EPA

Atlas Asbestos Mine Superfund Site

U.S. Environmental Protection Agency • Region 9 • San Francisco, CA • May 2008

U.S. EPA Releases Exposure and Risk Assessment for Clear Creek Management Area

Background

In 1991, U.S. EPA signed the Record of Decision (ROD) selecting the cleanup remedy for the Atlas Asbestos Mine Superfund site in San Benito and Fresno counties, California. In the ROD, EPA noted that it was not proposing any action for the Clear Creek Management Area (CCMA), one of the Atlas site's four geographic areas. Instead, EPA stated that it would evaluate whether the United States Department of Interior Bureau of Land Management's (BLM) plans for management of CCMA were adequate to protect public health from exposure to asbestos found in the Area's soil and air. The BLM is the agency responsible for administering the public lands of CCMA.

Photo 1

The CCMA contains the largest natural deposit of asbestos in the United States. Commercial asbestos mines operated in the deposit, including the Atlas Mine and the Coalinga Mine, which were addressed by the federal Superfund program. Dust-generating activities, like riding motorcycles on the roads and trails of the CCMA, can release asbestos into the air where it can be breathed into the lungs. Asbestos is a known human carcinogen, causing lung cancer and *mesothelioma**, as well as chronic and debilitating non-cancer respiratory disease.

In 2004, as part of the process of evaluating the completeness of the Atlas Mine cleanup for possible delisting from the federal Superfund 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 a 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. BLM will use the information to evaluate management and use alternatives in an upcoming environmental impact statement for managing the CCMA. 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).

Exposure Assessment

Asbestos Air Sampling

In 2004 and 2005, Region 9 collected air samples while EPA employees and contractors participated in typical recreational activities at the Clear Creek Management Area. The samples were collected from the breathing zone of individuals riding motorcycles and all-terrain vehicles (ATV), driving and riding in sports utility vehicles (SUV), hiking, camping, sleeping in a tent, fence-building, and washing and vacuuming vehicles after use at CCMA. Sample cassettes were placed to collect air samples representing the breathing zone heights of both adults and children (Photo 1), and samples were collected for both lead riders and those trailing behind them (Photo 2). These *activity-based* air samples were then analyzed for asbestos.

Photo 2

*Words in *italic* are defined in the Glossary on page 9.

Results

It is important to note that the asbestos concentrations used by EPA in the exposure and risk assessment and discussed in this fact sheet are for longer fibers known as phase contrast microscopy equivalent, or *PCME*, fibers. PCME fibers are those fibers whose shape and size have been most closely linked to asbestos disease.

The Activity Drives the Exposure - Figure 1 shows the individual sample results for each activity and for measurements of CCMA *ambient air*. The data shows that the activities which typically create the most soil disturbance and dust, motorcycling, ATV driving/riding, and SUV driving/riding, also release the most asbestos into the breathing zone. In some instances, the concentration of asbestos measured in the EPA samples even exceeded what the U.S. Occupational Safety and Health Administration (OSHA) sets for workers as a 30-minute limit for asbestos.

Position Is Important - Figure 2 shows the results for motorcycle riders in the lead and trailing behind and for ATV and SUV drivers/riders. First trailing drivers/riders encountered higher asbestos air concentrations than lead drivers/riders and second trailing drivers/riders typically encountered higher levels than first trailing. This means that the asbestos levels in the air increased with the larger dust clouds encountered by those riders following one or more riders ahead of them.

