Human Health Screening Evaluation

Crenshaw High School

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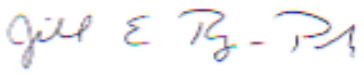

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Human Health Screening Evaluation

The purpose of this Human Health Screening Evaluation (HHSE) is to determine whether current and/or historical activities at the Crenshaw High School (the Site) have resulted in releases of chemicals that could adversely impact the health of school children or staff. The school is located at 5010 11th Avenue in Los Angeles, California. This HHSE is conducted in accordance with DTSC guidelines (DTSC, 2013) using data collected during the most current assessment (July, 2015).

A human health screening evaluation consists of three steps: 1) identifying potentially complete exposure pathways based on the conceptual site model (CSM), 2) identifying chemicals of potential concern (COPCs), and 3) estimating COPC exposures or doses, combining this information with the potential toxicity of the COPCs, and calculating cancer risk and noncancer hazard. Exposure to chemicals may occur if there is a complete pathway for humans to touch, ingest or inhale chemicals in site soil, water, or air. Potential dose and risk are calculated based on an evaluation of potential exposure concentrations of the COPCs, the chronic daily intake or dose for the relevant receptors, and the estimated health risks based on the toxicity of each COPC.

Default exposure parameters provided by the United States Environmental Protection Agency (USEPA) and California Environmental Protection Agency's Department of Toxic Substances Control (DTSC) that represent the Reasonable Maximum Exposure (RME) are incorporated in calculations of cancer risk and noncancer hazard. Incremental cancer risks and noncancer hazard indices are calculated for a residential scenario. Exposure pathways evaluated include incidental ingestion of soil, dermal contact with soils, and inhalation of fugitive dust and volatile chemicals in outdoor air. Assessments for soil exposures are conducted using the screening assessment methodology presented by DTSC (DTSC, 2013).

1.0 Conceptual Site Model

Chemicals detected in at least one sample in soil are initially evaluated as COPCs. Arsenic, lead, chlordane, and dieldrin were detected in soil samples. The maximum detected concentrations of chemicals in soil were used as the exposure point concentrations in evaluating the screening risk for the site. A summary of the data is presented in Table 1.

TABLE 1: SUMMARY OF DATA

Analyzed Compounds	EPA Analysis Method	Number. of Analyzed Samples	Number of Samples with Detections	Range of Detections
Organochlorine Pesticides	8081A	**25**	**3**	**2-26 ug/kg**
a-chlordane	8081A	*25*	*2*	*both 5 ug/kg*
d-chlordane	8081A	*25*	*2*	*3-4 ug/kg*
total chlordane	8081A	*25*	*2*	*11-26 ug/kg*
dieldrin	8081A	*25*	*1*	*2 ug/kg*
Total Lead	6010B	**32**	**31**	**1-53 mg/kg**
Arsenic	6010B	**75**	**47**	**1-34 mg/kg**

mg/kg - milligrams per kilogram

ug/kg - micrograms per kilogram

In keeping with DTSC (2013) guidance, this HHSE assumes that the entire site is available for contact by onsite residents. The CSM identifies the pertinent receptor groups, exposure media and exposure pathways associated with the site. The CSM is presented in Table 2.

TABLE 2: CONCEPTUAL SITE MODEL

Exposure Receptors	Exposure Pathways	Dataset Used	Exposure Point Concentration
Residential	Incidental Ingestion	Soil data from July 2015	Maximum concentration
Residential	Dermal Contact	Soil data from July 2015	Maximum concentration
Residential	Inhalation of Outdoor Air	Soil data from July 2015	Maximum concentration

1.1 Soil Exposure Pathways

The maximum detected concentrations of chemicals in soil were used as the exposure point concentrations in evaluating the screening risk for the site. A list of the chemicals their maximum detected concentrations are provided in Table 1. The potential exists for exposure to these chemicals by dermal contact and incidental soil ingestion, and indirect contact by inhalation of particulates in outdoor air.

Lead was detected at a maximum concentration of 53 mg/kg in soil (Table 1). The residential screening level for lead in soil is 80 mg/kg (OEHHA, 2009). Therefore, lead is not further evaluated as a COPC for this site. Arsenic was detected at concentrations between 1 and 34 mg/kg. The 95% upper confidence limit of the mean concentration was 12.4 mg/kg. Naturally occurring concentrations of arsenic in California soils are assumed, for school sites, to be approximately 12 mg/mg (DTSC, 2007). Arsenic present at concentrations greater than 12 mg/kg will be removed at the Site. Therefore, arsenic is not evaluated further in the human health screening evaluation.

1.2 Water Exposure Pathways

Groundwater beneath the site will not be used as a source of drinking water. No perennial surface water bodies currently occur on or in the vicinity of the site. For these reasons, exposures to drinking and surface waters were not evaluated.

