with a modification to count diameters of 0.25 microns or greater (See International Programs on Chemical Safety, Environmental Health Criteria #53, Asbestos and Other Natural Mineral Fibers, World Health Organization (WHO) Geneva 1986). Annex E was employed because it is specifically designed for counting asbestos structures of a size classification known as Phase Contrast Microscopy Equivalent (PCME) fibers. The PCME size classification is important to the CCMA exposure and risk assessments because human epidemiological studies, which form the basis of knowledge of asbestos health effects, measured asbestos fiber concentrations using phase contrast microscopy (PCM) analytical methods. PCME is the standard term for fibers counted by more modern analytical methods that are of equivalent size to those fibers that would be seen by PCM analysis, and includes fibers with a length to width aspect ratio of 3 to 1 or greater. The asbestos air exposure concentrations discussed in the exposure assessment and used to calculate the risk assessment estimations are all PCME fiber concentrations, derived using the ISO TEM method.

It should also be noted that PCM analytical techniques cannot distinguish between asbestos fibers and fibers of other minerals and materials which are the same size and shape. TEM analysis is able to specifically identify and count asbestos structures and can further determine the type of asbestos present in the sample.

EPA's samples were analyzed by an analytical laboratory accredited by the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) for Airborne Asbestos Fiber Analysis.

Analysis was performed per ISO 10312, with the following specifications:

1. Counted fiber/structure width was modified from 0.20 microns to 0.25 microns.
2. Annex E was employed to count fibers with a 3:1 aspect ratio and a length >5 microns.
3. Filters were considered to be overloaded when loading exceeded an additional 25% of prescribed levels, instead of 10%.

4. The laboratory was directed to continue counting until at least 50 structures were counted. If the 50 structures were counted in less than 4 grids, the laboratory was directed to go to a lower magnification and report an additional 50 PCME fibers. ISO requires minimum counting of 4 grids.
5. In the event that less than 4 PCME fibers were counted within the set of 50 structures, ASTM statistical procedures were used for reporting, instead of the ISO Poisson requirement.

The specifications were made to assure that the laboratory reported the asbestos structure sizes of health importance, to adapt for analysis of outdoor air samples from a dusty environment, and to assure that the analytical sensitivity was correct for the purposes of the sampling.

4.2 Soil Sampling

Soil/sediment samples were collected and analyzed for moisture by gravimetry, field probe, or the United State Department of Agriculture Natural Resource Conservation Service Estimating Soil Moisture by Feel and Appearance method. Samples were analyzed for asbestos by Polarized Light Microscopy using EPA Asbestos in Bulk Building Materials Method 600/R-93-116 with a reporting limit of 1.00%.

Surface soil samples were collected during activity-based air sampling runs. These soil samples were collected by the same individuals performing the activities. To minimize the time taken to perform soil sampling (thus improving the accuracy of the air exposure calculations), samplers were given discretion as to when and where to sample soil, with the primary goal of sampling from three widely spaced locations along the activity-based sampling route (for motorcycle/ATV/SUV/hiking). Fewer samples were taken from camping and fence-building locations because these activities took place in the same relatively small area. Samplers were asked to select soil that appeared “representative”, using visual cues such as color, texture, and dampness. Samples were collected with aluminum scoops and sufficient soil was collected to fill one 8-ounce jar. Soil sample results are presented in Appendix F.

4.3 Exposure Assessment Results

Important findings and trends of the asbestos exposure data from the samples collected by EPA at CCMA in 2004 and 2005 are presented in graphic form in Figures 3 through 9:

Figure 3: Comparison of Ambient Concentrations and Activities

Figure 4: Comparison of Different Weather Conditions for Adult Receptors

Figure 5: Comparison of Different Weather Conditions for Child Receptors

Figure 6: Comparison of Different Riding Positions for Adults

Figure 7: Comparison of Different Riding Positions for Children

Figure 8: Ratio of Child to Adult Exposure Levels for Each Activity for EachSampling Date

Figure 9: Windows Open vs. Windows Closed Scenarios (September 2005 – All Positions)

Source data for preparation of the Figures is available in Appendix G. All asbestos concentration results are for PCME fibers, defined as fibers greater than 5 microns in length, and 0.25 to 3 microns in width, inclusive, with a 3:1 or greater length to width aspect ratio.

Each individual point on Figures 3, 4, 5, 6, 7, and 9 represents an individual sample result. In addition, the mean and the 95% upper confidence level (95% UCL) of the mean is also shown for the collected samples for each of the activities. The mean is the sum of all the detected asbestos concentrations found in the samples for each activity divided by the number of detected samples. The 95% upper confidence limit of the mean is the level at which, if repeated samples were collected for a particular activity, the actual average value for the asbestos concentration related to that activity would fall below that limit about 95% of the time.

Figures 3, 4, 5, 6, 7, and 9 also show the OSHA 30-minute Excursion Limit for asbestos. According to OSHA regulation, an "...employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty (30) minutes..." OSHA set the excursion limit at this level because it determined that 1 f/cc measured over 30 minutes was "...the lowest feasible short term limit which can be reliably measured for purposes of the OSHA compliance programs..."[1] As was stated previously, the methods for sample collection and analysis used by EPA for this assessment are different than the methods prescribed by OSHA regulation, and the concentrations measured by EPA should not be used to make decisions regarding compliance with OSHA standards. However, as many of the activities measured by EPA, i.e. motorcycling, ATV riding, SUV driving/riding, can reasonably be expected to be conducted for 30 minutes or more during a typical CCMA visit, the OSHA Excursion Limit is shown on the figures for reference purposes.

4.3.1 Activity-Based Air Results

4.3.1.1 Figure 3: Comparison of Ambient Concentration and Activities

In Figure 3, all of the EPA sample results are stacked by activity, regardless of the date the sample was collected, or the position from which the sample was collected (lead vs. trailing, adult vs. child). The ambient or background results (Staging in CCMA mean 0.003 f/cc, 95% UCL 0.003 f/cc) are also shown for comparison purposes. Motorcycle riding (adult mean 0.31 f/cc, 95% UCL 0.51 f/cc), ATV riding (adult mean 0.32 f/cc, 95% UCL 0.61 f/cc), and SUV driving/riding (adult mean 0.18 f/cc, 95% UCL 0.32 f/cc) had the highest exposure concentrations, in some cases exceeding the OSHA Excursion Limit, followed by camping (adult mean 0.09 f/cc, 95% UCL 0.44 f/cc) and vehicle washing (adult mean 0.15 f/cc, 95% UCL 0.37 f/cc). Only hiking (adult mean 0.018 f/cc, 95% UCL 0.021 f/cc) was near ambient asbestos concentrations.

[1] Introduction to 29 CFR Parts 1910 and 1926, Occupational Exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, Section 5 – V. Feasibility of Measuring Excursion Limit [1988].

4.3.1.2 Figure 4: Comparison of Different Weather Conditions for Adult Receptors Figure 5: Comparison of Different Weather Conditions for Child Receptors

Figure 2 shows the rainfall pattern associated with each sampling event, and the effect of the weather conditions on asbestos air concentrations is shown in Figures 4 and 5. The 2004 and 2005 sampling events are stacked together in Figure 4, as they represent sampling under "dry" conditions. ATV riding was not conducted during the September 2004 event, so there are no concentrations presented in Figure 4 for that date. Child measurements were not taken during the September 2004 sampling event, so Figure 5 only includes September 2005 data for the "dry" event. The November 2004 event is designated as "moist". The November sampling was conducted within one week of a two-day rainfall that produced about one inch of precipitation in the CCMA area, and the preceding month of October was very rainy. During the sampling, low-lying areas contained standing water, while elevated areas were nearly dry. The February 2005 sampling event was determined to be "wet", with pouring rain the morning the sampling started, and then intermittent rain during the remainder of the event. Significant runoff was observed during this sampling effort.

Samples were collected under different weather conditions to provide information on whether meteorological effects could be used to manage exposure. Significantly lower concentrations were measured only during the "wet" event. The overall adult mean and 95% UCL for the "wet" event are 0.04 f/cc and 0.08 f/cc, respectively, compared to 0.24 f/cc and 0.40 f/cc for the "dry" event, and 0.29 f/cc and 0.54 f/cc for the "moist" event. The highest hiking concentrations were measured during the "dry" events (adult mean 0.02 f/cc), decreasing to "moist" (0.01 f/cc), and then to "wet" (0.005 f/cc). The levels measured for hiking were significantly lower for all events than those measured for the motorcycling, ATV, and SUV activities.

4.3.1.3 Figure 6: Comparison of Different Riding Positions for Adults Figure 7: Comparison of Different Riding Positions for Children

For activities which normally have multiple participants, EPA collected samples for both lead and trailing positions. The results showed that for motorcycling, ATV driving/riding, and SUV driving/riding, first trailing drivers/riders encountered higher asbestos air concentrations than lead drivers/riders and second trailing driver/riders typically encountered higher levels than first trailing (Overall adult lead mean 0.07 f/cc, 95% UCL 0.10 f/cc; adult first trailing mean 0.25 f/cc, 95% UCL 0.39 f/cc; adult second trailing mean 0.56 f/cc, 95% UCL 1.08 f/cc). Hikers had much lower levels of exposure for both positions and were close to ambient levels.

4.3.1.4 Figure 8: Ratio of Child to Adult Exposure Levels for Each Activity for Each Sampling Date

Figure 8 shows the ratio of the asbestos air concentrations collected by a sample filter placed at child height and the pair sample collected at adult height, for the same participant during the same sampling event, as shown in Photo 1. Ratios below 1 indicate that the child concentration was less than concurrent concentration collected for the adult, while 1 indicates that the sample concentrations were the same, and ratios more than 1 indicate that the child received an airborne asbestos concentration greater than the adult sample at the same time. With the exception of the camping activity, the majority of child exposures exceeded the exposures recorded for the paired adult sample. In the largest differences, the child exposures were almost 7 times those of the adult.

4.3.1.5 Figure 9: Windows Open vs. Windows Closed Scenarios

Figure 9 shows the results for samples which were collected for drivers/riders during the SUV simulations. The activity was conducted with both the SUV windows open, and with the windows closed and the ventilation system set to recirculate the indoor air. The exposures were higher with the windows open and one sample approximated the OSHA 30-minute Excursion Limit. The overall mean for the windows open activity was 0.22 f/cc, while the mean for the closed window activity was 0.14 f/cc. The 95% UCL was 0.40 f/cc and 0.21 f/cc, respectively.

5.0 Risk Characterization

5.1 Risk Estimation Methods

5.1.1 Scenarios

Using the asbestos air exposure data described in Section 4, EPA estimated excess lifetime cancer risks for seven CCMA use scenarios which combine the individual activities of the exposure assessment into typical day, weekend, or work visit experiences. EPA believes that using typical use scenarios for the risk estimations will provide more meaningful information to BLM and the public than presenting risk information for the individual activities in isolation.

Scenarios 1 through 4 were developed by EPA to represent typical recreational experiences. Scenario 5 is a recreational scenario that reflects the exposures of volunteers who assist BLM in fence building activities. Scenarios 6 and 7 were developed by BLM to represent typical worker experiences. DTSC, EPA, and BLM concurred on all the scenarios.

- Scenario 1 Weekend Rider:
  - Drive In (1 hour)
  - Motorcycling on Saturday (6 hours)
  - Camping on Saturday (9 hours)
  - Sleeping (8 hours)
  - Camping on Sunday (3 hours)
  - Motorcycling on Sunday (5 hours)
  - Drive Out (1 hour)
  - Decon Vehicle Wash (0.5 hour)
  - Decon Vehicle Vacuum (0.5 hour)
- Scenario 2 Day Use Rider
  - ATV:
    - Drive In (1 hour)
    - Staging (1 hour)
    - ATV riding (6 hours)
    - Staging (1 hour)
    - Drive Out (1 hour)
    - Decon Vehicle Wash (0.5 hour)
    - Decon Vehicle Vacuum (0.5 hour)
  - Motorcycle:
    - Drive In (1 hour)
    - Staging (1 hour)
    - Motorcycle riding (6 hours)
    - Staging (1 hour)
    - Drive Out (1 hour)
    - Decon Vehicle Wash (0.5 hour)
    - Decon Vehicle Vacuum (0.5 hour)

- Scenario 3 Day Use Hiker:
  Drive In (1 hour)
  Staging (1 hour)
  Hiking (6 hours)
  Staging (0.5 hours)
  Drive Out (1 hour)
- Scenario 4 Weekend Hunter:
  Drive In (1 hour)
  Hiking/Hunting on Saturday (8 hours)
  Camping on Saturday (7 hours)
  Sleeping (8 hours)
  Camping on Sunday (2 hours)
  Hiking/Hunting on Sunday (6 hours)
  Drive Out (1 hour)
  Decon Vehicle Wash (0.5 hour)
  Decon Vehicle Vacuum (0.5 hour)
- Scenario 5 Combined Rider/Workday
  ATV:
  Drive In (1 hour)
  Staging (0.5 hour)
  ATV Riding (3 hours)
  Fence Building/Repair (3 hours)
  Staging (1 hour)
  Drive Out (1 hour)
  Decon Vehicle Wash (0.5 hour)
  Decon Vehicle Vacuum (0.5 hour)

  Motorcycle:
  Drive In (1 hour)
  Staging (0.5 hour)
  Motorcycle Riding (3 hours)
  Fence Building/Repair (3 hours)
  Staging (1 hour)
  Drive Out (1 hour)
  Decon Vehicle Wash (0.5 hour)
  Decon Vehicle Vacuum (0.5 hour)
- Scenario 6 Patrol
  ATV:
  Staging at Section 8 (1 hour)
  Drive In and Stage at CCMA (Lead SUV only) (1 hour)
  ATV Patrolling (Lead rider only) (4 hours)
  Staging and Drive Out (Lead SUV only) (1 hour)
  Decon Vehicle Wash (0.5 hour)
  Decon Vehicle Vacuum (0.5 hour)
  Unpacking at Section 8 (0.5 hour)

  Motorcycle:
  Staging at Section 8 (1 hour)
  Drive In and Stage at CCMA (Lead SUV only) (1 hour)
  Motorcycle Patrolling (Lead rider only) (4 hours)

Staging and Drive Out (Lead SUV only) (1 hour)
Decon Vehicle Wash (0.5 hour)
Decon Vehicle Vacuum (0.5 hour)
Unpacking at Section 8 (0.5 hour)

- Scenario 7 SUV/Truck Patrol: SUV/Truck Patrol (Lead SUV only)(6 hours)
  Decon Vehicle Wash (0.5 hour)
  Decon Vehicle Vacuum (0.5 hour)

5.1.2 EPA and California EPA Toxicity Values

This assessment presents estimated excess lifetime cancer risks using both the EPA Integrated Risk Information System (IRIS) and the California EPA Office of Environmental Health Hazard Assessment (OEHHA) toxicity values for asbestos.[2] Both agencies classify asbestos as a known human carcinogen. The California OEHHA value was included to provide information for interested State agencies and to provide additional information to the public. Both the IRIS and OEHHA toxicity values use similar source data from human occupational studies and rely on the PCME fiber definitions. Similarly, both toxicity values rely on an analysis of many human studies, combining results from different work environments and for different mineral forms of asbestos (e.g. chrysotile and amosite). Excess lung cancer and mesothelioma were considered by both agencies. The IRIS toxicity value is based on the central tendency of the combined risk estimate for both lung cancer and mesothelioma in a general population (men and women, regardless of smoking status). The IRIS value does not provide an upper bound toxicity value. The OEHHA toxicity value is based on an estimate of upper bound risk, but is derived only from the cancer with the greater risk estimate (mesothelioma), in a segment of the population with the greatest risk for this disease (non-smoking women). As such, these two toxicity values cannot be directly compared, but together can be used to bracket site specific risk estimates.

The OEHHA toxicity value for asbestos is eight times larger than the value in IRIS (OEHHA is 1.9 per fibers/cc vs. IRIS 0.23 per fibers/cc), calculating excess lifetime cancer risk from a continuous exposure. In addition to presenting an upper bound risk estimate, the OEHHA toxicity value is also greater due to the mathematical function used in both models to describe mesothelioma risk with increasing age. The risk calculation for non-smoking females is greater than other sub-populations because non-smoking females live longer and therefore have more years over which to develop mesothelioma. Therefore, the OEHHA risk estimate is a more conservative estimate. Risk levels are presented using both values to provide both central tendency and upper bound risk estimates. There are uncertainties inherent in both risk estimates, which are discussed below.

There is currently no asbestos toxicity value available for non-cancer effects, and non-cancer risks were therefore not addressed in this assessment. It should be noted that epidemiological studies indicate that non-cancer health effects from exposure to asbestos,

[2] EPA IRIS website: http://cfpub.epa.gov/ncea/iris/index.cfm. California EPA website: http://www.arb.ca.gov/toxics/id/summary/summary.htm.

e.g. respiratory and pleural disease, can be significant and in some studies exceed the cancer risks.[3]

5.1.3 Adult, Child, and Child/Adult Estimations

Excess lifetime cancer risks were estimated for adults for all seven scenarios, assuming 30 years of visits to CCMA. In addition, for scenarios 1 – 4, the child asbestos exposure concentrations were used to estimate excess lifetime cancer for children who visit CCMA with their families for 12 years, beginning at age 6, and for a child/adult who visits for 12 years and then continues to recreate at CCMA for an additional 18 years as an adult (30 years total exposure – ages 6 to 36). The additional 18 year exposure uses the adult asbestos exposure concentrations, assuming that adult height and samples are most appropriate. Use of the 30-year total duration for recreational exposures is described in RAGS Supplemental Guidance, Standard Default Exposure Factors (1991) (OSWER Directive: 9285.6-03).

5.1.4 CCMA Use Frequency

The EPA RAGS guidance recommends that risks be calculated using the reasonable maximum exposure (RME) that is expected to occur at a site under both current and future land-use conditions. Based on national recreational survey data and statements made by CCMA users, the 1992 PTI HRA estimated an RME for the Clear Creek Area of 5 off-road vehicle rides of approximately 5.4 hours in duration per year. Some users indicated that they rode for longer periods and more frequently, so PTI also used a "high estimate" of 12 off-road rides per year. To provide a range of exposures and to facilitate the evaluation of different use patterns, 1 ride per year was additionally incorporated into the PTI risk assessment.

This EPA assessment adopts the 1992 PTI HRA exposure estimates and calculates risk for the various age groups and for the recreational scenarios (Scenarios 1 – 5) of 1 visit, 5 visits (RME), and 12 visits (High Estimate) per year. For the one-day scenarios (Scenarios 2, 3, and 5), the exposures translate to 1, 5, and 12 days per year. For the weekend scenarios (Scenarios 1 and 4), the exposures are estimated for 1, 5, and 12 weekend visits per year.

At the request of BLM, risk estimations for the worker scenarios, Scenarios 6 and 7, were conducted for 1-day per year exposure, a RME of 60 days per year exposure, and a High Estimate of 120 days per year exposure.

5.2 Risk Calculation

Cancer risk from asbestos is a function of exposure concentration, duration of exposure, and time from first exposure. Both the IRIS and OEHHA toxicity values are based on estimates of continuous lifetime exposure. Therefore the less-than-lifetime exposures used in this assessment must be converted to continuous lifetime exposures. For this assessment, excess lifetime cancer risks were calculated using the standard EPA Superfund risk equation as described in RAGS and presented in the 1992 PTI HRA:

$$ELCR = EC \times IUR$$

[3] Rohs, A.M. et al. "Low-Level Fiber-Induced Radiographic Changes Caused by Libby Vermiculite, A 25-Year Follow-up Study." American Journal of Respiratory Critical Care Medicine, Vol 177, pp 630-637, 2008.

Where,

ELCR = Excess Lifetime Cancer Risk

EC = Chronic Daily Exposure Concentration (fibers per cubic centimeter of air [f/cc] averaged over a 70-year lifetime)

IUR = IRIS Inhalation Unit Risk factor for inhalation of asbestos [0.23 per (f/cc)] or OEHHA Inhalation Unit Risk factor for asbestos [1.9 per (f/cc)]

Where excess cancer risk is considered proportional to cumulative exposure (concentration x time), the calculation of EC for episodic exposure does not impact the calculated life-time cancer risk. As discussed above, the asbestos value in IRIS is the result of a combination of lung cancer and mesothelioma health outcomes. Although the risk model for lung cancer is proportional to cumulative exposure, the model for mesothelioma includes the additional influence of time since first exposure. Therefore less-than-lifetime early-lifetime exposure may be underestimated due to the additional influence of time since first exposure on estimated lifetime mesothelioma risk. This is further discussed in Risk Uncertainty section 7.2 Toxicity Parameters. Calculations are performed to estimate the impact of the time after exposure parameter on risk estimates to demonstrate the uncertainty in applying the above risk equations to less-than-lifetime early-lifetime exposures. Since the OEHHA toxicity value is also based on mesothelioma risk, similar uncertainties should be considered in interpreting risk estimates from the OEHHA value as well.

5.2.1 Chronic Daily Exposure Concentration (EC)

To derive the Chronic Daily Exposure Concentration, the EC in the equation above, this risk assessment uses the standard EPA risk assessment asbestos inhalation exposure algorithm:

$$EC = \frac{C_a \times ET \times EF \times ED}{AT}$$

Where,

EC = Chronic Daily Exposure Concentration (fibers per cubic centimeter of air [f/cc] averaged over a 70-year lifetime)

C_a = Asbestos Concentration in fibers per cubic centimeter (f/cc)

ET = Exposure Time in hours/day

EF = Exposure Frequency in days/year

ED = Exposure Duration in years

AT = Averaging Time of 24 hours/day x 365 days/year x 70 years (lifetime)

5.2.1.1 Asbestos Concentration (C_a)

The PCME asbestos concentration data from activities measured in the exposure assessment were used to derive the C_a for the risk assessment equations. As recommended by RAGS and consistent with the 1992 PTI HRA, risks were calculated using the asbestos air concentration for each activity using the mean concentration, to represent a central tendency of the population exposed, and the 95% UCL of the mean concentration to represent a health protective concentration for all the samples analyzed for that activity. The 95% UCL and the mean for all the activities are shown in Table 2. The calculations to derive the UCL and mean values are available in Appendix G.

5.2.1.2 Exposure Time, Frequency, and Duration (ET, EF, and ED)

Exposure Time (ET) values were generated for each activity as needed for input into Scenarios 1 – 7, given the time allocation for each activity in each scenario. As discussed in Section 5.1.4, Exposure Frequency (EF) values for Scenarios 2, 3, and 5 were set at 1, 5, and 12 days per year and at 1, 5, and 12 weekend visits per year for Scenarios 1 and 4. EF values for worker Scenarios 6 and 7 were set at 1, 60, and 120 days per year. The Exposure Duration (ED) was set at 30-years for the Adult and Child/Adult (12 years child + 18 years adult) calculations, consistent with the recreational exposure determination in the RAGS Supplemental Guidance. The ED for the Child exposure was 12 years.

5.3 Risk Estimations

It is important to note that this risk assessment presents quantitative estimates of excess cancer risk over a lifetime based on the defined exposure scenarios. The scenarios have been designed to represent current and future exposures for recreational users of CCMA. The risk estimates are for an individual within a population and do not predict actual health outcomes.

Excess lifetime cancer risks were estimated for Scenarios 1 through 7 for Adult exposures and for Scenarios 1 through 4 for Adult/Child and Child exposures, using both the IRIS and OEHHA toxicity values and the mean and 95% UCL of the mean asbestos exposure concentrations measured by EPA. Each age range and scenario therefore has twelve calculated risk numbers which can be used to bracket the range of potential Excess Lifetime Cancer Risks.

The EPA Superfund program defines the acceptable risk range for exposure to a carcinogen, like asbestos, as 1 in 10,000 (10^{-4}) to 1 in 1,000,000 (10^{-6}) excess lifetime cancer risk.[4] Exposures which are calculated to cause more than 1 in 10,000 excess cancers are considered to be of concern and may require action to reduce the exposure and resulting risk.

Appendix G contains the risk calculation results for each of the scenarios by age using both IRIS and OEHHA toxicity value. The results are summarized in Tables 3 through 5. For comparison, Table 6 summarizes the cancer risk for an adult population with 30 years of exposure to ambient air at CCMA.

Table 3: Summary of Excess Cancer Risk Ranges for Adults for Scenarios 1 through 7

Table 4: Summary of Excess Cancer Risk Ranges for Child/Adult for Scenarios 1 through 4

Table 5: Summary of Excess Cancer Risk Ranges for Children for Scenarios 1 through 4

Table 6: Summary of Excess Cancer Risk Ranges for Adult 30-Year Exposure to CCMA Ambient Air

[4] 40 CFR Part 300, National Oil and Hazardous Substances Pollution Contingency Plan, section 430(e)(2)(i)(A)(2), "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response..."

5.3.1 Table 3: Summary of Excess Cancer Risk Ranges for Adults for Scenarios 1 through 7

There was no combination of scenario, toxicity value, or visits per year that was below the lower end of EPA's acceptable risk range, i.e. risks less than 1 in 1,000,000. When the 95% UCL of the mean concentration was used with the IRIS toxicity value, EPA calculations estimated that making five or more visits to CCMA per year for the 30 year recreation period to participate in recreational Scenarios 1 (Weekend Rider), 2 (Day Use Rider), 4 (Weekend Hunter), or 5 (Combined Rider/Workday) could put adult recreational users at an excess lifetime cancer risk above EPA's acceptable risk range of 1 in 10,000 (10^{-4}) to 1 in 1,000,000 (10^{-6}). Only Scenario 3 (Day Use Hiking) had risk estimations within the acceptable range. The highest IRIS risk estimations, 2 in 1,000 (2×10^{-3}), were calculated using the 95% UCL exposure concentration for 12 visits per year for recreational Scenario 1 and 120 visits per year for worker Scenario 7 (SUV Patrol).

Using the OEHHA toxicity value, even one visit per year for recreational scenarios 1, 2, 4, and 5, put users above the acceptable risk range. The OEHHA risk estimates are greater than those predicted with the IRIS toxicity value because the OEHHA asbestos toxicity value is 8 times larger. At the high end of the risk range, excess lifetime cancer risk estimations using the OEHHA value and the 95% UCL concentration indicate that recreational users riding motorcycles 12 weekends per year, and workers performing SUV patrol duties at CCMA (Scenario 7) for 120 days per year during a 30-year career, are estimated to have a lifetime excess cancer risk of 1 in 100 (1×10^{-2}). It should be noted that neither the IRIS nor OEHHA models are designed for very high exposure levels, so the number calculated for the high-end risk has a higher degree of uncertainty than the numbers calculated for the lower exposure scenarios. However, the risks are still extremely high.

5.3.2 Table 4: Summary of Excess Cancer Risk Ranges for Child/Adult for Scenarios 1 through 4

For most of the risk estimates that assume a 30-year exposure beginning at age 6, more than 5 visits per year puts the excess lifetime cancer risk above EPA's acceptable risk range of 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) using the IRIS risk model. Using the OEHHA model, even 1 visit per year was above the acceptable risk range. The highest estimated excess cancer risk was for weekend riders (Scenario 1) who visit 12 weekends a year. Use of the OEHHA toxicity value and the 95% UCL concentration for asbestos puts the excess lifetime cancer risk for the 12 visit High Estimate weekend rider population at 1 in 100 ($1x10^{-2}$).

5.3.3 Table 5: Summary of Excess Cancer Risk Ranges for Children (Ages 6 to 18) for Scenarios 1 through 4

For scenarios 1 and 2 and using the IRIS toxicity value, more than five visits per year for the 12 year period put the user population above the acceptable risk range. Scenario 3, Day Use Hiker, was within the range even at 12 visits per year, and Scenario 4, Weekend Hunter was in the range up to 12 visits per year. However, when the OEHHA value was used, all the activities beyond one visit per year for day use hiking (Scenario 3) or weekend hunting (Scenario 4) were above the acceptable risk range. Overall, day hiking was the lowest risk activity for children (range of 1 day IRIS mean of 3 x 10^{-6} to 12 day OEHHA 95% UCL of 6 x 10^{-4}) and weekend motorcycle riding was associated with the greatest excess lifetime cancer risk (range of 1 day IRIS mean of 2 x 10^{-5} to 12 day OEHHA 95% UCL of 5 x 10^{-3}).

5.3.4 Table 6: Summary of Excess Cancer Risk Ranges for Adult 30-Year Exposure to CCMA Ambient Air

As Table 6 summarizes, the excess lifetime cancer risk associated with 30-years of visits to CCMA with exposure only to ambient air asbestos concentrations is either below or within the acceptable EPA risk range. The lowest risk of 2 in 10,000,000 (2 x 10^{-7}) excess cancers was calculated using the IRIS toxicity value, the mean asbestos air concentration for Staging at Section 8, and 1 visit per year. The highest estimated risk was 1 in 10,000 (1 x 10^{-4}) for 12 visits per year to the Oak Flat campground using the OEHHA toxicity value and the 95% UCL concentration for asbestos.

6.0 Major Findings

6.1 The Activity Drives the Exposure and the Risk

Activities at CCMA which cause the most soil disturbance and dust generation also result in the highest exposures to asbestos structures. Asbestos levels measured for ATV riding, motorcycling, SUV driving/riding, vehicle washing, and camping were elevated over those measured for fence building, vehicle vacuuming, and hiking. This relationship was true for both adult and child measurements. Measured ambient levels, even though they were collected near the activities, were significantly lower. (See section 4.3.1.1, Figure 3, and Appendix G).

6.2 Position is Important

Trailing riders participating in motorcycling, ATV riding, and SUV driving/riding had generally higher exposures than the lead individuals participating in the same activities. This is because trailing riders encounter the dust clouds generated by the previous riders. This relationship was true for both adult and child measurements. (See section 4.3.1.3, Figures 6 and 7, and Appendix G).

6.3 Children are of Special Concern

Families with children are frequent users of the CCMA. The children are generally passengers in SUVs and often ride their own off-highway vehicles. Risk of adverse health effects to children are of particular concern in part due to the higher exposure measurements for their activities. The asbestos exposures measured by EPA for children were generally higher than those exposures measured for adults during the same activity. This may be because a child's breathing zone and smaller vehicles are closer to the ground. In addition, children often follow adult riders and are therefore exposed not only to their own dust plume, but also to the dust plume generated by the leading vehicle. For example, the mean for adult motorcyclist riding in "moist" conditions was 0.24 f/cc, and the child motorcycle mean was 0.38 f/cc, while the adult mean for first trailing riders in "moist" conditions was 0.35 f/cc and the child mean was 0.66 f/cc. (See section 4.3.1.4, Figure 8, and Appendix G). Therefore, even when applying the standard toxicity values for cancer risk based on cumulative exposure, children have greater risk than adults due to higher exposure measurements.

Children are also of special concern because their exposures occur earlier in their lives. As discussed above, the risk models for mesothelioma include a time function, so early-lifetime exposures contribute more to lifetime risk than exposures later in life. Therefore, a 30-year exposure beginning at age 6 is expected to have greater risk than the same exposure (concentration, frequency, and duration) occurring later in life. Section 7.2.4 further defines the uncertainties with early-lifetime exposures. It should be noted these calculations only reflect increased risk from the mathematical form of the mesothelioma risk model. Other potential sources for increased susceptibility for early-life exposures based on physiological differences, scaling, developmental stage, lung architecture, or mode of action are not addressed.

6.4 SUV Exposures were Significant

Activities which simulated driving a SUV into CCMA to access recreational opportunities measured significant asbestos exposures. While closing the windows did lower measured exposures, the exposure reduction was not considered significant to overall risk (windows open mean 0.22 f/cc, 95% UCL 0.40 f/cc; windows closed mean 0.14 f/cc, 95% UCL 0.21 f/cc). Vehicles which frequent CCMA may retain asbestos structures in carpets, upholstery, and ventilation systems and contribute to additional exposures that are not accounted for in this evaluation. The levels measured by EPA may therefore underestimate the exposures of frequent visitors. (See section 4.3.1.5, Figure 9, and Appendix G).