Figure 1: Comparison of Ambient Concentration and Activities

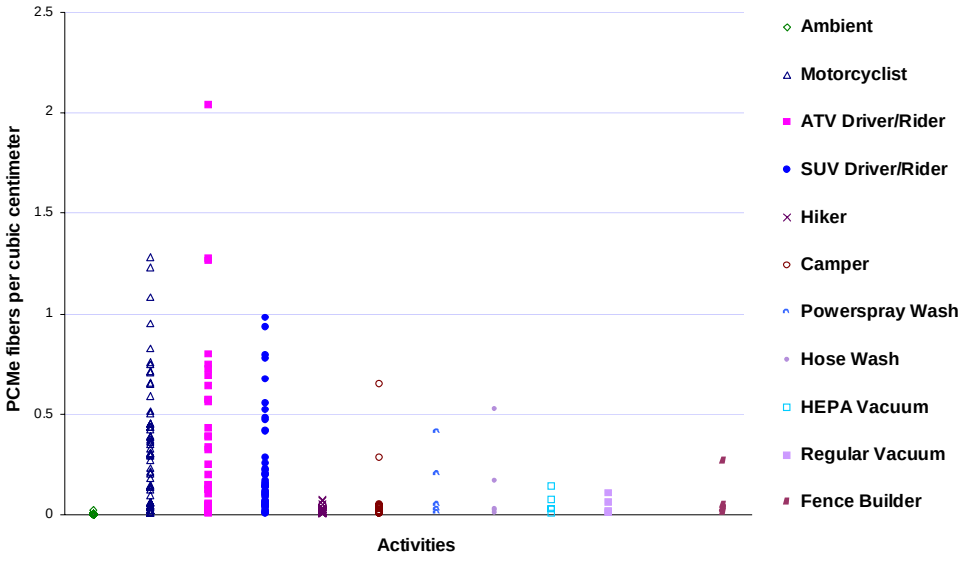


Figure 2: Comparison of Different Riding Positions for Adults

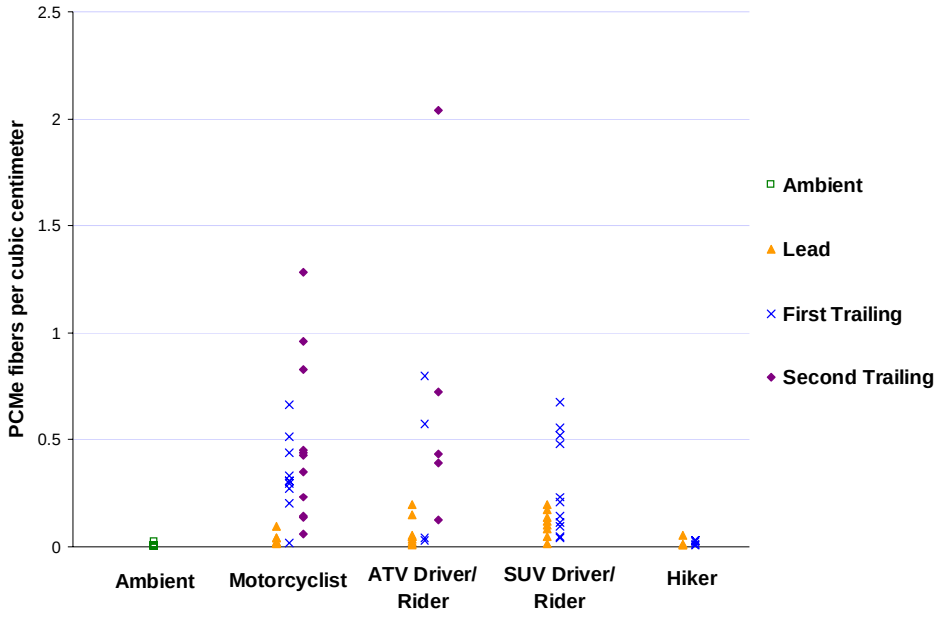


Figure 3: Comparison of Different Weather Conditions for Adult Receptors

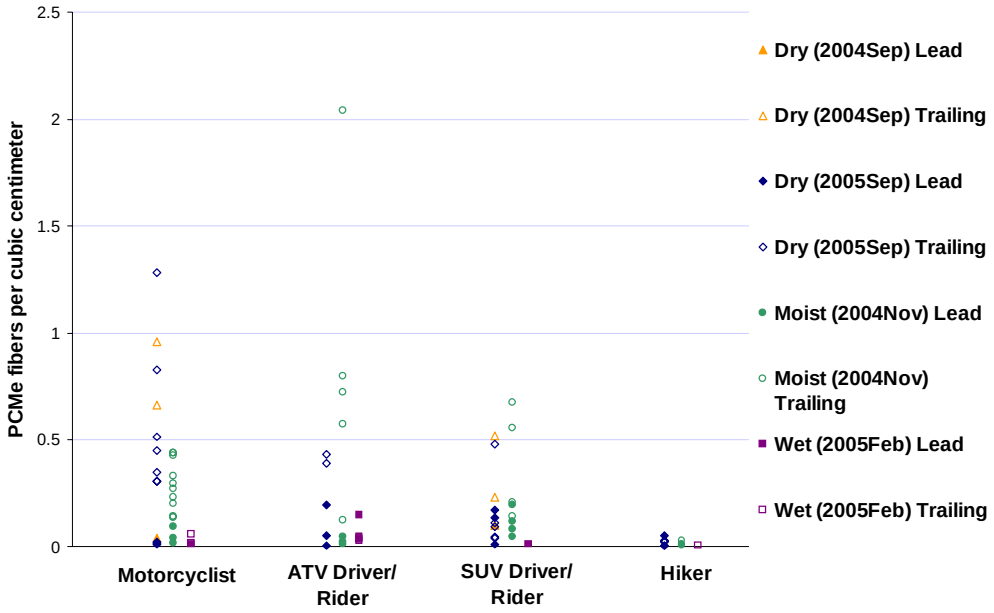
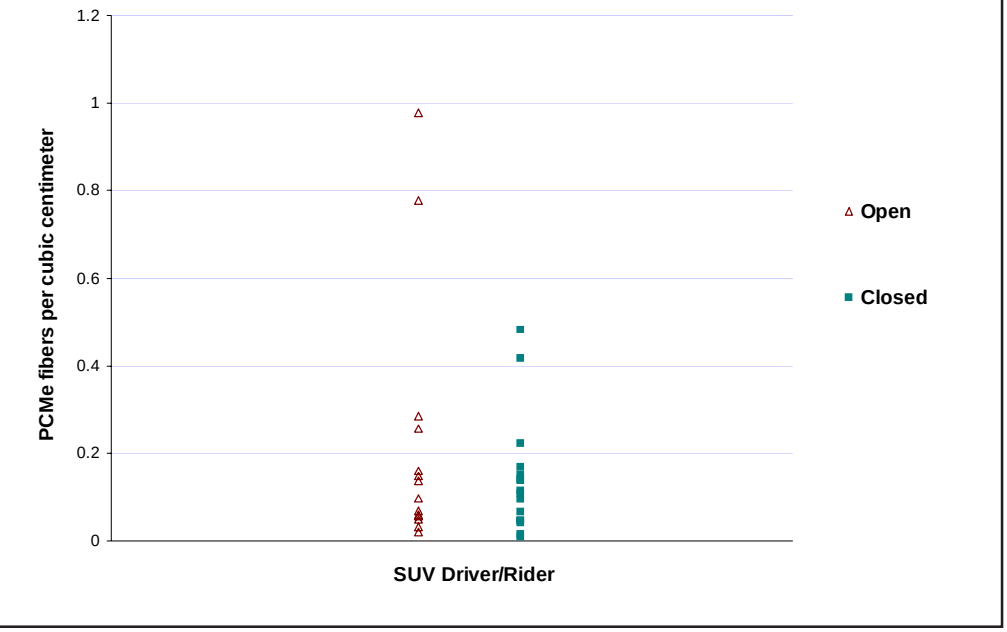


