

# Health Consultation

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HOPI SHEEP DIP VATS

HOPI INDIAN RESERVATION, ARIZONA

MARCH 29, 2006

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

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

HOPI SHEEP DIP VATS

HOPI INDIAN RESERVATION, ARIZONA

Prepared By  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry  
Division of Toxicology and Environmental Medicine  
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## **BACKGROUND AND STATEMENT OF ISSUES**

The Bureau of Indian Affairs (BIA) requested the Agency for Toxic Substances and Disease Registry (ATSDR) to review the results of soil and groundwater samples obtained from the Hopi Reservation, and provide a public health opinion regarding exposures to the contaminants reported.

Various pesticides were used in dip vat operations to control livestock parasites on the Hopi Reservation from the 1930s to the 1980s. Livestock were herded through a concrete lined trench which contained pesticide solutions, then allowed to dry in adjacent corrals [1,2].

OA Systems Corporation conducted a site investigation of 10 dip vat sites on the Hopi Reservation, which were selected by Hopi Tribal and BIA personnel. Phase I site investigations began in April 2005. During June 2005, Phase II site investigation was conducted at one site (Windmill 4M-89A) where toxaphene was detected during Phase I at levels which exceeded ATSDR's soil screening value [1].

All samples were analyzed in accordance with US EPA SW-846 Method 8081A for toxaphene and chlorinated pesticides, and Method 8270C for organophosphorus pesticides. Hopi Tribal personnel and BIA personnel were present during the sampling events. The Toxicity Characteristic Leaching Procedure (TCLP) was also performed on soil samples when contaminants levels exceeded the Phase I screening values. The TCLP is a test that measures the tendency of specific groups of toxic materials to leach from waste material and is used by regulators to define a waste as hazardous.

During the site investigations on the Hopi Reservation, surface soil samples were collected from 0 to 6 inches below surface from the 10 dip vat sites. Most of the contaminants (i.e., chlordane, endrin, dieldrin) analyzed for in the surface soil samples were not detected. However, toxaphene levels ranged from non-detect to 540 milligrams/kilogram (mg/kg). This represented the highest level of toxaphene detected at Windmill site 4M-89A.

Although groundwater tested at the following sites: (Badger/Bat Spring; Comar Spring West; Sagebrush Wash; and Sand Spring; Windmill 3M-175; Windmill D-6-3501; Windmill 4M-89A); is not normally used for domestic purposes, no pesticides were detected in groundwater samples at levels of public health concern. Furthermore, a background groundwater sample was collected from the Hopi Veterinary Clinic, which the results indicated that no pesticides were detected at levels of health concerns.

During January 17 to 20, 2006, ATSDR personnel visited 9 of the 10 dip vat sites that are being investigated by BIA

on the Hopi Reservation. ATSDR and Hopi personnel did not visit the Sagebrush Wash site, because of time and weather restraints, land usage, and lower levels of pesticides detected in soil samples. The Sagebrush Wash site is located in the Peabody Coalmining Operation Buffer Zone and is currently under Peabody's reclamation program [2]. Information provided to ATSDR during that site visit indicated that some of the residents may be using water from livestock wells for domestic use.

## **DISCUSSION**

In general, most exposures to toxaphene occur from dermal and inhalational occupational exposures [3]. At one site on the Hopi Reservation toxaphene was the only pesticide detected in surface soil samples at levels of public health concern for unintentional ingestion. It was detected at sampling location Windmill site 4M-89A at a maximum level of 540 mg/kg.

Exposure to pesticides may cause serious adverse health effects, particularly in young children. Factors influencing this susceptibility include (1) immaturity of the blood brain barrier which allows entrance of contaminants into the central nervous system; (2) hands to mouth behavior and pica activity; (3) nutritional status of the child; (4) low body weight; (5) and passive diffusion of contaminants across the placenta to developing fetus. Because of these factors, children are more at risk of developing adverse health effects than adolescents, adults and the elderly.