6.5 Amphibole Asbestos was Detected in the EPA Air Samples

While chrysotile asbestos was the predominant asbestos mineral type found in the air samples EPA collected at CCMA, amphibole asbestos structures were also detected. Almost 8% of the PCME fibers measured by EPA were tremolite asbestos, actinolite, or another amphibole asbestos mineral. More information on the mineral compositions found in the samples is available in Appendix H. Because the air samples were collected during activities that covered large geographic areas, the mineral compositions in the air samples are probably more representative of the CCMA mineral mix than soil samples collected from discrete locations or from CCMA mines. Both the IRIS and OEHHA cancer risk models for asbestos were derived from worker studies involving both chrysotile and amphibole exposures. As a result, both IRIS's and OEHHA's toxicity values are applied to both chrysotile and amphibole asbestos. There is an emerging consensus in the scientific and medical communities that amphiboles may present a greater health risk, especially for mesothelioma, and perhaps for pleural anomalies.[5] As the majority of exposures at CCMA involve chrysotile mineral fibers, there is no need to adjust the risk estimates for the presence of amphibole fibers, as both the IRIS and OEHHA toxicity values would be considered protective for this mixed mineral fiber exposure.

6.6 Wet Weather Reduces but Does Not Eliminate Exposure

The September 2004 and September 2005 sampling events were conducted under dry conditions. The November 2004 event was conducted within one week of a two day rainfall event that produced about one inch of precipitation in the CCMA area, and the preceding month of October was very rainy. During the sampling, low-lying areas contained standing water, while elevated areas were nearly dry. The February 20, 2005 sampling event was wet, with pouring rain the morning the sampling started and then intermittent rain during the remainder of the data collection. The weather was such that the race event ended earlier than originally planned.

The asbestos concentrations in the air samples collected during the February 20, 2005 sampling event were significantly lower than those of samples collected during the dry

[5] ATSDR (2001). Chemical-Specific Health Consultation: Tremolite Asbestos and Other Related Types of Asbestos. http://www.atsdr.cdc.gov/asbestos/more_about_asbestos/health_consultation/

September events and the moist November sampling ("wet" event adult mean 0.04 f/cc, 95% UCL 0.08 f/cc; "dry" event adult mean 0.24 f/cc, 95% UCL 0.40 f/cc; "moist" event adult mean 0.29 f/cc, 95% UCL 0.54 f/cc). In many instances, the concentrations in the samples from the November event were actually higher than those measured in the September events, leading to a higher overall mean and 95% UCL for the "moist" event. Based on the EPA sampling, it appears that only active rainfall reduces asbestos air concentrations, but further study would be necessary to define the exact conditions necessary to reduce dust generation. (See section 4.3.1.2, Figures 4 and 5, and Appendix G).

6.7 Many Activities are Above the EPA Acceptable Risk Range

As detailed in sections 5.3.1 through 5.3.3 and Tables 3 through 5, the exposures measured by EPA for many CCMA activities are above the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6} (1 in 10,000 to 1 in 1,000,000) excess lifetime cancers. The exceedences are related to the dust generating ability of the activity, the location of the exposed population (horizontally trailing or vertically lower child), and whether the mean or 95% UCL asbestos air concentration values were used in the IRIS or OEHHA risk estimations. The following Figures summarize the risk ranges for the combined scenarios:

Figure 10: Adult Cancer Risk, Scenarios 1 – 7: Mean and 95% UCL Exposures Using IRIS Unit Risk

Figure 11: Adult Cancer Risk, Scenarios 1 – 7: Mean and 95% UCL Exposures Using OEHHA Unit Risk

Figure 12: Child/Adult Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using IRIS Unit Risk

Figure 13: Child/Adult Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using OEHHA Unit Risk

Figure 14: Child Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using IRIS Unit Risk

Figure 15: Child Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using OEHHA Unit Risk

6.8 EPA Results are Qualitatively Consistent with Earlier Investigations, but Vary Quantitatively

During March through June 1979, researchers from the University of California, Berkeley, conducted measurements of dustfall, soil moisture, rainfall, and airborne asbestos related to activities at CCMA.[6] Dustfall samples were collected at five points along the Clear Creek county road and results showed that the amount of dust collected was closely correlated with vehicular activity. Personal air monitors were worn by motorcyclists and rangers and additional air samples were collected at campsites. Samples were analyzed by phase

[6] W.C. Cooper, J. Murchio, W. Popendorf, and H.R. Wenk, "Chrysotile Asbestos in a California Recreational Area", Science, Vol. 206, 9 November 1979 and W. Popendorf and H.R. Wenk, "Chrysotile Asbestos in a Vehicular Recreation Area: A Case Study" in 1983, Environmental Effects of Off-Road Vehicles: Impacts and Management in Arid Regions, R.H. Webb and H.G. Wilshire (eds), Springer Verlag, New York.

contrast microscopy (PCM). Mean asbestos concentrations for the riders ranged from 0.13 fibers/cc to 5.4 fibers/cc and the exposure concentrations for the first rider were lower than for following riders (mean of the EPA TEM-analyzed samples for all motorcycle riders, regardless of position, is 0.31 PCME fibers/cc). Analysis of the campsite samples showed that concentrations increased by an order of magnitude (0.05 fibers/cc v 0.5 fibers/cc) when vehicles were active (mean of EPA samples from staging areas inside CCMA was 0.003 PCME fibers/cc by TEM). Chrysotile was the predominant asbestos structure found in all the air and dust samples.

From November 1988 to April 1991, activity-based samples were collected by BLM personnel while they performed normal duties at CCMA and during sample runs which simulated motorcycle and ATV recreation. The samples were analyzed by PCM microscopy and formed the basis for the PTI Environmental Services "Human Health Risk Assessment for the Clear Creek Management Area" (1992 PTI HRA) which was prepared under contract with BLM. The data indicated that activities which disturbed soil resulted in asbestos air concentrations significantly higher than those measured in ambient air. Motorcycle riding, riding in an open SUV, and riding in a closed SUV produced significantly higher levels than those for ATV riding, and concentrations for lead riders participating in motorcycle and ATV activities were significantly lower than those for mid and tail riders. The results of the 1992 PTI HRA suggest that combined activities, including off-road vehicle riding for more than 9 days per year on average, could lead to unacceptable risk from asbestos exposure.

Quantitatively, the 95% UCL asbestos concentrations generated from the BLM samples were lower than the UCL concentrations generated from the EPA samples and the risk numbers calculated by PTI were therefore lower than those calculated in this risk assessment. The PTI report aggregated the BLM samples into an Off-Road Riding Scenario and an Other Activities Scenario. The 95% UCL for the Off-Road Scenario was 0.07 fibers/cc and for the Other Activities Scenario it was 0.04 fibers/cc. By comparison, the 95% UCLs for PCME fibers in the EPA samples by activity are: ATV riding 0.61 f/cc, motorcycle riding 0.51 f/cc, camping, 0.44 f/cc, vehicle washing 0.37 f/cc, SUV driving/riding 0.32 f/cc, fence building 0.11 f/cc, vacuuming 0.07 f/cc, hiking 0.02 f/cc, staging at Oak Flat 0.012 f/cc, staging at Section 8 0.003 f/cc, and staging in CCMA 0.003 f/cc. PTI reanalysis of some of the BLM samples by TEM found that the PCM analytical results were generally 2.5 times lower than the concentrations in the same sample analyzed by TEM, but the variation between the PTI and EPA sample measurements is significantly greater.

Some of the difference in the BLM and EPA sample results is probably attributable to the differences in the PCM and TEM analytical methods and the rules that each method employs for counting asbestos structures. PCM uses an optical microscope which magnifies the sample approximately 450 times. TEM uses an electron microscope that can magnify the sample 10,000 to 20,000 times or more. The greater magnification means that the TEM method can see asbestos structures much thinner than the 0.25 micron diameter visible by PCM and can see structures more clearly on a filter from a dusty environment. TEM can also determine whether a structure seen on the filter is actually asbestos and what type. In addition, the counting rules for PCM and TEM are different. The ISO 10312 TEM method has stringent counting rules that state, for example, that individual discernable fibers which are part of an attached group be counted individually, whereas the PCM methods would count the group as one structure. So, even when the results of TEM analysis are sorted for the PCME fiber size criteria, TEM may report more fibers. Hwang et al compared analytical methods and reported a correlation coefficient between direct TEM methods and PCM methods of 0.87 with values 3 to 15 times higher for TEM.[7]

[7] Hwang, C-Y and Wang, Z.M, ***Comparison of Methods of Assessing Asbestos Fiber Concentrations***, Archives of Environmental Health, Vol 38, 5-10, 1983

7.0 Risk Uncertainties

Evaluation of chemical risk involves the determination of the extent of exposure to the chemical of concern and the toxicity or dose-response of the organism to the chemical. All risk assessments have some level of uncertainty associated with them. EPA strives to conduct risk assessments that are neither underestimated nor grossly overestimated. However, because our mission is to protect public health and the environment, EPA tries to insure that the public is protected by not underestimating risk. In our risk characterization, we work to identify areas of uncertainty and, if possible, determine their potential impact on our risk estimates. Risk managers use the risk assessment and an understanding of the associated areas of uncertainty to make informed decisions to manage the risk. This section will attempt to present the major uncertainties inherent in the assessment of exposure to asbestos at CCMA and the resulting estimate of risk.

7.1 Exposure Parameters

Exposure to airborne asbestos at CCMA is associated with various recreational activities which cause fibers to be released from the soil, gravel, and rock. The magnitude of the exposure is dependent on the amount of dust generated by the specific activities, the asbestos content of the dust, the duration of the activities, their frequency over time, and, potentially, the amount of asbestos that is tracked out of the CCMA on clothes and equipment that could contribute to future exposures outside of the area.

7.1.1 Exposure Time and Frequency

Reasonable Maximum Exposure (RME) and High Estimate exposure estimates were calculated by considering daily exposure (hours per day), and yearly exposure (number of days per year). These two exposure assumptions are designed to allow for evaluation of a reasonable usage case, and a "high-end", yet still realistic, usage case. The effect of these exposure assumptions is directly proportional to the time engaged in the activities. For example, if an individual's exposure time were twice the assumed daily exposure or twice the assumed days per year, the resulting total exposure would be two times of that calculated. The uncertainty in using these exposure assumptions is that certain users may have activity patterns that vary from these assumptions. Most concerning, with respect to the uncertainty around these assumptions, are variations that exceed the "high-end" assumption.

7.1.2 Exposures of Children

Families with children are frequent users of the CCMA. The children are typically passengers in SUVs and often ride their own off highway vehicles. A child's exposure will differ from that of an adult for two reasons. First, as the EPA exposure data indicates, children are likely to be exposed to greater concentrations of airborne asbestos than adults, because their breathing zones are closer to the ground due to their shorter height and smaller vehicles. Second, children often follow adult riders and are, therefore, exposed to the dust plume generated by the leading vehicle, as well as their own plume.

To better estimate potential exposures for children, two sets of monitors were placed on the adults collecting the air samples (Photo 1). One monitor was placed near the breathing zone of the sampler, simulating adult exposure, while the second monitor was placed about 8-12 inches lower to simulate a child's exposure. For the SUV scenario, the child monitor was located on the back seat, rather than on the adult driver. While this approach did not exactly mimic the breathing zone of all potential child users of the CCMA, it provided an estimate of how exposure concentrations could differ with height above the ground. For specific child users the estimates of child exposure may overestimate or underestimate actual exposure. Most concerning is that exposures of small children younger than 6 years old, whose breathing zone might be still closer to the ground, were not measured. However, the site conceptual model did not include younger children or activities such as digging/playing in soils while camping, picnicking, or waiting/observing during staging.

7.1.3 Spatial Distribution

The level of exposure to asbestos dust during activities at CCMA will depend to some extent on the actual concentration of asbestos in the soil at the location of the activity. The activity sampling area in this study was selected due to its proximity to the most heavily used access to the CCMA. This access is the county road alongside Clear Creek which has "staging areas", specifically designed to provide a convenient access to off-highway routes and a camping spots. Since the CCMA may be accessed from other locations, which may have different asbestos concentrations, these exposure levels may either over- or underestimate exposures for users of other areas. However, exposures were calculated from an average of samples collected during activities that occurred over large areas and the potential that this is a significant area of uncertainty is relatively small.

7.1.4 Take-Home Exposures

The exposure times evaluated in this study were those directly associated with the activities and time spent at the CCMA. As asbestos can adhere to clothes and the interior and exterior of vehicles, fibers may be tracked out, resulting in future exposures outside the CCMA, and to CCMA-user's families and communities. The extent of this additional exposure is unknown and is not accounted for in this evaluation. The off-site exposure could increase the risk, proportional to the time of exposure and the concentration of asbestos tracked off-site.

7.2 Toxicity Parameters

7.2.1 Episodic Exposures

There is uncertainty in using dose-response data derived from occupational studies to predict risk for recreational exposure scenarios. Occupational studies typically consisted of examining exposure to relatively high concentrations of asbestos over relatively extended periods, namely 8 hour work days, 5 days per week, for weeks to years i.e. 5 years.[8] While the asbestos exposures at Clear Creek may be significantly elevated, the type of recreational activity that takes place at CCMA is likely to be less frequent than the occupational exposures that were used to derive the toxicity values of both IRIS and OEHHA. Because

[8] Hodgson JT, Darnton A. ***The quantitative risks of mesothelioma and lung cancer in relation to asbestos exposure***. Ann Occupational Hygiene 2000; 44:565-601.

there is no clear mode of action for asbestos induced disease and no threshold for health effects, using a direct time-weighted extrapolation from the longer, chronic occupational exposures to shorter-term, episodic exposures may underestimate or overestimate the risk. The risks could be much lower because the exposures may be too infrequent or the total retained fiber burden too few to initiate the asbestos disease process.

As previously stated, there are several dissimilarities between the exposures evaluated in this study and those used to develop EPA's IRIS risk factor. The occupational exposures were in work environments to commercial asbestos products which were mined and processed for fibrous habit, not to naturally occurring asbestos that exists in various forms and weathering states and was disturbed by recreational activities. However, peer reviewed epidemiological studies from around the world, e.g. Turkey, Cyprus, Crete, Sicily, New Caledonia, and Wittenoom, Australia,[9] demonstrate that exposure to naturally occurring asbestos causes health effects and death. Because exact toxicity studies on these asbestos forms and activities are not available, the occupational studies are the best approximation.

7.2.2 PCM and PCME Metrics for the Application of Toxicity Values

The IRIS and OEHHA toxicity values are given in units of PCM measured fibers per cubic centimeter of air. Although the PCM analytical method does not distinguish between mineral types, and misses the majority of respirable fibers present in most commercial environments, this method was the only available exposure metric for the human studies on which these toxicity values are based. The PCM exposure metric is a surrogate for the mineral fibers present in each environment. Different mineral fibers will have different fiber length distributions, so a PCM metric for crocidolite, which tends to occur as very short fibers, will count a smaller proportion of fibers present than a PCM metric for amosite. The majority of the fibers detected in CCMA air samples are chrysotile and present with a fiber size distribution similar to that recently published for commercial chrysotile.[10] Therefore, the PCM metric, as a surrogate for the fiber mixture present at CCMA, is appropriate when applying the IRIS and OEHHA unit risk.

The analytical methods used in this study measured not only the size and shape of the asbestos structures in the samples but also identified the mineral form. While the original asbestos mine sites in CCMA yielded asbestos which was primarily chrysotile of short (<5 micron) fiber length, the results of this study showed the presence of many of the longer fibers measured in the health studies (>5 micron), the PCME fibers, as well as amphibole fibers. Risk calculations followed RAGS, using the toxicity values from IRIS and OEHHA. These calculations were based on only those fiber sizes meeting the dimensions as described

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[9] Luce D, Bugel I, Goldberg P, Goldberg M, Salomon C, Billon-Galland MA, Nicolau J, Quenel P, Fvotte J, Brochard P. ***Environmental exposure to tremolite and respiratory cancer in New Caledonia: a case-control study.*** Amer. Journal of Epidemiology 2000. Feb. 1; 151(3): 259-65.
McConnochie K, Simonato L, Mavrides P, Christofides P, Mitha R, Griffiths DM, Wagner JC: ***Mesothelioma in Cyprus. In: Non-Occupational Exposure to Mineral Fibres.*** J. Bignon, J. Peto, R. Saracci (Eds) WHO, IARC Scientific Publications, 1989, No. 90 p. 411-419.
Baris YI, Artvinli M, Sahin AA, Bilir N, Kalyoncu F, Sebastien P: ***Non-occupational asbestos related chest diseases in a small Anatolian village.*** Brit J Ind Med, 1988, 45:841-842.
Billon-Galland, MAG, Dufour A, Gaudichet C, Boutin & JR Viallat. ***Environmental airborne asbestos pollution and pleural plaques in Corsica.*** Ann Occup Hyg 32(Suppl. 1): 497-504.
Constantopoulos SH, Langer AM, Saratzis N, Nolan RP: ***Regional findings in Metsovo lung.*** Reply: The Lancet, Aug. 22, 1987, p. 452-453.

[10] Dement-JM; Kuempel-E; Zumwalde-R; Smith-R; Stayner-L; Loomis-D, ***Development of a fiber size-specific job-exposure matrix for airborne*** *asbestos* ***fibers***, Occup Environ Med 2008 Jan

or deduced from the original worker exposure studies, the PCME fibers. In this assessment, PCME fibers were specifically defined as (International Programs on Chemical Safety, Environmental Health Criteria #53, Asbestos and Other Natural Mineral Fibers, World Health Organization (WHO) Geneva 1986):

Dimensions:
Length: >5 um
Width: >=0.25 to <=3 um
Aspect Ratio: >=3:1

Included Structures:
Fibers
Bundles
Fiber subcomponent of a matrix
Bundle subcomponent of a matrix
Fiber subcomponent of a cluster
Bundle subcomponent of a cluster

Neither EPA's IRIS nor Cal EPA's OEHHA toxicity values differentiate between the forms of asbestos, but consider whether a fiber fits the PCME size definition. At this time there is no consensus on the exact causative form or dimension that is most correlated with asbestos disease. Therefore this study evaluated the exposure risks based on the fiber dimensions from the original toxicity studies of the occupational data. If longer fibers, mineralogy, or other factors are important, then new evaluations of the cancer potency would be necessary, based on a new definition coupled with a dose to which the workers in the original occupation studies were exposed.

7.2.3 Effect of Smoking

One key point from the asbestos toxicity evaluations that form the basis for the IRIS slope factor is that smoking status is important in evaluating the probability or risk of lung cancer. Asbestos exposure and smoking appear to be synergistic for lung cancer. Smoking increases the risk of disease from asbestos exposure, because the risks associated with each stressor contribute to total risk. The US EPA's IRIS toxicity value was based on mortality statistics from 1977 population data, including smokers. Since then, the number of smokers in the population has decreased. Therefore, the risk calculations may overestimate risks for CCMA users based on current population smoking patterns but may underestimate the risk for the population of users that smoke.

7.2.4 Adjustment for Early-lifetime, Less-than-lifetime Exposure

Age at first exposure is important because mesothelioma disease risk increases with the time since first exposure. There is a delay of 10 to 20 years or longer from first exposure to disease effect. Therefore, the longer one lives after asbestos exposure, the greater the probability of contracting mesothelioma. The probability is dependent on the cube of the elapsed time since first exposure. Although this factor was not fully used in calculating child risk in this study, it can be estimated through a life table analysis that incorporates time from first exposure and population life expectancy. The following is a comparison of early life exposure risks.

ELCR = EC x IUR

Where,

ELCR = Excess Lifetime Cancer Risk
EC = Chronic Daily Exposure Concentration (fibers per cubic centimeter of air [f/cc] averaged over a 70-year lifetime)
IUR = IRIS Inhalation Unit Risk factor for inhalation of asbestos

Evaluate an individual exposed to 0.01 f/cc for 30 years using the chronic lifetime IRIS unit risk of 0.23 [per f/ml] or the OEHHA unit risk of 1.9 [per f/cc] and the same exposures for 30 years starting at age 6 or starting at age 30, with unit risks taken from the life table calculation in the IRIS supporting document, Airborne Asbestos Health Assessment Update 1986, for the population.

Source IUR	IUR per (f/cc)	Risk	ratio
IRIS	0.23	1E-3	1
Life table beginning at age 6 to 36	0.14	1.4E-3	1.4
Life table beginning at age 30 to 60	0.046	0.46E-3	0.5
OEHHA	1.9	8E-3	8

Therefore, early life exposure could be 3 times greater (1.4 vs. 0.5) than the same exposure that began later in life. However, using the IRIS value consistently, regardless of age of first exposure, results in risk values within a factor of 2 of the risks based on the life table analysis (1 vs. 1.4 or 0.5).

In this report, risk calculations are presented for both the IRIS toxicity value, and the toxicity value derived by Cal EPA's OEHHA. The inhalation unit risk for the OEHHA model is 1.9 per f/ml, which is 8 times greater than the IRIS value. The difference in the two toxicity values is the endpoint chosen for the evaluation. The IRIS toxicity value used human occupational studies that represent the entire population, male and female combined, including smokers. Also, it represents an average or mean for that population. The OEHHA toxicity value, on the other hand, uses a specific segment of the population, the non-smoking female, and relies on an upper-end probability calculation for that sub-population. Because of the importance of the time since first exposure in asbestos-related disease, the increased longevity of non-smoking females increases this population's probability of expressing asbestos disease. The two toxicity values demonstrate the quantitative effect of different policy decisions on agency toxicity values. Both use similar data from human occupational studies, as well as the same fiber definition and mineralogy. However, the difference in the population evaluated and the mathematical procedure used to represent that population results in a quantitative value differing by a factor of 8. For asbestos, these two toxicity values can best be thought of as risk determinations for the entire population (EPA's IRIS) and for a sub-population (CalEPA's OEHHA).

7.2.5 Limits of Models

An additional uncertainty is presented for risks that are calculated to be greater than 10^{-2}. Above this range the simplifying assumptions used to derive the total risk are no longer additive, and for those affected scenarios, the summed risks from all the different activities may slightly overestimate the total risk, although would still be within the rounding estimate. However, regardless of the absolute value of the risk calculated, the amount of asbestos exposure modeled for these hypothetical scenarios over a 30 year exposure would be extremely high and well above the risk range.

7.2.6 Non-Cancer Adverse Health Effects Are Not Addressed in the Quantitative Risk Assessment

This risk evaluation assesses only the excess cancer risk from exposure to asbestos at the CCMA. It is known that asbestos causes diseases other than cancer, such as respiratory and pleural disease. The non-cancer effects are not quantitatively taken into account in this assessment, but could actually be more significant to total disease outcome from CCMA asbestos exposure. **Therefore, the general probability of developing disease from exposure related to activities at Clear Creek may be significantly underestimated in this report.**

8.0 Conclusions

Asbestos is a known human carcinogen. Despite the uncertainties inherent in risk assessment, the EPA evaluation of asbestos exposures and risks at the Clear Creek Management Area has led to some important conclusions.

- The Activity Causes the Exposure – The concentration of asbestos in the breathing zone is directly related to the degree that an activity disturbs the soil and creates dust.
- Children Are of Special Concern – In a majority of the samples, the concentration of asbestos measured in the child's breathing zone exceeded the asbestos concentration in the companion adult sample. Further, a child's life expectancy exceeds the latency period for asbestos-related disease.
- The Higher the Exposure, the Higher the Risk – The activities with the highest exposure - motorcycling, ATV riding, and SUV driving/riding - had the highest corresponding excess lifetime cancer risk.
- Reducing the Exposure Will Reduce the Risk – The risk of developing asbestos-related disease is dependent on the level of exposure, the duration of exposure, and the time since first exposure. Reducing exposure will reduce the risk of developing asbestos-related cancers and debilitating and potentially fatal non-cancer disease.

In summary, the asbestos exposures that EPA measured at CCMA are high and the resulting health risks are of concern.

Tables

TABLE 1
Numbers and Types of Activity-Based Air Samples By Sampling Date

Activity	Type of Sample	Position		Date							
				9/15/2004	11/2/2004	11/3/2004	2/11/2005	2/20/2005	9/27/2005	9/28/2005	9/29/2005
ATV Routes	Adult	Lead			4	2	2		4	4	2
		Middle			2	2			3	4	2
		Tail			4	2	2		4	4	2
	Child	Lead			4	2	1		2	4	2
		Middle			2	2			1	4	2
		Tail			4	2	1		4	4	1
ATV Routes to Race Checkpoints	Adult	Lead						3	2		
Motorcycle Routes	Adult	Lead		1	4	4	2		4	3	1
		Middle		1	4	5	2		6	6	0
		Tail		1	4	3	2		3	4	2
	Child	Lead			3	4	1		3	4	2
		Middle			5	1	1		4	4	0
		Tail			4	4	1		3	3	2
SUV	Adult	Open Window	Lead						3	4	2
			Tail						3	4	2
	Child		Lead						4	4	2
			Tail						3	3	2
	Adult	Closed Window	Lead	1	4	4	2	1	4	3	4
			Tail	1	4	4	2		4	4	4
	Child		Lead		4	3	1		3	4	4
			Tail		4	4	1		3	3	4
	Front passenger	Closed Window	Tail	1							
	Post-decon										
Hiker	Adult	Lead			2	2	1		4	4	1
		Follow			2	2	1		4	5	2
	Child	Lead			2	2	1		4	5	1
		Follow			1	2	1		4	1	2
Camper	Adult				4					5	4
	Child				4					6	4
Sleeping Camper	Adult				6				5		
	Child										
Fence-building	Adult								7	7	6
Vehicle-washing	Adult	Open Window	Hose								
			Spray								
		Closed Window	Hose		2	2					
			Spray		2	2					
Vehicle-vacuuming	Adult	Open Window	HEPA								
			non-HEPA								
		Closed Window	HEPA		1	1					
			non-HEPA		2	2					
Observer (outside ACEC)	Adult			1							

TABLE 2

Mean and 95% Upper Confidence Limit (UCL) Values for CCMA Exposure Activity Air Sample Results

	Number of Samples	Minimum Detected (f/cc)	Maximum Detected (f/cc)	Mean (f/cc)	95% UCL (f/cc)
Adult Activities					
ATV	18	0.0044	2.0392	0.3174	0.6070
Camping	11	0.0045	0.6495	0.0874	0.4390
Fence Building	9	0.0124	0.2648	0.0619	0.1093
Hiking	15	0.0042	0.0510	0.0183	0.0209
Motorcycle	33	0.0099	1.2822	0.3071	0.5045
Sleeping	5	ND	ND	0.0003*	0.0005*
Staging at Oak Flat	13	0.0005	0.0252	0.0050	0.0122
Staging at Section 8	11	0.0003	0.0055	0.0027	0.0031
Staging in CCMA**	16	0.0005	0.0061	0.0029	0.0034
SUV	29	0.0099	0.6724	0.1841	0.3146
Vacuum	10	0.0078	0.1446	0.0541	0.0737
Vehicle Wash	11	0.0098	0.5295	0.1466	0.3731
Child Activities					
ATV	17	0.0091	1.2765	0.4404	0.7414
Camping	12	0.0046	0.2843	0.0460	0.1826
Hiking	13	0.0049	0.0749	0.0260	0.0509
Motorcycle	29	0.0099	1.2277	0.3671	0.6292
SUV	25	0.0050	0.9788	0.2605	0.5189

Notes:

ND-non detect

*-The minimum and maximum analysis sensitivities were used as the mean (central tendency) and the UCL, respectively.