Figure 4: Windows Open vs. Windows Closed Scenarios (September 2005 - All Positions)

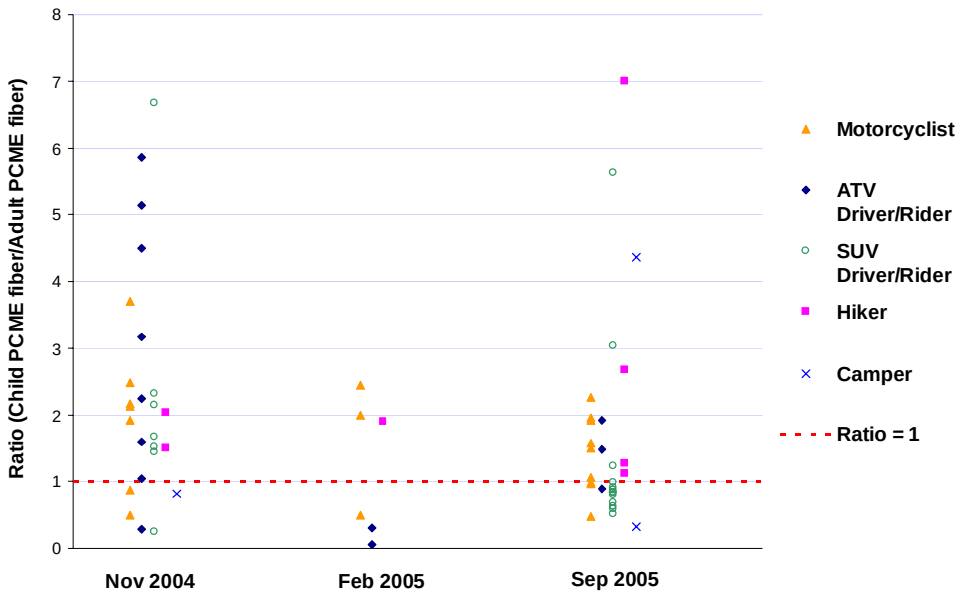


Wet Weather Reduces But Does Not Eliminate Exposure – Figure 3 shows the effect of sampling event weather conditions on asbestos air concentrations. Using rainfall patterns and on-site observations, the September 2004 and 2005 events were determined to be conducted under "dry" conditions, with little or no precipitation in the month prior to the event. The November 2004 event was designated as occurring under "moist" conditions, with two to three inches of rain in the two weeks before the event. The February 2005 events were conducted under "wet" conditions, with rain immediately before and during the events. Based on the sampling results, it appears that only active rainfall reduces asbestos air concentrations, although further study would be needed to define the exact conditions necessary to reduce dust generation and asbestos exposure.

SUV Exposures Were Significant – As shown in Figure 4, driving on the unpaved CCMA access roads resulted in significant measured asbestos air concentrations inside the vehicles, even with the windows closed and the air system set to "recirculate".

Child Exposures Tend to Be Higher – Figure 5 shows the ratio between the child and adult samples collected at the same time on the same sampler i.e. the ratio between the child and adult sample cassettes shown in Photo 1. With the exception of the camping activity, the majority of child exposures exceeded the exposure recorded for the paired adult sample. In total, the asbestos concentration in the child sample exceeded the concentration in the adult sample 64% of the time.