Oral exposures to toxaphene contaminated soils at Windmill site 4M-89A could occur to children who play in the soils, or accidentally ingest the soil on a daily basis for several months during the year. However, toxaphene levels and exposure conditions are such that inhalation and dermal exposures are not expected to be of concern under the current land use scenarios.

### **Physical and Chemical Properties of Toxaphene**

Toxaphene is a non-corrosive yellow waxy solid in its natural state. In 1990, US EPA banned all uses of toxaphene in the United States and its territories [2]. In general, because of its resistance to biodegradation in aerobic (living in air) soils and its lipid (fat loving) solubility, it has a tendency to adsorb tightly to soil and become immobile. However, mobility of toxaphene in soils is also influenced by the soil moisture status and the presence of other organic materials [3]. Toxaphene is highly insoluble in water, and because of its stability in soil is not expected to leach significantly into the groundwater, and is inhibited from volatilizing from sub-surface soils [3]. In surface soils, where volatilization will be a significant

partitioning process, half lives of 2 months to 4 months have been reported for toxaphene in samples taken at the top 2.5 centimeters (cm) and top 7.5 cm, respectively [3]. Toxaphene in deeper subsurface aerobic soils has a half life in soils from 1 to 11 years [3,4].

Toxaphene is considered a B-2 probable human carcinogen by US EPA. A B-2 probable human carcinogen is a contaminant that causes cancer to develop in laboratory animals, but the evidence is lacking to show that it is definitely a carcinogen in humans. Studies have shown that toxaphene residues have been detected in certain vegetables and in more than 50% of the samples the levels were below food tolerance levels [4]. Food tolerance levels represent contaminant levels at or above which the Food and Drug Administration (FDA) may take legal action to remove adulterated products from the market.

#### **Adverse Health Effects of Toxaphene Exposures**

The following are a list of adverse health effects that may be expected if humans are exposed to environmental toxaphene levels above those levels which are of public health concern: tremors; reflex hyper-excitability; vomiting; generalized epileptiform convulsions; and mild irritation of the skin after dermal exposure [4]. However, if exposures are below levels of public health concern, these effects would not be expected. Toxaphene is considered as an endocrine disruptor, because it mimics estrogen and may produce reversible, or irreversible biological effects in individuals by interfering with normal hormone function. Endocrine disruptors act through a number of mechanisms by temporary, or permanently altering feedback loops involving the brain, pituitary, testes, ovary, thyroid gland, or other organs. Their actions are attributed to mimicking, or interfering with normal functioning of sex hormones such as estrogen, progesterone, and testosterone.

ATSDR's oral intermediate (15 to 365 days) Minimal Risk Level (MRL) for toxaphene is at 0.001 mg/kg/d (milligrams/kilogram/day) which is based on adverse liver effects in animals studies. An MRL is the amount of chemical that the general population can be exposed to over a specified duration that is unlikely to result in adverse health effects. The MRL is based on acute exposure (1 to 14 days); intermediate exposure (15 to 365 days); and chronic exposure (greater than 365 days).

ATSDR's Environmental Media Exposure Guide (EMEG) is that amount of chemical in environmental media (e.g., soil) that a person can be exposed to on a daily basis that probably would not exceed the MRL. The EMEG is derived at by using certain EPA's default assumptions (e.g., 200 mg/d soil ingestion rate for children; standard body weight of 15

kg) for human exposures and back calculating using the MRL.

In characterizing the public health hazard posed by ingestion of contaminated soil at the Hopi Reservation, ATSDR assumes the following: (1) that a child who weighs 15 Kg gains site access; (2) ingests 200 mg of soil per day; (3) for 7 days per week; (4) for 1 year; (5) which contains toxaphene at 540 mg/kg; (6) would receive toxaphene at an estimated exposure dose of 0.007 mg/kg/d. This value exceeds the oral intermediate MRL for toxaphene of 0.001 mg/kg/d.