**-Used as ambient air value within CCMA.

TABLE 3

Summary of Excess Lifetime Cancer Risk Ranges for Adults for Scenarios 1 through 7

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 1: Weekend Motorcycle Rider	IRIS Mean	1		X	
		5 (RME)			3×10^{-4}
		12(High Estimate)			6×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)			7×10^{-4}
		12(High Estimate)			2×10^{-3}
	OEHHA Mean	1			4×10^{-4}
		5 (RME)			2×10^{-3}
		12(High Estimate)			5×10^{-3}
	OEHHA 95% UCL	1			1×10^{-3}
		5 (RME)			5×10^{-3}
		12(High Estimate)			1×10^{-2}
Scenario 2: Day Use ATV Rider	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)			2×10^{-4}
		12(High Estimate)			6×10^{-4}
	OEHHA Mean	1			2×10^{-4}
		5 (RME)			1×10^{-3}
		12(High Estimate)			2×10^{-3}
	OEHHA 95% UCL	1			4×10^{-4}
		5 (RME)			2×10^{-3}
		12(High Estimate)			5×10^{-3}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 3

Summary of Excess Lifetime Cancer Risk Ranges for Adults for Scenarios 1 through 7

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 2: Day Use Motorcycle	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)			2×10^{-4}
		12(High Estimate)			5×10^{-4}
	OEHHA Mean	1			2×10^{-4}
		5 (RME)			1×10^{-3}
		12(High Estimate)			2×10^{-3}
	OEHHA 95% UCL	1			3×10^{-4}
		5 (RME)			2×10^{-3}
		12(High Estimate)			4×10^{-3}
Scenario 3: Day Use Hiker	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	OEHHA 95% UCL	1		X	
		5 (RME)			2×10^{-4}
		12(High Estimate)			5×10^{-4}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 3

Summary of Excess Lifetime Cancer Risk Ranges for Adults for Scenarios 1 through 7

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 4: Weekend Hunter	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			3 x 10-4
		12(High Estimate)			6 x 10-4
	OEHHA Mean	1		X	
		5 (RME)			6 x 10-4
		12(High Estimate)			1 x 10-3
	OEHHA 95% UCL	1			4 x 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			5 x 10-3
Scenario 5: Combined Rider/Workday (Motorcycle	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)			3 x 10-4
	OEHHA Mean	1		X	
		5 (RME)			6 x 10-4
		12(High Estimate)			2 x 10-3
	OEHHA 95% UCL	1			2 x 10-4
		5 (RME)			1 x 10-3
		12(High Estimate)			3 x 10-3

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 3

Summary of Excess Lifetime Cancer Risk Ranges for Adults for Scenarios 1 through 7

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 5: Combined Rider/Workday (ATV)	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			2 x 10-4
		12(High Estimate)			4 x 10-4
	OEHHA Mean	1		X	
		5 (RME)			7 x 10-4
		12(High Estimate)			2 x 10-3
	OEHHA 95% UCL	1			3 x 10-4
		5 (RME)			1 x 10-3
		12(High Estimate)			3 x 10-3
Scenario 6: Worker Motorcycle Patrol (8.5 Hours)	IRIS Mean	1		X	
		60 (RME)			2 x 10-4
		120 (High Estimate)			3 x 10-4
	IRIS 95% UCL	1		X	
		60 (RME)			3 x 10-4
		120 (High Estimate)			6 x 10-4
	OEHHA Mean	1		X	
		60 (RME)			1 x 10-3
		120 (High Estimate)			3 x 10-3
	OEHHA 95% UCL	1		X	
		60 (RME)			2 x 10-3
		120 (High Estimate)			5 x 10-3

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 3

Summary of Excess Lifetime Cancer Risk Ranges for Adults for Scenarios 1 through 7

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 6: Worker ATV Patrol (8.5 Hours)	IRIS Mean	1		X	
		60 (RME)			2×10^{-4}
		120 (High Estimate)			5×10^{-4}
	IRIS 95% UCL	1		X	
		60 (RME)			5×10^{-4}
		120 (High Estimate)			1×10^{-3}
	OEHHA Mean	1		X	
		60 (RME)			2×10^{-3}
		120 (High Estimate)			4×10^{-3}
	OEHHA 95% UCL	1		X	
		60 (RME)			4×10^{-3}
		120 (High Estimate)			9×10^{-3}
Scenario 7: Worker SUV Patrol (7 Hours)	IRIS Mean	1		X	
		60 (RME)			5×10^{-4}
		120 (High Estimate)			1×10^{-3}
	IRIS 95% UCL	1		X	
		60 (RME)			1×10^{-3}
		120 (High Estimate)			2×10^{-3}
	OEHHA Mean	1		X	
		60 (RME)			4×10^{-3}
		120 (High Estimate)			8×10^{-3}
	OEHHA 95% UCL	1		X	
		60 (RME)			6×10^{-3}
		120 (High Estimate)			1×10^{-2}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 4

Summary of Excess Lifetime Cancer Risk Ranges for Child/Adult for Scenarios 1 through 4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 1: Weekend Motorcycle Rider	IRIS Mean	1		X	
		5 (RME)			3 x 10-4
		12(High Estimate)			7 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			6 x 10-4
		12(High Estimate)			2 x 10-3
	OEHHA Mean	1			5 x 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			6 X 10-3
	OEHHA 95% UCL	1			1 x 10-3
		5 (RME)			5 x 10-3
		12(High Estimate)			1 x 10-2
Scenario 2: Day Use ATV Rider	IRIS Mean	1		X	
		5 (RME)			2 X 10-4
		12(High Estimate)			4 X 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			3 x 10-4
		12(High Estimate)			7 x 10-4
	OEHHA Mean	1			3 x 10-4
		5 (RME)			1 x 10-3
		12(High Estimate)			3 x 10-3
	OEHHA 95% UCL	1			5 x 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			6 x 10-3

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 4

Summary of Excess Lifetime Cancer Risk Ranges for Child/Adult for Scenarios 1 through 4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 2: Day Use Motorcycle	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3 X 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			2 x 10-4
		12(High Estimate)			6 x 10-4
	OEHHA Mean	1			2 x 10-4
		5 (RME)			1 x 10-3
		12(High Estimate)			3 x 10-3
	OEHHA 95% UCL	1			4 x 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			5 x 103
Scenario 3: Day Use Hiker	IRIS Mean	1		X	
		5 (RME)			2 x 10-4
		12(High Estimate)			4 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			3 X 10-4
		12(High Estimate)			8 X 10-4
	OEHHA Mean	1			3 X 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			4 x 10-3
	OEHHA 95% UCL	1			6 x 10-4
		5 (RME)			3 x 10-3
		12(High Estimate)			7 x 10-3

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 4

Summary of Excess Lifetime Cancer Risk Ranges for Child/Adult for Scenarios 1 through4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 4: Weekend Hunter	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2 x 10-4
	IRIS 95% UCL	1		X	
		5 (RME)			3 x 10-4
		12(High Estimate)			6 x 10-4
	OEHHA Mean	1		X	
		5 (RME)			7 x 10-4
		12(High Estimate)			2 x 10-3
	OEHHA 95% UCL	1			4 x 10-4
		5 (RME)			2 x 10-3
		12(High Estimate)			5 x 10-3

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 5

Summary of Excess Lifetime Cancer Risk Ranges for Children for Scenarios 1 through 4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 1: Weekend Motorcycle Rider	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)			2×10^{-4}
		12(High Estimate)			6×10^{-4}
	OEHHA Mean	1			2×10^{-4}
		5 (RME)			1×10^{-3}
		12(High Estimate)			2×10^{-3}
	OEHHA 95% UCL	1			4×10^{-4}
		5 (RME)			2×10^{-3}
		12(High Estimate)			5×10^{-3}
Scenario 2: Day Use ATV Rider	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	OEHHA Mean	1		X	
		5 (RME)			6×10^{-4}
		12(High Estimate)			1×10^{-3}
	OEHHA 95% UCL	1			2×10^{-4}
		5 (RME)			1×10^{-3}
		12(High Estimate)			3×10^{-3}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 5

Summary of Excess Lifetime Cancer Risk Ranges for Children for Scenarios 1 through 4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 2: Day Use Motorcycle	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			2×10^{-4}
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	OEHHA Mean	1		X	
		5 (RME)			5×10^{-4}
		12(High Estimate)			1×10^{-3}
	OEHHA 95% UCL	1			2×10^{-4}
		5 (RME)			9×10^{-4}
		12(High Estimate)			2×10^{-3}
Scenario 3: Day Use Hiker	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA Mean	1		X	
		5 (RME)		X	
		12(High Estimate)			3×10^{-4}
	OEHHA 95% UCL	1		X	
		5 (RME)			3×10^{-4}
		12(High Estimate)			6×10^{-4}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 5

Summary of Excess Lifetime Cancer Risk Ranges for Children for Scenarios 1 through 4

Activity	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Scenario 4: Weekend Hunter	IRIS Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)			2×10^{-4}
	OEHHA Mean	1		X	
		5 (RME)			3×10^{-4}
		12(High Estimate)			6×10^{-4}
	OEHHA 95% UCL	1		X	
		5 (RME)			7×10^{-4}
		12(High Estimate)			2×10^{-3}

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 6

Summary of Excess Lifetime Cancer Risk Ranges for Adult 30-Year Exposure to CCMA Ambient Air Asbestos Concentrations

Location	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
Staging in CCMA (Staging in Areas #2 and #6)	IRIS Mean	1	X		
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1	X		
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
Oak Flat Campground	IRIS Mean	1	X		
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

TABLE 6

Summary of Excess Lifetime Cancer Risk Ranges for Adult 30-Year Exposure to CCMA Ambient Air Asbestos Concentrations

Location	Parameter	Visits/Year	Below Risk Range	In Risk Range	Above Risk Range*
BLM Decontamination Area - Section 8	IRIS Mean	1	X		
		5 (RME)		X	
		12(High Estimate)		X	
	IRIS 95% UCL	1	X		
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA Mean	1		X	
		5 (RME)		X	
		12(High Estimate)		X	
	OEHHA 95% UCL	1		X	
		5 (RME)		X	
		12(High Estimate)		X	

*Risks in this range may require ameliorating action dependent on additional criteria and considerations

Figures

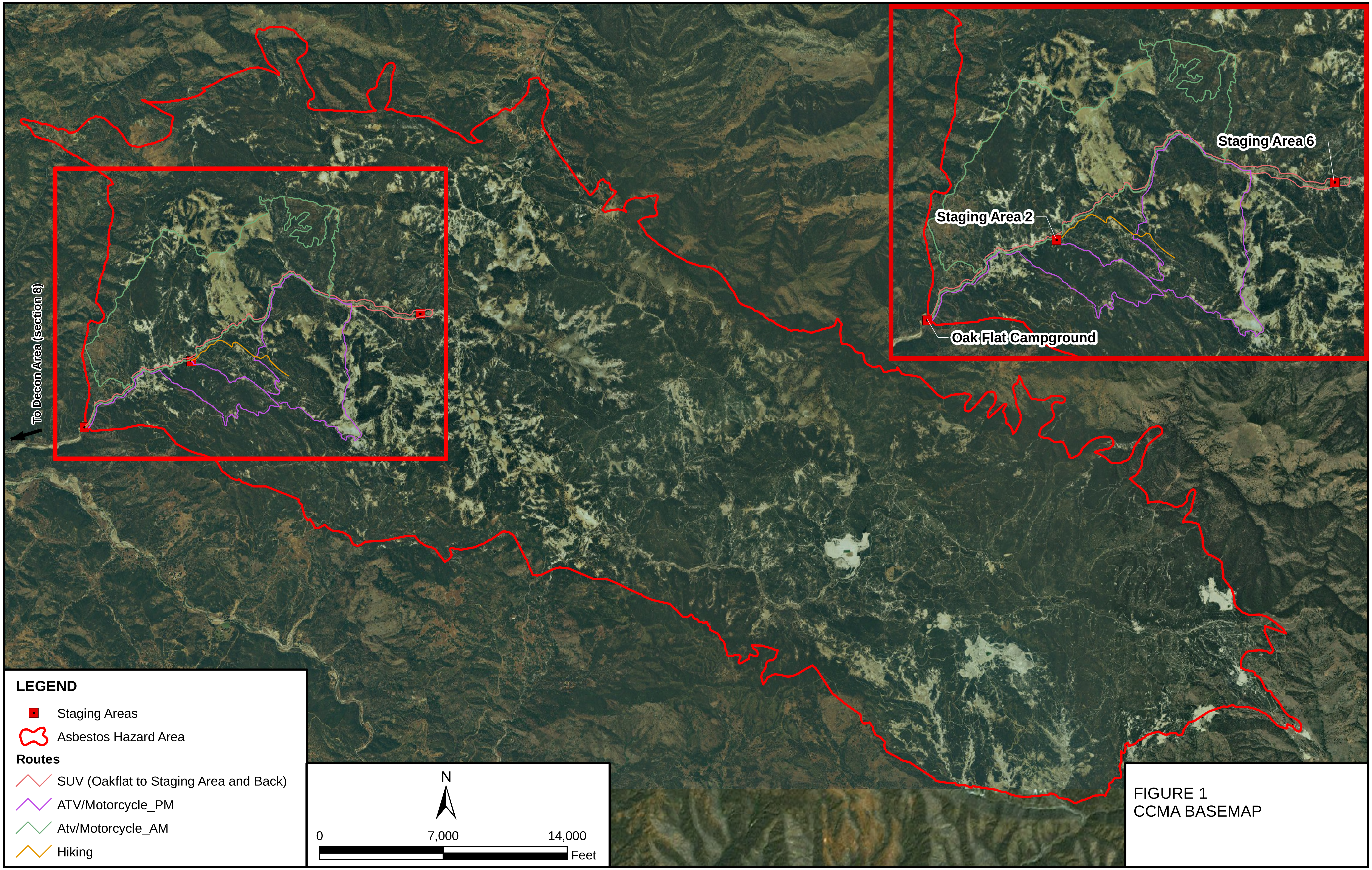


FIGURE 1
CCMA BASEMAP

\\ZINFANDEL\PROJ\USENVIRONMENTALPROTE\335365ATLAS\CCMA\GIS\MAPFILES\CCMA_BASE.MXD CCMA_BASE.MXD 4/23/2008 14:45:55

Figure 2: Rainfall vs. Sampling Events

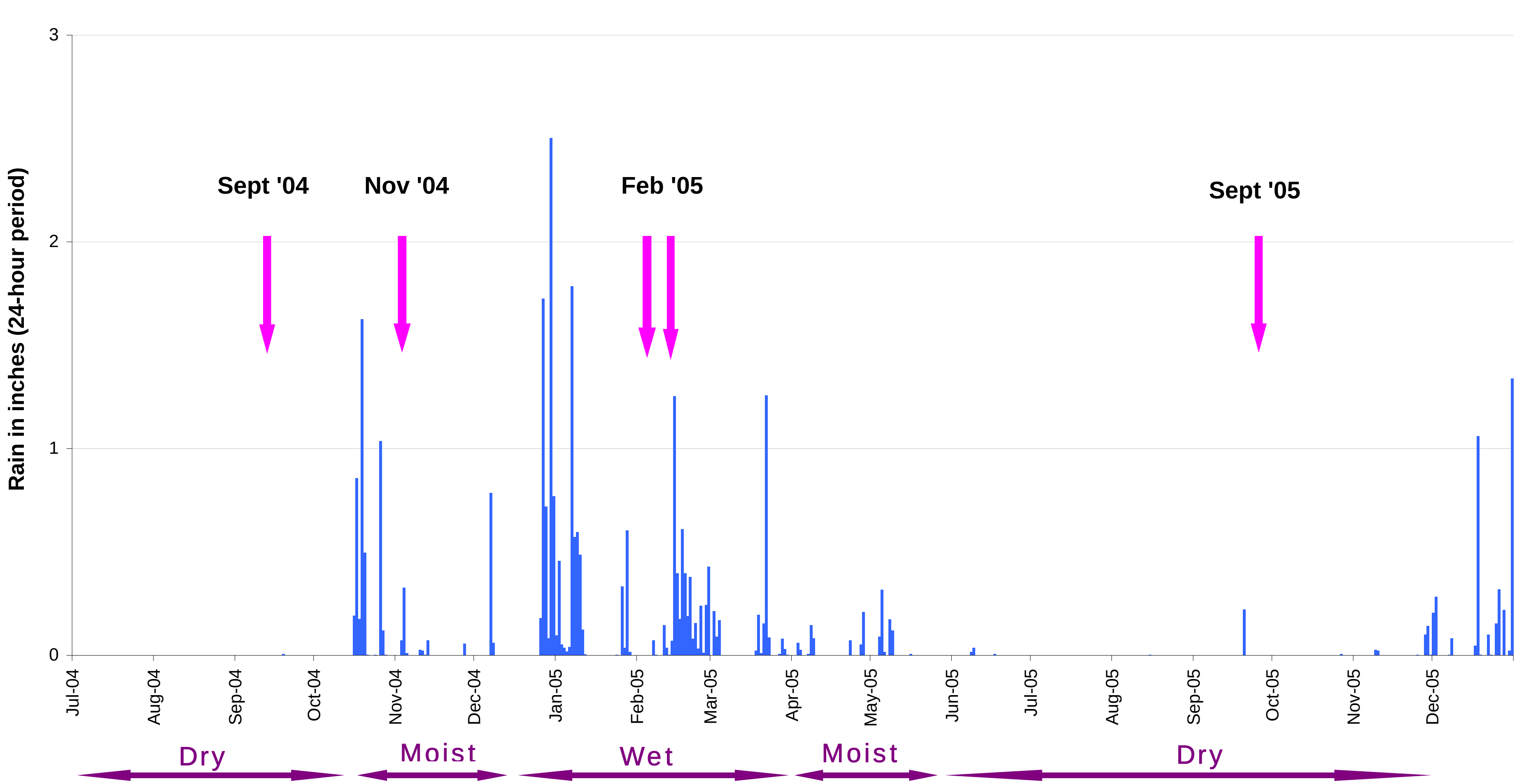
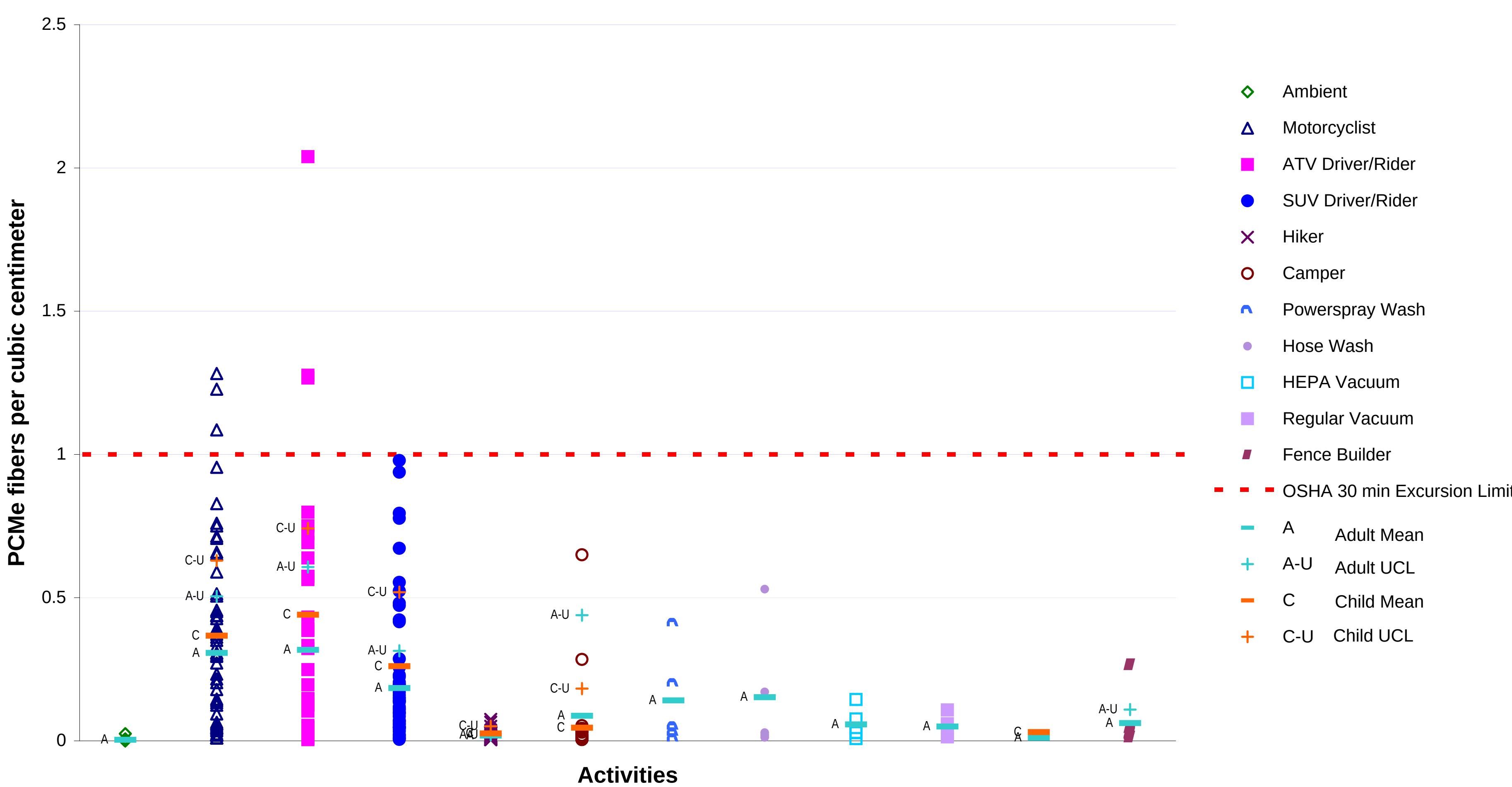


Figure 3: Comparison of Ambient Concentration and Activities



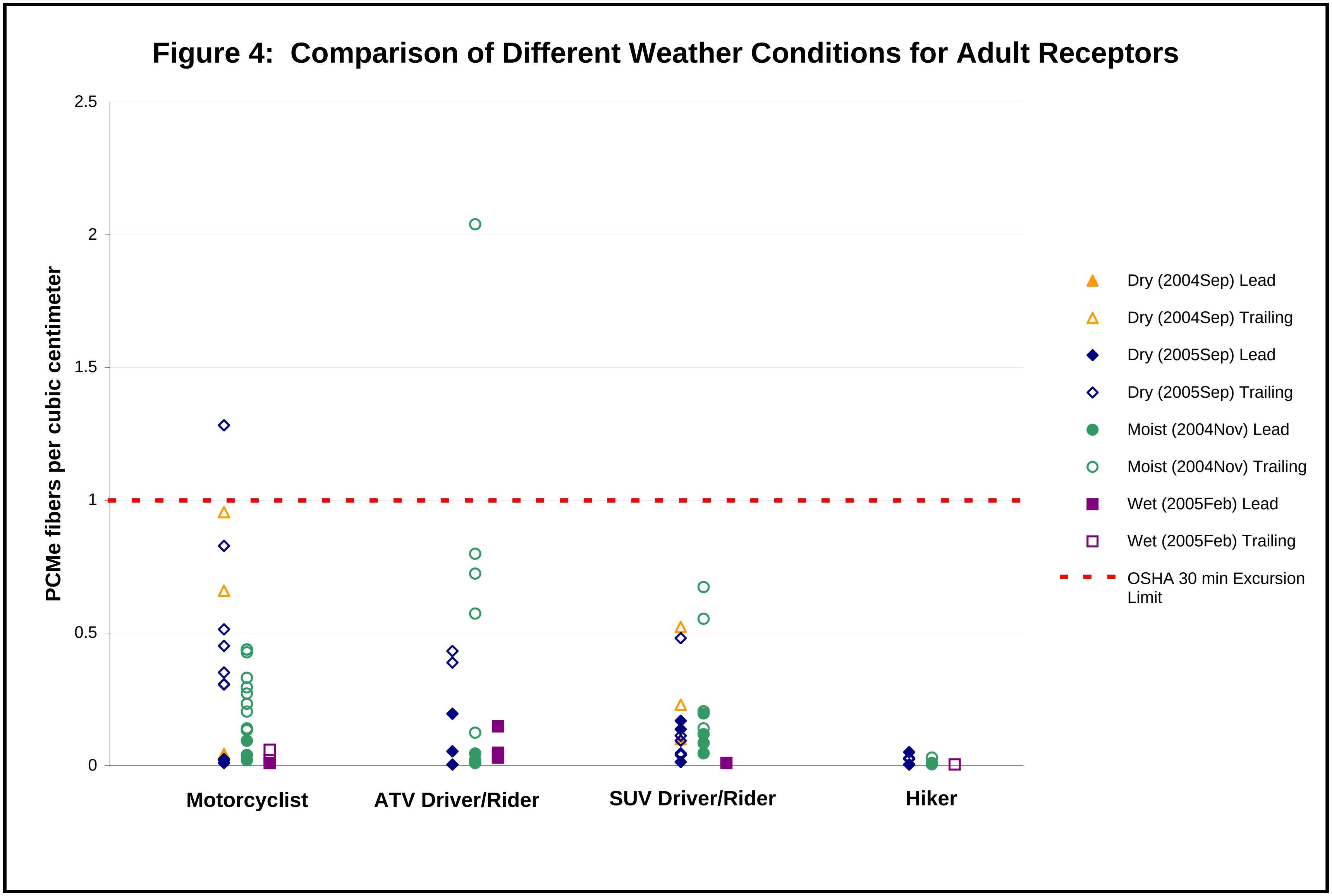


Figure 4: Comparison of Different Weather Conditions for Adult Receptors
PCMe fibers per cubic centimeter
2.5
2
1.5
1
0.5
0
Motorcyclist
ATV Driver/Rider
SUV Driver/Rider
Hiker
Dry (2004Sep) Lead
Dry (2004Sep) Trailing
Dry (2005Sep) Lead
Dry (2005Sep) Trailing
Moist (2004Nov) Lead
Moist (2004Nov) Trailing
Wet (2005Feb) Lead
Wet (2005Feb) Trailing
OSHA 30 min Excursion Limit

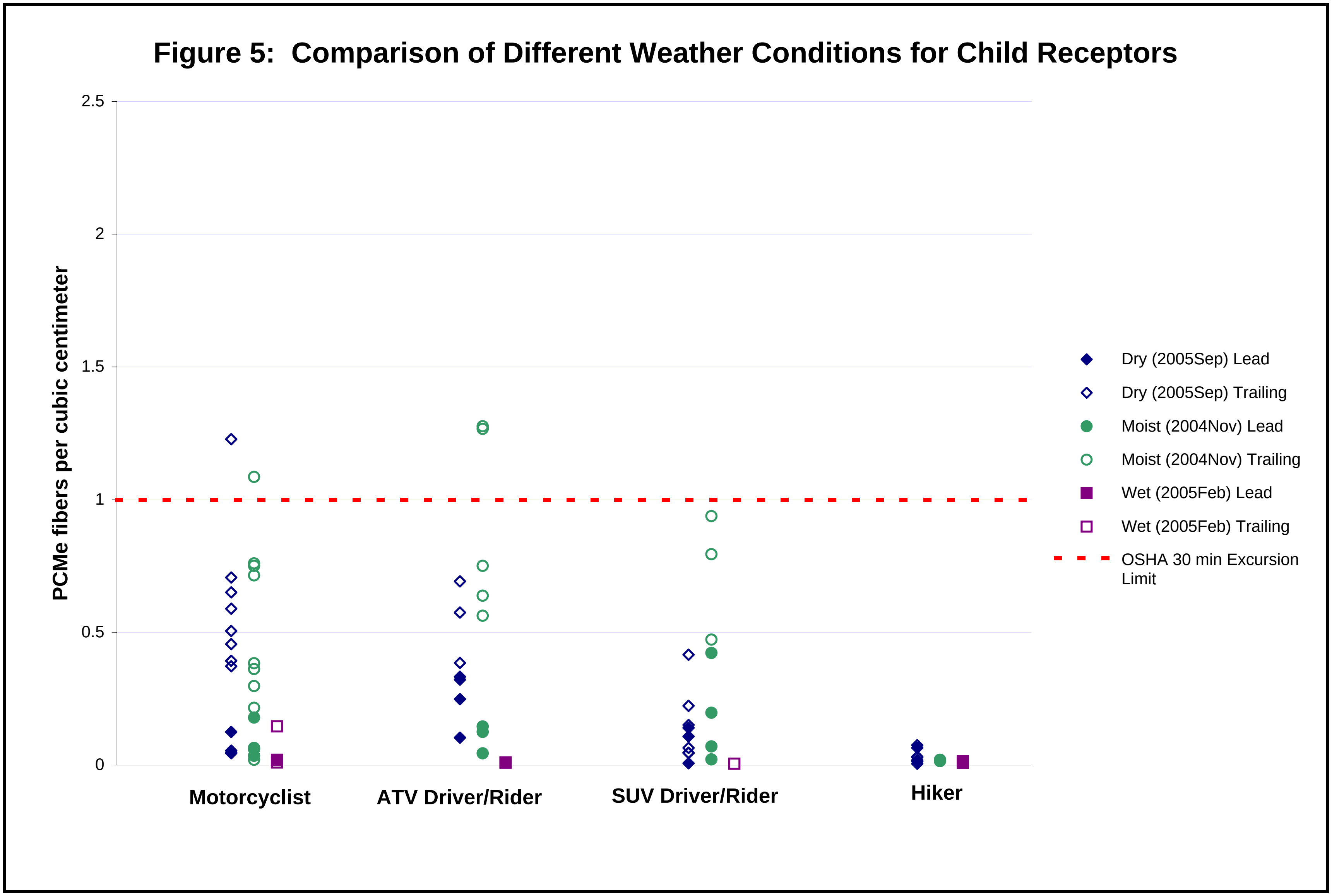


Figure 5: Comparison of Different Weather Conditions for Child Receptors
PCMe fibers per cubic centimeter
2.5
2
1.5
1
0.5
0
Motorcyclist
ATV Driver/Rider
SUV Driver/Rider
Hiker
Dry (2005Sep) Lead
Dry (2005Sep) Trailing
Moist (2004Nov) Lead
Moist (2004Nov) Trailing
Wet (2005Feb) Lead
Wet (2005Feb) Trailing
OSHA 30 min Excursion Limit

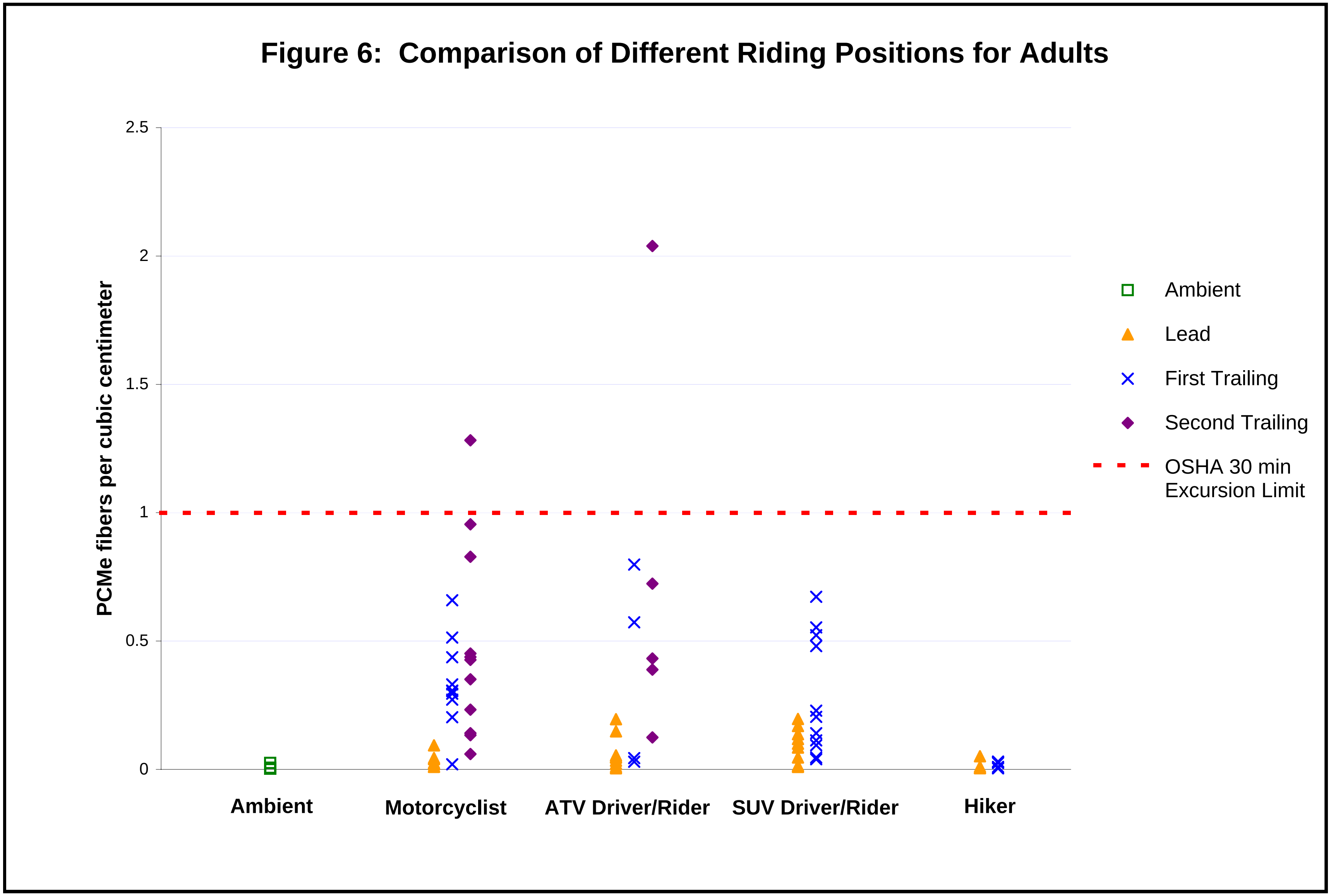


Figure 6: Comparison of Different Riding Positions for Adults
PCMe fibers per cubic centimeter
2.5
2
1.5
1
0.5
0
Ambient
Motorcyclist
ATV Driver/Rider
SUV Driver/Rider
Hiker
Ambient
Lead
First Trailing
Second Trailing
OSHA 30 min Excursion Limit