Figure 5: Ratio of Child to Adult Exposure Levels for Each Activity for Each Sampling Date



***Amphibole* Asbestos was Detected in the Air Samples** – While *chrysotile* asbestos was the predominant asbestos mineral type found in the EPA air samples, almost 8% of the PCME fibers were identified as tremolite, actinolite, or another amphibole asbestos mineral. There is an emerging consensus in the scientific community that amphibole asbestos may present an even greater health risk.

Risk Assessment

Scenarios

Seven typical CCMA use scenarios were created from the individual activities for which EPA collected air samples. Risk estimate calculations were then conducted for the scenarios. The scenarios were designed to make the risk estimations better reflect typical CCMA use patterns and provide more useable information to BLM and the public. The scenarios were developed with input from BLM and DTSC. Five of the seven scenarios represent recreational/volunteer use of CCMA, and two represent typical worker use. The five recreational scenarios are:

- **Scenario 1 Weekend Rider:** Drive in, motorcycle on Saturday, camp on Saturday, sleep in tent, camp on Sunday, motorcycle on Sunday, drive out, vehicle wash, vehicle vacuum.
- **Scenario 2 Day Use Rider:** Drive in, stage (prepare for riding), ATV or motorcycle riding, stage, drive out, vehicle wash, vehicle vacuum.
- **Scenario 3 Day Use Hiker:** Drive in, stage, hike, stage, drive out.
- **Scenario 4 Weekend Hunter:** Drive in, hike/hunt on Saturday, camp on Saturday, sleep in tent, camp on Sunday, hike/hunt on Sunday, drive out, vehicle wash, vehicle vacuum.
- **Scenario 5 Combined Rider/Workday:** Drive in, stage, ATV or motorcycle riding, fence building/repair, stage, drive out, vehicle wash, vehicle vacuum.

The typical worker scenarios are:

- **Scenario 6 Patrol:** Stage at Section 8 outside of CCMA, drive in and stage at CCMA (lead driver/rider SUV, ATV or motorcycle patrolling), stage and drive out, vehicle wash, vehicle vacuum, unpacking at Section 8.
- **Scenario 7 SUV/Truck Patrol:** SUV/truck patrol (lead SUV only), vehicle wash, vehicle vacuum.

Risk Assessment Methods - Excess Lifetime Cancer Risk estimates were calculated for the scenarios using both the U.S. EPA Integrated Risk Information System (IRIS) and the California EPA Office of Environmental Health Hazard Assessment (OEHHA) toxicity values for asbestos. These are standard methods for estimating risk.

Adult, Child, and Child/Adult Risk Estimates - Consistent with the EPA Risk Assessment Guidance for Superfund (RAGS), a 30-year exposure duration was used for estimating excess cancer risks from the CCMA adult recreational and worker exposures. The risk assessment estimates risks for an adult who visits CCMA for 30 years, a child who visits for 12 years (ages 6 to 18) with his/her parents and then continues to visit for an additional 18 years as an adult (30 years total exposure), and a child who visits for 12 years from ages 6 to 18.

CCMA Use Frequency - The EPA RAGS guidance requires that risks be estimated for the reasonable maximum exposure (RME) that is expected to occur at a site under both current and future land-use conditions. Based on surveys and interviews, an earlier risk assessment conducted by BLM estimated a CCMA recreational RME of five off-road vehicle rides a year. Because some users indicated that they rode more frequently, the BLM assessment also used a "high" estimate of 12 days per year. Risks were also calculated for one day per year to provide a range of estimates and exposures. The EPA risk assessment incorporates the 1, 5, and 12 visit-per-year frequency of the earlier BLM assessment for Scenarios 1 through 5 and, at BLM's request, uses a 1, 60, and 120 day-per-year frequency for the worker Scenarios 6 and 7.