1.3 Air Exposure Pathways

Exposure to nonvolatile chemicals may occur via inhalation of fugitive dust. Exposure to volatile chemicals may occur via inhalation of vapors that migrate from soil to outdoor air. Exposures via inhalation of fugitive dust and ambient air are accounted for in the Regional Screening Levels used in this screening health risk assessment.

1.4 Summary of Selected Exposure Pathways

For the purpose of this human health screening evaluation, residents were assumed to be exposed to chemicals detected in soil by direct dermal contact, incidental ingestion, and inhalation of particulates and inhalation of volatile chemicals. Exposure to groundwater and surface water were deemed incomplete pathways and not further evaluated.

2.0 Exposure Point Concentrations and Chemicals

In accordance with the DTSC guidance (DTSC, 2013), the maximum detected COPC concentrations were evaluated as potential exposure point concentrations (EPCs) for soil exposures. Soil data collected from the sampled depths (6, 12, 18, 24, 30, and 36 inches below ground surface) were used in the evaluation.

3.0 Toxicity Values

The toxicity assessment characterizes the relationship between the magnitude of exposure to a COPC, and the nature and magnitude of adverse health effects that may result from such exposure. For purposes of calculating exposure criteria to be used in risk assessments, adverse health effects are classified into two broad categories – carcinogens and noncarcinogens. Toxicity values are generally developed based on the threshold approach for noncarcinogenic effects and the non-threshold approach for carcinogenic effects. Toxicity values may be based on epidemiological studies and/or subchronic or chronic animal data. Toxicity values used in this assessment are embedded into the Regional Screening Levels (RSLs) (USEPA, 2015) modified, if necessary as discussed in DTSC HHRA Note 3 (DTSC, 2015).

3.1 Carcinogenic Effects

Certain chemicals are regulated as carcinogens based on the likelihood that exposure may cause cancer in humans. Numerical estimates of cancer potency for these chemicals are presented as cancer slope factors (CSFs). The CSF defines the cancer risk due to constant lifetime exposure to one unit of a carcinogen (units of risk per mg/kg-day). CSFs are derived by calculating the 95% upper control level (UCL) on the slope of the linear portion of the dose-response curve using the multistage cancer model on the study data. Use of the 95% UCL of the slope means that there is a 5% chance that the probability of a response could be greater than the estimated value for the experimental data used. This is a conservative approach and may overestimate the actual risk. Carcinogenic slope factors assume no threshold for effect, i.e. all exposures to a chemical are assumed to be associated with some risk. CSFs used in this assessment are embedded into the RSLs (USEPA, 2015; DTSC, 2015).

3.2 Noncarcinogenic Effects

For the purpose of assessing hazard associated with noncarcinogenic effects, the EPA has adopted a science policy position that protective mechanisms such as repair, detoxification, and compensation must be overcome before an adverse health effect is manifested. Therefore, it is assumed that a range of exposures exists from zero to some finite value (a threshold) that can be tolerated by the organism without appreciable risk of adverse effects occurring.

Noncarcinogenic effects are evaluated using EPA Reference Concentrations (RfCs) and Reference Doses (RfDs) (USEPA, 2015). The RfCs and RfDs are health-based criterion based on the assumption that thresholds exist for noncarcinogenic toxic effects. In general, the RfC and RfD are estimates (with uncertainty) of a daily exposure to the human population that are likely without appreciable risk of chronic effects during a lifetime of exposure. RfCs are expressed as acceptable daily doses in milligrams per cubic meter (mg/m^3). RfDs are expressed as acceptable daily doses in milligrams of compound per kilogram of body weight per day (mg/kg-day). RfCs and RfDs used in this assessment are embedded into the RSLs (USEPA, 2015).

4.0 Risk Characterization

The risk characterization process integrates the quantitative and qualitative results of the data evaluation, exposure and toxicity assessments. The purpose is to estimate the likelihood, incidence, and magnitude of the potential human health effects from exposure to the COPCs under study and provide summary judgments regarding the nature of the health threat to the defined receptor populations.

4.1 Cancer Risks

For a chemical identified as a carcinogen, the maximum soil concentration detected is divided by its RSL for a residential receptor (modified, if necessary, as discussed in DTSC HHRA Note 3 so that the screening levels utilized are those specifically recommended by the DTSC), and multiplied by 10^{-6} to calculate the cancer risk pose by that chemical. The risk for each individual chemical is then added to get a screening estimate of the cumulative risk. The cumulative risk is then compared with a one-in-a million (1×10^{-6}, or 1E-06) *de minimis*, or insignificant risk level. The results of the soil assessment are presented in Table 3.