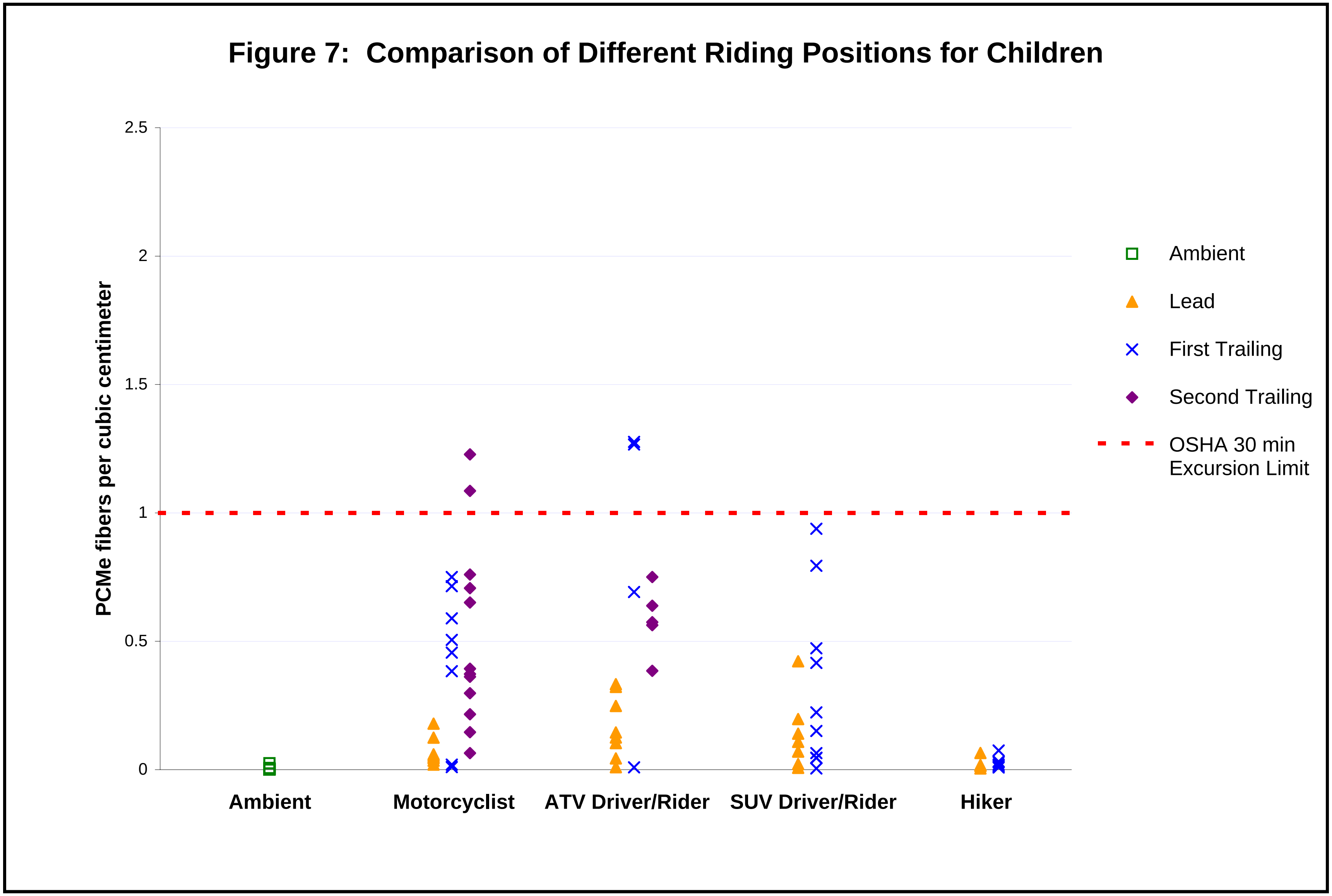


Figure 7: Comparison of Different Riding Positions for Children
PCMe fibers per cubic centimeter
2.5
2
1.5
1
0.5
0
Ambient
Motorcyclist
ATV Driver/Rider
SUV Driver/Rider
Hiker
Ambient
Lead
First Trailing
Second Trailing
OSHA 30 min Excursion Limit

Figure 8: Ratio of Child to Adult Exposure Levels for Each Activity for Each Sampling Date

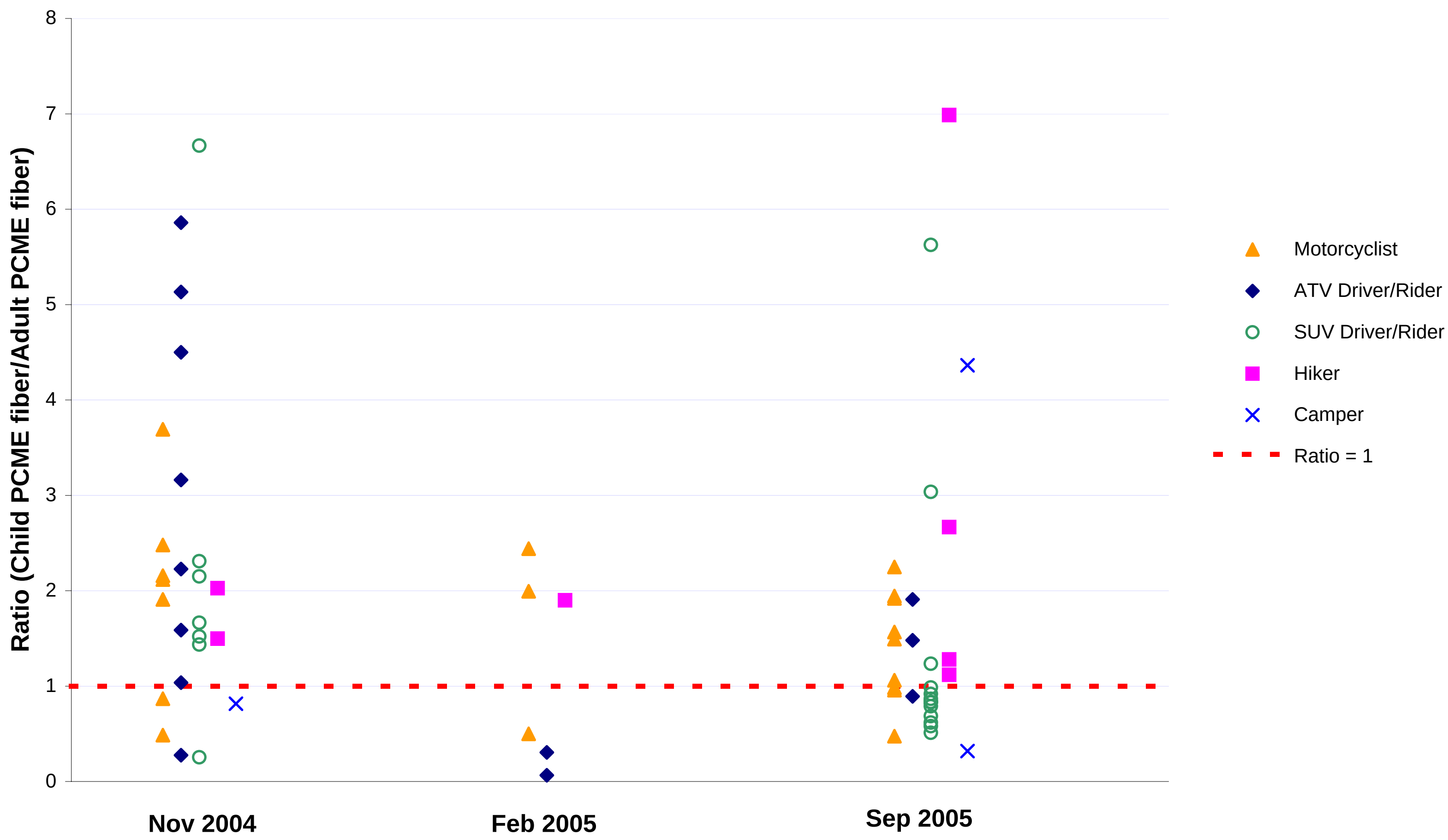


Figure 9: Windows Open vs. Windows Closed Scenarios (September 2005 - All Positions)

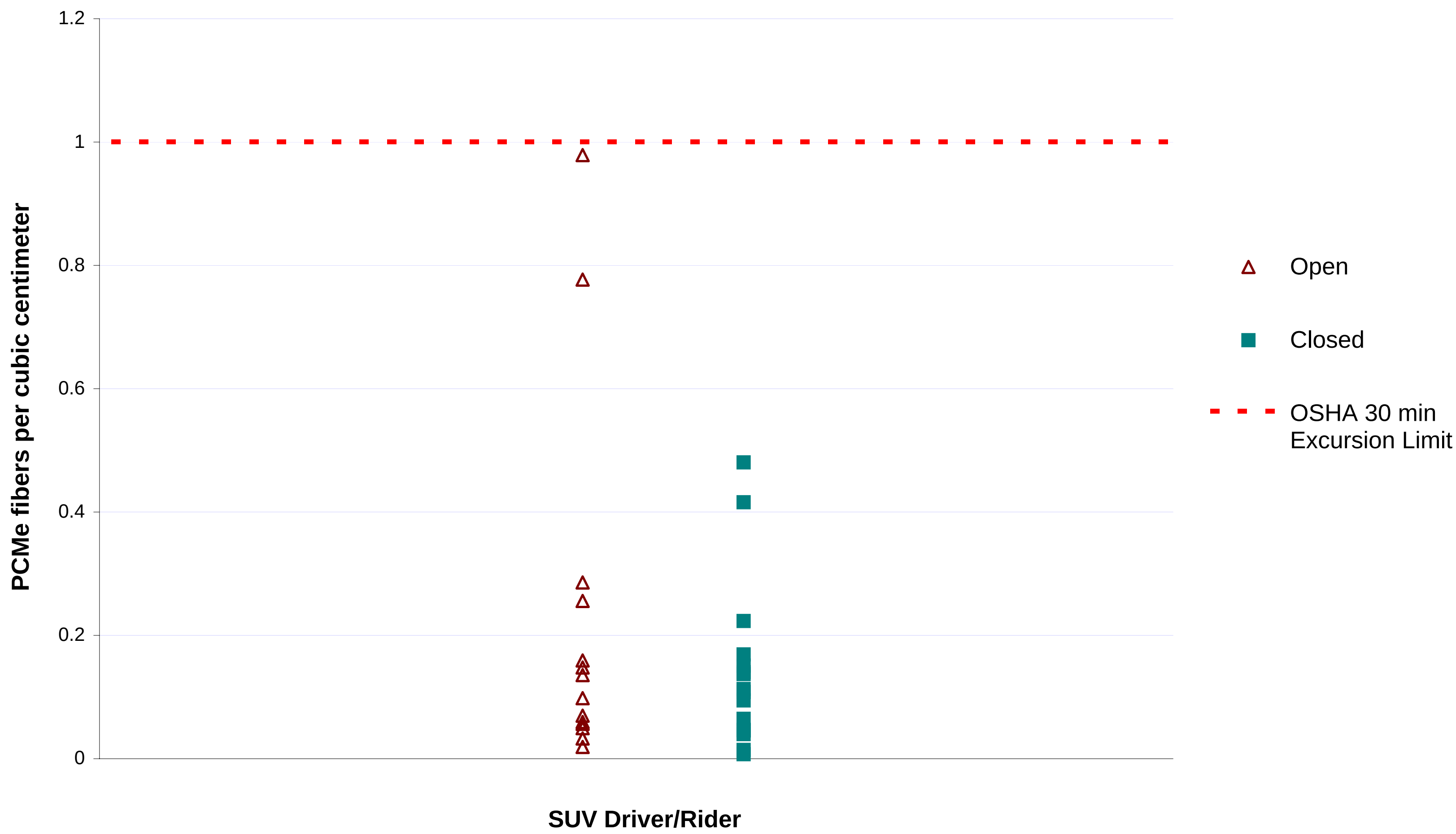


Figure 10: Adult Cancer Risk, Scenarios 1 – 7
Mean and 95%UCL Exposures Using IRIS Unit Risk

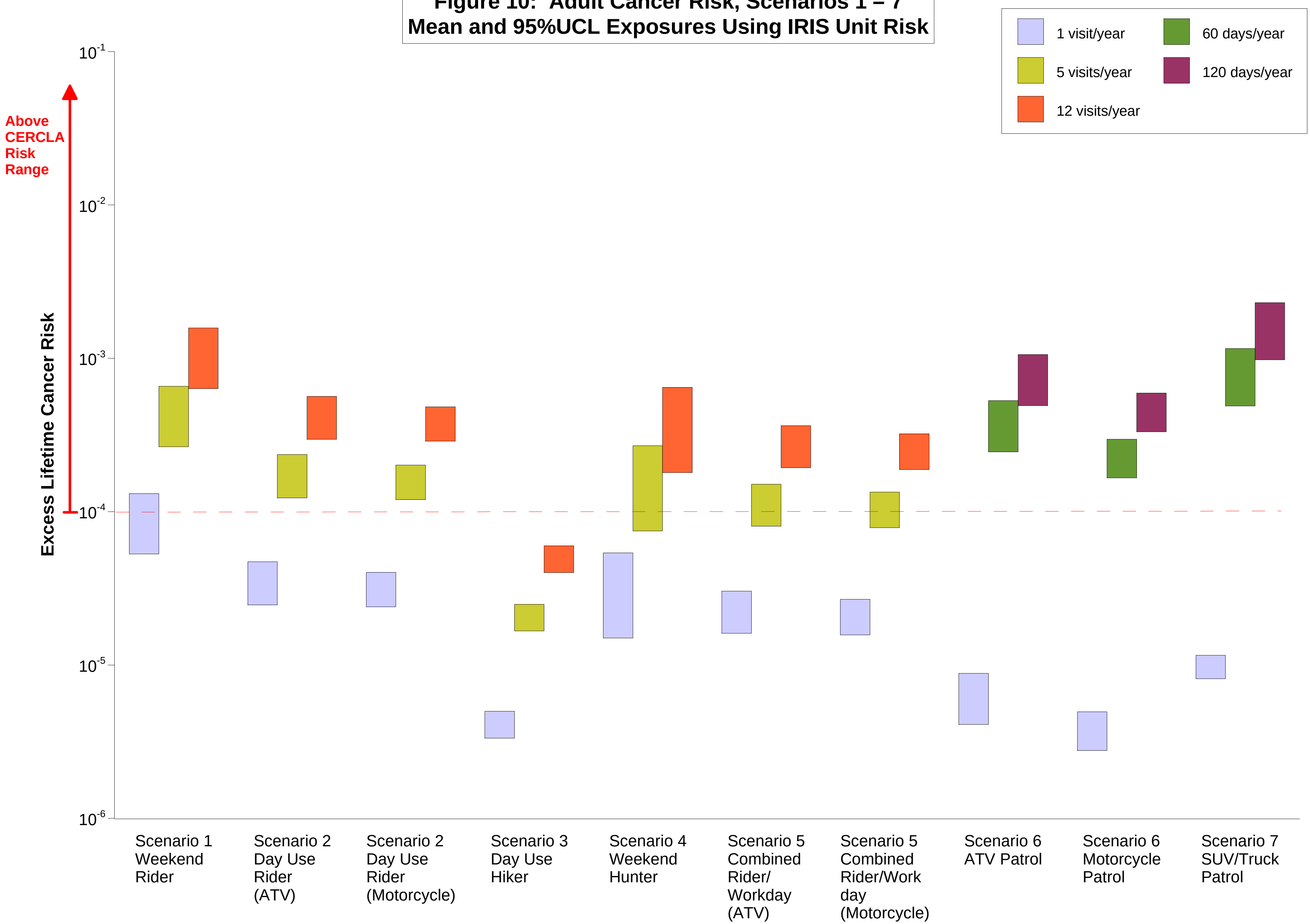
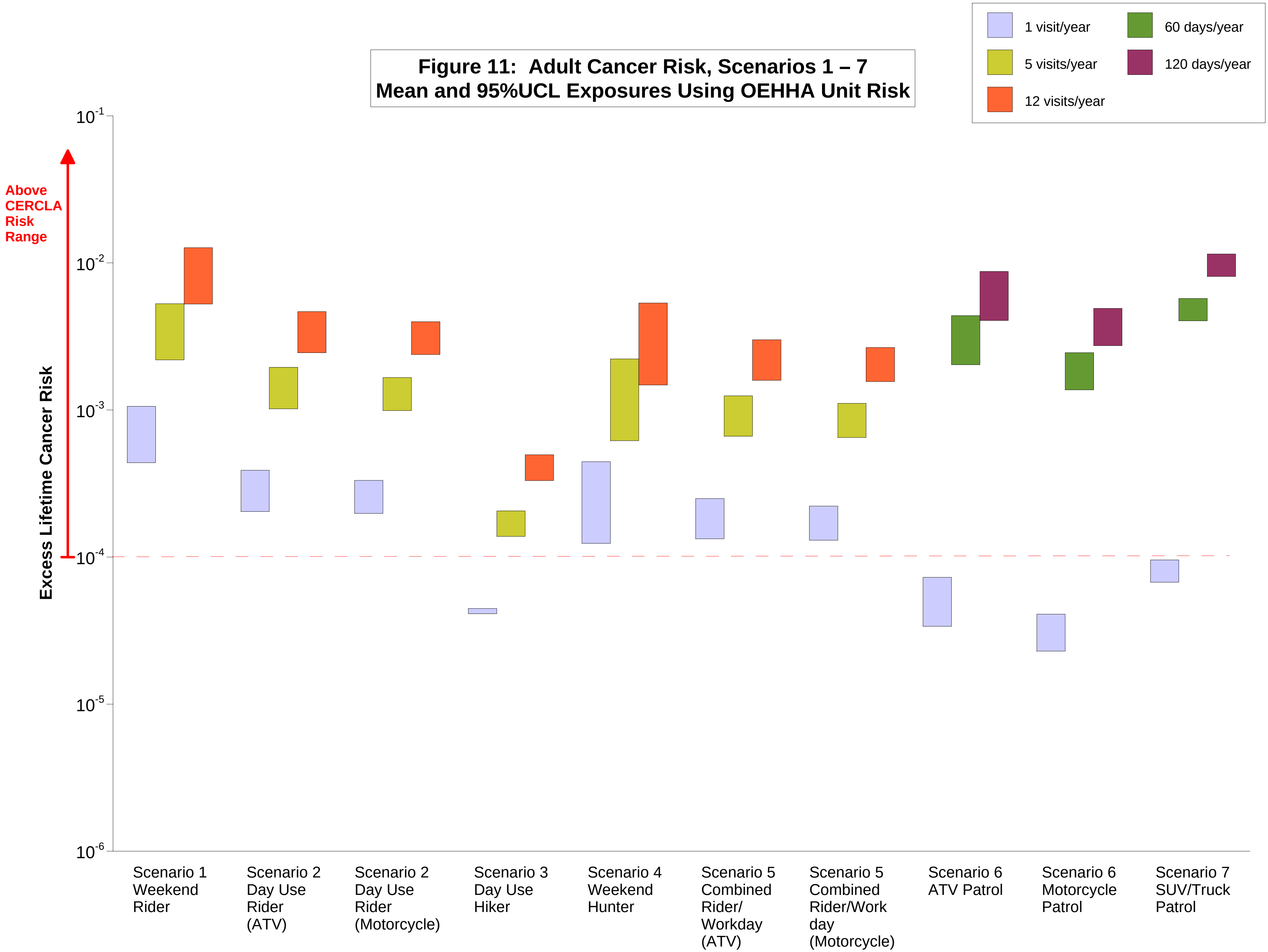


Figure 11: Adult Cancer Risk, Scenarios 1 – 7
Mean and 95%UCL Exposures Using OEHHA Unit Risk



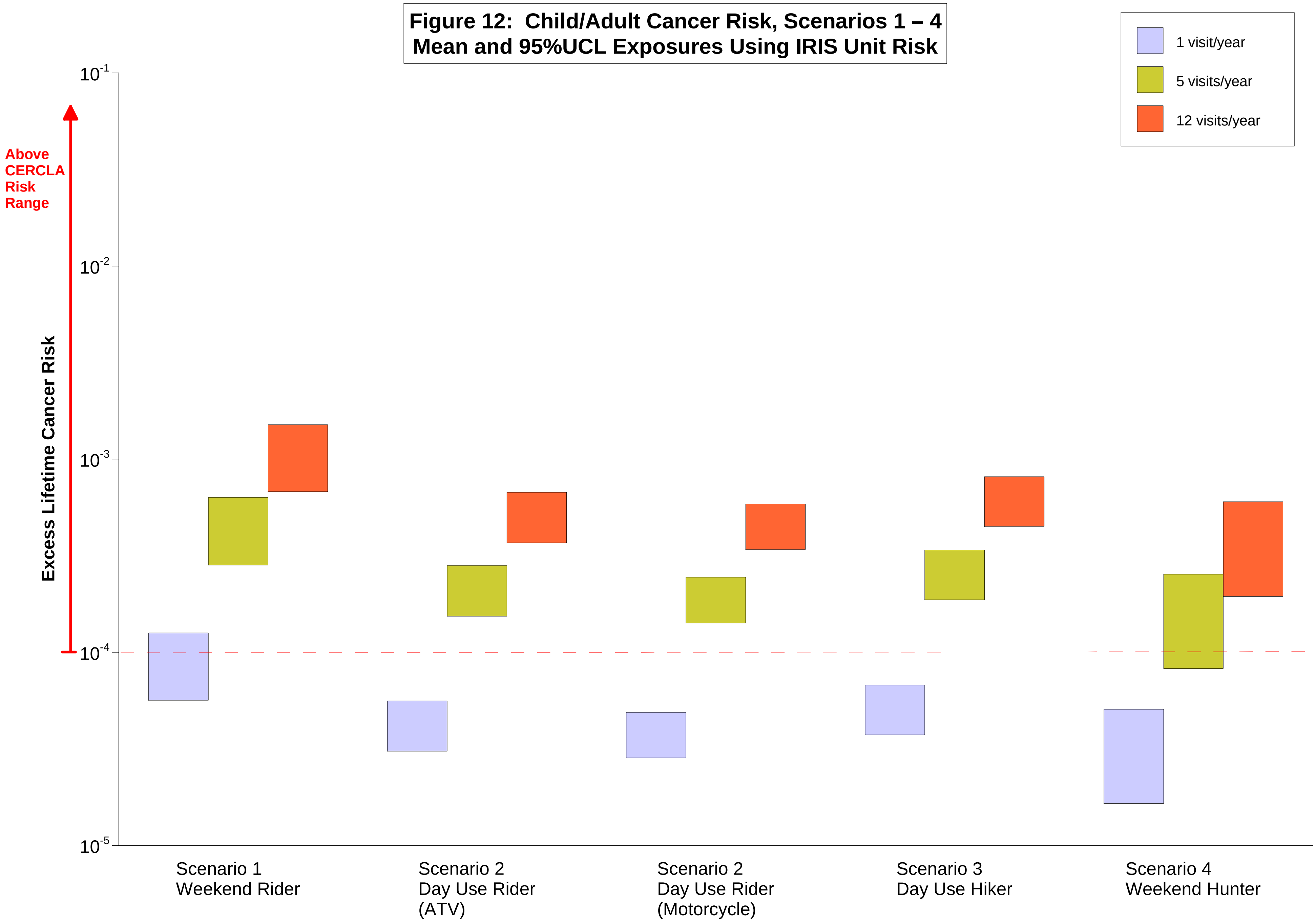


Figure 12: Child/Adult Cancer Risk, Scenarios 1 – 4
Mean and 95%UCL Exposures Using IRIS Unit Risk
1 visit/year
5 visits/year
12 visits/year
Above CERCLA Risk Range
Excess Lifetime Cancer Risk
10-1
10-2
10-3
10-4
10-5
Scenario 1 Weekend Rider
Scenario 2 Day Use Rider (ATV)
Scenario 2 Day Use Rider (Motorcycle)
Scenario 3 Day Use Hiker
Scenario 4 Weekend Hunter

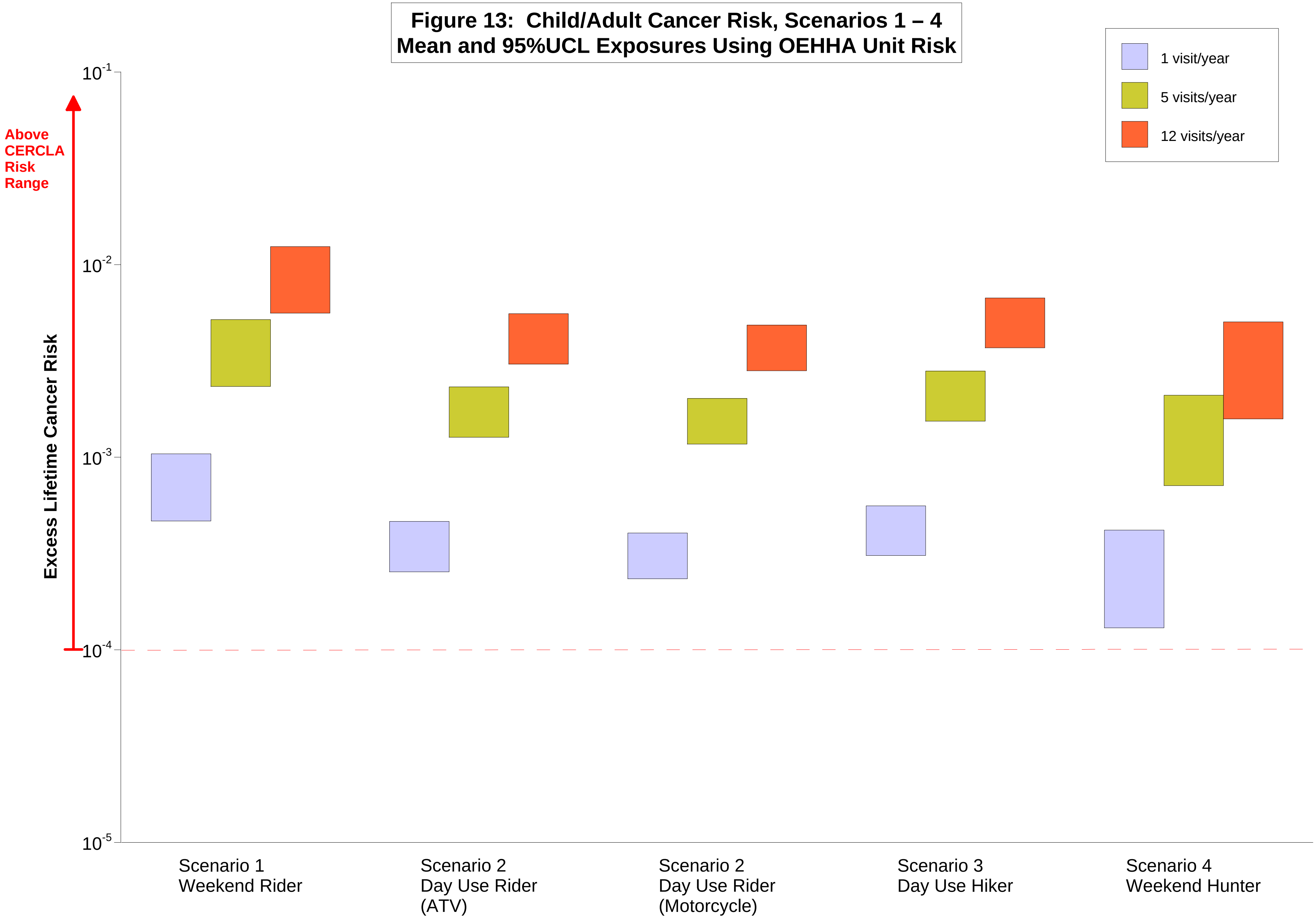


Figure 13: Child/Adult Cancer Risk, Scenarios 1 – 4
Mean and 95%UCL Exposures Using OEHHA Unit Risk

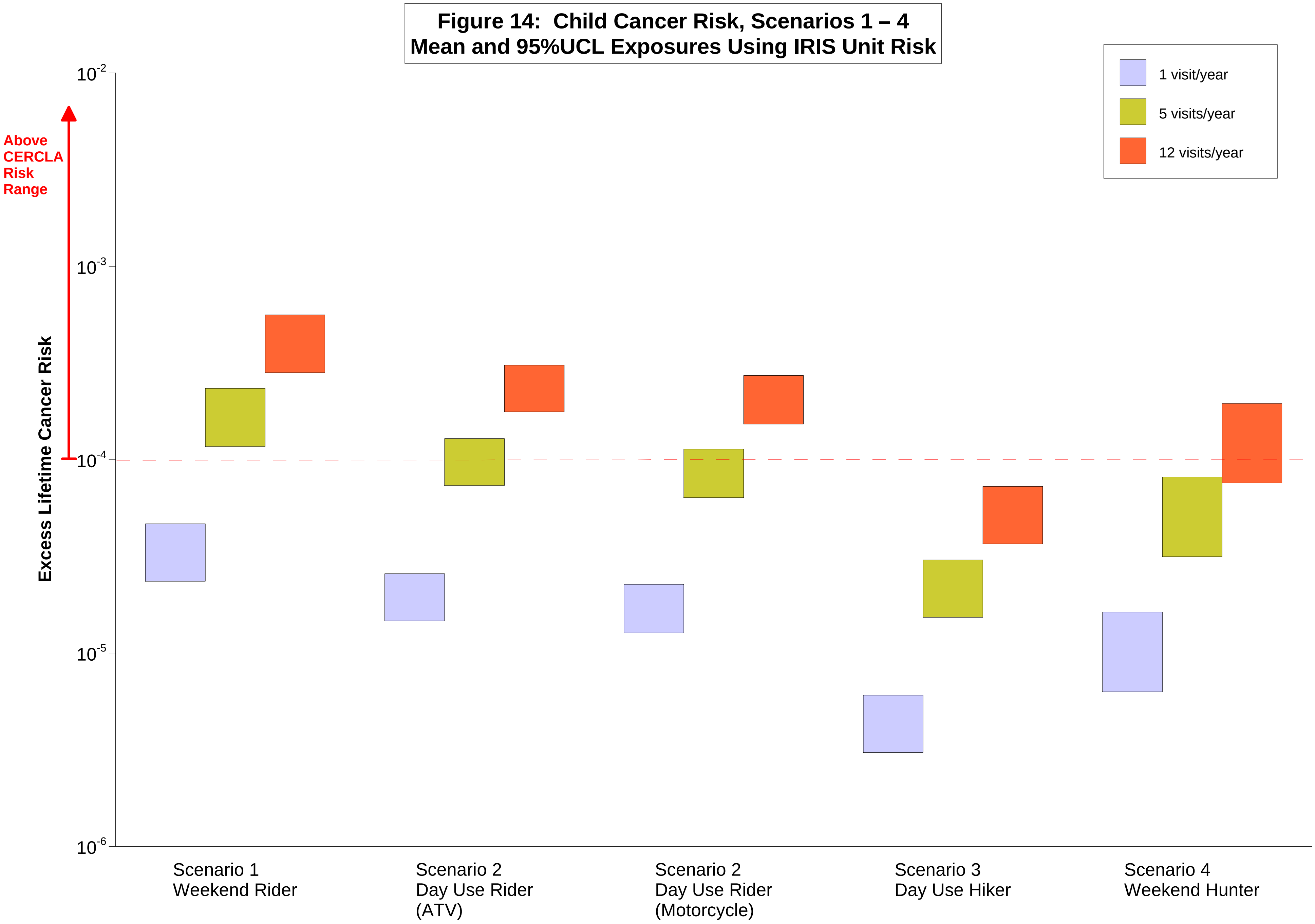


Figure 14: Child Cancer Risk, Scenarios 1 – 4
Mean and 95%UCL Exposures Using IRIS Unit Risk
1 visit/year
5 visits/year
12 visits/year
Above CERCLA Risk Range
Excess Lifetime Cancer Risk
10-2
10-3
10-4
10-5
10-6
Scenario 1 Weekend Rider
Scenario 2 Day Use Rider (ATV)
Scenario 2 Day Use Rider (Motorcycle)
Scenario 3 Day Use Hiker
Scenario 4 Weekend Hunter