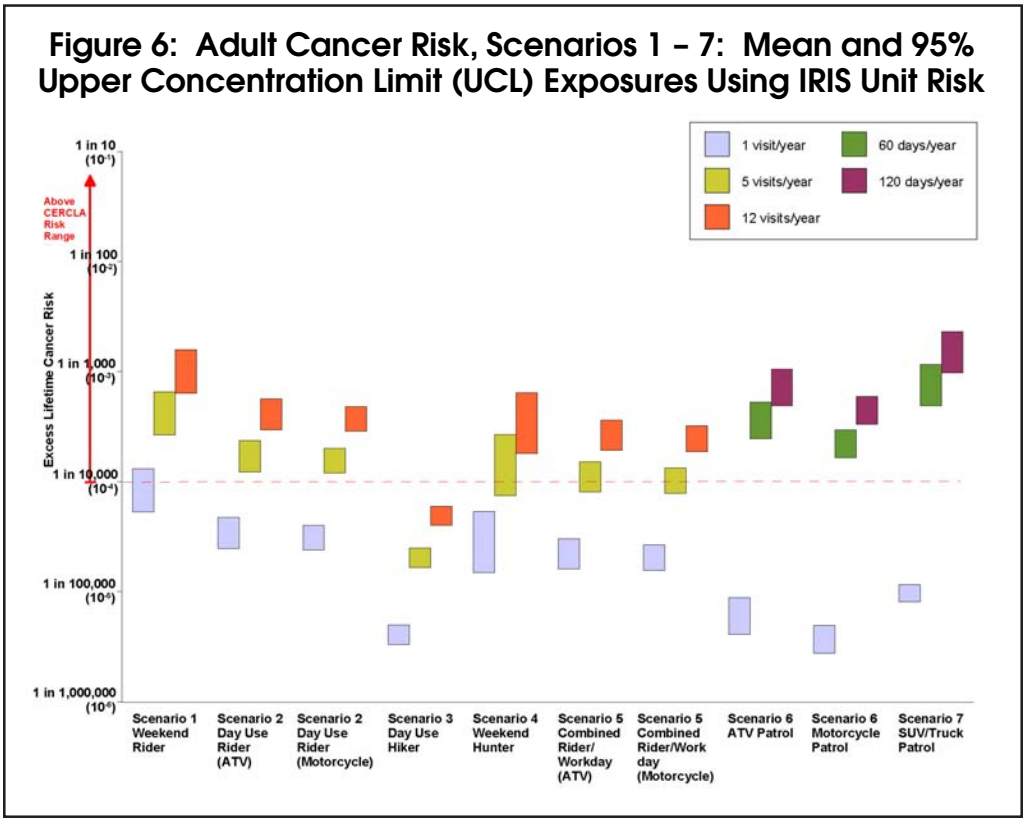
Risk Assessment Results - *Excess Lifetime Cancer Risk* estimates for Adult, Adult/Child, and Child exposures using the U.S. EPA IRIS risk model are shown in Figures 6, 8, and 10. The Excess Lifetime Cancer Risk estimates using the Cal/EPA OEHHA model are shown in Figures 7, 9, and 11. For reasons that are explained in more detail in the risk assessment report, the OEHHA toxicity value for asbestos is eight times higher than the IRIS value, and the OEHHA risk estimations are therefore eight times higher. The IRIS and OEHHA risk estimates can be thought of as bracketing the range of possible risks from CCMA asbestos exposure.

The EPA Superfund program defines the acceptable risk range for exposure to a carcinogen, like asbestos, as 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000) excess lifetime cancer risk. 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. It is important to note that the risk assessment present quantitative estimates of excess cancer risk over a lifetime in a population based on the defined exposure scenarios. The scenarios have been designed to represent current and future exposures for recreational and working users of CCMA. The numbers do not predict individual exposures or individual health outcomes.

What Do The Results Mean?

There was no combination of scenario, toxicity value, or visits per year that was below the risk of 1 in 1,000,000. Using the IRIS model, as shown in Figure 6, EPA's risk estimations found that, with the exception of Scenario 3 Day Use Hiker, making five or more visits to CCMA per year over a 30-year period would put recreational users above the 10^{-4} risk range (1 in 10,000). Only Scenario 3 (Day Use Hiking) had risk calculations within the acceptable range. The highest IRIS risk estimations, 2 x 10^{-3} (2 in 1,000), 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).

Figure 6: Adult Cancer Risk, Scenarios 1 – 7: Mean and 95% Upper Concentration Limit (UCL) Exposures Using IRIS Unit Risk



Using the OEHHA model, even one visit per year for recreational Scenarios 1, 2, 4, and 5, creates a risk that exceeds EPA's acceptable range (Figure 7). The higher risks reflect the fact that the OEHHA asbestos toxicity value is eight times higher than the value in IRIS. At the high end of the risk range, excess lifetime cancer risk estimations using the OEHHA model and the 95% UCL concentration level indicate that recreational users riding motorcycles 12 weekends per year (Scenario 1), and workers performing SUV patrol duties at CCMA (Scenario 7) for 120 days per year during a 30-year career, could have as much as a 1 in 100 (1×10^{-2}) chance of developing asbestos-related cancer. It should be noted that neither the IRIS nor OEHHA models are designed for very high exposure levels, so the absolute 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.

The Child/Adult estimations using the IRIS model found that five or more visits per year for Scenarios 1 through 4 was above the 10^{-4} risk range (Figure 8) and all visits were above the acceptable range using the OEHHA model (Figure 9).

