Health Consultation

STATE OF ARIZONA
SILVER CREEK SUBDIVISION

TUCSON, PIMA COUNTY, ARIZONA

JUNE 3, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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.

HEALTH CONSULTATION

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Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
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Purpose

The Arizona Department of Health Services (ADHS) completed this health consultation at the request of the Arizona Department of Environmental Quality (ADEQ). This consult evaluates whether soil vapors from volatile organic compounds in the subsurface near the Silver Creek Subdivision in Tucson, Arizona are present at levels that may cause adverse health effects.

Background

The Silver Creek subdivision is located approximately 4 miles northwest of downtown Tucson. Approximately 700 residents live in the 288 home subdivision. A gasoline release from a ruptured high-pressure pipeline occurred in the Silvercroft Wash near the Silver Creek subdivision on July 20, 2003. Over 50,000 gallons of gasoline have been recovered from the subsurface. Five homes under construction in the area were demolished following the pipeline rupture because of gasoline contamination. The homes in this portion of the subdivision have not been rebuilt.

Levine Fricke (LFR) on behalf of pipeline owner Kinder Morgan Energy Partners (KMEP) performed a soil vapor survey as part of the Silvercroft Wash Fuel Release site assessment and remediation project. In addition to total petroleum hydrocarbons (TPH) and their related compounds (benzene, toluene, ethylbenzene, and xylenes [BTEX], methyl-t-butyl ether [MTBE]), LFR sampling detected non-fuel related chlorinated solvents, such as tetrachloroethene (PCE) and trichloroethene (TCE) in soil vapor and groundwater samples beneath the study area. As the study focused only on fuel-related volatile organic compounds, it did not fully evaluate the extent of the non-fuel related volatile organic compounds. The Arizona Department of Environmental Quality conducted additional soil vapor sampling to obtain analytical soil vapor data to independently verify and expand upon soil vapor data collected by Levine Fricke.

Exposure Pathways

Five elements are considered in the evaluation of exposure pathways:

- A source of contamination
- Transport through an environmental medium
- A point of exposure
- Exposure route
- A receptor population.

The Arizona Department of Health Services categorizes an exposure pathway either as "completed" or as a "potential" exposure pathway if the pathway cannot be eliminated.

In completed exposure pathways, all five elements exist, and exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future.

In potential exposure pathways, at least one of the five elements is missing but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, or may occur in the future. A potential exposure pathway may be eliminated if one of the five elements is missing and is unlikely ever to be present.

Vapor intrusion and inhalation of those vapors is a potentially complete exposure pathway. Soil vapor intrusion refers to the migration of volatile chemicals from the subsurface into overlying buildings. Volatile chemicals in contaminated soils, buried wastes and/or contaminated groundwater can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings similar to the seepage of radon gas into homes. Residents are likely to be exposed to the soil vapors that migrate into homes in the Silver Creek neighborhood resulting in a completed exposure pathway.

ADEQ Flux Chamber Sampling – Silver Creek Subdivision

The Arizona Department of Environmental Quality conducted additional soil vapor sampling to evaluate the potential public health impact to the residents of the Silver Creek subdivision from vapors detected previously during investigation of Silvercroft Wash Fuel Release.

The Arizona Department of Environmental Quality collected soil vapor samples by placing a flux chamber over open soil and on concrete. The data set available for this health consultation is limited to the results of environmental samples collected at 60 flux chambers samples collected at a fixed point in time. One of the flux chambers was set up directly adjacent to the pipeline where no homes are present and was excluded from the database. In addition, there were 2 background samples that were collected but excluded from the database because they are not specific to the neighborhood. Data from a total of 57 flux chambers were used in this health consultation.

An extensive list of target contaminants, including volatile organic compounds not associated with gasoline was evaluated. The results of the evaluation found elevated concentrations of compounds that are consistent with materials that have been previously detected at and near known sources in the area as well as compounds that may be associated with the gasoline pipeline release.

