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APPENDIX B
VAPOR INTRUSION RISK ASSESSMENT

for

Laboratory for Energy-related Health Research/ Old Campus Landfill Superfund Site University of California, Davis

prepared for

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ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
Cal EPA	California Environmental Protection Agency
CHHSL	California Human Health Screening Level
COC	constituent of concern
COPC	constituent of potential concern
DB Stephens	Daniel B. Stephens and Associates, Inc.
DOE	United States Department of Energy
DTSC	California Department of Toxic Substances Control
EPC	exposure point concentration
ET	Eastern Trenches
FS	Feasibility Study
FS – Volume 1	*Final Feasibility Study for the University of California, Davis Areas Volume 1: Soil/Solid Waste and Soil Gas*
IRIS	Integrated Risk Information System
J&E	Johnson, P.C. and Ettinger, R. A.
LEHR	Laboratory for Energy-related Health Research
LFU	landfill unit
MWH	Montgomery Watson Harza
mg/m^3	milligram per cubic meter
OCL	Old Campus Landfill
OEHHA	Office of Environmental Health Hazard Assessment
RfC	reference concentration

RSL	Regional Screening Level
Site	Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site
ST	Southern Trenches
UC Davis	University of California, Davis
URF	unit risk factor
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WBH	Waste Burial Holes
α	soil gas-to-indoor air attenuation factor
$\mu g/m^3$	microgram per cubic meter

VAPOR INTRUSION RISK ASSESSMENT

A vapor intrusion risk assessment was conducted to estimate risks in the six land disposal units at the Laboratory for Energy-related Health Research (LEHR)/Old Campus Landfill (OCL) Superfund Site (Site), located at the University of California, Davis (UC Davis) (Figure B-1). Vapor intrusion risks were originally estimated and characterized in the Site Wide Risk Assessment (MWH, 2004). Vapor intrusion risks are re-assessed here to incorporate soil gas data collected in 2008 during the *Feasibility Study* (FS) *Data Gaps Technical Report* (Appendix A) and to account for new toxicity values issued after the Site Wide Risk Assessment was completed.

This risk assessment was conducted using a two-tiered approach. The first-tier evaluation was a screening comparison of soil gas data with conservative non-Site-specific screening values. The second-tier evaluation calculated risk by employing forward risk calculations using soil gas data, Site-specific soil property data, and exposure assumptions established for the Site. The estimated risks were then evaluated using a multiple-lines-of-evidence approach to identify and recommend constituents of concern (COCs) to assist in making risk management decisions.

B1. Tier 1 Risk Screening

The Tier 1 risk screening was conducted using soil gas data collected during the FS data gaps investigation (Appendix A). Soil gas samples were collected from depths of 5 feet below ground surface (bgs), 15 feet bgs, and 25 feet bgs in the Eastern Trenches (ET), Landfill Unit (LFU) No. 1, LFU-2, LFU-3, the Southern Trenches (ST), and the Waste Burial Holes (WBH) areas in September 2008 (Appendix A) (Figure B-2).

The Tier 1 risk screening was conducted in two phases. During the first phase, maximum detected soil gas concentrations were compared with soil gas screening values. As recommended by the California Department of Toxic Substances Control (DTSC) (DTSC, 2009a and 2011), the Tier 1 soil gas screening values were California Human Health Screening Levels (CHHSLs) for soil gas (Cal EPA, 2005; Cal EPA, 2009) and indoor air Regional Screening Levels (RSLs) (US EPA, 2011a), which were adjusted for soil-to-indoor air attenuation. The CHHSLs account for the attenuation that is expected to occur between subsurface soil gas and indoor air. The RSLs are screening concentrations for indoor air and were adjusted by a soil gas-to-indoor air attenuation factor (α) of 0.01 for basements (DTSC, 2005). Although most residential construction in California is slab-on-grade or crawl space, the basement attenuation factor was selected as a conservative measure. If the maximum detected concentration of a particular constituent was greater than the screening value, then the constituent was retained as a constituent of potential concern (COPC).

The results of the first phase of the Tier 1 analysis are summarized in Table B-1. Concentrations of seven volatile organic compounds (VOCs) were greater than the screening values. All other constituents were eliminated from further evaluation.