In contrast, assuming the same 15 Kg child gains site access and ingests 200 mg of soil per day for 7 days per week for 1 year, which contains toxaphene at 40 mg/kg, would receive toxaphene at an estimated exposure dose of 0.0005 mg/kg/d, which is below toxaphene's oral intermediate MRL of 0.001 mg/kg/d. Therefore, under current land use, toxaphene remaining in surface soil at **40 mg/kg or below should not pose a threat to public health for children and adults who gain site access on a frequent basis.** However, if land-use changes for these sites at the Hopi Reservation, then this surface soil clean-up level should be re-evaluated and adjusted accordingly, especially if a site is being considered for residential or daycare purposes and anticipated potential exposure scenarios change.

### CONCLUSIONS

Based on the data reviewed, ATSDR concludes the following:

1. Contaminants detected in surface soil samples from 9 of 10 dip vat sites collected during Phase I site investigation **DO NOT** pose a public health hazard;
2. Surface soil levels of toxaphene detected at the Windmill 4M-89A site pose a potential public health hazard to children if they frequent the site on a daily basis;
3. Concrete dip vats and other structures remaining on-site pose a physical hazard to those residents and livestock that gain access to the site;
4. Uncapped well heads at the Comar **West** site pose a physical hazard to children who gain access to the site;
5. The groundwater sampling results indicate that toxaphene and other pesticides were not detected at concentrations that pose a public health hazard;
6. Domestic use of livestock watering points as residential water sources could pose a health hazard to people who use or drink the water on a daily basis, because of potential exposure to pathogenic organisms and other contaminants.

## RECOMMENDATIONS

1. Remediate surface soil levels of toxaphene at the Windmill 4M-89A site to a level that does not pose a public health threat (see discussion);
2. Consider posting warning signs at those sites where existing dip vats represent physical hazards, until the hazards are removed or remediated;
3. Eliminate or mitigate the physical hazards posed by the existing concrete dip vats;
4. Consider converting the non-potable livestock watering point currently in use at the Sand Spring site to domestic water sources.
5. Contact the Hopi Indian Health Service, Office of Environmental Health and Engineering for technical assistance.

ATSDR is willing to re-assess the 10 dip vat sites and re-evaluate its conclusions and recommendations based on (1) if land use changes; (2) and/or additional sampling data, or other scientific pertinent information becomes available.



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## REFERENCES

1. Investigation Report Sheep Dip Vat Investigation and Removal Action Various Locations on The Hopi Reservation, August 2005, prepared by OA Systems Corporation, United States  
Department of Interior, Bureau of Indian Affairs, Washington, DC, Division of Environmental and Cultural Resources Management, Amarillo, TX
2. Hopi Reservation Abandoned Livestock Dip Vat Sites: Land Use Descriptions, Dec 2005, Anna Masayesva, Pesticide Program, Hopi Environmental Protection Office
3. Toxicological Profile for Toxaphene (Update), U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, August 1996.
4. National Library of Medicine, Hazardous Substance Data Bank, Toxaphene, 2006

**SITE INDEX**

<u>Site Name</u>	<u>Latitude</u>	<u>Longitude</u>
Badger/Bat Springs	36° 02.715N	110°51.928W
Comar Spring East	35°31.866N	110°24.888W
Comar Spring West	35°31.858N	110°24.979W
Sagebrush Wash	36°24.083N	110°23.211W
Sand Spring	35°43.109N	110°55.760W
Wepo	35°53.569N	110°22.258W
Windmill 3M-175	35°52.121N	110°58.367W
Windmill 4T-383	36°05.928N	110°40.938W
Windmill D-6-3501	35°49.827N	110°38.208W
Windmill 4M-89A	36°04.684N	110°26.346W