The results from the flux chambers samples were used to estimate indoor air concentrations using standard box models (SECOR 2005). The models provide a conservative estimate of predicted indoor air concentrations. This formula takes into account the mobility of the contaminants and use factors designed to result in the highest (and thus most protective) concentration estimates of contaminants in the air. The following expressions display the model equations and assumptions used to calculate predicted indoor air concentration at both the open soil and concrete slab sampling locations:

Open Soil Flux Chamber Expression:

$$C_{air} = \frac{F_i \times SA \times CL \times CF}{AER \times V}$$

Where:

C_{air}	=	Indoor air concentration in micrograms per cubic meter ($\mu g/m^3$)
F_i	=	Site specific Infiltration flux, in micrograms per feet a minute (μg/ft-min)
SA	=	Surface Area Perimeter, 144 square meters (m^2)
CL	=	Crack level, estimated to be 0.01 (unitless) (ASTM 1997)
CF	=	Conversion factor 60 minutes per hour;
AER	=	Air exchange rate, assumed at 0.25 $hour^{-1}$ (USEPA 2003)
V	=	Average volume of residential structure, assumed 351 cubic meters (m^3) estimated for a home measuring 12 meters (m) by 12 meters (m) and a ceiling height of 2.44 meters (m)

Concrete Slab Flux Chamber Expression:

$$C_{air} = \frac{F_i \times P \times CF_1 \times CF_2}{AER \times V}$$

Where:

C_{air}	=	Indoor air concentration in micrograms per cubic meter ($\mu g/m^3$)
F_i	=	Site specific Infiltration flux, in micrograms per feet a minute (μg/ft-min)
P	=	Perimeter, 48 meters (m)
CF_1	=	Conversion factor 1, 0.3 feet per minute (ft/m)
CF_2	=	Conversion factor 2, 60 minutes per hour
AER	=	Air exchange rate, assumed at 0.25 $hour^{-1}$ (USEPA 2003)
V	=	Average volume of residential structure, assumed 351 cubic meters (m^3) for a home measuring 12 meters (m) by 12 meters (m) and a ceiling height of 2.44 meters (m).

Modeling results for each flux chamber are available in the document entitled Soil Vapor Sampling Report, Silver Creek Subdivision. (SECOR 2005)

Risk Analysis

Contaminants of Concern (COCs) were evaluated for systemic toxicity and carcinogenicity. Systemic toxicity refers to the potential for a compound to cause either symptomatic or asymptomatic health problems in humans. Carcinogenicity refers to the potential for compounds to cause cancer in humans.

Systemic Toxicity

The Arizona Department of Health Services selected contaminants of concern by comparing the average predicted indoor air concentrations to the Agency for Toxic Substances and Disease Registry (ATSDR) Comparison Values (CVs) and the United States Environmental Protection Agency (USEPA) Reference Concentrations (RfC).

The flux chamber samples were used to predict indoor air concentrations by applying conservative assumptions that provide an upper-bound estimate of actual indoor air concentrations. These modeled results represent conditions observed on the days samples were collected and do not predict potential variations in contaminant concentrations that may occur over time.

The Arizona Department of Health Services selected the contaminants of concern by averaging the predicted indoor air concentrations and comparing the resulting concentrations to screening levels. Compounds were selected as a contaminant of concern if the predicted average concentration exceeded a screening level.

The average indoor air concentrations, rather than the maximum indoor air concentrations, were chosen for comparison with the screening levels to optimize the limited dataset available from this single sampling event, to provide a broader statistical base to make comparisons, and to provide a better benchmark for drawing conclusions for the entire neighborhood.

The primary screening levels that were used to select contaminants of concern are called Air Comparison Values (CVs). These screening levels are concentrations in air that are unlikely to pose a health threat. Where the air comparison values were not available for a specific compound, the modeled results were compared to the United States Environmental Protection Agency's Reference Concentration (RfC) or preliminary remediation goals (PRGs). The air reference concentrations and the preliminary remediation goals are applicable to both indoor and outdoor air and are based on a residential exposure scenario using standard exposure factors. These screening levels may also be used as a health protective indoor air target for determining soil gas screening levels for the evaluation of the subsurface vapor intrusion pathway (ATSDR 2005).

