INTERNATIONAL ENVIRONMENTAL RESEARCH FOUNDATION

Asbestos Exposures Associated with Motorcycle Riding and Hiking on Asbestos Containing Soils: Risk of Asbestos-Related Cancer: An Update

Prepared for
Off-Highway Motor Vehicle Recreation Division
Department of Parks and Recreation
Sacramento, California

By
International Environmental Research Foundation
New York, New York
www.ierfinc.org

July 7, 2016

Phase-1 (Pilot Study):

Phase-1 of the International Environmental Research Foundation (IERF) study was a two day pilot study to collect activity-based air samples in the Serpentine Area of Critical Environmental Concern (ACEC) of the Clear Creek Management Area ("Clear Creek") in San Benito County, California. The pilot study was to determine if IERF could independently verify the earlier airborne asbestos exposure and associated risk results reported by Cooper *et al*., 1979 and EPA Region 9 (2008).

Personal air samples were collected from two motorcycle riders and a hiker to determine the asbestos exposures associated with these two activities. Ambient air was also sampled to determine the background concentration of airborne asbestos in Clear Creek.

Eight air samples were collected on two motorcycle riders, during four rides on two consecutive days in April 2010. Rides occurred on the morning and afternoon of each day. The routes ridden were within the western half of the ACEC, on routes that were used by EPA Region 9 for its 2008 study. For each ride, the second motorcycle rider was instructed to follow at a distance sufficient to avoid any visible dust generated by the lead rider. This riding practice was not done in the earlier studies by Cooper *et al*., 1979 or EPA Region 9 Study (Figure 1). In addition, each day a hiker air sample and an ambient air sample were collected. Rain had occurred in the days leading up to the start of the air sampling. There was no precipitation in the field investigation area on the days of the air sampling (for details see Wilson *et al.,* 2016).

The air samples were analyzed for the presence of any fibers having aspect ratios of 3:1 or greater and lengths equal to (or greater than) five microns. To preserve the morphology of the airborne fibers, the samples were prepared by a direct-transfer method for examination by analytical transmission electron microscopy (ATEM) at 20,000x magnification. Under these conditions any airborne asbestos or any other mineral fiber present can be imaged.

The asbestos exposures of the two IERF riders were statistically identical and their average exposure was less than 0.013 fibers per milliliter (f/mL). No asbestos was detected in three of eight air samples. The sensitivity of the analysis (value if 1 fiber had been found) was used in the exposure calculations for these three samples. As this concentration of airborne fiber was not observed but was less than this value a less than sign (<) is placed before these three values (Table 1).

Half the fibers and fibrils were chrysotile asbestos and the others had elemental compositions consistent with tremolite (another mineral that can occur as asbestos). The average concentration of total airborne dust for the lead and second motorcycle rider was 0.17 milligram per cubic meter (mg/m^3) in the IERF study based on five measurements.

Assuming the average asbestos exposure IERF measured from the motorcycle-trail-rider samples collected at Clear Creek and assuming individual motorcycle-trail riding occurs for 8-hours/day for 5-days/year, Wilson *et al.,* 2016 calculated the risk of asbestos-related cancers using the two current risk models of the United State Environmental Protection Agency (EPA 1986, IRIS). The results indicate the maximum lifetime excess cancer risk for motorcycle trail riders exposed to this

concentration of airborne asbestos is approximately 0.18 asbestos-related cancer per million people exposed (for details see Wilson *et al.*, 2016).

The Phase-1 risk assessment clearly indicates there is at least a limited opportunity for motorcycle trail riding recreation within the ACEC at Clear Creek. These earlier findings led to a Phase-2 investigation by IERF to collect additional air samples to better characterize the airborne concentration of asbestos from motorcycle trail riding at Clear Creek at times of year other than the hot and dry months. The studies by Cooper *et al*., 1979 and EPA Region 9 (2008) had three major limitations – it is unlikely that air samples collected during the hot and dry period will be representative of airborne asbestos levels at other times of the year, the small number of air samples collected in both studies and the collection of air samples on multiple trailing riders (See Wilson *et al*., 2016 for further discussion of this issue).

Airborne Asbestos Exposures Reported in the Earlier Studies by Cooper *et al., 1979* and EPA Region 9:

Cooper *et al*., 1979 collected air samples on the lead rider and trailing riders on three runs during a dry day in June 1978. The air samples in this study were analyzed by phase-contrast light microscopy using the NIOSH 7400 method OSHA recommends for monitoring occupational exposure to asbestos. Asbestos exposures to the lead and second motorcycle riders were 0.6 and 3.5 f/mL respectively based on a total of six measurements (Table 1). Asbestos exposure to a hiker and in the ambient air was reported to be 0.4 and 0.2 f/mL based on one measurement for each type of air sample.

The total airborne dust concentration for the lead rider was 0.65 mg/m^3 while the second motorcycle rider's exposure was 20 mg/m^3 (based on the average of three rides), which was markedly higher than the total dust average of 0.17 mg/m^3 found in the IERF Pilot Study (Table 1).

Region 9's (2008) study found the concentration of asbestos in the ambient air in Clear Creek to be 0.003 f/mL based on 29 air samples. They collected 18 air samples on lead and secondary rider over four sampling periods (September 2004 & 2005, November 2004 and February 2005). Asbestos exposures to the lead and secondary riders were 0.033 and 0.25 f/mL respectively based on the 18 measurements (Table 1).