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

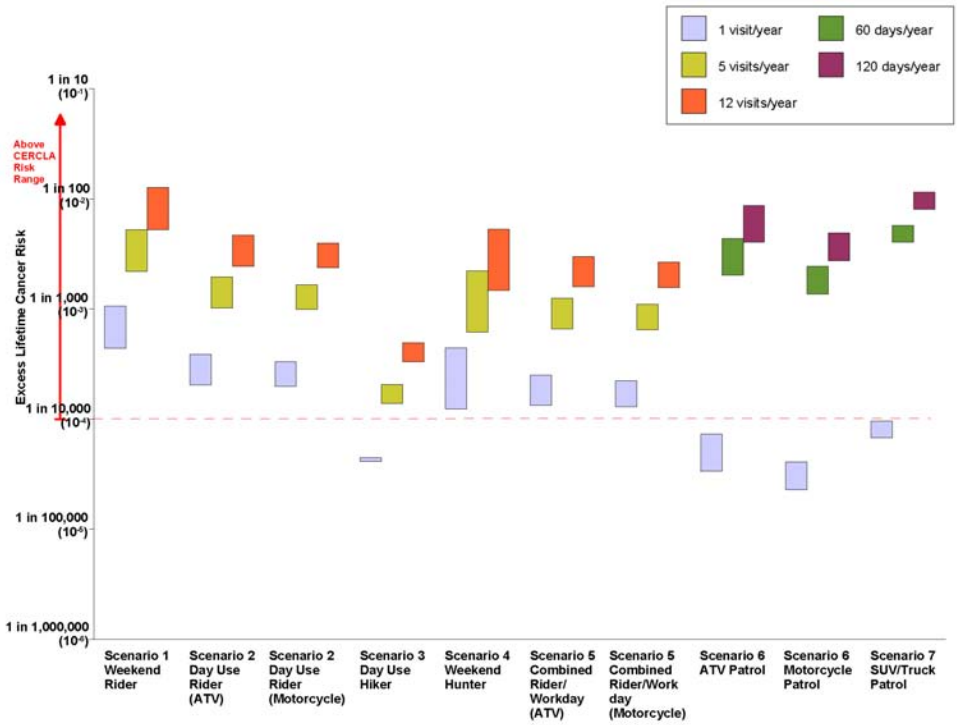


Figure 8: Child/Adult Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using IRIS Unit Risk

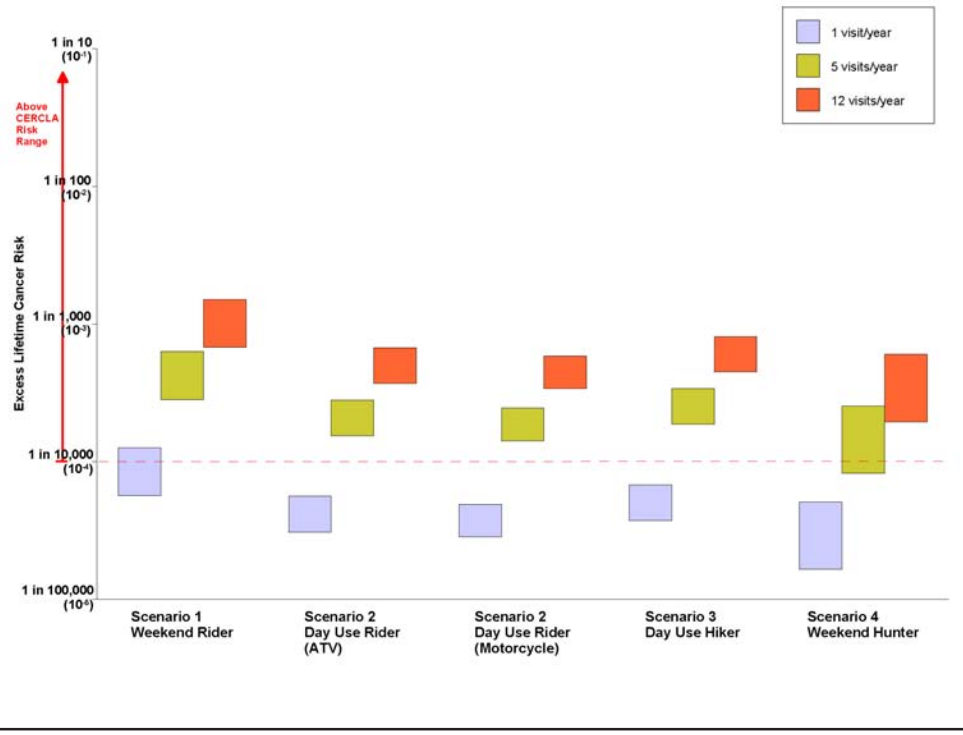


Figure 9: Child/Adult Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using OEHHA Unit Risk