## Appendix A Site Summaries

**Site Name:** Badger/Bat Spring 36° 02.715N 110°51.928W

**Current and Future Land Use:** The area surrounding the site is currently being used as a grazing unit. The area is used year round by local ranchers for water of livestock. The area is designated part of a special management area, located in the vicinity of Blue Canyon, a culturally and ecological important riparian area. The area will eventually exclude the grazing of cattle.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Chlordane soil 0.6 mg/kg to 0.0097 mg/kg
2. Chlordane water non detected or below 0.00005 mg/l
3. Endrin aldehyde soil 0.078 mg/kg to 0.036 mg/kg
4. Endrin aldehyde water non detected or below 0.0001 mg/l
5. Deildrin soil 1.9 mg/kg to non detect
6. Deildrin water non detected or below 0.0001 mg/l
7. 4,4'-DDE soil 1.8 mg/kg to 0.023 mg/kg
8. 4,4'-DDE water non detected or below 0.0001 mg/l
9. 4,4'-DDT soil 0.41 mg/kg to 0.024 mg/kg
10. 4,4'-DDT water non detected or below 0.0001 mg/l

### Physical Hazards:

The cement trench with protruding bolts, wooden posts, and broken masonry are present at the site as documented in the photos.



**Site Name:**  
Comar Spring East



35°31.866N110°24.888W

**Current and Future Land Use:** The area surrounding the sites is currently being used as a grazing unit by both Navajo and Hopi families.. The area is used year round by local ranchers for water of livestock. The Hopi Tribe has begun wetlands rehabilitation projects in the area to have the area turned into a wetland reserve.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. 4,4'-DDD soil 0.035 mg/kg to non-detect
2. Toxaphene soil 16 mg/kg to 2.1 mg/kg

**Physical Hazards:**

The cement trench with protruding bolts, debris, and broken masonry are present at the site as documented in the photos.



**Site Name:** Comar Spring West  
35°31.858N 110°24.979W

**Current and Future Land Use:**

The area surrounding the sites is currently being used as a



grazing unit by both Navajo and Hopi families. The area is used year round by local ranchers for water of livestock. The Hopi Tribe has begun wetlands rehabilitation projects in the area to have the area turned into a wetland reserve.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

- 1) Endrin soil 0.02 mg/kg to non-detect
- 2) Endrin water non detected or below 0.0001 mg/l
- 3) Deildrin soil 0.035 mg/kg to non detect
- 4) Deildrin water non detected or below 0.0001 mg/l
- 5) 4,4'-DDE soil 0.12 mg/kg to non-detect
- 6) 4,4'-DDE water non detected or below 0.0001 mg/l
- 7) Lindane isomers (20) soil 4.3 mg/kg to non detect
- 8) Lindane isomers (20) water non detected or below 0.0001 mg/l
- 9) Lindane isomers (10) soil 0.039 mg/kg to non detect
- 10) Lindane isomers (10) water non detected or below 0.0001 mg/l

**Physical Hazards:**

The cement trench with protruding bolts, wooden posts, and broken masonry are present at the site as documented in the photos. The well lid was unlocked which could allow a child to become trapped.



**Site Name:** Sagebrush Wash 36°31.083N 110°23.211W

**Current and Future Land Use:** The area is currently located in the "buffer zone" of the Peabody Coal Mining operations. The site is currently being used as a grazing unit by Navajo families.. The area is used year round by local ranchers for water of livestock. The reclamation of the buffer zone by Peabody is currently under way and it is expected that once it is completed the area may be used for recreation and development.

**Chemical Levels Reported:**

None detected.

**Physical Hazards:**

Since the site was not visited during the site visit we are not able to document any physical hazards. It maybe assumed that the physical hazards cited at the other locations may also be present at this location.

**Site Name:** Sand Spring 35°43.109N 110°55.760W

**Current and Future Land Use:** The Hopi Office of Range Management fenced off the dip vat area due to family concerns regarding the safety of the site. A Navajo family has an accommodation agreement with the tribe for the next 75 year which stipulates the family cannot build any additional structures or expand their existing home site area. The family raises sheep and goats and terrace farm directly outside the dip vat area. The water from the artesian well feeds a livestock storage tank and trough as well as the source of drinking water for the residence.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Chlordane soil 0.0053 mg/kg to non detect
2. Chlordane water non detected or below 0.00005 mg/l
3. Deildrin soil 0.015 mg/kg to non detect
4. Deildrin water non detected or below 0.0001 mg/l
5. 4,4'-DDE soil 0.018 mg/kg to non detect
6. 4,4'-DDE water non detected or below 0.0001 mg/l

**Physical Hazards:**

The cement trench with protruding bolts and pipes, broken masonry are present at the site as documented in the photos.