Arizona Ambient Air Quality Guidelines were used as screening levels when no comparison values, reference concentrations or preliminary remediation goals were available. These guidelines are developed by the Arizona Department of Health Services, and are protective of human health, including children, over a lifetime. Chemical concentrations in air that exceed any of these guidelines may not necessarily represent a health risk (AAAQG 1999).

Predicted indoor air concentrations that exceed a screening criteria do not necessarily pose a health threat, but require further evaluation.

Table 1. Predicted Indoor Air Concentrations Compared to Screening Values

Compound	Frequency Detected (n=57)	Average Predicted Indoor Air Concentration (micrograms per cubic meter (µg/m³)	Health Effect Screening Value (µg/m³)	Air Concentration Average Above Screening Value?	Chemical of Concern?
Acetone	1	0.51	13000[1]	No	No
Acrylonitrile	7	0.06	2[2]	No	No
Allyl chloride	6	0.06	1[3]	No	No
Benzene	32	0.47	30[2]	No	No
Benzyl chloride	8	0.11	37.7[4]	No	No
Bromodichloromethane	0	0	na[5]	No	No

Compound	Frequency Detected (n=57)	Average Predicted Indoor Air Concentration (micrograms per cubic meter (µg/m^3)	Health Effect Screening Value (µg/m^3)	Air Concentration Average Above Screening Value?	Chemical of Concern?
Bromoform	3	0.16	1.7[3]	No	No
Bromomethane	5	0.03	5[1]	No	No
1,3 Butadiene	0	0	na	No	No
2 Butanone	24	0.06	5000[2]	No	No
Carbon disulfide	18	0.24	900[1]	No	No
Carbon tetrachloride	19	0.02	195[1]	No	No
Chlorobenzene	0	0	na	No	No
Chloroethane	5	0.08	10000[2]	No	No
Chloroform	6	0.03	100[1]	No	No
Chloromethane	27	0.04	50[1]	No	No
1,2 Dibromoethane	4	0.12	9[2]	No	No
Dibromomethane	0	0	na	No	No
1,2 Dibromo-3-chloropropane	5	0.21	2[1]	No	No
Dibromochloromethane	0	0	na	No	No
t-1,4 Dichloro-2-butene	5	0.25	na	No	No
1,2 Dichlorobenzene	6	0.18	9[2]	No	No
1,3 Dichlorobenzene	4	0.14	120[3]	No	No
1,4 Dichlorobenzene	7	0.15	600[1]	No	No
Dichlorodifluoromethane	47	0.08	210[4]	No	No
1,1 Dichloroethane	0	0.03	na	No	No
1,2 Dichloroethane	5	0.02	600[1]	No	No
1,1 Dichloroethene	0	0.06	20[1]	No	No
t-1,2- Dichloroethene	0	0.06	200[1]	No	No
Dichloromethane	22	2.70	4.1[3]	No	No
1,2- Dichloropropane	1	0.08	33[1]	No	No
1,3- Dichloropropane	1	0.08	na	No	No
2,2 Dichloropropane	0	0	na	No	No
1,1 Dichloropropene	0	0	na	No	No
cis,-1,3 Dichloropropene	11	0.03	2[1]	No	No
cis-1,2 Dichloroethene	0	0	na	No	No
t-1,3- Dichloropropene	5	0.03	20[2]	No	No
Ethylbenzene	5	0.16	1000[2]	No	No
4- Ethyltoluene	14	0.11	300[1]	No	No
Freon 113	12	0.04	31000[3]	No	No
Freon 114	0	0.07	na	No	No
n- Heptane	4	0.12	3500[2]	No	No
Hexachlorobutadiene	7	0.83	0.86[3]	No	No
2 Hexanone	17	0.06	40[3]	No	No
Isobutyl alcohol	8	0.13	1500[3]	No	No
Methane	57	92	5E+7[5,6]	No	No
Methacrylonitrile	1	0.12	na	No	No
Methyl iodide	0	0.18	na	No	No
Methyl isobutyl ketone	20	9.06	3000[2]	No	No
Methyl methacrylate	3	0.14	110[4]	No	No