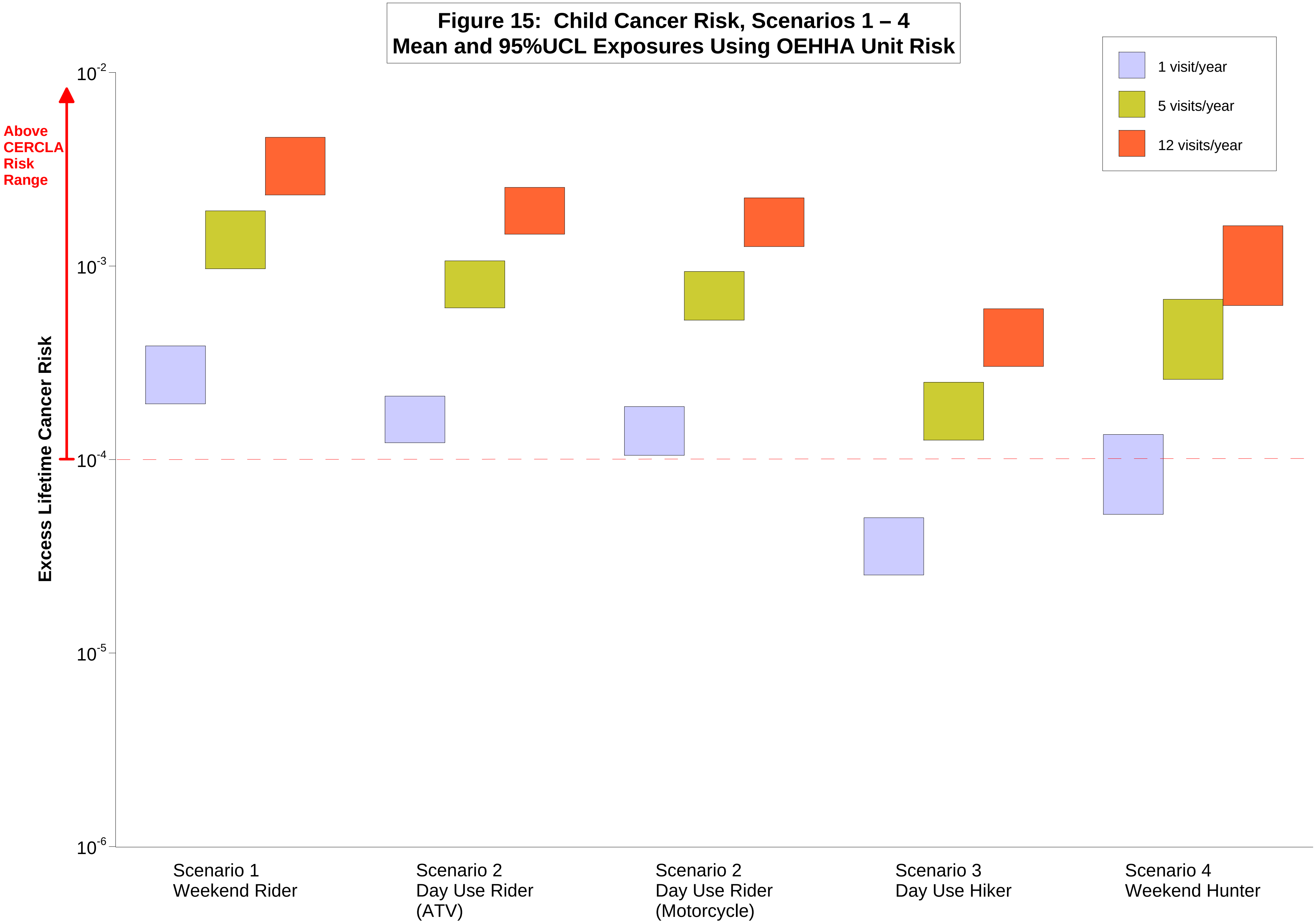
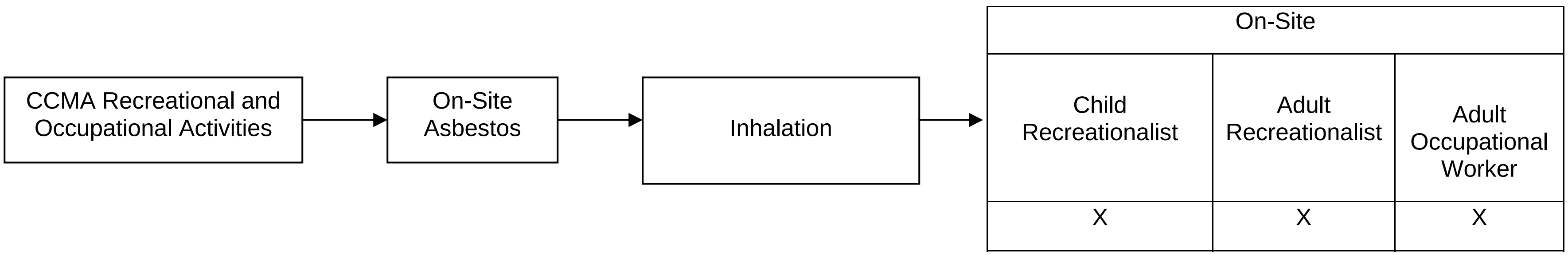


Figure 15: Child Cancer Risk, Scenarios 1 – 4
Mean and 95%UCL Exposures Using OEHHA Unit Risk
1 visit/year
5 visits/year
12 visits/year
Above
CERCLA
Risk
Range
Excess Lifetime Cancer Risk
10-2
10-3
10-4
10-5
10-6
Scenario 1
Weekend Rider
Scenario 2
Day Use Rider
(ATV)
Scenario 2
Day Use Rider
(Motorcycle)
Scenario 3
Day Use Hiker
Scenario 4
Weekend Hunter

Appendix A
CCMA Asbestos Exposures (All Events) Human Health Risk Assessment Conceptual Site Model

CCMA Asbestos Exposures (All Events) Human Health Risk Assessment
Conceptual Site Model



Notes:

X = Pathway is complete and may be significant; sufficient data are available for quantitative evaluation

Appendix B
Activity-Based Sampling "Scripts"

APPENDIX B

Activity-Based Sampling "Scripts"

The following describes the scripts that were followed during activity-based air sampling at the CCMA. The monitoring activities were conducted by private contractors or EPA staff with 40-hour hazardous waste certifications, or the Pacific/Atlantic Strike Teams of the U.S. Coast Guard, trained in emergency response. The samplers wore personal protective gear that included, at a minimum, tyvec suits and a full or half face respirator with filters. Additional protective gear was worn depending on the activity (e.g., helmets for recreational vehicle operation).

The specific activities included: recreational vehicle operation (motorcycle, ATV and SUV), hiking, camping, fence building, vehicle decontamination (washing and vacuuming).

Motorcycle Riding: "Motocross" type bikes with rock and hand guards were used. A group of 2-3 riders wore personal air samplers while riding in single file along a specified route. The distance between riders varied depending on visibility, terrain, and safety considerations, with the ultimate objective to realistically simulate the behavior of recreational riders. The second and third trailing riders rode in the dust cloud of the lead rider, to the extent safe and practical. The average speed was approximately 18 mph, although this speed varied considerably due to rough terrain, which included serpentine barrens, stream crossings, steep hills, flat roads, and gullies.

Motorcyclists followed Routes A (morning) or B (afternoon). These routes were selected based on input by CCMA recreational users and the enforcement officer. Two different routes were used in order to increase the geographic coverage of the sampling effort and, therefore, better represent the exposure of a typical rider. In addition, the length of each route was selected such that riders completed their route shortly after the pre-programmed pumps shut off. Based on the results of the September 04 pilot sampling event, this duration was determined to be less than 1 hour for vehicular activities. The selected routes were loops that started and ended at Oak Flat Campground and were approximately 15-20 miles long.

The route that riders actually followed varied slightly from run to run. In some cases, this was due to variations in road conditions which forced diversions from the main route. In other cases, differences in the expertise of the riders in rough terrain forced them to take alternative routes. These variations were not unlike those that might occur among typical recreational users due to safety concerns (e.g., fatigue), level of expertise, or individual preference.

4-Wheel Drive SUV: 4-wheel drive SUV vehicles (similar to a Jeep Cherokee) were used. Two vehicles were driven in single file, with windows open or closed, depending on the specification for a given sampling run. A personal air sampler was worn by the drivers of both leading and trailing vehicles. Another air sampler was attached to the back seat, behind the driver, to simulate a child's exposure. Distance between vehicles was based on terrain, visibility, and safety considerations with the trailing driver riding in the dust clouds of the lead driver, as much as safe and practical. The average speed was approximately 10 mph, although this speed varied considerably due to variable terrain.

The SUV route was the main county road, running alongside Clear Creek, that provides access to six OHV staging areas. The approximately 10-mile loop on this dirt road started at the Oak Flat Campground with a turn-around at Staging Area 6.

ATV (All Terrain Vehicle): Two to three 4-wheel-drive ATVs (also referred to as "quads") were used. The vehicles were driven in single file on approximately 15-20 mile loops at an average speed of about 15-20 mph. The distance between riders was based on terrain, visibility, and safety considerations. The trailing rider(s) remained in the dust cloud of the leading rider, to the extent safe and practical. The specified routes (A and B) were the same as those used by the motorcycle riders. As with the motorcyclists, the actual route traveled varied slightly from run to run due to variations in route conditions and/or rider expertise.

Hiking: Two persons, wearing personal air samplers, hiked about 1 mile along a CCMA hiking trail then returned by the same route. The hikers maintained their positions as either lead or trailing hiker for the entire run. The hikers were directed to take at least one 5-minute rest stop during which the hiker could take a short side trip off the route to explore for rocks or observe the creek. The hiker maintained a casual pace (e.g., 1-2 miles/hr), so that the hike duration was approximately 1 hour. The route selected for this hike began at Staging Area 2 and followed a well traveled path up a hill along a creek.

Camping: Two persons, wearing personal air samplers simulated camping activities at Staging Area 2. The camping activities were designed to simulate setting up a tent camp in early evening, preparing dinner, and then dismantling the camp the next morning. The activities included removing camping gear from the back of an SUV, pretending to cook a meal using a portable charcoal grill and typical cooking equipment, pitching a small 2-person tent, moving sleeping bags and pads into the tent and unrolling them, dismantling the tent, and sitting on a chair next to the cooking stove for the duration of the sampling run (until the pumps shut off). The duration of these activities was approximately 1 hour.

Sleeping Camper: A stationary monitor mounted on a tripod was placed inside the pitched tent alongside the sleeping bags. This sampler ran for approximately 8 hours to simulate a sleeping camper.

Fence Building: Monitors were placed on persons who helped BLM staff build a fence in an unvegetated, barren area. Each person's activities included post-hole digging for at least 5 minutes, while the majority of time was spent stringing fence wire between poles and connecting wires to each other.

Vehicle Decontamination: The SUVs used during the study were decontaminated at the BLM vehicle decontamination facility located outside the CCMA at "Section 8". Washing and vacuuming activities were monitored separately.
Vehicle washing was performed in two different ways, each monitored separately: 1) a freely running garden hose with no nozzle attachment was used to wet the vehicle, which was then washed with a cloth followed by rinsing. 2) a high pressure spray wand, similar to those available at commercial carwashes, was directed at the vehicle. The vehicle undercarriage and tire wells were cleaned to the extent possible. In addition, the hood of

the vehicle was raised and rinsed to remove as much dust as possible. The duration of the activity was 20-30 minutes per vehicle.

The interiors of the vehicles were vacuumed using one of two types of vacuum: 1) HEPA vacuum; 2) regular vacuum with non-HEPA filter. The vacuuming continued until the air sampling pump was shut off, which was approximately 20 minutes.

Post decontamination SUV riding: On several occasions, persons driving decontaminated SUVs to destinations outside the CCMA wore personal samplers. These runs were conducted at the end of a sampling day or event.

Appendix C
Activity-Based and Ambient Air Sampling Pump Calibration and Technical Information

APPENDIX C

Activity-Based and Ambient Air Sampling Pump Calibration and Technical Information

Activity Based Sampling (ABS)

For the activity based sampling events, calibrated air pumps were carried inside the backpacks of the samplers and were connected to the air filter cassettes by plastic tubing. The pumps were on automatic timers that controlled the duration of pumping. The personal sampling pumps were calibrated to collect between 1 and 4 L/min of air through the filter depending on the capacity of the pump. The sampling pumps used provided non-fluctuating airflows through the filter, and maintained the initial volume flow rate to within ± 10% throughout the sampling period. If the flow rate changed by more than 5% during the sampling period, the average of the pre- and post-sampling rates was used to calculate the total sample volume.

During ABS activities, participants were generally fitted with two sampling pumps to collect a high-flow or volume and a low-flow or volume sample. Co-located samples were collected to sample a high and low volume of air to increase the likelihood that at least one of the two samples would be readable using the direct analytical method (ISO 10312).

For all activity-based sampling events, except as noted otherwise, asbestos samples were collected from the breathing zones of the event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual is actually breathing. Additionally, for many events, air samples were also collected from the breathing zone height of a child to simulate potential exposure to a child.

Sampling Pump Calibration

Personal Sampling Pumps were calibrated using a rotameter that had been calibrated against a primary standard as follows:

- The sampling/calibration train was assembled by attaching one end of a section of polyvinyl chloride (PVC) tubing (approx. 2 ft) to the cassette base and the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.
- The rotameter flow meter was held within 6 degrees of vertical (Omega 1987) to ensure correct flow measurements.
- The sampling pump was turned on.
- The flow adjustment screw on the personal sampling pump was adjusted until the float ball on the rotameter lined up with the pre-calibrated flow rate value on the rotameter.

Pre and post flow rate verification of calibration was performed on-site in the clean zone immediately prior to and subsequent the sampling.

Ambient Air Stationary Sampling

Background/reference samples were collected for all sampling events. A background or reference sample is defined as a sample collected upwind at a distance sufficient to prevent being influenced by the simulated activities and outside the site perimeter. To the degree practical, the area selected for background or reference sampling should be free of known asbestos contamination. The background level should reflect the concentration of asbestos in air for the environmental setting on or near a site or activity location and can be used to evaluate whether or not a release from the site or activity has occurred. A background level may or may not be less than the detection limit, but if it is greater than the detection limit, it should account for variability in local concentrations. Background or reference samples were collected concurrent with ABS using stationary sampling pumps. Sampling and analytical parameters (sample volume grid opening count, etc.) were prescribed to permit a detection limit approximately an order of magnitude below that of the ABS detection limit.

Aircon II sampling pumps were calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate allowed a minimum target volume of 4000 L to provide a sensitivity limit appropriate for the CCMA site.

The area referred to as Section 8 or the BLM facility was designated as the background or reference location. Additional ambient air sampling locations were established for asbestos monitoring at the Oak Flats Campground, Staging Area 2, and Staging Area 6.

Appendix D
Laboratory QA/QC and Data Management

APPENDIX D

Laboratory QA/QC and Data Management

The following Laboratory Requirements were stipulated for analysis of the CCMA air samples:

Laboratory analysis will be performed to identify and determine asbestos fiber concentrations using Transmission Electron Microscopy (TEM) methodology based on International Organization for Standardization (ISO), International Standard, ISO 10312 (1995(E)), Ambient Air – Determination of Asbestos Fibers – direct-transfer TEM Methodology.

Samples must be analyzed by an analytical laboratory that is currently accredited by the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) for Airborne Asbestos Fiber Analysis.

The laboratory must have successfully analyzed an Environmental Protection Agency Performance Evaluation (PE) sample for asbestos in air within the past 12 months. These samples were produced for EPA by RTI Inc. Research Triangle Park, North Carolina.

The Laboratory must have experience, and provide documentation, analyzing air samples containing naturally occurring asbestos from California.

Analysis shall be performed per ISO 10312 and shall include but not be limited to the following asbestos fiber and mineral identification criteria for each of the collected samples:

Asbestos fibers and complex structures:

- Fibers between 0.5 µm (micrometers) and 5 µm in length
- Fibers and Structures greater than 5 µm in length
- Phase Contrast Microscopy Equivalent U.S. (PCME US) fibers and structures (greater than 5 µm in length with a 3:1 aspect ratio and a width between 0.25 to 3 microns, inclusive).
- Fibers and structures greater than 0.5µm in length with a 3:1 aspect ratio.

Asbestos fiber mineral identification procedures (e.g. chrysotile, asbestiform amphibole, and other "regulated" asbestiform minerals); as well as any other asbestiform fibers identified during TEM analysis including unregulated fibers (e.g. wincherite and richerite), cleavage fragments, and transition fibers:

- Energy Dispersive X-ray Analysis or Electron Diffraction analysis is required to identify structure/fiber minerals.

The required TEM Analytical Sensitivity (S/cc) and Limit of Detection (fibers/cc) are:

- 0.005 S/cc for activity related sampling and
- 0.0005 S/cc for ambient air sampling.

Unique Counting Rules

The laboratory shall continue to count structures until at least 50 structures have been counted; in the event that less than 4 PCME US fibers have been counted with in the set of 50 structures, contact the REAC Contracting Officer for direction.

Laboratory QA/QC

Laboratory shall conduct internal QA/QC checks on the analysis per section 9.7 of ISO 10312. Laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment. Calibration activities performed will be documented in the analytical data package and will be available for review during internal and external laboratory audits.

Reports and Deliverables

The Laboratory shall provide an electronic data deliverable compatible with Microsoft Access, Excel or Scribe. The laboratory shall use a modified version of the Region 8 Excel Spreadsheet TEM27 (or latest version available at the time of analysis) or similar database to record all applicable sample, analytical and fiber/structure data including but not limited to the following:

- Grid
- Grid Opening
- Number of Structures
- Structure Type or class
- Mineral classification
- Length
- Width
- Aspect ratio
- Comments
- Sketches
- Photos

In addition to the previously requested electronic deliverable, the laboratory shall provide a summary table containing the information in the following example:

Table 9e										
Summary of Asbestos results for all sampling events										
Sample #	Analyte	Result	Units	Qualifier	MDL	Units	Analytical Sensitivity	Volume		Field Remarks
16571-A	Asbestos Concentration	0.00148	(S/cc)	<	0.00148	(S/cc)	0.0005	1189.5	Liters	
16571-A			Structures	ND			0.0005	1189.5	Liters	
16572-A	Asbestos Concentration	0.0015	(S/cc)	<	0.0015	(S/cc)	0.0005	2408.25	Liters	

The laboratory shall also summarize the data as follows or similar for each sample:

Lab Sample #	**Volume (L)**
REAC Id #	**Number of Grid Openings**
REAC Description	**Filter Area (mm²)**
Analysis Date	**Area analyzed (mm²)**
Analyst Initials	**Analytical Sensitivity. (Structures/cc)**
	Detection Limit. (Structures/cc)

Structure Type	Filter Density (s/mm2)	Concentration (struc/cc)	95% Confidence Interval (struc/cc)	Structure count
Primary Asbestos Structures				
Total Asbestos Structures				
Asbestos Structures > 5µm				
Asbestos Fibers and Bundles > 5µm				
PCM Equivalent Fibers-US				
PCM Equivalent Structures-US				
PROTOCOL ASB STRUCS				
PROTOCOL ASB STRUCS				
PROTOCOL ASB STRUCS TOTAL				
PROTOCOL CHRYS STRUCS				
PROTOCOL CHRYS STRUCS >10 0.0				
PROTOCOL CHRYS STRUCS TOTAL				
PROTOCOL AMPH STRUCS 5-10 0.0				
PROTOCOL AMPH STRUCS >10 0.0				
PROTOCOL AMPH STRUCS TOTAL				
EPA2-like Total Asbestos Structures				
EPA2-like Asbestos Structures 0.5-5.0				
EPA2-like Asbestos Structures > 5				
EPA2-like Asbestos Structures 5-10				
EPA2-like Asbestos Structures > 10				
EPA2-like Total Other Amph Strucs				
EPA2-like Other Amph Strucs > 5 0				
EPA2-like Other Amph Strucs 5-10 0.0				
EPA2-like Other Amph Structs >10 0.0				
Cleavage Fragments				

The following table represents the approximate number of samples, volume of air collected and level of analytical sensitivity required.

SAMPLE NUMBER AND VOLUME ESTIMATE

Number of Samples	Sample Volume (L)	Level of Sensitivity	Price/Sample
70 low volume	120	0.005 S/cc	
70 high volume	**240**	**0.005 S/cc**	
35 low volume	80	0.005 S/cc	
35 high volume	**160**	**0.005 S/cc**	
15 low volume	60	0.005 S/cc	
15 high volume	**120**	**0.005 S/cc**	
35 low volume	840	0.0005 S/cc	
35 high volume	**4200**	**0.0005 S/cc**	
15 blanks	0	0.005 S/cc	

Overloading of samples is a concern so typically a high and a low volume sample was collected for each activity. The highest volume sample that is readable will be analyzed and the remaining sample, if any, will be archived for a period of 6 months by the laboratory. Values in bold are the anticipated high volumes, which should be analyzed if not overloaded.

Quality Control Data Utilization:

The laboratory that performed the asbestos counts reported a number of Quality Control (QC) sample types. Because of these differences in reporting, the sample results, and how they were utilized in the risk calculations, were treated differently depending upon their QC designation. Non-detected values are reported as less than the sensitivity analysis value. The equation used to calculate the sensitivity analysis value is:

$$\text{Sensitivity (S)} = Af / (k*Ag*V)$$

Where:
Af = the area, in square millimeters, of sampling collection filter;
Ag = the area, in square millimeters, of TEM specimen grid opening;
k = the number of grid openings examined;
V = the volume of air sampled, in liters

Listed below are the QC sample types, how they were used or considered in the risk calculations, and the rationale:

- **<u>Not QC sample</u>, revised count:** Use the latest revision, since multiple analysts determined the best definitions for fibers and the latest revision is their consensus opinion

- **Recount same grid (RS):** Average the recounted sample results since they are independent samples and there is no reason to expect one count to be more reliable than another
- **Recount different grid (RD):** Average the recounted sample results for same reason as for the RS sample results
- **Interlab (IL):** Average the result of the interlab sample results with the result of the original sample (not QC), since they are independent samples and there is no reason to expect one count to be more reliable than another
- **Repreparation (RP):** Average the result of the repreparation sample with the result of the original sample (not QC), since they are independent samples and there is no reason to expect one count to be more reliable than another
- **Verified Analysis (VA):** Use Verified Analysis result over original sample results
- **Field Duplicates:** Take the average of the sample results, since they are independent samples

Appendix E
Meteorological Information

APPENDIX E

Meteorological Information

Rainfall Preceding the Sampling Events[1]

The weeks leading up to all of the sampling events had weather that would be expected for the particular time of year. The local climatological stations, Santa Rita Peak (SRI) and Hernandez Reservoir (HDZ), reported no precipitation in the month leading up to the September 2004 sampling event and 0.55 inches was recorded at SRI on September 20, 2005, a week before the September 2005 sampling events. No rainfall was detected at HDZ for the month before the September 2005 event. For the two weeks prior to the November 2004 sampling, 3.27 inches of rain was recorded at SRI and 2.76 inches at HDZ. In the two weeks prior to the February 11, 2005 sampling event, 0.84 inches of rain was recorded at SRI and 0.65 inches at HDZ, including 0.16 inches and 0.12 inches recorded at each location on February 11 itself. Between February 11 and February 20, 2005, 1.93 inches of rain was recorded at SRI and 3.87 inches of rain fell at HDZ.

Meteorological Station Data

A meteorological station was deployed at Staging Area 2 during the November 2004, February 2005, and September 2005 sampling events. Graphs for each day depicting incoming solar radiation, relative humidity, and temperature are displayed in the following pages. Additionally, there are wind roses showing the frequency of speed and direction for each sampling day.

November 2, 2004

A typically sunny day – the solar radiation graphic is nearly a perfect parabola indicating highest values at noon and increasing and decreasing values before and after midday. The temperature graph is very typical for a sunny California day; chilly and below freezing before sunrise, quickly warming to over 70 degrees, before dropping back into the 30s before midnight. The relative humidity curve is opposite the temperature curve; highest in the morning than the air quickly dries out with percentages in the teens during the warmest part of the day before rising back into the 90s after sunset.

November 3, 2004

Unlike the first day of sampling, this day turned cloudy and cool with some drizzle. It is clear a weather system moved in from the Pacific Ocean as solar radiation readings were about 25% of the first day and temperatures remained in a tight range in the 50s. Humidity during much of the day ranged from 70 to 90 percent. It should be noted that after sampling ceased for the day, approximately .30 inches of rain fell later on the November 3 into the morning of November 4.

[1] Precipitation data from Department of Water Resources, California Data Exchange Center, www.cdec.water.ca.gov.

February 11, 2005

NOTE: There was a malfunction with the weather station that limited data collection to a start time of 1050 AM.

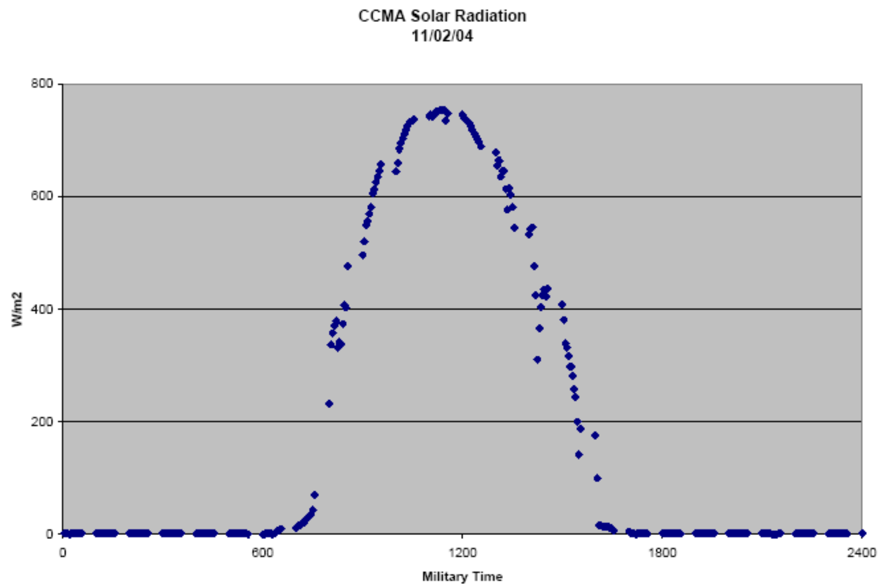
Solar radiation for this day was clearly minimized by cloud cover which is evident in the .04 inches of rain that fell during midday. Although it may not be intuitive, the maximum possible solar radiation for CCMA on February 11 is actually slightly higher than November 2 and 3. Even though the air temperature, on average, is noticeably cooler, the energy available for evaporation is slightly higher. Cloud cover limited solar radiation values to about ½ of the maximum seen in the November event. Additionally, the day was cool and moist with temperatures remaining in the 50s throughout the day.

February 20, 2005

An intermittent cloudy and damp day characterized the final sampling day in February. The solar radiation graph indicates that sunshine was able to break through the clouds at times as readings exceeded 500 watts per square meter (W/m2), more than ½ of the possible maximum for the day. Rainfall of .11 inches spread over the day indicates intermittent thick cloud cover and this helped suppress temperatures in the upper 40s and lower 50s while leaving the relative humidity high throughout the day.