Phase-2:

As indicated above, IERF initiated a Phase 2 investigation to collect activity-based air samples at times of the year more reflective of traditional Clear Creek visitation patterns—from November through April. To this end, IERF collected and analyzed a total of 44 air samples from lead and secondary motorcycle riders in the western portion of the ACEC at Clear Creek. The air sampling methodology is described in Wilson *et al*., 2016. The motorcycle trail riding occurred over 2-day periods in April 2010, November & December 2013 and January & March of 2014 and one day in February 2014.

The results of all the 44 air samples collected on motorcycle trail riders during Phase 1 & 2 of the IERF study are shown in Table 1. The 2013-2014 sampling strategy was the same as the

strategy employed for IERF's Phase-1 investigation in April 2010 (Wilson *et al.*, 2016). Two motorcycle rides were taken each day, one in the morning and another in the afternoon. Although air samples were collected on the two motorcycle riders, additional riders were following, taking videos of the two air-sampling riders using helmet-mounted cameras. The lead and following motorcycle rider did not change places.

The IERF Study analytical results of the 44-air samples collected over 11-days indicate the average asbestos exposure to the motorcycle riders is less than 0.058 f/ml (Table 1). Exposure levels for the trailing motorcycle rider were about 2-fold higher than the lead rider. The IERF results from all the air samples are about 4.5-fold higher than the IERF Phase 1 results.

Risk calculations were then performed using the results for all the air samples collected by IERF. The study assumes in its risk assessment that motorcycle trail riding enthusiasts will visit Clear Creek 5-days during one year and ride for 8-hours on each of those days. Using the pessimistic 1986 EPA Airborne Asbestos Health Assessment Update risk model, the lifetime risk of asbestos-related cancer to a motorcycle enthusiast riding trails in the ACEC of Clear Creek for 5-days in one year, under the conditions we observed, would be 0.81 asbestos-related cancers per million riders.

Based on the results of the Phase-2 study and Wilson *et al*., 2016, there is clearly an opportunity to allow OHV recreation at Clear Creek, under the conditions we observed, and similar seasonal conditions, OHV enthusiasts would not be exposed to unacceptably high levels of asbestos.

References

Cooper WC, Murchio W, Popendorf W, Wenk HR (1979) Chrysotile Asbestos in California Recreational Area. Science 206: 685-688.

Environmental Protection Agency. Airborne Asbestos Health Assessment Update. EPA-600-8-84/003F; 1986.

Environmental Protection Agency Region 9. Report on the Clear Creek Management Area Asbestos Exposure and Human Health Risk Assessment. (San Francisco, CA); 2008.

Integrated Risk Information System (IRIS). Asbestos. Retrieved from http://www.epa.gov/iris/subst/0371.htm/

Nolan RP, Langer AM: Concentration and Type of Asbestos Fibers in Air Inside Buildings In: The Health Effects of Chrysotile-Asbestos: Contribution of Science to Risk-Management Decisions, Canadian Mineralogist, Special Publication 5, pp. 39-51, 2001.

World Health Organization (1986) *Asbestos and Other Natural Minerals, Environmental Health Criteria* 53, International Programme on Chemical Safety, Geneva, page 12.

Wilson R, Kelse J, Nord GL, Nolan RP, Langer AM (2016) Asbestos Exposures Associated with Motorcycle Riding and Hiking on Asbestos-Containing Soils: Risk of Asbestos-Related Cancer. Technology and Innovation 17(3): 93-112.

Figure 1. The lead rider in the EPA Region 9 study is shown to be generating a large dust cloud to which the trailing rider is exposed. By comparison neither the lead nor trailing IERF riders are generating visible dust during the April, 2010 activity based air sampling, the airborne asbestos exposure for both IERF riders is statistically identical. Asbestos exposure to the EPA Region 9 trailing rider is about 20-fold higher than the two IERF riders.

Table 1. Summary of the air samples for lead and second motorcycle riders reported by Cooper *et al.,* 1979, EPA Region 9 (2008) and the IERF Phase-1 and Phase-2 Studies at the Clear Creek Management Area. The air samples collected by Cooper *et al*., 1979 were examined by phase-contrast optical microscopy while the air samples collected by EPA Region 9 and the IERF were analyzed by analytical transmission electron microscopy (ATEM).

Air Sample Type	**Total Dust (mg/m^3) (№ of Samples)**	**№ of Air Samples Analyzed**	**№ of Air Samples Where no Fibers were Detected**	**Concentration of Airborne Fibers (Fiber/Milliliter)**
Cooper *et al., 1979*				
Lead Motorcycle Rider	0.65 (3)	3		0.6
Second Motorcycle Rider	20 (3)	3		3.5
All Lead and Secondary Motorcycle Riders		**6**		**2.1**
Hiker		1		0.4
Ambient		1		0.2
EPA Region 9				
Lead Motorcycle Rider		9		0.033
Second Motorcycle Rider		10		0.25
All Lead and Secondary Motorcycle Riders		**19**		**0.14**
Ambient		29		0.003
IERF Study				
Lead Motorcycle Rider	<0.15(3)†	22	14	<0.036
Second Motorcycle Rider	<0.83 (15)	22	3	<0.080
All Lead and Second Motorcycle Riders		**44**	**17**	**<0.058**
Ambient Air	**0.11 (6)**	**10**	**8**	**<0.006**
Control		22		No Fibers Detected
Background of Asbestos in the Ambient Air in US (Nolan and Langer, 2001)				**<0.0012**
Background of Asbestos in Ambient Air Worldwide (see WHO, 1986)				**<0.001 and 0.01**
United States Occupational Safety and Health Administration (OSHA) Asbestos Permissible Exposure Limit (PEL)				**0.1**
Russian Federation Standard for Asbestos in the Ambient Air				**0.06**
†All three Total Dust samples for the Lead Motorcycle were collected in April, 2010.				