Compound		Frequency Detected (n=57)	Average Predicted Indoor Air Concentration (micrograms per cubic meter (μg/m³)	Health Effect Screening Value (μg/m³)	Air Concentration Average Above Screening Value?	Chemical of Concern?
	Methyl tert butyl ether	6	11.31	3000[2]	No	No
	Methylstyrene	6	0.10	42[4]	No	No
	Napthalene	18	0.46	3.5[1]	No	No
	Octane	21	0.10	2160[1]	No	No
	Propionitrile	7	0.07	240[1]	No	No
	Styrene	7	0.08	258[1]	No	No
1,1,1,2	Tetrachloroethane	2	0.10	40[1]	No	No
1,1,2,2	Tetrachloroethane	6	0.15	40[1]	No	No
	Tetrachloroethene	7	0.08	40[1]	No	No
	Toluene	10	0.86	300[1]	No	No
1,2,4	Trichlorobenzene	6	1.48	320[4]	No	No
1,1,2	Trichloroethane	5	0.04	Na	No	No
1,1,1	Trichloroethane	0	0.03	700[1]	No	No
	Trichloroethene	1	0.03	na	No	No
	Trichlorofluoromethane	30	0.06	56200[2]	No	No
1,2,3	Trichloropropane	3	0.11	18[1]	No	No
1,2,4	Trimethylbenzene	36	0.19	6.2[3]	No	No
1,3,5	Trimethylbenzene	22	0.11	6.2[3]	No	No
	Vinyl acetate	14	0.21	30[1]	No	No
	Vinyl chloride	0	0	na	No	No
m & p	Xylene	5	0.62	435[1]	No	No
o-	Xylene	5	0.19	435[1]	No	No

[1] ATSDR EMEG
[2] EPA Reference Concentration
[3] EPA Region 9 Preliminary Remediation Goal
[4] Arizona Ambient Air Quality Value
[5] No screening value available (na)
[6] Simple asphyxiant value is the Lower Explosive Limit

As shown in Table 1, no chemicals of concern were selected for further analysis, indicating that for all of the compounds, predicted indoor air concentrations in the neighborhood do not pose a systemic health hazard.

Carcinogenicity

Carcinogenic risk is calculated as the incremental probability of an individual developing cancer over a lifetime (70 years), due to exposure to a carcinogenic compound. This is also referred to as incremental or excess lifetime cancer risk (ELCR) and represents the increased risk of developing cancer above the background rate, which is estimated to be about 33%.

While the criteria for selecting the contaminants of concern for cancer are the same as with the systemic health effects, predicted indoor air concentrations are compared to a different set of air comparison values. The guidelines used for this selection are also from the Agency for Toxic Substances and Disease Regeistry's air comparison values, but are values used to screen contaminants that are suspected of causing cancer. These guidelines are known as cancer risk evaluation guides (CREGs).

If there are no cancer risk evaluation guides for contaminants, then the U.S. Environmental Protection Agency's Cancer Preliminary Remediation Goal is used to determine if more evaluation is warranted. The contaminants of concern were selected by comparing the average predicted indoor air concentrations to the air comparison values. Contaminants of concern were selected for further analysis if the average predicted indoor air concentration exceeded its screening level. Table 2 displays a list of all suspected carcinogens observed in the sampling and their screening value.