September 27 through 29, 2005

Sunny and dry weather dominated the three-day sampling period. Afternoon temperatures reached the upper 70s on the 27th, increasing to the upper 80s on the 28th and the lower 90s on the 29th. Concurrently, minimum daytime relative humidity decreased each day from around 30% on the 27th to 10% on the 28th and 5% on the 29th. Solar radiation graphs for each day depict plenty of sunshine with graphical readings depicting a parabolic curve peaking just short of 900 W/m2 early each afternoon.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11/02/04
W/m2
800
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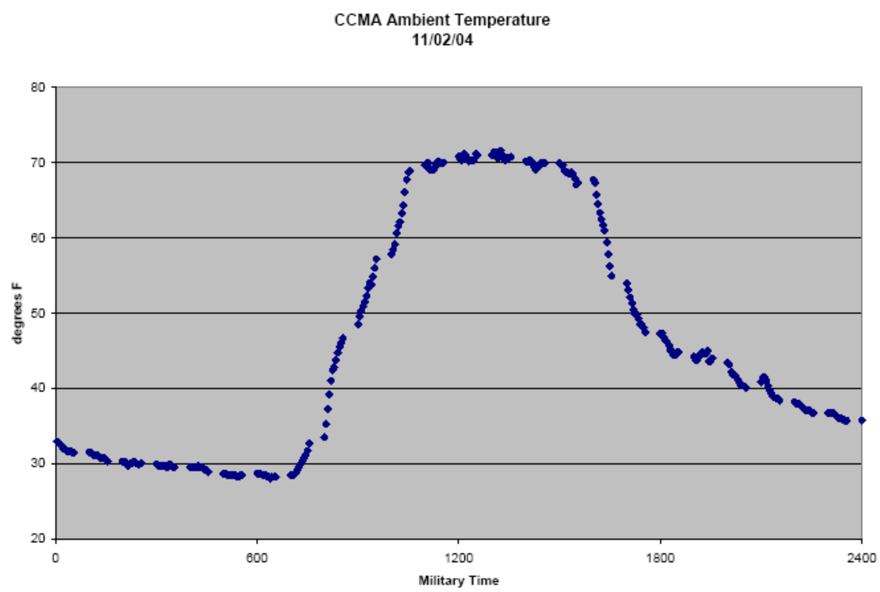
Military Time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degrees F
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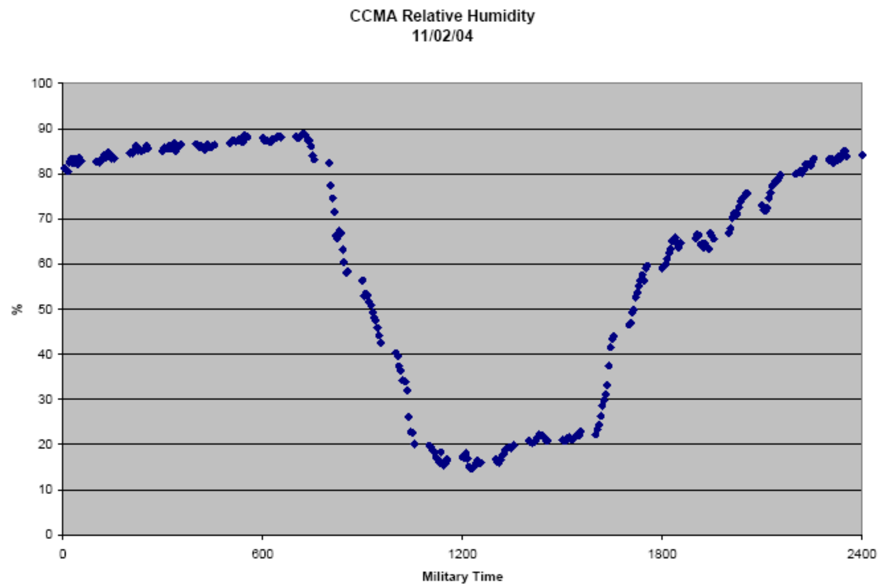
Military Time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11/02/04
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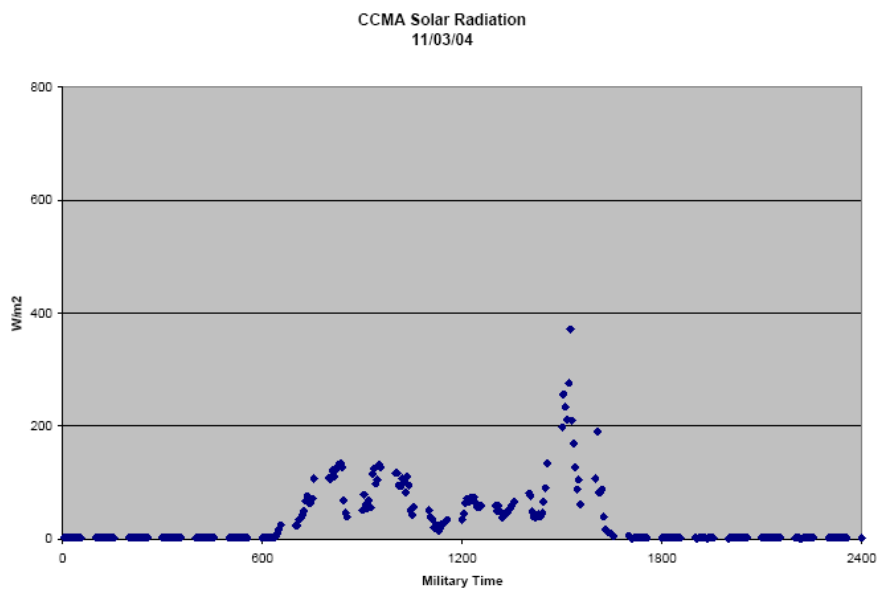
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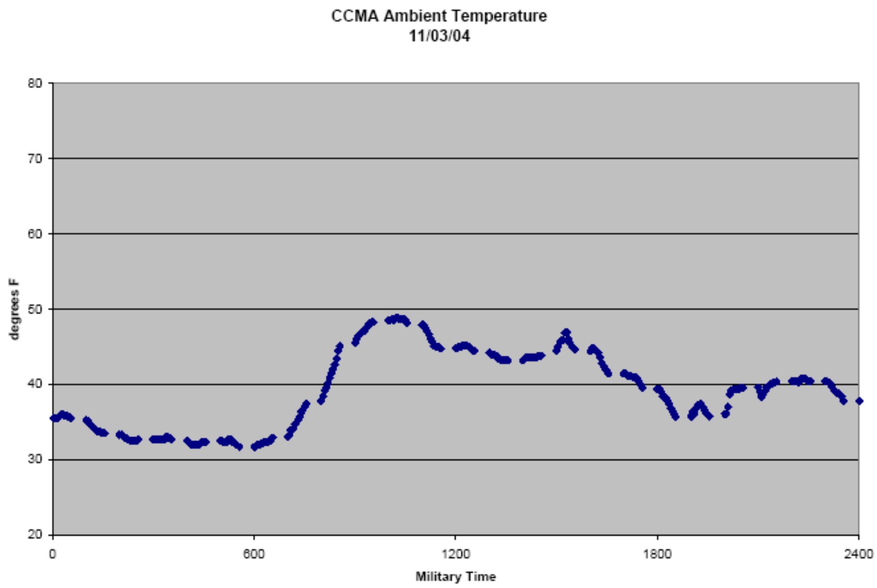
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degrees F
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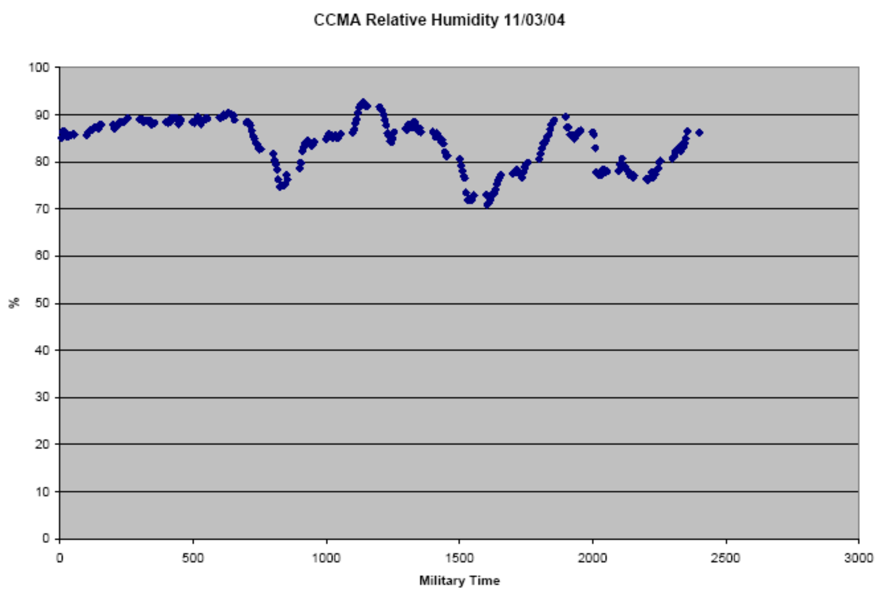
Military Time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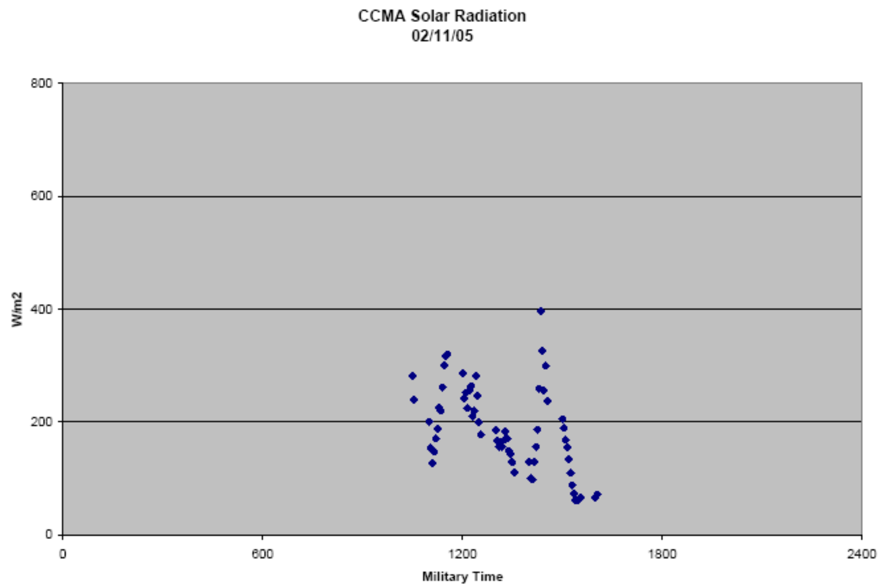
Military Time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02/11/05
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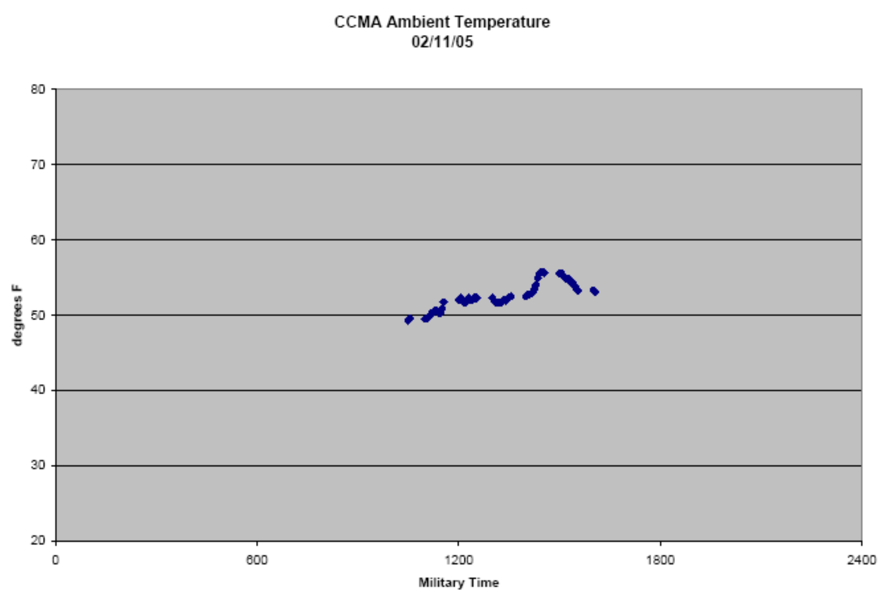
Military Time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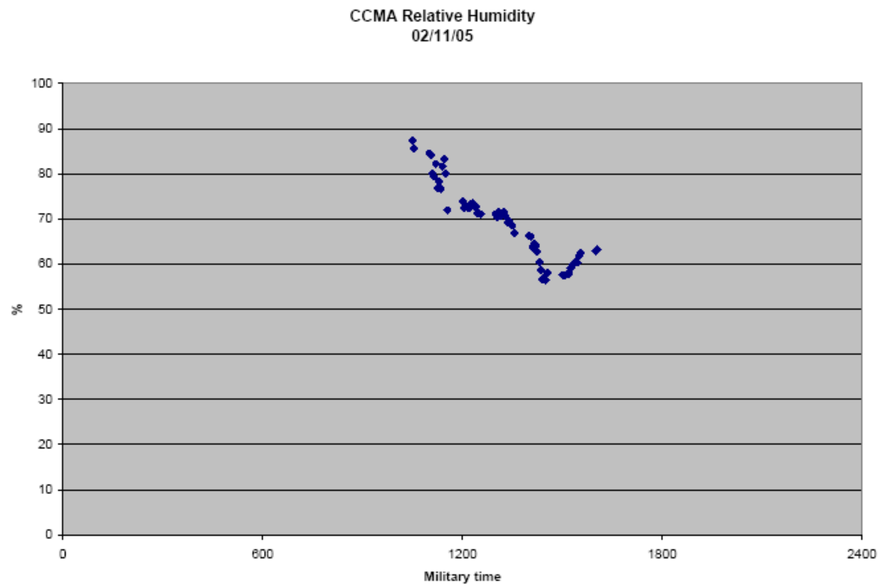
CCMA Relative Humidity
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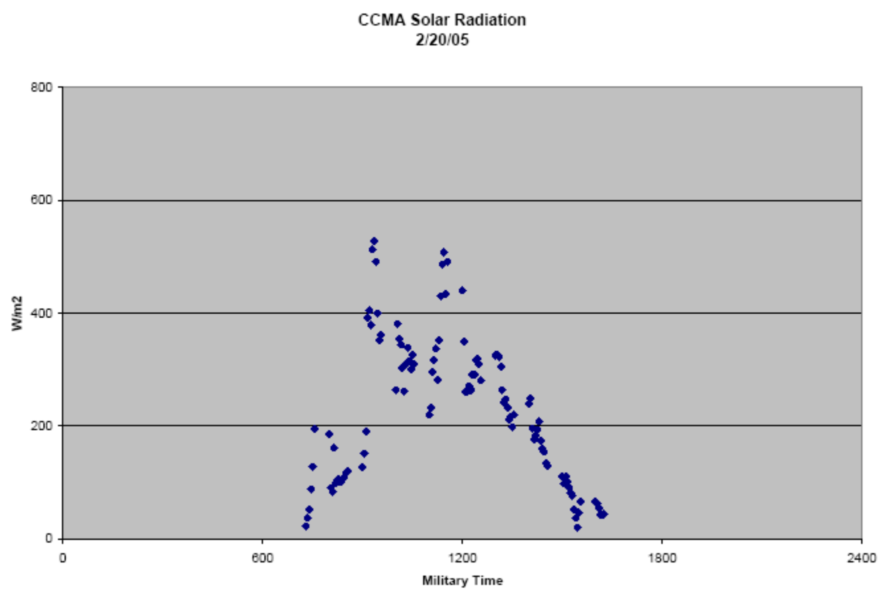
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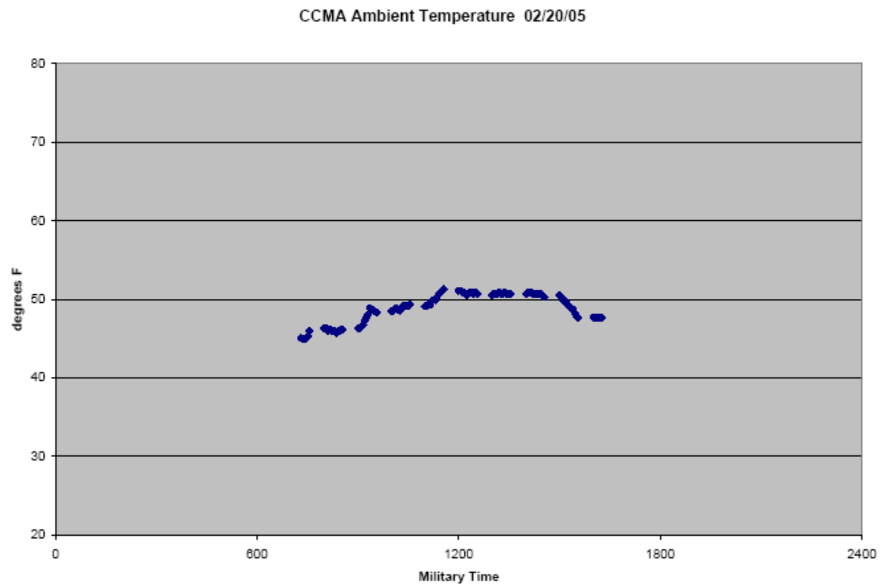
Military Time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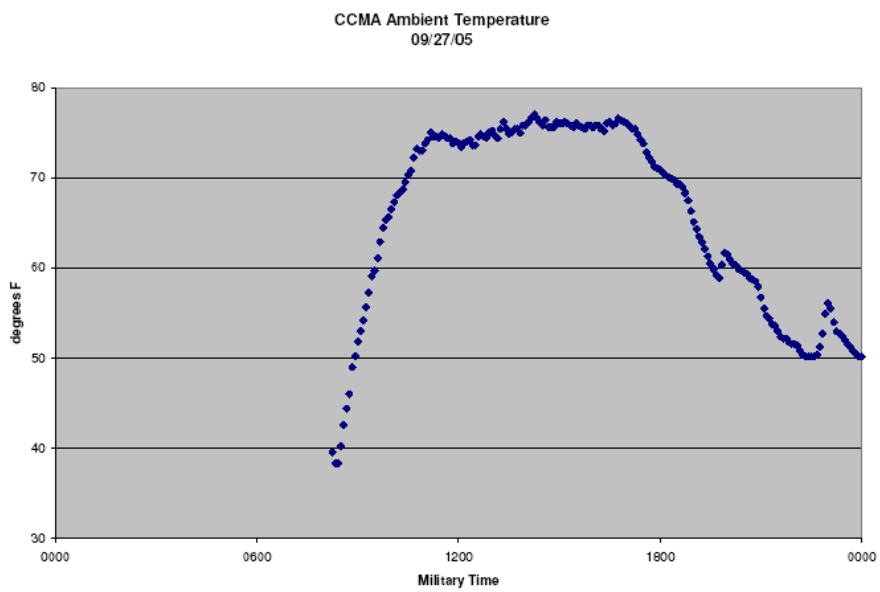
Military Time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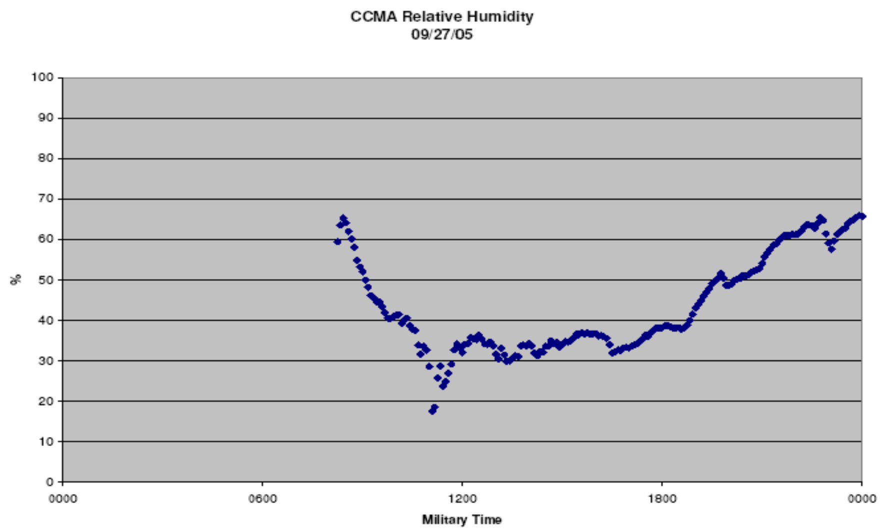
Military Time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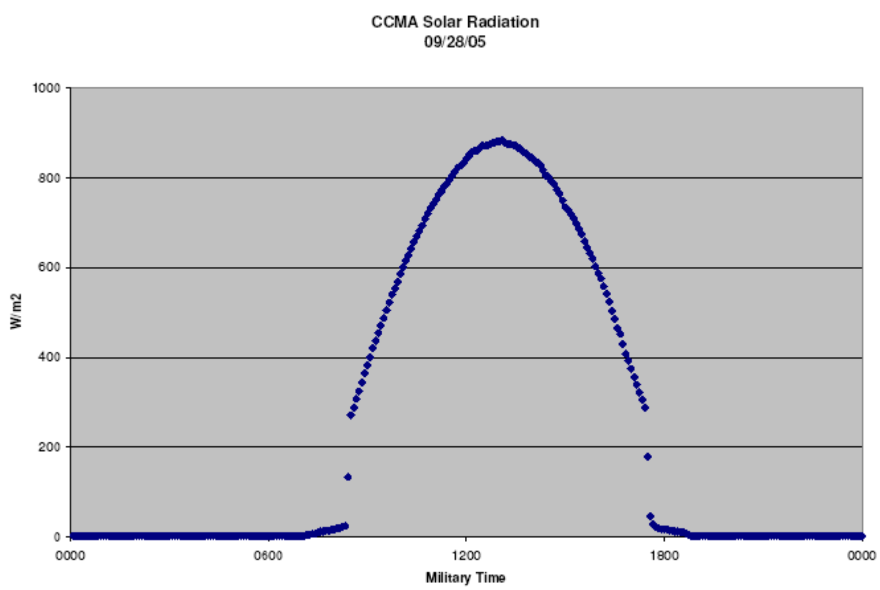
CCMA Solar Radiation
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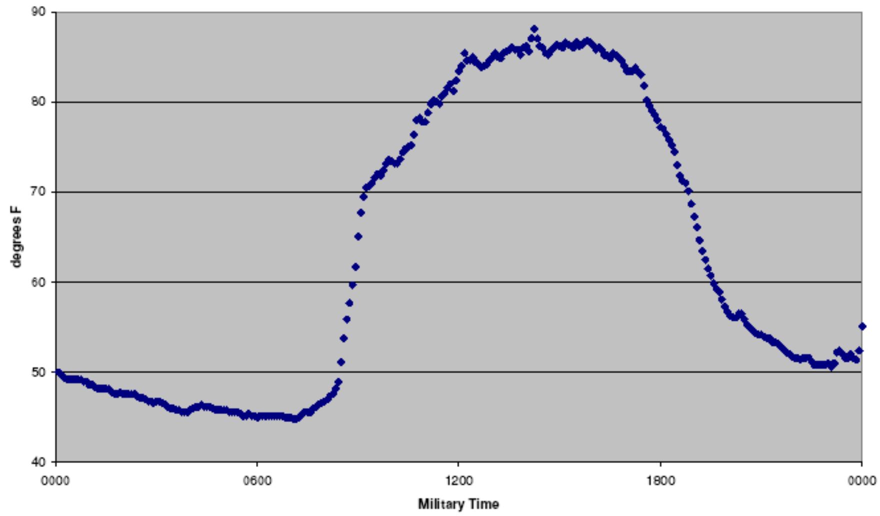
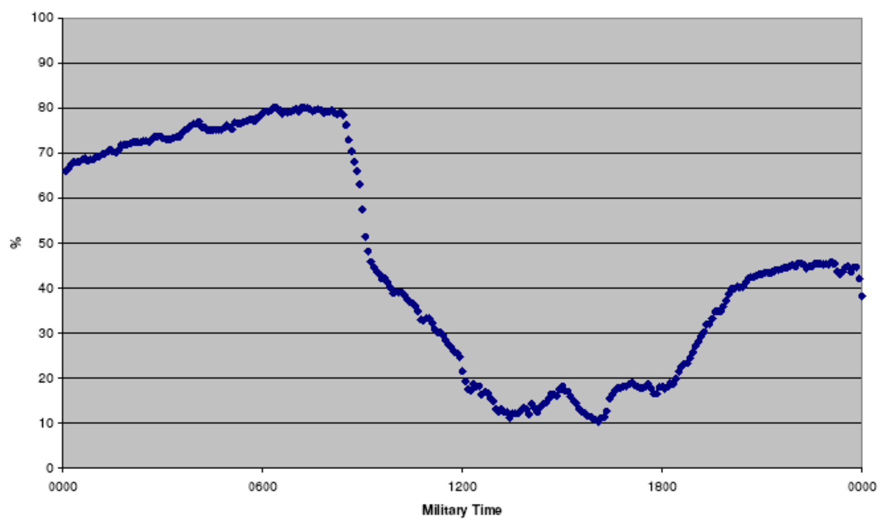
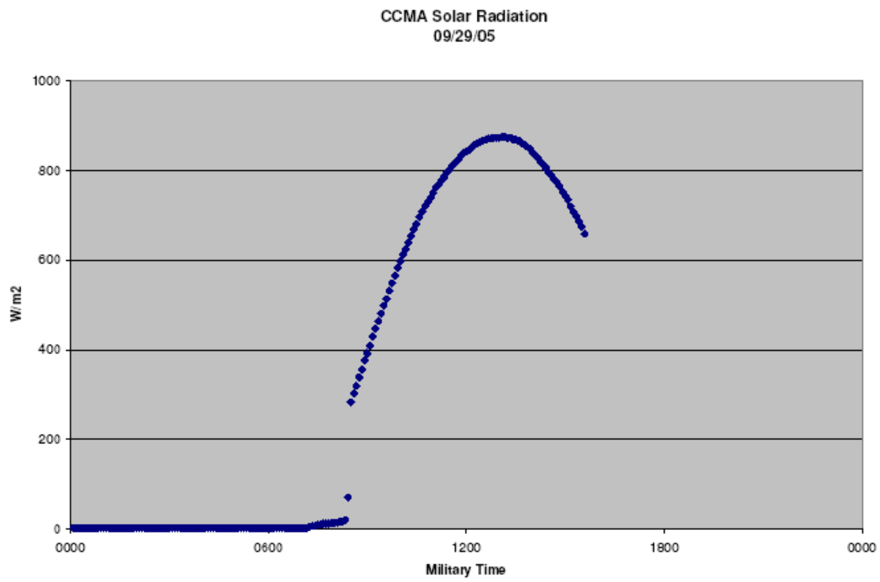
**CCMA Ambient Temperature
09/28/05**