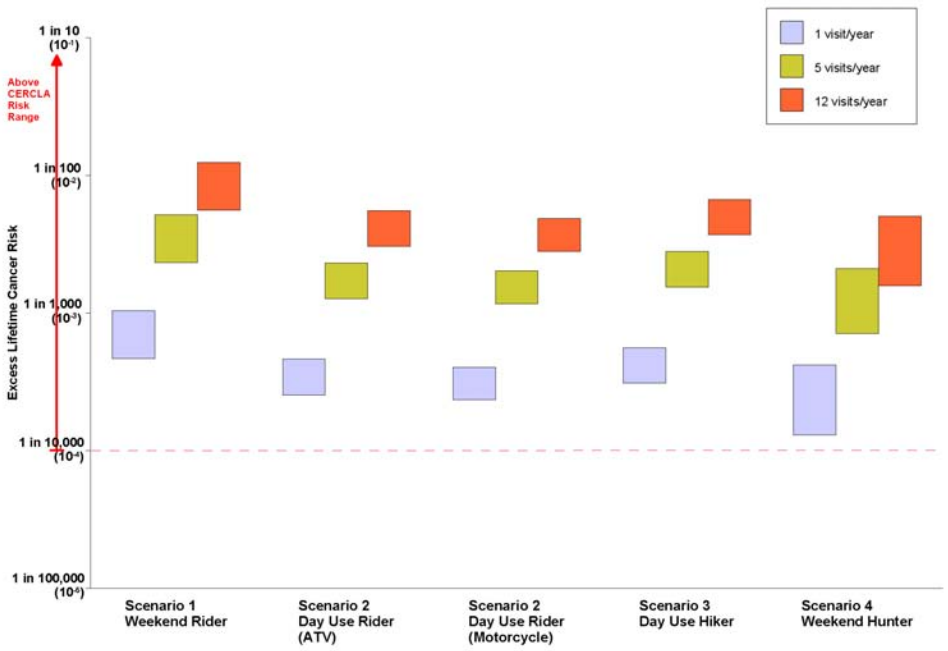
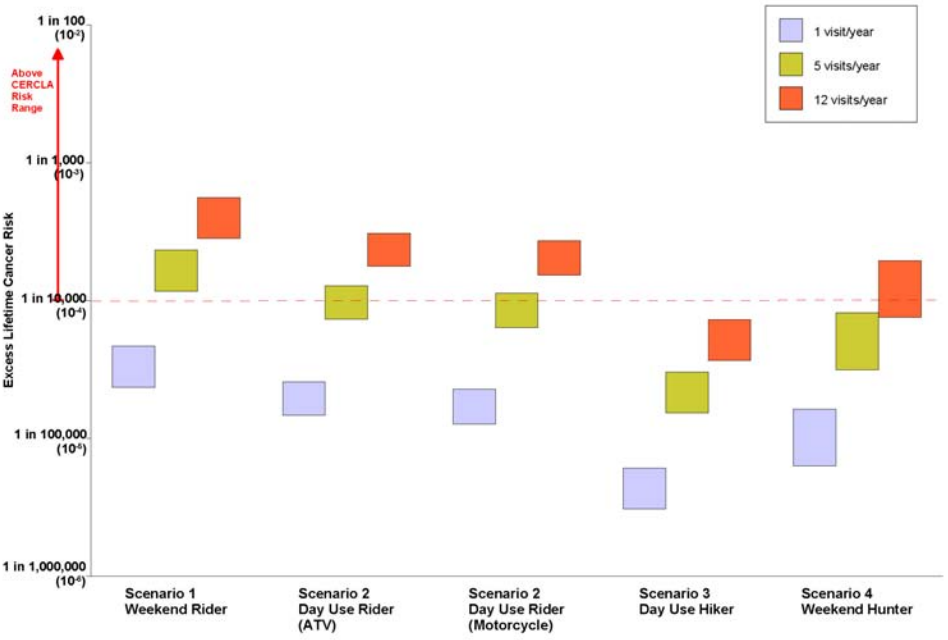


Figure 10: Child Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using IRIS Unit Risk



For the Child risks, which were calculated for a 12-year exposure from ages 6 to 18, less than five visits per year for Scenarios 1 and 2; one, five, and twelve visits for Scenario 3; and one and five visits per year for Scenario 4 were within the acceptable risk range using IRIS (Figure 10). Using the OEHHA model, only less than five visits per year for Scenario 3 Day Use Hiker was within the acceptable range (Figure 11).

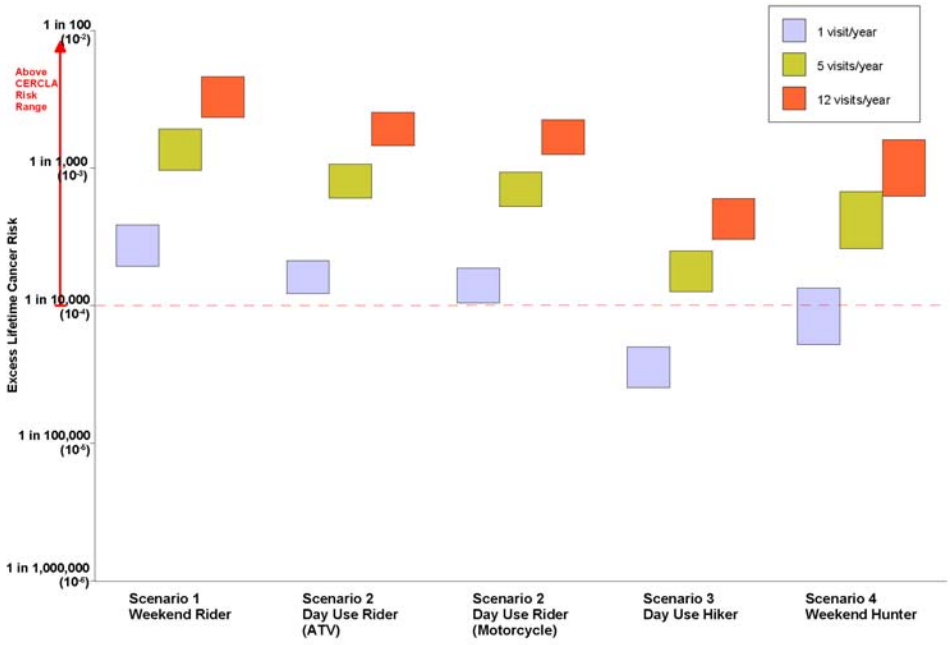
Limitations of the Assessment

With any assessment of risk, there are assumptions and variables that can cause the calculations to either overestimate or underestimate the actual risk. The CCMA risk assessment report contains a more detailed discussion of the exposure and toxicity parameters which affect the calculations of estimated risk.