Table 2. Predicted Indoor Air Concentrations Compared to Cancer Screening Values

Compound	Frequency Detected (n=57)	Average Predicted Indoor Air Concentration (µg/m³)	Cancer Screening Value (µg/m³)	Air Concentration Average Above Screening Value?	Chemical of Concern?
Acrylonitrile	7	0.06	0.01[1]	Yes	Yes
Allyl chloride	6	0.06	3 [1]	No	No
Benzene	32	0.47	0.1[1]	Yes	Yes
Bromodichloromethane	0	0	0.11[2]	No	No
Bromoform	3	0.16	0.9[1]	No	No
1,3 Butadiene	0	0	0.03[1]	No	No
Carbon tetrachloride	19	0.02	0.07[1]	No	No
Chloroethane	5	0.08	2.3 [2]	No	No
Chloroform	6	0.03	0.04[1]	No	No
Dibromochloromethane	0	0	0.08[2]	No	No
1,2 Dibromoethane	4	0.12	0.0034	Yes	Yes
1,4 Dichlorobenzene	7	0.15	0.31[2]	No	No
1,2 Dichloroethane	5	0.02	0.04[1]	No	No
Dichloromethane	22	2.70	3[1]	No	No
1,2- Dichloropropane	1	0.08	0.09[2]	No	No
cis,-1,3 Dichloropropene	11	0.03	0.3[1]	No	No
trans-1,3-Dichloropropene	5	0.03	0.3[1]	No	No
Hexachlorobutadiene	7	0.83	0.05[1]	Yes	Yes
Napthalene	18	0.46	.01[2]	Yes	Yes
1,1,1,2 Tetrachloroethane	2	0.10	0.1[1]	No	No
1,1,2,2 Tetrachloroethane	6	0.15	0.02[1]	Yes	Yes
Tetrachloroethene	7	0.03	0.32[2]	No	No
1,1,2 Trichloroethane	5	0.04	0.06[1]	No	No
Trichloroethene	1	0.03	0.017[2]	Yes	Yes
Vinyl chloride	0	0	0.1[1]	No	No

[1] ATSDR Cancer Risk Evaluation Guideline
[2] USEPA Region 9 Preliminary Remediation Goal

There were 7 contaminants with an average predicted indoor air concentration that exceeded the screening levels. Table 3 summarizes these 7 contaminants.

Table 3. Suspected carcinogenic contaminants detected above the screening levels

Compound	Frequency Detected (n=57)	Average Predicted Indoor Air Concentration (µg/m³)	Cancer Screening Value (µg/m³)	Above Screening Value?	Contaminant of Concern?
Acrylonitrile	7	0.06	0.01[1]	Yes	Yes
Benzene	32	0.47	0.01[1]	Yes	Yes
1,2 Dibromoethane	4	0.12	0.0034	Yes	Yes
Hexachlorobutadiene	7	0.83	0.05[1]	Yes	Yes
Napthalene	18	0.46	0.01[2]	Yes	Yes
1,1,2,2 Tetrachloroethane	6	0.15	0.02[1]	Yes	Yes
Trichloroethene	1	0.03	0.017[2]	Yes	Yes

[1] ATSDR Cancer Risk Evaluation Guideline

[2] USEPA Region 9 Preliminary Remediation Goal

Using the list of contaminants of concern, estimates of estimated lifetime cancer risk were developed by evaluating potential exposure pathways, estimating exposure concentrations and intake, and combining exposure estimates with toxicology information (USEPA 1991).

The dose-response relationship is considered to be linear under the low dose conditions usually encountered in environmental exposures. Under this assumption, the US Environmental Protection Agency slope factor (SF) for a compound is a constant, and risk is directly related to intake. Therefore, the linear low-dose cancer risk is:

$$\text{Risk} = \text{Cancer Inhalation Unit Risk } (1/\mu g/m^3) \times \text{Concentration } (\mu g/m^3)$$

where:

Risk	=	a unitless probability of an individual developing cancer;
Unit Risk	=	Dose averaged over 70 years ($1/\mu g/m^3$) (USEPA 2005); and
Concentration	=	Predicted indoor air concentration ($\mu g/m^3$).

Table 4 summarizes estimated lifetime cancer risk using average predicted indoor air concentrations. Cancer inhalation unit risk is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to a compound at a concentration 1 $\mu g/m^3$ in air. The unit risk values are developed by the US Environmental Protection Agency after careful and detailed analyses of data regarding the potential cancer potency of a compound.