The second phase of the Tier 1 risk screening consisted of tabulating maximum soil gas concentrations for the seven constituents at each of the six land disposal areas and depth intervals sampled (Table B-2). (Constituents with concentrations greater than the screening values were identified as COPCs for further evaluation in the Tier 2 risk estimate.)

B2. Tier 2 Calculated Risk Estimate

Risks were calculated using the United States Environmental Protection Agency (US EPA) version of the Johnson and Ettinger model (J&E, 1991). The model software (spreadsheet) was downloaded from the DTSC Johnson and Ettinger Model website (DTSC, 2009b). This model simulates the transport of soil gases through subsurface soil into indoor air by both diffusion and advection. The model contains a health risk component added by the US EPA to calculate the risk from inhaling a specific chemical at an estimated indoor air concentration. Exposure assumptions and model inputs, as well as toxicity data, are discussed below.

B2.1 Exposure Assumptions and Model Input Values

The soil gas exposure point concentrations (EPCs) used in the model were the maximum detected concentrations for constituents that exceeded screening values at the depths and locations identified in the second phase of the Tier 1 risk screening (Table B-3).

Site-specific soil parameters were used in the risk estimations. The parameters were obtained from soil samples collected at the Site and analyzed by a soil property laboratory (DB Stephens, 1996; DB Stephens, 2008). A Weiss Associates geologist compared soil boring logs with soil sample descriptions and the soil laboratory results to select representative Site-specific parameters for each area. For each area, the most permeable soil type recorded within each of the three depth intervals (5, 15, and 25 feet bgs) was selected to represent Site-specific conditions. The representative soil samples, rationale for their selection, soil type, and soil parameters are presented in Table B-4. A Site-specific soil temperature of 65 degrees Fahrenheit (18.3 degrees Celsius) was used to correct the Henry's law constant to the appropriate subsurface temperature, as recommended by DTSC (DTSC, 2005). This temperature was based on *in situ* measurements of shallow groundwater at the Site.

Human receptors that could be exposed to the VOCs in indoor air include on-Site indoor researchers and hypothetical future on-Site residents (MWH, 2004). Research facility buildings currently overlie some disposal unit areas (Figure B-1). Geriatrics Buildings 1 and 2 (H-292 and H-293) partially overlie the northernmost part of LFU-2. The Cobalt-60 Annex Building (H-290) overlies a small footprint within the north end of the ET and the northeast corner of LFU-2. Buildings H-290 and H-293 are unoccupied, but part of Building H-292 is regularly occupied by workers. Four small unoccupied buildings overlie a small fraction of LFU-1, and part of a storage building overlies the west border of LFU-3. No residents are currently on-Site, but could be present in the future. In addition, research facilities may occupy these or other parts of the Site in the future.

Site-specific parameters were developed for indoor researchers at LFU-2, based on the size of Building H-292 (greater than 10 meters by 10 meters). Default values from the J&E model were used for residential receptor buildings. The area of Building H-292 (482 square meters) was used for the area of enclosed space in the model. The perimeter of Building H-292 (92.7 meters) was used for the length of the floor/wall seam perimeter crack. A Site-specific ventilation rate (32,600 cubic centimeters per second) was developed, based on one air exchange per hour (commercial building exchange rate from the DTSC *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* [Interim VI Guidance] [DTSC, 2005]). The area of Building H-292 was used to develop the Site-specific volume per hour air exchange rate, but a Site-specific ceiling height was not used because the program does not enable ceiling height parameter input (set at 8 feet).

Human health exposure parameters established in the *Site-Wide Risk Assessment Work Plan, LEHR/SCDS Environmental Restoration* (UC Davis, 2002) were used for indoor researchers and hypothetical future residents (child and age-adjusted adult). Exposure duration was assumed for three receptors: 25 years for indoor researchers, six years for resident children, and 30 years for the age-adjusted resident adult (six years as a child plus 24 years as an adult). The averaging time for carcinogens was 70 years for all three receptors. Non-carcinogen averaging time assumptions were 25 years, six years, and 30 years for indoor researchers, resident children, and age-adjusted resident adults, respectively. Assumed exposure frequencies were 250 days per year for indoor researchers and 350 days per year for residents.