**CCMA Relative Humidity
09/28/05**




CCMA Solar Radiation
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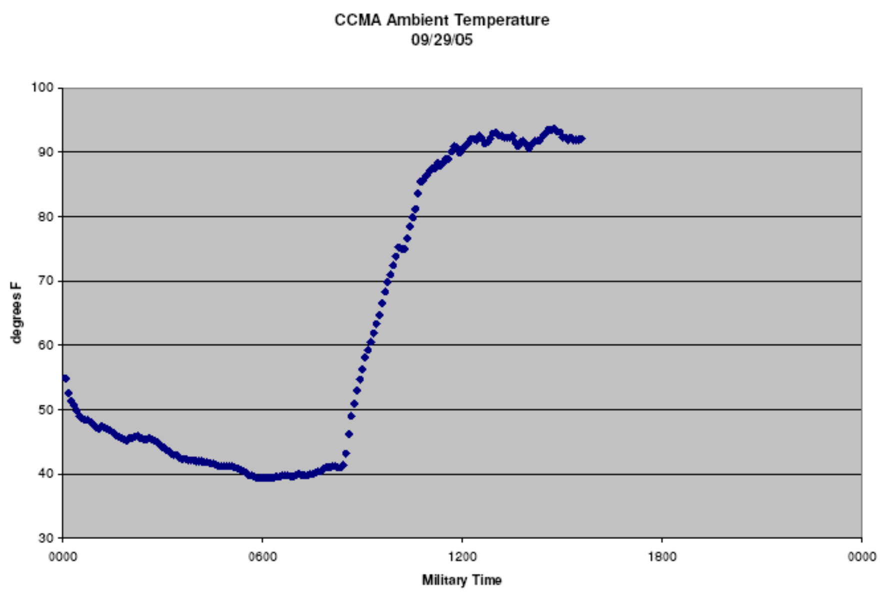
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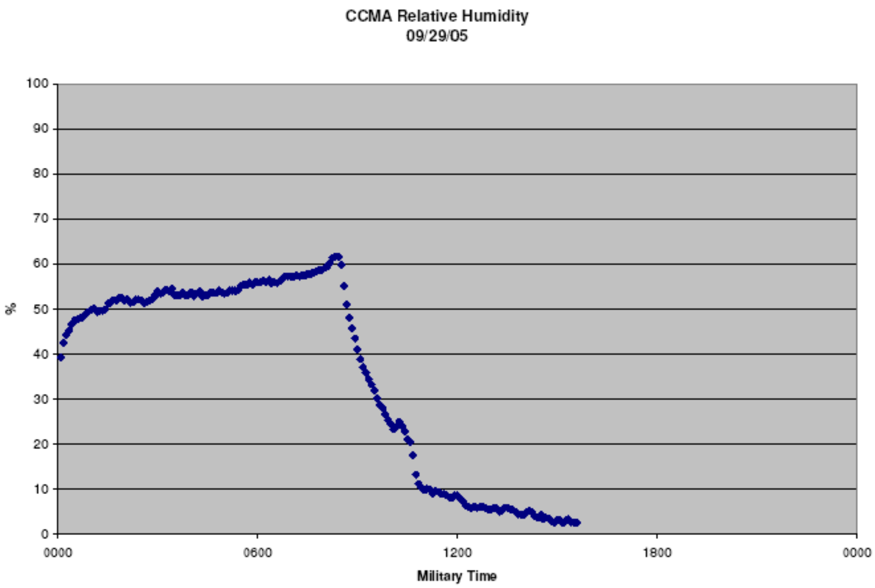
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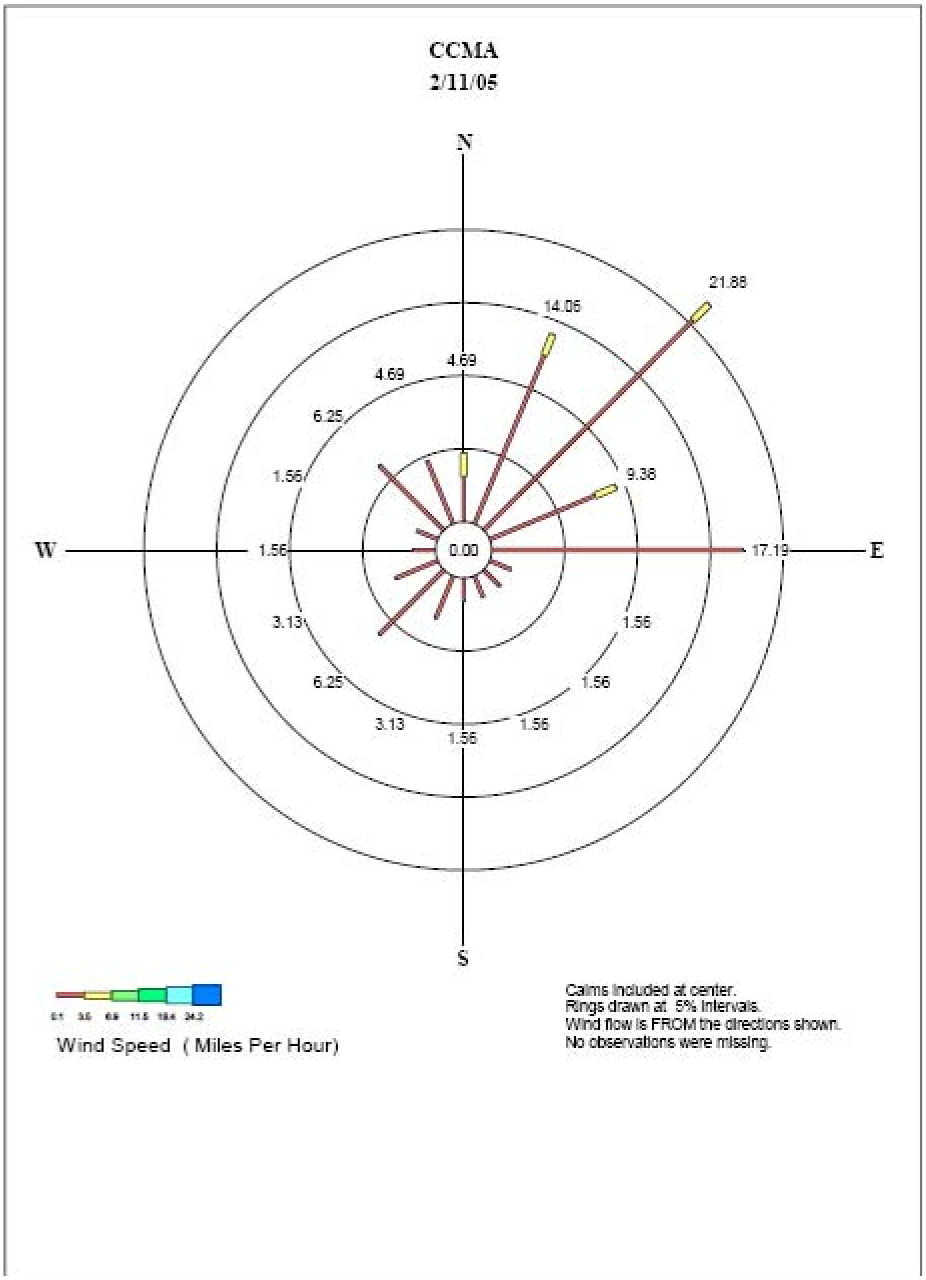
CCMA
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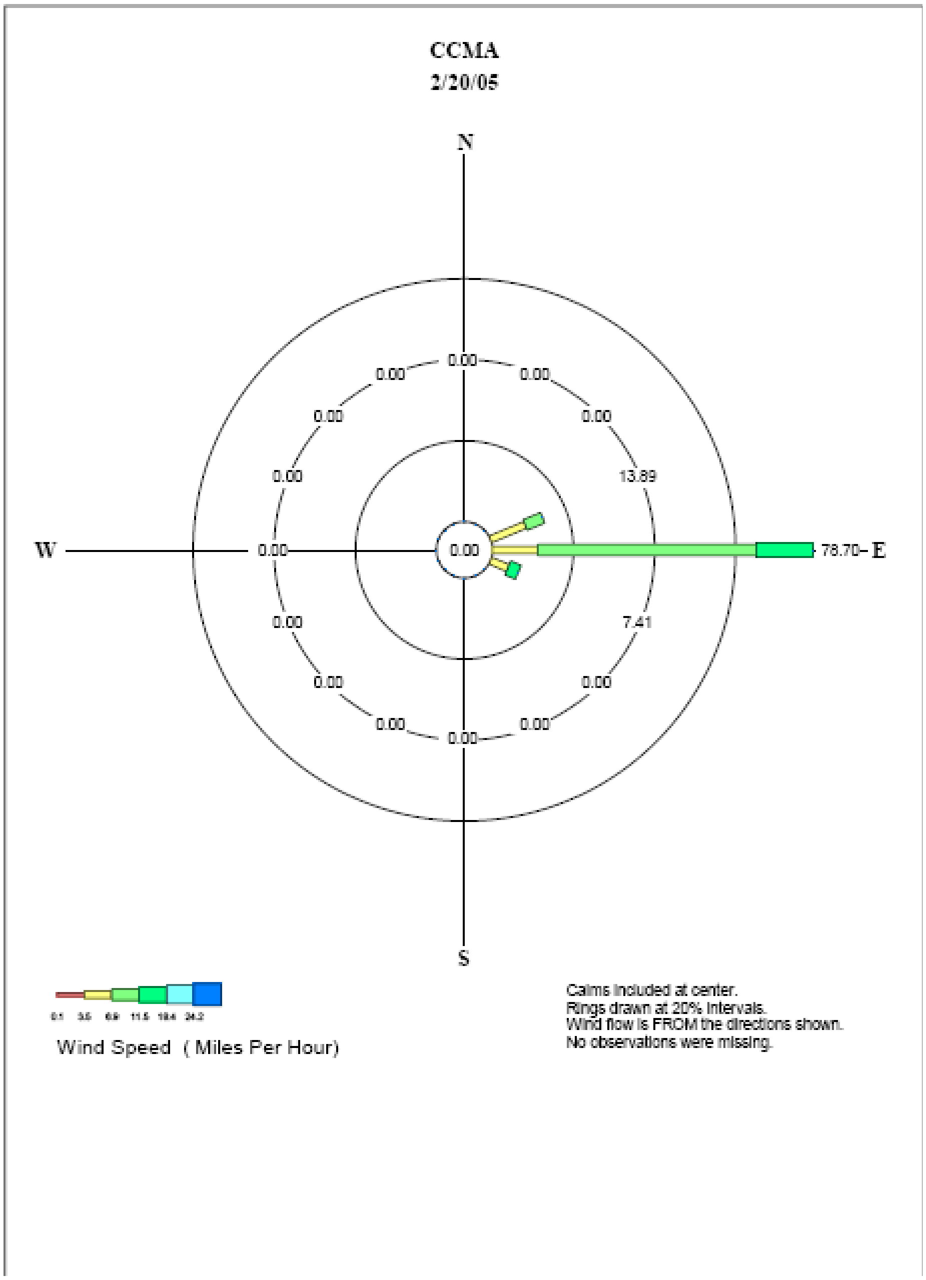
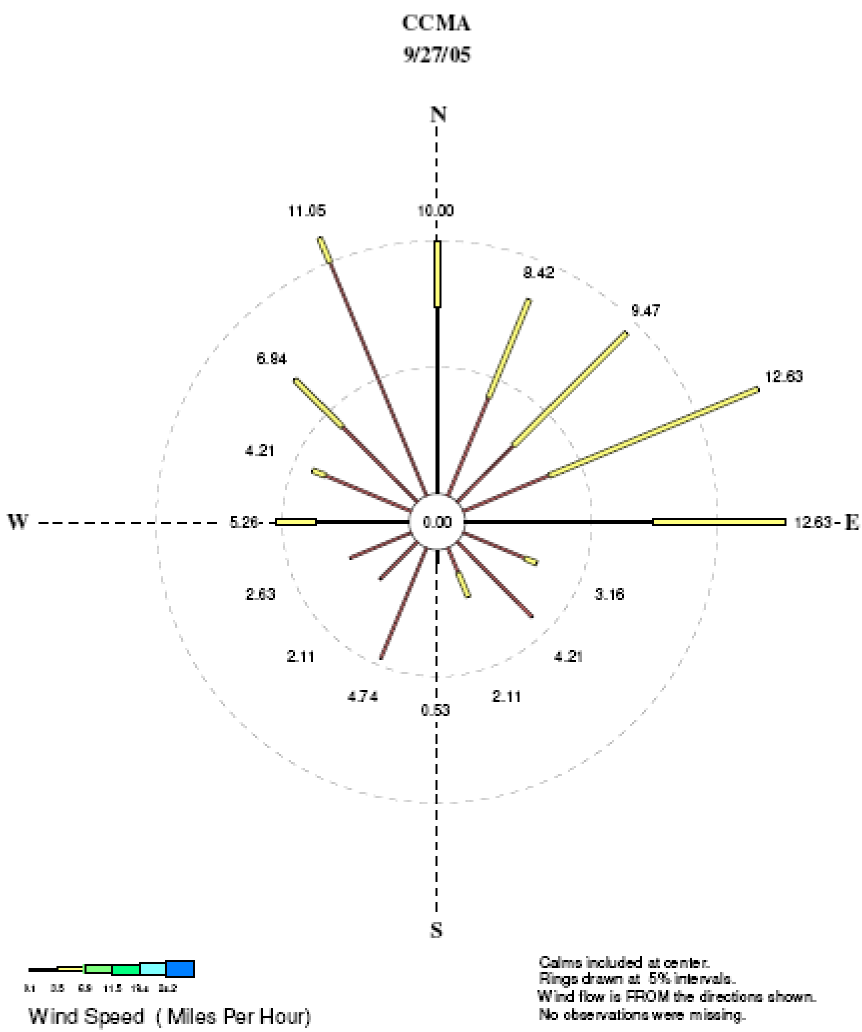
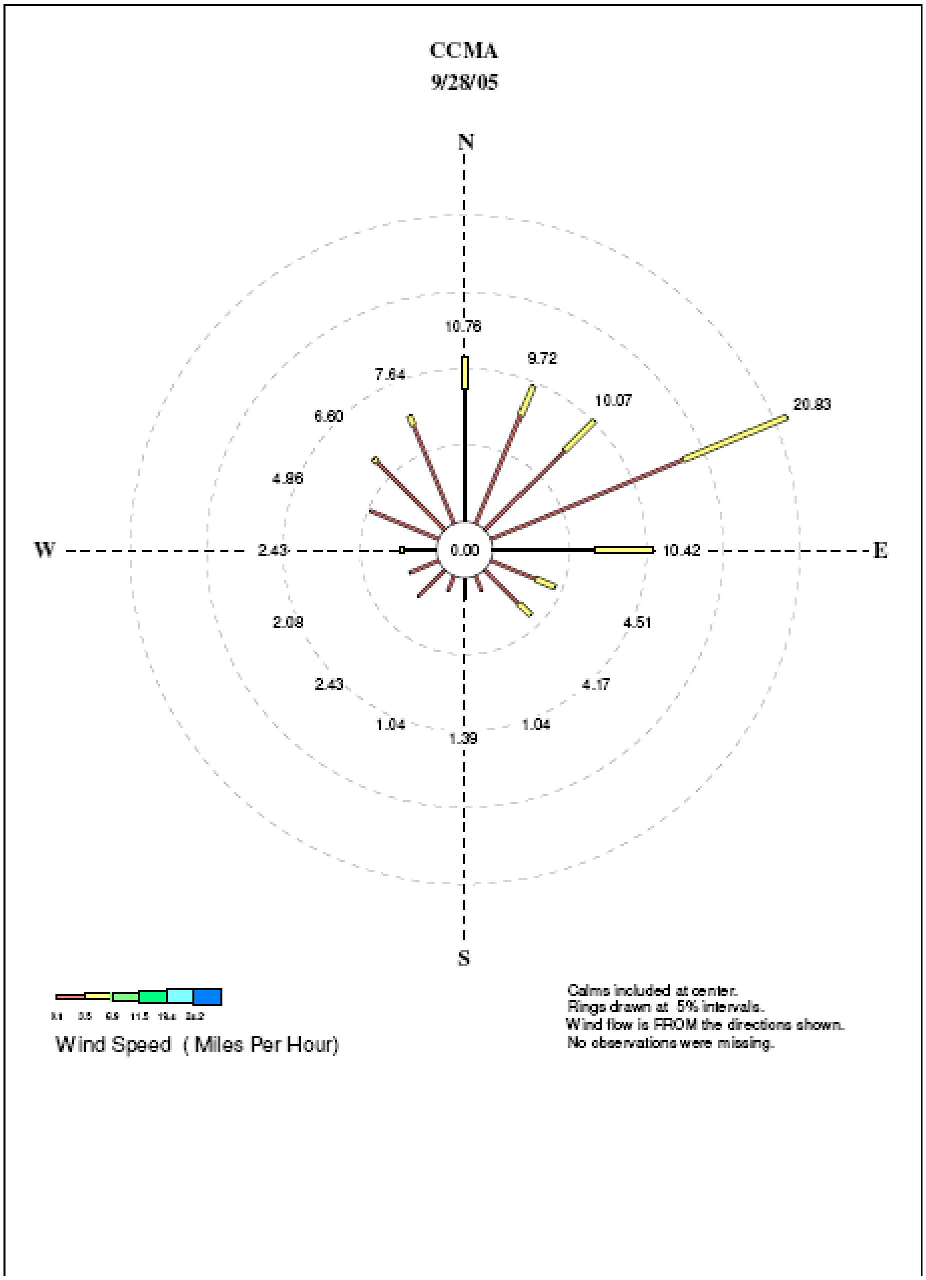
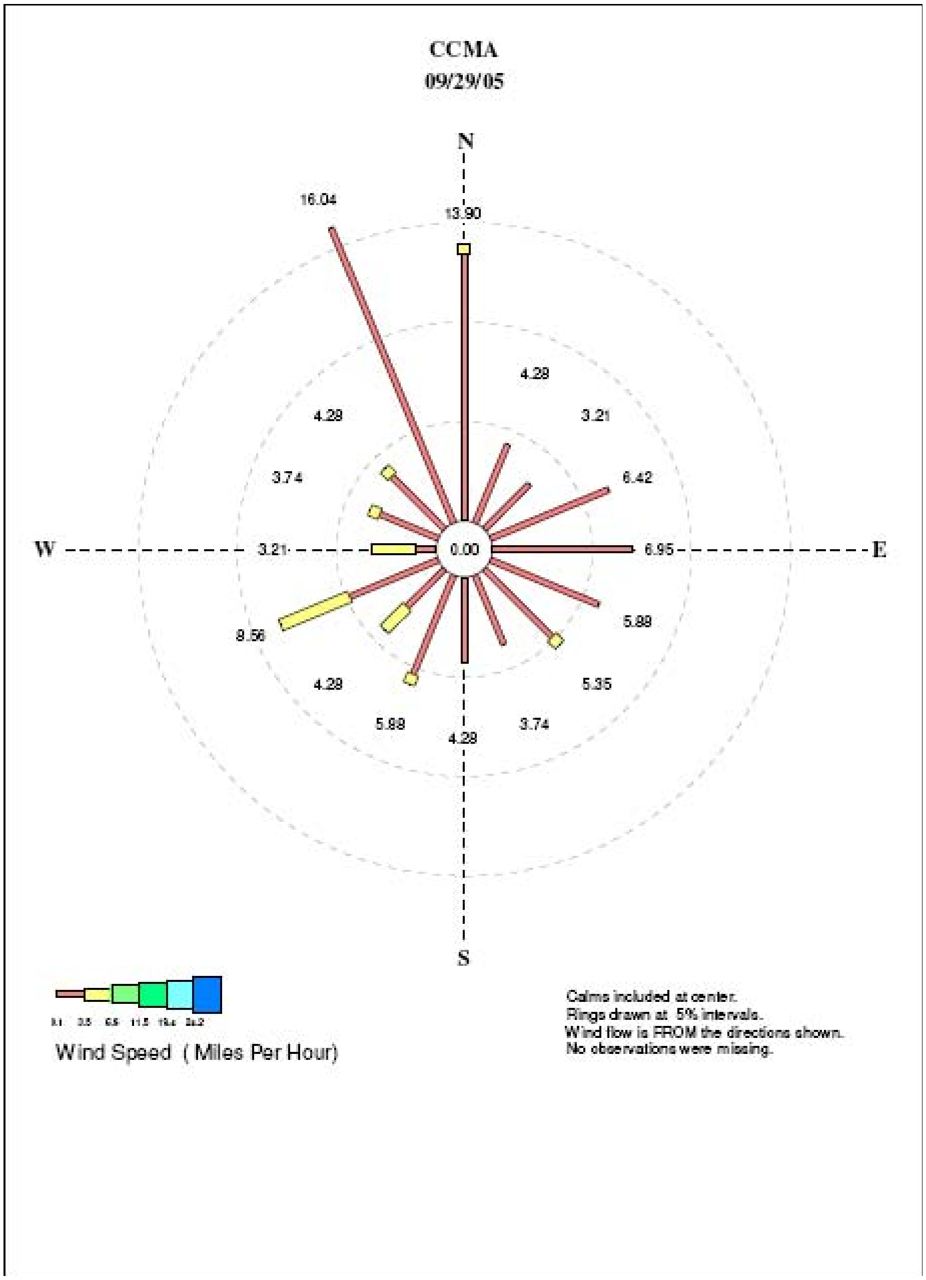
N
W
E
S
21.88
14.06
4.69
4.69
6.25
1.56
9.38
1.56
0.00
17.19
3.13
1.56
6.25
1.56
3.13
1.56
1.56
0.1 3.5 6.9 11.5 18.4 24.2
Wind Speed (Miles Per Hour)
Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.


CCMA
2/20/05
N
W
E
S
0.00
13.89
78.70
7.41
Wind Speed (Miles Per Hour)
Calms included at center.
Rings drawn at 20% intervals.
Wind flow is FROM the directions shown.
No observations were missing.


CCMA
9/27/05
N
11.05
10.00
8.42
9.47
12.63
6.94
4.21
W
5.26
0.00
12.63
E
2.63
3.16
2.11
4.21
4.74
0.53
2.11
S
Wind Speed (Miles Per Hour)
Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.


CCMA
9/28/05
N
E
S
W
10.76
9.72
10.07
20.83
7.64
6.60
4.86
2.43
0.00
10.42
2.08
4.51
2.43
4.17
1.04
1.39
1.04
Wind Speed (Miles Per Hour)
Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.


CCMA
09/29/05
N
W
E
S
16.04
13.90
4.29
3.21
6.42
6.95
5.89
5.35
3.74
4.29
5.88
4.29
8.56
3.21
3.74
4.29
0.00
Wind Speed (Miles Per Hour)
Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.

Appendix F
Soil Sample Results

APPENDIX F

Soil Sample Results

Sample Date	Sample Location	Sample Number	Asbestos % Type	% Soil Moisture [a,b]
11/3/2004	CCMA ATV AM	18576	2% Chrysotile <1%Tremolite/ Actinolite	22.4
11/3/2004	CCMA ATV AM	18577	2% Chrysotile	10.2
11/3/2004	CCMA Cinnabar Trail Head Top 1"	18578	2% Chrysotile	14.1
11/2/2004	CCMA Hiking Trail fork above Staging Area 2	18579	3% Chrysotile <1% Tremolite/ Actinolite	3.1
11/3/2004	CCMA Hiking Trail fork above Staging Area 2	18580	2% Chrysotile	2.9
11/3/2004	CCMA ATV AM	18581	8% Chrysotile	11.7
11/2/2004	CCMA Hiking Trail @T110	18582	5% Chrysotile	5.2
11/2/2004	CCMA ATV PM Top 1"	18583	3% Chrysotile	7.8
11/3/2004	CCMA Hiking Trail above staging near two marker	18584	8% Chrysotile	5.3
11/3/2004	CCMA Indian Hill	18585	5% Chrysotile	16.6
11/2/2004	CCMA ATV PM Top 1"	18586	15% Chrysotile	12.4
11/2/2004	CCAM ATV PM Top 1"	18587	2% Chrysotile	2.9
11/3/2004	CCMA Motorcycle AM R001:R008 Junction	18588	3% Chrysotile	8.6
11/3/2004	CCMA R001 SUV Route Staging 2	18589	2% Chrysotile	4.9
11/2/2004	CCMA Motorcycle PM Route R005 T141W	18590	5% Chrysotile	9.2
11/2/2004	CCMA Cinnabar Trail Head Top 1"	18591	2% Chrysotile	14.3

APPENDIX F

Soil Sample Results

Sample Date	Sample Location	Sample Number	Asbestos % Type	% Soil Moisture [a,b]
11/3/2004	CCMA Motorcycle AM R002 T116 Top 1"	18592	2% Chrysotile	8.1
11/3/2004	CCAM R001 SUV Route between Stg 2 + 3	18593	<1% Chrysotile	3.0
11/2/2004	CCMA Motorcycle PM Route R005 + 147	18594	15% Chrysotile	5.7
11/2/2004	CCMA R001 between staging 2 + 3 Top 1"	18595	5% Chrysotile	1.8
11/3/2004	CCMA Motorcycle AM T107 & R002 Top 1"	18596	5% Chrysotile	7.4
11/3/2004	CCMA R001 SUV route near staging	18597	5% Chrysotile	6.9
11/2/2004	CCAM Staging 4 Indian Hill Top 1"	18598	10% Chrysotile	17.9
11/2/2004	CCMA Staging Area 2 Far Corner Top 1"	18599	8% Chrysotile	14.6
2/11/2005	Staging Area 2	9961	8% Chrysotile	75-100
2/11/2005	Cinnabar Hill Trailhead R001	9962	5% Chrysotile	75-100
2/11/2005	R001 between Staging Areas 2 + 3	9963	3% Chrysotile	25-50[1]
2/11/2005	LOC 3	9964	5% Chrysotile	50-75
2/11/2005	R005 and T110	9965	2% Chrysotile	50-75
2/11/2005	Indian Hill Staging Area 4	9966	5% Chrysotile	75-100
2/11/2005	Hike #2/T110 Branch	9967	8% Chrysotile	75-100
2/11/2005	Staging Area 5	9968	8% Chrysotile	50-75

APPENDIX F
Soil Sample Results

Sample Date	Sample Location	Sample Number	Asbestos % Type	% Soil Moisture [a,b]
2/11/2005	Location #4	9969	8% Chrysotile	50-75
2/11/2005	Hike #3 between #1 and #2	9970	2% Chrysotile	50-75
2/11/2005	R005 to Indian Hill 2	9971	3% Chrysotile	50-75
2/11/2005	R001 to Indian Hill 1	9972	2% Chrysotile	50-75
2/11/2005	Hike from Stage #2, Sample A	9973	5% Chrysotile	50-75
2/20/2005	R001 up canyon from Stg 2	9974	8% Chrysotile	75-100
2/20/2005	Oak Flat Kiosk	9975	5% Chrysotile	75-100
2/20/2005	R001 btwn Stg 2,3	9976	8% Chrysotile	75-100
2/20/2005	Stg Area 2 - Hike Route	9977	10% Chrysotile	75-100
2/20/2005	Stg Area 2	9978	2% Chrysotile	100
9/27/2005	Fence Builder 1	40449	18.4% Chrysotile	8.36
9/28/2005	Hiker 3	40450	18.3% Chrysotile	3.82
9/27/2005	Hiker 3	40451	0.86% Chrysotile	1.34
9/29/2005	Indian Hill	40452	22.4% Chrysotile	1.39
9/29/2005	Staging Area 6	40453	0.84% Chrysotile	0.75
9/28/2005	Fence	40454	22.7% Chrysotile	1.86
9/27/2005	SUV 1	40455	20.3% Chrysotile	1.04
9/29/2005	Fence 1	40456	24.1% Chrysotile	6.52
9/27/2005	Hiker 1	40457	23.2% Chrysotile	0.74
9/27/2005	Hiker 2	40458	21.8% Chrysotile	2.33
9/29/2005	Staging Area 2	40459	23.1% Chrysotile	0.98
9/27/2005	ATV 1	40460	0.38% Chrysotile	1.09
9/28/2005	T151/R015/T159	40569	22.3% Chrysotile	1.51
9/27/2005	ATV 3	40570	25.6% Chrysotile	0.87
9/28/2005	Staging Area 2	40571	20.1% Chrysotile	0.71
9/28/2005	Hiker 2	40572	23.6% Chrysotile	3.75
9/27/2005	SUV 3	40573	24.8% Chrysotile	3.52
9/28/2005	T151/T158	40574	32% Chrysotile	3.11

APPENDIX F
Soil Sample Results

Sample Date	Sample Location	Sample Number	Asbestos % Type	% Soil Moisture [a,b]
9/28/2005	Staging Area 6	40575	16.8% Chrysotile	1.26
9/27/2005	Indian Landfill Trailhead	40576	20.4% Chrysotile	0.62
9/27/2005	ATV 2	40577	0.2% Chrysotile	0.33
9/27/2005	T151/T150	40578	11.9% Chrysotile	3.45
9/28/2005	R127/R128	40579	44.1% Chrysotile	1.47
9/27/2005	Oak Flat Parking Lot 3	40580	0.09% Chrysotile	0.35
9/27/2005	Oak Flat	40581	0.51% Chrysotile	0.39
9/28/2005	R002/T116	40582	13.1% Chrysotile	1.22
9/27/2005	T114/R0002	40583	8.3% Chrysotile	1.26
9/27/2005	Oak Flat 1	40584	0.35% Chrysotile	0.41
9/28/2005	Hiker 1	40585	33.4% Chrysotile	1.22
9/28/2005	T128	40586	5.4% Chrysotile	1.57
9/28/2005	ATV 3	40587	8.65% Chrysotile	

[a] Samples 9961-9978 Soil Moisture Analysis by USDA, Natural Resource Conservation Service, Estimating Soil Moisure by Feel and Appearance

[b] Samples 40449-40587 Soil Moisture Analysis by Gravimetry

Appendix H
Summary of Chrysotile and Amphibole Structures

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Sep	K095746	Adult	Motorcyclist	Lead		3		100		
2004Nov	09417	Adult	Motorcyclist	Lead		8		100		
2004Nov	09449	Adult	Motorcyclist	Lead		10		100		
2004Nov	09558	Adult	Motorcyclist	Lead		4		100		
2005Feb	09707	Adult	Motorcyclist	Lead		2		100		
2005Sep	40109	Adult	Motorcyclist	Lead		2		100		
2005Sep	40109	Adult	Motorcyclist	Lead	Recount Different	2		100		
2005Sep	40222	Adult	Motorcyclist	Lead		3	1	75	25	Actinolite
2005Sep	40398	Adult	Motorcyclist	Lead		4	1	80	20	Actinolite
2004Sep	N020999	Adult	Motorcyclist	First Trailing		6		100		
2004Nov	09505	Adult	Motorcyclist	First Trailing		42		100		
2004Nov	09507	Adult	Motorcyclist	First Trailing		32	1	97	3	Other
2004Nov	09433	Adult	Motorcyclist	First Trailing		35	5	88	13	Other
2004Nov	09422	Adult	Motorcyclist	First Trailing		9	1	90	10	Other
2004Nov	09421	Adult	Motorcyclist	First Trailing		8	1	89	11	Other
2005Feb	09712	Adult	Motorcyclist	First Trailing		4		100		
2005Sep	40113	Adult	Motorcyclist	First Trailing		32		100		
2005Sep	40226	Adult	Motorcyclist	First Trailing		38	10	79	21	Actinolite
2005Sep	40136	Adult	Motorcyclist	First Trailing		22	4	85	15	Actinolite
2004Sep	N020995	Adult	Motorcyclist	Second Trailing		5		100		
2004Nov	09426	Adult	Motorcyclist	Second Trailing		12		100		
2004Nov	09427	Adult	Motorcyclist	Second Trailing		5		100		
2004Nov	09438	Adult	Motorcyclist	Second Trailing		47	4	92	8	Other
2004Nov	09439	Adult	Motorcyclist	Second Trailing		5	2	71	29	Other
2004Nov	09566	Adult	Motorcyclist	Second Trailing	Recount Different	8		100		
2005Feb	09714	Adult	Motorcyclist	Second Trailing		12		100		
2005Sep	40116	Adult	Motorcyclist	Second Trailing		38		100		
2005Sep	40231	Adult	Motorcyclist	Second Trailing		47		100		
2005Sep	40263	Adult	Motorcyclist	Second Trailing		39		100		
2005Sep	40401	Adult	Motorcyclist	Second Trailing		30	8	79	21	Actinolite
2004Nov	09452	Adult	ATV Driver/Rider	Lead		2		100		
2004Nov	09452	Adult	ATV Driver/Rider	Lead	Recount Different	1		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Nov	09515	Adult	ATV Driver/Rider	Lead		2		100		
2004Nov	09401	Adult	ATV Driver/Rider	Lead		9		100		
2005Feb	09732	Adult	ATV Driver/Rider	Lead		10		100		
2005Feb	09717	Adult	ATV Driver/Rider	Lead		10		100		
2005Feb	09731	Adult	ATV Driver/Rider	Lead		7		100		
2005Sep	40301	Adult	ATV Driver/Rider	Lead		1		100		
2005Sep	40160	Adult	ATV Driver/Rider	Lead		11		100		
2005Sep	40104	Adult	ATV Driver/Rider	Lead		39	3	93	7	Actinolite
2004Nov	09456	Adult	ATV Driver/Rider	First Trailing		43	2	96	4	Other
2004Nov	09518	Adult	ATV Driver/Rider	First Trailing		29		100		
2005Feb	09720	Adult	ATV Driver/Rider	First Trailing		6		100		
2005Feb	09733	Adult	ATV Driver/Rider	First Trailing		9		100		
2004Nov	09522	Adult	ATV Driver/Rider	Second Trailing		8		100		
2004Nov	09461	Adult	ATV Driver/Rider	Second Trailing		15		100		
2004Nov	09406	Adult	ATV Driver/Rider	Second Trailing		9		100		
2005Sep	40321	Adult	ATV Driver/Rider	Second Trailing		15	3	83	17	Actinolite, Tremolite
2005Sep	40100	Adult	ATV Driver/Rider	Second Trailing		2		100		
2005Sep	40100	Adult	ATV Driver/Rider	Second Trailing		46	1	98	2	Actinolite
2004Sep	N020964	Adult	SUV Driver/Rider	Lead		1		100		
2004Nov	09441	Adult	SUV Driver/Rider	Lead		31	8	79	21	Other
2004Nov	09526	Adult	SUV Driver/Rider	Lead		8	1	89	11	Other
2004Nov	09550	Adult	SUV Driver/Rider	Lead		9	3	75	25	Other
2004Nov	09413	Adult	SUV Driver/Rider	Lead		5	3	63	38	Other
2005Feb	09735	Adult	SUV Driver/Rider	Lead		2		100		
2005Sep	40214	Adult	SUV Driver/Rider	Lead		7		100		
2005Sep	40289	Adult	SUV Driver/Rider	Lead		27	2	93	7	Actinolite
2005Sep	40089	Adult	SUV Driver/Rider	Lead		3		100		
2005Sep	40347	Adult	SUV Driver/Rider	Lead		12		100		
2005Sep	40152	Adult	SUV Driver/Rider	Lead		11	1	92	8	Actinolite
2005Sep	40279	Adult	SUV Driver/Rider	Lead		37	2	95	5	Actinolite
2005Sep	40339	Adult	SUV Driver/Rider	Lead		30	7	81	19	Tremolite
2005Sep	40214	Adult	SUV Driver/Rider	Lead	Recount Same	7		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40095	Adult	SUV Driver/Rider	Lead		30	2	94	6	Actinolite
2004Sep	N021328	Adult	SUV Driver/Rider	First Trailing		5		100		
2004Sep	N021030	Adult	SUV Driver/Rider	First Trailing		2	1	67	33	Edenite
2004Nov	09409	Adult	SUV Driver/Rider	First Trailing		13		100		
2004Nov	09447	Adult	SUV Driver/Rider	First Trailing		1		100		
2004Nov	09530	Adult	SUV Driver/Rider	First Trailing		10		100		
2004Nov	09554	Adult	SUV Driver/Rider	First Trailing		7	1	88	13	Other
2005Sep	40343	Adult	SUV Driver/Rider	First Trailing		23	1	96	4	Tremolite
2005Sep	40292	Adult	SUV Driver/Rider	First Trailing		9	1	90	10	Actinolite
2005Sep	40218	Adult	SUV Driver/Rider	First Trailing		10	1	91	9	Tremolite
2005Sep	40148	Adult	SUV Driver/Rider	First Trailing		12	7	63	37	Actinolite
2005Sep	40092	Adult	SUV Driver/Rider	First Trailing		10		100		
2005Sep	40218	Adult	SUV Driver/Rider	First Trailing		35		100		
2005Sep	40387	Adult	SUV Driver/Rider	First Trailing		36	6	86	14	Actinolite
2005Sep	40098	Adult	SUV Driver/Rider	First Trailing		45	1	98	2	Actinolite
2004Nov	09466	Adult	Hiker	Lead		2		100		
2004Nov	09534	Adult	Hiker	Lead			1		100	Other
2005Sep	40172	Adult	Hiker	Lead		1		100		
2005Sep	40271	Adult	Hiker	Lead		5	6	45	55	Actinolite
2004Nov	09470	Adult	Hiker	First Trailing		6		100		
2004Nov	09538	Adult	Hiker	First Trailing		2		100		
2005Feb	09728	Adult	Hiker	First Trailing			1		100	Other
2005Sep	40379	Adult	Hiker	First Trailing		1		100		
2005Sep	40122	Adult	Hiker	First Trailing		5	1	83	17	Actinolite
2005Sep	40210	Adult	Hiker	First Trailing		3	3	50	50	Actinolite
2005Sep	40275	Adult	Hiker	First Trailing		5	1	83	17	Actinolite
2004Nov	09479	Adult	Camper	Lead		1		100		
2004Nov	09483	Adult	Camper	Lead		10	1	91	9	Other
2005Sep	40371	Adult	Camper	Lead		7		100		
2005Sep	40375	Adult	Camper	Lead		7		100		
2005Sep	40369	Adult	Camper	Lead		11		100		
2005Sep	40254	Adult	Camper	Lead		10		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40252	Adult	Camper	Lead		43		100		
2005Sep	40204	Adult	Camper	Lead		2		100		
2005Sep	40200	Adult	Camper	Lead		1		100		
2005Sep	40198	Adult	Camper	Lead		2		100		
2004Nov	09583	Adult	Powerspray Wash	Lead		6		100		
2004Nov	09584	Adult	Powerspray Wash	Lead		48		100		
2004Nov	09492	Adult	Powerspray Wash	Lead		2		100		
2005Sep	40328	Adult	Powerspray Wash	Lead		24	2	92	8	Tremolite
2005Sep	40326	Adult	Powerspray Wash	Second Trailing		11		100		
2004Nov	09585	Adult	Hose Wash	Lead		27		100		
2004Nov	09586	Adult	Hose Wash	Lead	Interlab	4		100		
2004Nov	09494	Adult	Hose Wash	Lead		4		100		
2005Sep	40329	Adult	Hose Wash	Lead	Repreparation	8		100		
2005Sep	40329	Adult	Hose Wash	Lead		4		100		
2005Sep	40325	Adult	Hose Wash	Second Trailing		21	1	95	5	Tremolite
2004Nov	09587	Adult	HEPA Vacuum	Lead		2		100		
2004Nov	09496	Adult	HEPA Vacuum	Lead		28	2	93	7	Other
2005Sep	40188	Adult	HEPA Vacuum	Lead		6		100		
2005Sep	40332	Adult	HEPA Vacuum	Lead		16		100		
2005Sep	40327	Adult	HEPA Vacuum	Second Trailing		6		100		
2004Nov	09490	Adult	Regular Vacuum	Lead		20	2	91	9	Other
2004Nov	09582	Adult	Regular Vacuum	Lead		12		100		
2005Sep	40189	Adult	Regular Vacuum	Lead		3		100		
2005Sep	40331	Adult	Regular Vacuum	Lead		4		100		
2005Sep	40337	Adult	Post Decon Drivers	Lead		1		100		
2005Sep	40334	Adult	Post Decon Drivers	Lead		2		100		
2005Sep	40195	Adult	Post Decon Drivers	Lead	Verified Analysis	2		100		
2005Sep	40195	Adult	Post Decon Drivers	Lead		3		100		
2005Sep	40128	Adult	Fence Builder	Lead		31	2	94	6	Actinolite
2005Sep	40126	Adult	Fence Builder	Lead		6		100		
2005Sep	40248	Adult	Fence Builder	Lead		5		100		
2005Sep	40391	Adult	Fence Builder	Lead		4		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40393	Adult	Fence Builder	Lead		6		100		
2005Sep	40395	Adult	Fence Builder	Lead		8	1	89	11	Actinolite
2005Sep	40246	Adult	Fence Builder	Lead		6		100		
2005Sep	40235	Adult	Raking	Lead		1		100		
2005Sep	40269	Adult	Raking	Lead	Verified Analysis	1		100		
2004Nov	09474	Adult	Staging Area 2	Lead		16		100		
2004Nov	09573	Adult	Staging Area 2	Lead		1		100		
2004Nov	09574	Adult	Staging Area 2	Lead		4		100		
2005Sep	40183	Adult	Staging Area 2	Lead		2		100		
2005Sep	40298	Adult	Staging Area 2	Lead		7	1	88	13	Actinolite
2005Sep	40298	Adult	Staging Area 2	Lead	Recount Different	7	1	88	13	Actinolite
2005Sep	40407	Adult	Staging Area 2	Lead		17	1	94	6	Actinolite
2004Nov	09475	Adult	Staging Area 6	Lead		9		100		
2004Nov	09476	Adult	Staging Area 6	Lead		12		100		
2004Nov	09477	Adult	Staging Area 6	Lead		11		100		
2004Nov	09575	Adult	Staging Area 6	Lead		5		100		
2004Nov	09576	Adult	Staging Area 6	Lead		2		100		
2004Nov	09577	Adult	Staging Area 6	Lead		3		100		
2005Sep	40299	Adult	Staging Area 6	Lead		5		100		
2005Sep	40408	Adult	Staging Area 6	Lead		6		100		
2004Sep	N021009	Adult	Oak Flat	Lead		1		100		
2004Sep	N020965	Adult	Oak Flat	Lead		1		100		
2004Nov	09465	Adult	Oak Flat	Lead		3		100		
2004Nov	09464	Adult	Oak Flat	Lead		1		100		
2004Nov	09465	Adult	Oak Flat	Lead	Recount Different	3		100		
2004Nov	09571	Adult	Oak Flat	Lead		8		100		
2004Nov	09572	Adult	Oak Flat	Lead		8		100		
2005Feb	09723	Adult	Oak Flat	Lead		1		100		
2005Sep	40300	Adult	Oak Flat	Lead		13		100		
2005Sep	40409	Adult	Oak Flat	Lead		10	1	91	9	Actinolite
2005Sep	40182	Adult	Oak Flat	Lead		3		100		
2004Nov	09488	Adult	Section 8	Lead	Recount Same	5		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Nov	09488	Adult	Section 8	Lead		4		100		
2004Nov	09487	Adult	Section 8	Lead		9		100		
2004Nov	09489	Adult	Section 8	Lead		11		100		
2005Sep	40297	Adult	Section 8	Lead		1		100		
2005Sep	40406	Adult	Section 8	Lead		3		100		
2004Nov	09420	Child	Motorcyclist	Lead		7		100		
2004Nov	09431	Child	Motorcyclist	Lead	Recount Same	8		100		
2004Nov	09503	Child	Motorcyclist	Lead		12		100		
2004Nov	09431	Child	Motorcyclist	Lead		6		100		
2005Feb	09709	Child	Motorcyclist	Lead		4		100		
2005Sep	40224	Child	Motorcyclist	Lead		8	1	89	11	Actinolite
2005Sep	40134	Child	Motorcyclist	Lead		11		100		
2005Sep	40110	Child	Motorcyclist	Lead		27		100		
2005Sep	40400	Child	Motorcyclist	Lead		5	6	45	55	Actinolite
2004Nov	09424	Child	Motorcyclist	First Trailing		15		100		
2004Nov	09425	Child	Motorcyclist	First Trailing		11		100		
2004Nov	09434	Child	Motorcyclist	First Trailing		12		100		
2004Nov	09565	Child	Motorcyclist	First Trailing		4		100		
2005Feb	09713	Child	Motorcyclist	First Trailing		2		100		
2005Sep	40115	Child	Motorcyclist	First Trailing		54		100		
2005Sep	40140	Child	Motorcyclist	First Trailing		14	16	47	53	Actinolite
2005Sep	40229	Child	Motorcyclist	First Trailing		36	3	92	8	Actinolite
2004Nov	09568	Child	Motorcyclist	Second Trailing		13		100		
2004Nov	09429	Child	Motorcyclist	Second Trailing		6		100		
2004Nov	09440	Child	Motorcyclist	Second Trailing		9		100		
2004Nov	09451	Child	Motorcyclist	Second Trailing		4	5	44	56	Other
2004Nov	09512	Child	Motorcyclist	Second Trailing		33		100		
2004Nov	09428	Child	Motorcyclist	Second Trailing		9		100		
2005Feb	09716	Child	Motorcyclist	Second Trailing		12	7	63	37	Other
2005Sep	40403	Child	Motorcyclist	Second Trailing		29	11	73	28	Actinolite
2005Sep	40117	Child	Motorcyclist	Second Trailing		39		100		
2005Sep	40143	Child	Motorcyclist	Second Trailing		23	4	85	15	Actinolite