**Site Name:** WEPO 35°53.569N 110°22.258W

**Current and Future Land Use:** The area around the WEPO site is being utilized by a local community group for a demonstration project on terrace farming. This group also uses the land for a youth camp during the summer months. The Villages of Tewa, Sichomovi, and Walpi will continue to use the site as a farming site with plans to expand the farming plots to cover the larger traditional areas.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Toxaphene soil 11 mg/kg to 0.96 mg/kg

**Physical Hazards:**

The cement trench with protruding bolts and pipes, broken masonry are present at the site as documented in the photos.



**Site Name:** Windmill 3M-175 35°52.121N 110°58.367W

**Current and Future Land Use:** The area surrounding the site is currently being used as a grazing unit. The area is used year round by local ranchers for water of livestock. The tribe plans on keeping the area as a grazing unit. Due to the proximity to third mesa villages there is a potential for establishment of home sites in the area.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Endrin aldehyde soil 0.028 mg/kg to non detect
2. Endrin aldehyde water non detected or below 0.0001 mg/l
3. Deildrin soil 0.058 mg/kg to 0.012 mg/kg
4. Deildrin water non detected or below 0.0001 mg/l
5. 4,4'-DDE soil 0.022 mg/kg to non detect
6. 4,4'-DDE water non detected or below 0.0001 mg/l

**Physical Hazards:**

The cement trench with protruding bolts and broken masonry are present at the site as documented in the photos.



**Site Name:** Windmill 4T-383 36°05.928N 110°40.938W

**Current and Future Land Use:** The area surrounding the site is currently being used as a grazing unit. The area is used year round by local ranchers for water of livestock. The tribe plans on keeping the area as a grazing unit.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Endrin soil 0.02 mg/kg to non detect
2. Endrin water non detected or below 0.0001 mg/l
3. Deildrin soil 0.035 mg/kg to non detect
4. Deildrin water non detected or below 0.0001 mg/l
5. 4,4'-DDE soil 0.012 mg/kg to non detect
6. 4,4'-DDE water non detected or below 0.0001 mg/l
7. Lindane isomer (20) soil 4.3 mg/kg to non detect
8. Lindane isomer (20) water non detected or below 0.0001 mg/l

**Physical Hazards:**

The cement trench with protruding bolts and broken masonry are present at the site as documented in the photos.





**Site Name:** Windmill D-6-3501 35°49.827N 110°38.208W

**Current and Future Land Use:** The area is heavily utilized by local ranchers and residents for obtaining water for livestock and household use. The land is owned by the Village of Old Oraibi and several members have established home sites within the vicinity of the dip vat site. Due to the location of water on the site it is projected to have an increase of home site usage in the area.

**Chemical Levels Reported:** The level reported are below levels expect to cause health problems.

1. Toxaphene soil 3.8 mg/kg to 0.51 mg/kg
2. Toxaphene water non detected or below 0.003 mg/l

**Physical Hazards:**

The cement trench with protruding bolts and pipes, broken masonry are present at the site as documented in the photos.



**Site Name:** Windmill 4M-89A 36°04.684N 110°26.346W

**Current and Future Land Use:** The area surrounding the site is currently being utilized as a grazing unit. The area is used year round by local ranchers due to the location of the watering source. There is a proposed planned community called Tawaovi that is approximately 3 miles from the site. The Tribe believes that once the Tawaovi community is developed then additional residences or businesses could possible move towards the 4M-89A windmill.

**Chemical Levels Reported:** The level reported pose a potential public health hazard.

1. Toxaphene soil 540 mg/kg to 1.4 mg/kg
2. Toxaphene water Non detect or below .003 mg/l

**Physical Hazards:**

The cement trench with protruding bolts and broken masonry are present at the site as documented in the photos.