4.2 Noncancer Hazards

For a chemical identified as causing adverse non-cancer health effects, the maximum concentration is divided by its RSL to get a Hazard Quotient (HQ) for that chemical. The HQs for each individual chemical are summed to obtain a site-related Hazard Index (HI). The HI is then compared to a DTSC acceptable benchmark level of 1.0. Implicit in the HQ is the assumption of a threshold level of exposure below which no adverse effects would occur. This evaluation is presented in Table 3.

TABLE 3: SCREENING HUMAN HEALTH RISK ASSESSMENT

Chemical	Maximum Concentration (mg/kg)	Residential Cancer RSL (mg/kg)	Residential Noncancer RSL (mg/kg)	Residential Cancer Risk	Residential Noncancer Hazard Index
alpha-Chlordane	5.00E-03	4.30E-01	34	1.28E-08	1.5E-04
delta-Chlordane	4.00E-03	4.30E-01	34	9.3E-09	1.2E-04
total chlordane	2.60E-02	4.30E-01	34	6.0E-08	7.7E-04
dieldrin	2.00E-03	3.40E-02	3.2	5.9E-08	6.3E-04
				1.40E-07	**0.002**

RSL - Regional Screening Level
HERO Note 3 RSL, October 2015
EPA RSL, June 2015
mg/kg - milligrams per kilogram

5.0 Uncertainty Analysis

Risk assessments are a management tool for developing conservative estimates of health hazards that are unlikely to underestimate the true risk for potentially exposed populations. As a result, the numerical estimates in a risk assessment have associated uncertainties reflecting the limitations in available knowledge about site concentrations, exposure assumptions (e.g., chronic exposure concentrations, intake rates, frequency of time spent at home), and chemical toxicity. Where information is incomplete, conservative (over-protective) assumptions must be made. The greater the uncertainty, the more conservative are the assumptions, in an attempt to be protective of public health. In other words, although calculations of exposure often must be simplified to a few pathways or subgroups within a population, the simplifying assumptions should be more likely to overestimate than underestimate risk so that public health is protected regardless of other unknown conditions. Even when actual characteristics of a population are known, assumptions for exposure are often biased toward producing over-protective rather than under-protective health risk estimates for the majority of the population.

This assessment is conducted for a residential receptor. The Site is currently used for a school. Therefore, exposure parameters used in this assessment represent a greater exposure than what actually will occur.

6.0 Results of the Risk Characterization

The COPCs identified for the site included chlorinated insecticides. Table 4 presents a summary of the cancer risk and noncancerous hazard index for exposure to COPCs in soil for residential receptors.

TABLE 4: SUMMARY OF CANCER RISK / NONCANCER HAZARD INDEX - SCREENING HUMAN HEALTH RISK ASSESSMENT

Cancer Risk from Soil Exposures	1.4E-07
Noncancer Hazard Index from Soil Exposures	0.002

7.0 Post Construction Assessment

An assessment was conducted to calculate the cancer risk and noncancer hazard index associated with post-construction conditions. The following data points were removed from the database to represent post-construction conditions:

All PB-1 samples
All PB-2 samples
PB 21-6
PB 25-6
PB 25-12
PB 26-6
PB 30-6
PB 31-6
PB-34-6
PB 41-6
PB 42-6
PB 52-0.5
PB 53-1

PB 55-1
PB 55-0.5
PB 55-1.5
PB 56-0.5

Table 5 presents a summary of the post-construction data.

TABLE 5: POST-CONSTRUCTION DATA

Analyzed Compounds	EPA Analysis Method	Number. of Analyzed Samples	Number of Samples with Detections	Range of Detections
Organochlorine Pesticides	8081A	**22**	**2**	**3-26 ug/kg**
a-chlordane	8081A	*22*	*2*	*both 5 ug/kg*
d-chlordane	8081A	*22*	*2*	*3-4 ug/kg*
total chlordane	8081A	*22*	*2*	*11-26 ug/kg*
dieldrin	8081A	*22*	*1*	*2 ug/kg*
Total Lead	6010B	**28**	**27**	**1-53 mg/kg**
Arsenic	6010B	**52**	**28**	**1-23 mg/kg**

mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram

With regards to the organochlorine pesticides, the cancer risk and noncancer hazard indices with not change with the post-construction conditions. Lead will remain at a maximum concentration of 53 mg/kg in soil. The residential screening level for lead in soil is 80 mg/kg (OEHHA, 2009). Therefore, lead is not further evaluated as a COPC for this site. Arsenic will remain at concentrations between 1 and 23 mg/kg. The 95% upper confidence limit of the mean concentration will be 4.9 mg/kg. Naturally occurring concentrations of arsenic in California soils are assumed, for school sites, to be approximately 12 mg/mg (DTSC, 2007). Therefore, the 95% UCL post-construction arsenic concentration would be below the naturally occurring concentration of arsenic assumed for school sites.

8.0 References

DTSC, 2007. Arsenic Strategies, Determination of Arsenic Remediation, Development of Arsenic Cleanup Goals for Proposed and Existing School sites: Department of Toxic Substances Control, Sacramento, CA. March 21.