Table 4. Estimated Excess Cancer Risk

Cancer	Average Predicted Indoor Air Concentration (µg/m³)[1]	Cancer Inhalation Unit Risk[2] 1/(µg/m³)	Excess Lifetime Cancer Risk[3]
Acrylonitrile	0.06	0.000068	0.000004
Benzene	0.47	0.0000078	0.000003
1,2 Dibromoethane	0.12	0.0003	0.00003
Hexachlorobutadiene	0.83	0.000022	0.00002
Napthalene	0.46	0.0000015	0.0000006
1,1,2,2 tetrachloroethane	0.15	0.000058	0.000009
Trichloroethene	0.03	0.000017	0.0000005
	Total Excess Lifetime Cancer Risk		**0.00007**

[1] Micrograms per cubic meter of air
[2] Source: (USEPA 2005)
[3] Average Air Concentration X Unit Risk

The estimated upper-bound excess cancer risk estimate of 0.00007 or seven-in-one-hundred-thousand represents the increased risk of developing cancer. This estimate was calculated by multiplying average predicted contaminant concentrations by the Unit Risk.

There is general (although not unanimous) consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. An increased lifetime cancer risk of one in one million or less is generally considered negligible. According to the United States Environmental Protection Agency National Contingency Plan and subsequent guidance, an estimate of excess cancer risk between one in a million to less and one in ten thousand is within a range of acceptable risk (USEPA 1990, 1991). Risks greater than one in ten thousand do not necessarily pose a significant cancer risk, but require additional in-depth analysis in order to draw conclusions about potential cancer risk.

The upper-bound estimated risk from indoor infiltration of contaminants is within the range of acceptable risk and poses no apparent public health hazard to neighborhood residents.

Limitations

There are many sources of uncertainty in every risk analysis. The objective of this health consultation is to determine whether soil vapors from compounds in the subsurface near the Silver Creek Subdivision in Tucson, Arizona are present at levels that may cause adverse health effects. This health consultation is a screening level analysis of health risks, meaning that the report uses a conservative (or upper-bound) analysis.

Several conservative assumptions were made in this analysis. Infiltration into neighborhood homes was assumed to be a complete exposure pathway even though this pathway may not actually be complete. Compounds that were detected in flux chambers at levels less than the reporting limits (called J Flagged Data - meaning that they were qualitatively but not quantitatively accurately identified) were still included in the database to ensure that no compounds were left out of the analysis. The screening levels that were used to select contaminants of concern have a large margin of safety. The exposure assumptions used to develop the screening levels assume continuous 30-year exposure averaged over a 70-year lifetime. Finally, the US Environmental Protection Agency unit risk values used to calculate cancer risk are upper-bound estimates that almost certainly overestimate risk.

The average air concentrations used in this health consultation are estimates based on flux chamber air sampling data collected at the site. The results were used to estimate indoor air concentrations. The air concentrations used in this health consultation represent environmental conditions at one point in time. Ideally, for where vapor intrusion is a concern, permanent sub-surface monitoring points for sample collection would be used to evaluate the long-term behavior of soil vapors. In addition, it may be necessary to collect soil gas samples at different time intervals to compensate for the effects of weather events, such as recent rainfall or barometric fluctuations (DTSC 2004).

Child Health Issues

The Agency for Toxic Substances and Disease Registry recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contaminants in air. Children's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. Children breathe a greater volume of air relative to body weight, resulting in higher burden of pollutants. Furthermore, children, even those without pre-existing illness or chronic conditions, are susceptible to air pollution because their lungs are still developing, and they often engage in vigorous outdoor activities, making them more sensitive to pollution than healthy adults. All calculations and health analyses in this report take into consideration the unique vulnerability of children.

Conclusion

- The predicted indoor air concentrations in Silver Creek neighborhood suggest that the subsurface contaminants pose **no apparent public health hazard.**

Recommendations

The Arizona Department of Health Services has no recommendations at this time.

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Certification

This Silver Creek Subdivision Public Health Consultation was prepared by the Arizona Department of Health Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

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