The CCMA assessment may overestimate or underestimate risk if EPA's measurements of exposure and the assumptions of exposure frequency are either greater or less than actual conditions. Additional uncertainty is introduced because both the IRIS and the OEHHA toxicity values for asbestos are based on epidemiological studies of work place exposures to intermittent high asbestos concentrations over extended periods. While the concentrations measured for activities at CCMA are significantly elevated, the exposure is infrequent and episodic. Because there is no clear mode of action for asbestos-induced disease and no threshold for cancer 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.

On the other hand, the EPA risk calculations may underestimate the risk because take-home exposures and non-cancer health effects were not considered. Asbestos can adhere to equipment, clothes, and the interior and exterior of vehicles, and can be tracked out of CCMA resulting in future exposures to CCMA users, families, and communities. The off-site exposure could increase the risk, proportional to the time of exposure and the concentration of asbestos tracked off-site. Perhaps most important, there is currently no reference value for calculating non-cancer risks from asbestos exposures and non-cancer risks were therefore not addressed in the EPA assessment. However, epidemiological studies indicate that non-cancer respiratory health effects from exposure to asbestos can be significant and in some studies exceed the cancer cases. Therefore, the general probability of developing disease from exposure related to activities at Clear Creek may be significantly underestimated in the EPA risk estimations.

Figure 11: Child Cancer Risk, Scenarios 1 – 4: Mean and 95% UCL Exposures Using OEHHA Unit Risk



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.

Glossary

Activity-based sampling – Activity-based sampling of the air in the breathing zone of an individual while that individual participates in typical work or recreational activities. It has been used for decades by industrial hygienists to measure personal exposures in workplace environments. It is more representative of actual individual exposures than fixed, stationary monitors and soil sampling, and is being used by EPA to sample exposures at asbestos sites across the country.

Ambient air – Ambient air is surrounding air that is not immediately affected by a disturbance or activity.

Amphiboles – One of two mineral families which contain asbestos minerals. Amphibole asbestos tends to form in needle-like shapes and includes tremolite, actinolite, winchite, richterite, anthophyllite, crocidolite, and amosite asbestos.

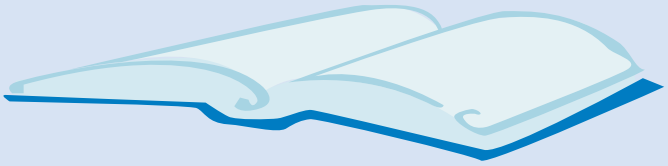
Chrysotile – Asbestos from the serpentine family of minerals. Chrysotile asbestos is flexible and historically accounts for about 95% of the asbestos used commercially in the United States.

Excess Lifetime Cancer Risk – An estimate of the probability that a person may develop cancer in excess of background rates sometime in his or her lifetime following exposure to a particular contaminant.

Mesothelioma - A rare cancer which may affect the lining of the lungs (pleura) or the abdominal contents (peritoneum). Most mesotheliomas are caused by exposure to asbestos. Most cases of mesothelioma are diagnosed 30 years or more after the first exposure to asbestos.

PCME or Phase Contrast Microscopy Equivalent - Phase Contrast Microscopy (PCM) is the analytical method for asbestos used in occupational environments. Current health standards for asbestos are based on studies which document the adverse health effects from asbestos exposure in workers. Since the worker exposures used PCM, the health standards are based on the fibers which are counted in PCM. Today, the EPA uses an analytical technique, Transmission Electron Microscopy or TEM, which can see much smaller and thinner fibers. In order to apply the current health standards to fibers which were counted using a TEM analysis, the EPA used only those fibers which would have been seen in the PCM method, and this equivalent count of fibers is called the Phase Contrast Microscopy Equivalent or PCME. For this risk assessment, only those fibers which are considered to be of PCME dimensions, greater than 5 microns in length, with at least a 3:1 length to width ratio, and a diameter between 0.25 microns and 3 microns inclusive, were used. To give some idea of the size of a PCME fiber, the average width of a human hair is 80 microns.

95% UCL or 95% Upper Confidence Limit of the Mean – A statistical calculation of the mean concentration so that the actual mean will be less than this value 95% of the time.



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U.S. EPA Releases Exposure and Risk Assessment for Clear Creek Management Area

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