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40265	Child	Motorcyclist	Second Trailing		39		100		
2005Sep	40233	Child	Motorcyclist	Second Trailing		39	1	98	3	Tremolite
2004Nov	09516	Child	ATV Driver/Rider	Lead		9		100		
2004Nov	09403	Child	ATV Driver/Rider	Lead		8		100		
2004Nov	09454	Child	ATV Driver/Rider	Lead		6		100		
2005Feb	09719	Child	ATV Driver/Rider	Lead		2		100		
2005Sep	40357	Child	ATV Driver/Rider	Lead		2		100		
2005Sep	40357	Child	ATV Driver/Rider	Lead		29	1	97	3	Tremolite
2005Sep	40315	Child	ATV Driver/Rider	Lead		29	1	97	3	Actinolite
2005Sep	40303	Child	ATV Driver/Rider	Lead		37		100		
2005Sep	40162	Child	ATV Driver/Rider	Lead		18	3	86	14	Actinolite
2004Nov	09520	Child	ATV Driver/Rider	First Trailing		30		100		
2004Nov	09459	Child	ATV Driver/Rider	First Trailing		5	1	83	17	Other
2005Feb	09722	Child	ATV Driver/Rider	First Trailing		2		100		
2005Sep	40319	Child	ATV Driver/Rider	First Trailing		25	3	89	11	Actinolite
2004Nov	09524	Child	ATV Driver/Rider	Second Trailing		15		100		
2004Nov	09462	Child	ATV Driver/Rider	Second Trailing		4	1	80	20	Other
2004Nov	09408	Child	ATV Driver/Rider	Second Trailing		8		100		
2005Sep	40102	Child	ATV Driver/Rider	Second Trailing		44	4	92	8	Actinolite
2005Sep	40323	Child	ATV Driver/Rider	Second Trailing		15	2	88	12	Tremolite
2005Sep	40323	Child	ATV Driver/Rider	Second Trailing		6		100		
2004Nov	09414	Child	SUV Driver/Rider	Lead		5	4	56	44	Other
2004Nov	09552	Child	SUV Driver/Rider	Lead		4	2	67	33	Other
2004Nov	09528	Child	SUV Driver/Rider	Lead		11		100		
2004Nov	09442	Child	SUV Driver/Rider	Lead		10	2	83	17	Other
2005Sep	40216	Child	SUV Driver/Rider	Lead		1	3	25	75	Actinolite
2005Sep	40091	Child	SUV Driver/Rider	Lead		2		100		
2005Sep	40154	Child	SUV Driver/Rider	Lead		10		100		
2005Sep	40290	Child	SUV Driver/Rider	Lead		20	3	87	13	Actinolite
2005Sep	40341	Child	SUV Driver/Rider	Lead		23	5	82	18	Actinolite, Tremolite
2005Sep	40349	Child	SUV Driver/Rider	Lead		10	5	67	33	Tremolite
2005Sep	40096	Child	SUV Driver/Rider	Lead		25	6	81	19	Actinolite

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Nov	09556	Child	SUV Driver/Rider	First Trailing		15		100		
2004Nov	09532	Child	SUV Driver/Rider	First Trailing		13	1	93	7	Other
2004Nov	09448	Child	SUV Driver/Rider	First Trailing		5		100		
2005Feb	09706	Child	SUV Driver/Rider	First Trailing	Recount Different	1		100		
2005Sep	40220	Child	SUV Driver/Rider	First Trailing		18	3	86	14	Actinolite
2005Sep	40244	Child	SUV Driver/Rider	First Trailing		5	5	50	50	Actinolite
2005Sep	40287	Child	SUV Driver/Rider	First Trailing		33	3	92	8	Actinolite
2005Sep	40150	Child	SUV Driver/Rider	First Trailing		13		100		
2005Sep	40345	Child	SUV Driver/Rider	First Trailing		29	3	91	9	Tremolite
2005Sep	40294	Child	SUV Driver/Rider	First Trailing		10		100		
2005Sep	40099	Child	SUV Driver/Rider	First Trailing		2		100		
2005Sep	40094	Child	SUV Driver/Rider	First Trailing		45		100		
2005Sep	40389	Child	SUV Driver/Rider	First Trailing		36	4	90	10	Actinolite
2005Sep	40099	Child	SUV Driver/Rider	First Trailing		54	3	95	5	Actinolite
2004Nov	09467	Child	Hiker	Lead		2	1	67	33	Other
2005Feb	09727	Child	Hiker	Lead			4		100	Other
2005Sep	40378	Child	Hiker	Lead		1		100		
2005Sep	40273	Child	Hiker	Lead		14	3	82	18	Actinolite
2005Sep	40208	Child	Hiker	Lead		2	1	67	33	Actinolite
2005Sep	40120	Child	Hiker	Lead		4		100		
2004Nov	09540	Child	Hiker	First Trailing		4		100		
2005Feb	09729	Child	Hiker	First Trailing		1	1	50	50	Other
2005Sep	40212	Child	Hiker	First Trailing		11	5	69	31	Actinolite
2005Sep	40381	Child	Hiker	First Trailing		4	3	57	43	Actinolite
2005Sep	40124	Child	Hiker	First Trailing		7		100		
2005Sep	40178	Child	Hiker	First Trailing		3		100		
2004Nov	09480	Child	Camper	Lead		3		100		
2004Nov	09484	Child	Camper	Lead		7	2	78	22	Other
2005Sep	40253	Child	Camper	Lead	Verified Analysis	3		100		
2005Sep	40374	Child	Camper	Lead	Interlab	3		100		
2005Sep	40374	Child	Camper	Lead		2		100		
2005Sep	40370	Child	Camper	Lead		5		100		

Table H-1
Summary of Chrysotile and Amphibole Structures (Region IX PCME Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40253	Child	Camper	Lead		3		100		
2005Sep	40251	Child	Camper	Lead		46		100		
2005Sep	40205	Child	Camper	Lead		9		100		
2005Sep	40203	Child	Camper	Lead		1		100		
2005Sep	40201	Child	Camper	Lead		4		100		
2005Sep	40199	Child	Camper	Lead		4		100		
2005Sep	40372	Child	Camper	Lead		10		100		
2005Sep	40333	Child	Post Decon Drivers	Lead		3		100		
2005Sep	40336	Child	Post Decon Drivers	Lead		10		100		

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Sep	K095746	Adult	Motorcyclist	Lead		92		100		
2004Nov	09417	Adult	Motorcyclist	Lead		65		100		
2004Nov	09449	Adult	Motorcyclist	Lead		101	1	99	1	Other
2004Nov	09501	Adult	Motorcyclist	Lead		114		100		
2004Nov	09501	Adult	Motorcyclist	Lead	Recount Different	107		100		
2004Nov	09558	Adult	Motorcyclist	Lead		161		100		
2005Feb	09707	Adult	Motorcyclist	Lead		60	1	98	2	Other
2005Sep	40109	Adult	Motorcyclist	Lead		67		100		
2005Sep	40398	Adult	Motorcyclist	Lead		116	1	99	1	Actinolite
2005Sep	40109	Adult	Motorcyclist	Lead	Recount Different	54		100		
2005Sep	40222	Adult	Motorcyclist	Lead		69	1	99	1	Actinolite
2004Sep	N020999	Adult	Motorcyclist	First Trailing		443	1	99.8	0.2	Tremolite
2004Nov	09507	Adult	Motorcyclist	First Trailing		100	2	98	2	Other
2004Nov	09421	Adult	Motorcyclist	First Trailing		94	1	99	1	Other
2004Nov	09422	Adult	Motorcyclist	First Trailing		102	1	99	1	Other
2004Nov	09433	Adult	Motorcyclist	First Trailing		110	5	96	4	Other
2004Nov	09505	Adult	Motorcyclist	First Trailing		107		100		
2004Nov	09562	Adult	Motorcyclist	First Trailing		57		100		
2005Feb	09710	Adult	Motorcyclist	First Trailing		59		100		
2005Feb	09712	Adult	Motorcyclist	First Trailing		87		100		
2005Sep	40113	Adult	Motorcyclist	First Trailing		193		100		
2005Sep	40136	Adult	Motorcyclist	First Trailing		169	8	95	5	Actinolite
2005Sep	40226	Adult	Motorcyclist	First Trailing		111	11	91	9	Actinolite
2004Sep	N020995	Adult	Motorcyclist	Second Trailing		174		100		
2004Nov	09427	Adult	Motorcyclist	Second Trailing		100		100		
2004Nov	09566	Adult	Motorcyclist	Second Trailing	Recount Different	177		100		
2004Nov	09566	Adult	Motorcyclist	Second Trailing		527		100		
2004Nov	09510	Adult	Motorcyclist	Second Trailing		63		100		
2004Nov	09438	Adult	Motorcyclist	Second Trailing		125	4	97	3	Other
2004Nov	09426	Adult	Motorcyclist	Second Trailing		96		100		
2004Nov	09439	Adult	Motorcyclist	Second Trailing		159	2	99	1	Other
2005Feb	09714	Adult	Motorcyclist	Second Trailing		87		100		

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
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CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40263	Adult	Motorcyclist	Second Trailing		129		100		
2005Sep	40401	Adult	Motorcyclist	Second Trailing		175	11	94	6	Actinolite
2005Sep	40116	Adult	Motorcyclist	Second Trailing		232		100		
2005Sep	40231	Adult	Motorcyclist	Second Trailing		200		100		
2004Nov	09401	Adult	ATV Driver/Rider	Lead		69		100		
2004Nov	09452	Adult	ATV Driver/Rider	Lead		201		100		
2004Nov	09452	Adult	ATV Driver/Rider	Lead	Recount Different	102		100		
2004Nov	09515	Adult	ATV Driver/Rider	Lead		55		100		
2005Feb	09717	Adult	ATV Driver/Rider	Lead		223		100		
2005Feb	09731	Adult	ATV Driver/Rider	Lead		72		100		
2005Feb	09732	Adult	ATV Driver/Rider	Lead		78		100		
2005Sep	40301	Adult	ATV Driver/Rider	Lead		1		100		
2005Sep	40160	Adult	ATV Driver/Rider	Lead		100		100		
2005Sep	40104	Adult	ATV Driver/Rider	Lead		188	5	97	3	Actinolite
2004Nov	09518	Adult	ATV Driver/Rider	First Trailing		176		100		
2004Nov	09456	Adult	ATV Driver/Rider	First Trailing		233	2	99	1	Other
2005Feb	09720	Adult	ATV Driver/Rider	First Trailing		103		100		
2005Feb	09733	Adult	ATV Driver/Rider	First Trailing		73		100		
2004Nov	09522	Adult	ATV Driver/Rider	Second Trailing		111		100		
2004Nov	09406	Adult	ATV Driver/Rider	Second Trailing		180		100		
2004Nov	09461	Adult	ATV Driver/Rider	Second Trailing		157		100		
2005Sep	40321	Adult	ATV Driver/Rider	Second Trailing		300	9	97	3	Actinolite, Tremolite
2005Sep	40100	Adult	ATV Driver/Rider	Second Trailing		308	4	99	1	Actinolite, Tremolite
2004Sep	N020964	Adult	SUV Driver/Rider	Lead		77	1	99	1	Tremolite
2004Nov	09526	Adult	SUV Driver/Rider	Lead		119	1	99	1	Other
2004Nov	09413	Adult	SUV Driver/Rider	Lead		96	3	97	3	Other
2004Nov	09441	Adult	SUV Driver/Rider	Lead		96	9	91	9	Other
2004Nov	09550	Adult	SUV Driver/Rider	Lead		101	4	96	4	Other
2005Feb	09735	Adult	SUV Driver/Rider	Lead		52		100		
2005Sep	40152	Adult	SUV Driver/Rider	Lead		139	1	99	1	Actinolite
2005Sep	40214	Adult	SUV Driver/Rider	Lead	Recount Same	86		100		
2005Sep	40347	Adult	SUV Driver/Rider	Lead		268	2	99	1	Tremolite

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40095	Adult	SUV Driver/Rider	Lead		147	3	98	2	Actinolite
2005Sep	40214	Adult	SUV Driver/Rider	Lead		61		100		
2005Sep	40089	Adult	SUV Driver/Rider	Lead		103	1	99	1	Amosite
2005Sep	40289	Adult	SUV Driver/Rider	Lead		371	9	98	2	Actinolite
2005Sep	40279	Adult	SUV Driver/Rider	Lead		146	2	99	1	Actinolite
2005Sep	40339	Adult	SUV Driver/Rider	Lead		183	8	96	4	Tremolite
2004Sep	N021328	Adult	SUV Driver/Rider	First Trailing		233	4	98	2	Actinolite
2004Sep	N021030	Adult	SUV Driver/Rider	First Trailing		154	1	99	1	Edenite
2004Nov	09554	Adult	SUV Driver/Rider	First Trailing		112	1	99	1	Other
2004Nov	09530	Adult	SUV Driver/Rider	First Trailing		166		100		
2004Nov	09409	Adult	SUV Driver/Rider	First Trailing		123		100		
2004Nov	09447	Adult	SUV Driver/Rider	First Trailing		105		100		
2005Feb	09704	Adult	SUV Driver/Rider	First Trailing		9		100		
2005Sep	40148	Adult	SUV Driver/Rider	First Trailing		112	13	90	10	Actinolite
2005Sep	40343	Adult	SUV Driver/Rider	First Trailing		146	5	97	3	Tremolite
2005Sep	40092	Adult	SUV Driver/Rider	First Trailing		310		100		
2005Sep	40292	Adult	SUV Driver/Rider	First Trailing		79	1	99	1	Actinolite
2005Sep	40218	Adult	SUV Driver/Rider	First Trailing		276	4	99	1	Tremolite
2005Sep	40387	Adult	SUV Driver/Rider	First Trailing		343	21	94	6	Actinolite
2005Sep	40098	Adult	SUV Driver/Rider	First Trailing		184	2	99	1	Actinolite
2004Nov	09466	Adult	Hiker	Lead		75		100		
2004Nov	09534	Adult	Hiker	Lead			2		100	Other
2005Feb	09726	Adult	Hiker	Lead		14		100		
2005Sep	40377	Adult	Hiker	Lead		4		100		
2005Sep	40118	Adult	Hiker	Lead		71	3	96	4	Actinolite
2005Sep	40118	Adult	Hiker	Lead	Verified Analysis	49	3	94	6	Actinolite
2005Sep	40172	Adult	Hiker	Lead		62		100		
2005Sep	40206	Adult	Hiker	Lead		23	4	85	15	Actinolite
2005Sep	40271	Adult	Hiker	Lead		76	16	83	17	Actinolite
2004Nov	09538	Adult	Hiker	First Trailing		66		100		
2004Nov	09470	Adult	Hiker	First Trailing		56		100		
2005Feb	09728	Adult	Hiker	First Trailing		149	5	97	3	Other

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
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CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40210	Adult	Hiker	First Trailing		65	10	87	13	Actinolite
2005Sep	40379	Adult	Hiker	First Trailing		5		100		
2005Sep	40122	Adult	Hiker	First Trailing		90	2	98	2	Actinolite
2005Sep	40275	Adult	Hiker	First Trailing		71	2	97	3	Actinolite
2004Nov	09483	Adult	Camper	Lead		89	2	98	2	Other
2004Nov	09479	Adult	Camper	Lead		33		100		
2005Sep	40200	Adult	Camper	Lead		40		100		
2005Sep	40202	Adult	Camper	Lead		17		100		
2005Sep	40204	Adult	Camper	Lead		38	1	97	3	Actinolite
2005Sep	40252	Adult	Camper	Lead		161		100		
2005Sep	40254	Adult	Camper	Lead		104	4	96	4	Actinolite
2005Sep	40369	Adult	Camper	Lead		117		100		
2005Sep	40371	Adult	Camper	Lead		132		100		
2005Sep	40375	Adult	Camper	Lead		98		100		
2005Sep	40198	Adult	Camper	Lead		71		100		
2004Nov	09982	Adult	Sleeping Camper	Lead		28		100		
2004Nov	09983	Adult	Sleeping Camper	Lead		23		100		
2004Nov	09984	Adult	Sleeping Camper	Lead		3		100		
2005Sep	40190	Adult	Sleeping Camper	Lead		36		100		
2005Sep	40192	Adult	Sleeping Camper	Lead		15	1	94	6	Actinolite
2004Nov	09584	Adult	Powerspray Wash	Lead		114		100		
2004Nov	09583	Adult	Powerspray Wash	Lead		59		100		
2004Nov	09492	Adult	Powerspray Wash	Lead		60		100		
2005Sep	40185	Adult	Powerspray Wash	Lead		104		100		
2005Sep	40328	Adult	Powerspray Wash	Lead		154	2	99	1	Tremolite
2005Sep	40326	Adult	Powerspray Wash	Second Trailing		130		100		
2004Nov	09586	Adult	Hose Wash	Lead		12		100		
2004Nov	09585	Adult	Hose Wash	Lead		112		100		
2004Nov	09586	Adult	Hose Wash	Lead	Interlab	64		100		
2004Nov	09494	Adult	Hose Wash	Lead		64		100		
2005Sep	40329	Adult	Hose Wash	Lead		91	1	99	1	Actinolite
2005Sep	40329	Adult	Hose Wash	Lead	Repreparation	90		100		

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
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CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40325	Adult	Hose Wash	Second Trailing		139	1	99	1	Tremolite
2004Nov	09496	Adult	HEPA Vacuum	Lead		77	2	97	3	Other
2004Nov	09587	Adult	HEPA Vacuum	Lead		20		100		
2004Nov	09587	Adult	HEPA Vacuum	Lead	Recount Different	8		100		
2005Sep	40332	Adult	HEPA Vacuum	Lead		120		100		
2005Sep	40188	Adult	HEPA Vacuum	Lead		83		100		
2005Sep	40327	Adult	HEPA Vacuum	Second Trailing		103		100		
2004Nov	09490	Adult	Regular Vacuum	Lead		75	3	96	4	Other
2004Nov	09582	Adult	Regular Vacuum	Lead		68		100		
2005Sep	40331	Adult	Regular Vacuum	Lead		97	2	98	2	Crocidolite
2005Sep	40189	Adult	Regular Vacuum	Lead		84		100		
2005Sep	40195	Adult	Post Decon Drivers	Lead		155		100		
2005Sep	40565	Adult	Post Decon Drivers	Lead		5		100		
2005Sep	40195	Adult	Post Decon Drivers	Lead	Verified Analysis	69		100		
2005Sep	40334	Adult	Post Decon Drivers	Lead		46		100		
2005Sep	40337	Adult	Post Decon Drivers	Lead		86		100		
2005Sep	40566	Adult	Post Decon Drivers	Lead		2		100		
2005Sep	40395	Adult	Fence Builder	Lead		107	1	99	1	Actinolite
2005Sep	40393	Adult	Fence Builder	Lead		102		100		
2005Sep	40391	Adult	Fence Builder	Lead	Repreparation	47		100		
2005Sep	40391	Adult	Fence Builder	Lead		71		100		
2005Sep	40248	Adult	Fence Builder	Lead		55		100		
2005Sep	40246	Adult	Fence Builder	Lead		60		100		
2005Sep	40130	Adult	Fence Builder	Lead		113		100		
2005Sep	40128	Adult	Fence Builder	Lead		209	3	99	1	Actinolite
2005Sep	40126	Adult	Fence Builder	Lead		104	1	99	1	Actinolite
2005Sep	40250	Adult	Fence Builder	Lead		39		100		
2005Sep	40269	Adult	Raking	Lead	Verified Analysis	18		100		
2005Sep	40269	Adult	Raking	Lead		11		100		
2005Sep	40268	Adult	Raking	Lead		8		100		
2005Sep	40234	Adult	Raking	Lead	Repreparation	12		100		
2005Sep	40235	Adult	Raking	Lead		9		100		

Table H-2
Summary of Chrysotile and Amphibole Structures (All Fibers)
Human Health Risk Assessment
CCMA Asbestos Exposures (All Events)

Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40236	Adult	Raking	Lead		19		100		
2004Sep	N021026	Adult	use	Lead		77		100		
2004Sep	N021085	Adult	Staging Area 2	Lead		35		100		
2004Nov	09573	Adult	Staging Area 2	Lead		64		100		
2004Nov	09474	Adult	Staging Area 2	Lead		91		100		
2004Nov	09574	Adult	Staging Area 2	Lead		69		100		
2005Feb	09725	Adult	Staging Area 2	Lead	Repreparation	2		100		
2005Sep	40183	Adult	Staging Area 2	Lead		86		100		
2005Sep	40298	Adult	Staging Area 2	Lead		70	3	96	4	Actinolite
2005Sep	40298	Adult	Staging Area 2	Lead	Recount Different	69	3	96	4	Actinolite
2005Sep	40407	Adult	Staging Area 2	Lead		128	1	99	1	Actinolite
2004Nov	09475	Adult	Staging Area 6	Lead		73		100		
2004Nov	09577	Adult	Staging Area 6	Lead		71		100		
2004Nov	09576	Adult	Staging Area 6	Lead		61		100		
2004Nov	09575	Adult	Staging Area 6	Lead		67		100		
2004Nov	09476	Adult	Staging Area 6	Lead		67		100		
2004Nov	09477	Adult	Staging Area 6	Lead		76		100		
2005Sep	40299	Adult	Staging Area 6	Lead		20		100		
2005Sep	40408	Adult	Staging Area 6	Lead		89		100		
2004Sep	N020965	Adult	Oak Flat	Lead		96		100		
2004Sep	N021009	Adult	Oak Flat	Lead		82		100		
2004Nov	09464	Adult	Oak Flat	Lead		4		100		
2004Nov	09572	Adult	Oak Flat	Lead		55		100		
2004Nov	09571	Adult	Oak Flat	Lead		45		100		
2004Nov	09465	Adult	Oak Flat	Lead		54		100		
2004Nov	09465	Adult	Oak Flat	Lead	Recount Different	49		100		
2005Feb	09723	Adult	Oak Flat	Lead		67		100		
2005Feb	09724	Adult	Oak Flat	Lead		20		100		
2005Feb	09734	Adult	Oak Flat	Lead		8		100		
2005Feb	09734	Adult	Oak Flat	Lead	Recount Same	8		100		
2005Sep	40409	Adult	Oak Flat	Lead		139	2	99	1	Actinolite
2005Sep	40182	Adult	Oak Flat	Lead		62		100		

Table H-2
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Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Sep	40300	Adult	Oak Flat	Lead		78		100		
2004Nov	09580	Adult	Section 8	Lead		10		100		
2004Nov	09579	Adult	Section 8	Lead	Repreparation	21		100		
2004Nov	09579	Adult	Section 8	Lead		29		100		
2004Nov	09578	Adult	Section 8	Lead		8		100		
2004Nov	09489	Adult	Section 8	Lead		85		100		
2004Nov	09488	Adult	Section 8	Lead	Recount Same	91		100		
2004Nov	09487	Adult	Section 8	Lead		81		100		
2004Nov	09488	Adult	Section 8	Lead		90		100		
2005Sep	40181	Adult	Section 8	Lead		148		100		
2005Sep	40297	Adult	Section 8	Lead		2		100		
2005Sep	40406	Adult	Section 8	Lead		95		100		
2005Sep	40181	Adult	Section 8	Lead	Verified Analysis	84		100		
2004Nov	09560	Child	Motorcyclist	Lead		61		100		
2004Nov	09503	Child	Motorcyclist	Lead		81		100		
2004Nov	09431	Child	Motorcyclist	Lead	Recount Same	108		100		
2004Nov	09431	Child	Motorcyclist	Lead		209		100		
2004Nov	09420	Child	Motorcyclist	Lead		73		100		
2005Feb	09709	Child	Motorcyclist	Lead		62		100		
2005Sep	40110	Child	Motorcyclist	Lead		147		100		
2005Sep	40400	Child	Motorcyclist	Lead		94	6	94	6	Actinolite
2005Sep	40134	Child	Motorcyclist	Lead		113		100		
2005Sep	40224	Child	Motorcyclist	Lead		66	1	99	1	Actinolite
2004Nov	09424	Child	Motorcyclist	First Trailing		112		100		
2004Nov	09425	Child	Motorcyclist	First Trailing		119		100		
2004Nov	09434	Child	Motorcyclist	First Trailing		124		100		
2004Nov	09565	Child	Motorcyclist	First Trailing		112	2	98	2	Other
2005Feb	09713	Child	Motorcyclist	First Trailing		58		100		
2005Sep	40115	Child	Motorcyclist	First Trailing		208		100		
2005Sep	40229	Child	Motorcyclist	First Trailing		134	5	96	4	Actinolite
2005Sep	40140	Child	Motorcyclist	First Trailing		102	30	77	23	Actinolite
2004Nov	09451	Child	Motorcyclist	Second Trailing		112	7	94	6	Other

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Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2004Nov	09440	Child	Motorcyclist	Second Trailing		108		100		
2004Nov	09429	Child	Motorcyclist	Second Trailing		101		100		
2004Nov	09428	Child	Motorcyclist	Second Trailing		101		100		
2004Nov	09568	Child	Motorcyclist	Second Trailing		86		100		
2004Nov	09512	Child	Motorcyclist	Second Trailing		122		100		
2005Feb	09716	Child	Motorcyclist	Second Trailing		87	12	88	12	Other
2005Sep	40233	Child	Motorcyclist	Second Trailing		138	1	99	1	Tremolite
2005Sep	40117	Child	Motorcyclist	Second Trailing		209		100		
2005Sep	40143	Child	Motorcyclist	Second Trailing		140	7	95	5	Actinolite
2005Sep	40265	Child	Motorcyclist	Second Trailing		118		100		
2005Sep	40403	Child	Motorcyclist	Second Trailing		137	12	92	8	Actinolite
2004Nov	09516	Child	ATV Driver/Rider	Lead		86		100		
2004Nov	09454	Child	ATV Driver/Rider	Lead		88		100		
2004Nov	09403	Child	ATV Driver/Rider	Lead		100		100		
2005Feb	09719	Child	ATV Driver/Rider	Lead		72		100		
2005Sep	40303	Child	ATV Driver/Rider	Lead		118		100		
2005Sep	40162	Child	ATV Driver/Rider	Lead		118	4	97	3	Actinolite
2005Sep	40315	Child	ATV Driver/Rider	Lead		173	1	99	1	Actinolite
2005Sep	40357	Child	ATV Driver/Rider	Lead		338	3	99	1	Tremolite
2004Nov	09459	Child	ATV Driver/Rider	First Trailing		105	1	99	1	Other
2004Nov	09520	Child	ATV Driver/Rider	First Trailing		119		100		
2005Feb	09722	Child	ATV Driver/Rider	First Trailing		77	1	99	1	Other
2005Sep	40319	Child	ATV Driver/Rider	First Trailing		263	8	97	3	Actinolite
2004Nov	09462	Child	ATV Driver/Rider	Second Trailing		107	1	99	1	Other
2004Nov	09524	Child	ATV Driver/Rider	Second Trailing		103		100		
2004Nov	09408	Child	ATV Driver/Rider	Second Trailing		129		100		
2005Sep	40102	Child	ATV Driver/Rider	Second Trailing		182	7	96	4	Actinolite
2005Sep	40323	Child	ATV Driver/Rider	Second Trailing		447	6	99	1	Tremolite
2004Nov	09414	Child	SUV Driver/Rider	Lead		90	5	95	5	Other
2004Nov	09442	Child	SUV Driver/Rider	Lead		114	4	97	3	Other
2004Nov	09528	Child	SUV Driver/Rider	Lead		102		100		
2004Nov	09552	Child	SUV Driver/Rider	Lead		98	2	98	2	Other

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Event	Sample Number	Age	Receptor	Position	QC Type	Chrysotile	Amphibole	Percent Chrysotile	Percent Amphibole	Amphibole Type
2005Feb	09703	Child	SUV Driver/Rider	Lead		1		100		
2005Sep	40290	Child	SUV Driver/Rider	Lead		98	7	93	7	Actinolite
2005Sep	40341	Child	SUV Driver/Rider	Lead		169	8	95	5	Actinolite, Tremolite
2005Sep	40091	Child	SUV Driver/Rider	Lead		223		100		
2005Sep	40096	Child	SUV Driver/Rider	Lead		162	10	94	6	Actinolite
2005Sep	40154	Child	SUV Driver/Rider	Lead		107		100		
2005Sep	40349	Child	SUV Driver/Rider	Lead		111	14	89	11	Tremolite