DTSC, 2013. Preliminary Endangerment Assessment Guidance Manual. California Department of Toxic Substances Control, Sacramento, CA. October.

DTSC, 2015. Department of Toxic Substances Control. Human Health Risk Assessment (HHRA) Note Number 3, DTSC-modified Screening Levels. October.

OEHHA, 2009. Revised California Human Health Screening Levels for Lead. September.

United States Environmental Protection Agency (USEPA). 2015. Regional Screening Levels. June.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	3/15/2016 2:35:26 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Postconstruction Calculations

General Statistics

Total Number of Observations	52	Number of Distinct Observations	13
Number of Detects	28	Number of Non-Detects	24
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	1
Maximum Detect	23	Maximum Non-Detect	1
Variance Detects	30.92	Percent Non-Detects	46.15%
Mean Detects	5.464	SD Detects	5.561
Median Detects	3	CV Detects	1.018
Skewness Detects	1.764	Kurtosis Detects	3.186
Mean of Logged Detects	1.23	SD of Logged Detects	1.004

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.404	Standard Error of Mean	0.647
SD	4.584	95% KM (BCA) UCL	4.519
95% KM (t) UCL	4.488	95% KM (Percentile Bootstrap) UCL	4.462
95% KM (z) UCL	4.469	95% KM Bootstrap t UCL	4.853
90% KM Chebyshev UCL	5.346	95% KM Chebyshev UCL	6.225
97.5% KM Chebyshev UCL	7.446	99% KM Chebyshev UCL	9.844

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.821	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.769	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.169	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.208	k star (bias corrected MLE)	1.103
Theta hat (MLE)	4.523	Theta star (bias corrected MLE)	4.956
nu hat (MLE)	67.66	nu star (bias corrected)	61.74
MLE Mean (bias corrected)	5.464	MLE Sd (bias corrected)	5.204

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.551	nu hat (KM)	57.35
Approximate Chi Square Value (57.35, α)	40.94	Adjusted Chi Square Value (57.35, β)	40.55
95% Gamma Approximate KM-UCL (use when n>=50)	4.768	95% Gamma Adjusted KM-UCL (use when n<50)	4.814

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.947

63					Maximum	23				Median		1
64					SD	4.89				CV		1.659
65					k hat (MLE)	0.275				k star (bias corrected MLE)		0.272
66					Theta hat (MLE)	10.72				Theta star (bias corrected MLE)		10.84
67					nu hat (MLE)	28.6				nu star (bias corrected)		28.28
68					MLE Mean (bias corrected)	2.947				MLE Sd (bias corrected)		5.651
69										Adjusted Level of Significance (β)		0.0454
70					Approximate Chi Square Value (28.28, α)	17.15				Adjusted Chi Square Value (28.28, β)		16.9
71					95% Gamma Approximate UCL (use when n>=50)	4.861				95% Gamma Adjusted UCL (use when n<50)		4.932
72												
73					**Lognormal GOF Test on Detected Observations Only**							
74					Shapiro Wilk Test Statistic	0.909				**Shapiro Wilk GOF Test**		
75					5% Shapiro Wilk Critical Value	0.924				Detected Data Not Lognormal at 5% Significance Level		
76					Lilliefors Test Statistic	0.176				**Lilliefors GOF Test**		
77					5% Lilliefors Critical Value	0.167				Detected Data Not Lognormal at 5% Significance Level		
78					**Detected Data Not Lognormal at 5% Significance Level**							
79												
80					**Lognormal ROS Statistics Using Imputed Non-Detects**							
81					Mean in Original Scale	3.094				Mean in Log Scale		0.00215
82					SD in Original Scale	4.804				SD in Log Scale		1.643
83					95% t UCL (assumes normality of ROS data)	4.21				95% Percentile Bootstrap UCL		4.254
84					95% BCA Bootstrap UCL	4.406				95% Bootstrap t UCL		4.593
85					95% H-UCL (Log ROS)	7.885						
86												
87					**DL/2 Statistics**							
88					**DL/2 Normal**					**DL/2 Log-Transformed**		
89					Mean in Original Scale	3.173				Mean in Log Scale		0.343
90					SD in Original Scale	4.756				SD in Log Scale		1.213
91					95% t UCL (Assumes normality)	4.278				95% H-Stat UCL		4.541
92					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
93												
94					**Nonparametric Distribution Free UCL Statistics**							
95					**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**							
96												
97					**Suggested UCL to Use**							
98					95% KM (t) UCL	4.488				95% GROS Approximate Gamma UCL		4.861
99					95% Approximate Gamma KM-UCL	4.768						
100												
101	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
102	Recommendations are based upon data size, data distribution, and skewness.											
103	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
104	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
105												