To estimate exposure for hypothetical future on-Site residents, the soil gas advection rate of 5 liters per minute and default building parameters were used, as recommended by DTSC (DTSC, 2005). On-Site indoor researcher exposure was estimated using the calculation option for soil gas advection rates and using Site-specific soil parameters. No modifications were made to any other building parameter assumptions provided in the model.

B2.2 Toxicity Data

Inhalation unit risk factors (URFs) were drawn from US EPA and California Environmental Protection Agency (Cal EPA) sources. The US EPA source was the Integrated Risk Information System (IRIS) database (US EPA, 2011b). The Cal EPA source was the Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database (Cal EPA, 2011). The most conservative toxicity value from these sources was selected as the input to the model. Cancer toxicity values are shown in Table B-5.

Non-cancer toxicity reference concentrations (RfCs) were obtained from IRIS (US EPA, 2011b), OEHHA (Cal EPA, 2011), *the Provisional Peer Reviewed Toxicity Values (PPRTV) for Superfund Database* (US EPA, 2012), and the United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR) via the US EPA Region 9 RSLs (US EPA, 2011a). The most conservative RfC value from IRIS and OEHHA was used, when available. ATSDR RfCs were used when both IRIS and OEHHA values were unavailable. No RfC value was found for 1,1-dichloroethane. In its version of the vapor intrusion model, DTSC provides an RfC for 1,1-dichloroethane (DTSC, 2009b), but the source of this value is not evident. The non-cancer toxicity values are shown in Table B-6.

The inhalation URFs and RfCs provided by IRIS, OEHHA, and ATSDR are based on adult body weight and inhalation rate. These URFs and RfCs are not applicable (or conservative) when estimating child risk. As shown in Tables B-5 and B-6, URFs and RfCs were derived for the resident child using child body weight and inhalation rate. The child URFs and RfCs were used to estimate child risks and the child fraction of age-adjusted adult risks.

B2.3 Risk and Hazard Results

The estimated vapor intrusion risks for on-Site indoor researchers, hypothetical future on-Site resident age-adjusted adults (resident adults), and hypothetical future on-Site resident children (resident children) are shown in Tables B-7 through B-9, respectively. Risks above 1 in 1,000,000 (1E-06) are presented in boldface. Hazard quotients for non-carcinogens were below the threshold of 1.0 in each area for each receptor.

Total cancer risk to the indoor researcher was below 1E-06 at LFU-3, the ST, and the WBH areas. Total risk to the indoor researcher above 1E-06 was calculated for the following locations:

- LFU-1: 2.7E-06 at 15 feet bgs;
- LFU-2: 1.3E-05 at 5 feet bgs and 1.5E-05 at 15 feet bgs; and
- ET: 9.1E-06 at 5 feet bgs, 3.3E-05 at 15 feet bgs, and 1.4E-06 at 25 feet bgs.

Total cancer risk to the age-adjusted adult was equal to or below 1E-06 at the ST. Total cancer risk above 1E-06 was calculated for the following locations:

- LFU-1: 5.7E-06 at 15 feet bgs;
- LFU-2: 1.6E-04 at 5 feet bgs, 1.2E-04 at 15 feet bgs, and 4.3E-06 at 25 feet bgs;
- LFU-3: 1.2E-06 at 25 feet bgs;
- ET: 1.9E-05 at 5 feet bgs, 7.0E-05 at 15 feet bgs, and 3.0E-06 at 25 feet bgs; and
- WBH: 1.4E-06 at 5 feet bgs.

Estimated resident child total risk was approximately 60 percent less than resident adult total risk. The resident adult risk is greater because it consists of the sum of child exposure and adult exposure (age-adjusted sum of risk). Thus, the resident child risks (Table B-9) are a fraction of the total estimated risks for resident adults (Table B-8). Total cancer risk to the resident child was below 1E-06 at LFU-3, the ST, and the WBH. Total cancer risk above 1E-06 was calculated for the following locations:

- LFU-1: 2.1E-06 at 15 feet bgs;
- LFU-2: 5.9E-05 at 5 feet bgs, 4.4E-05 at 15 feet bgs, and 1.6E-06 at 25 feet bgs; and
- ET: 7.2E-06 at 5 feet bgs, 2.6E-05 at 15 feet bgs, and 1.1E-06 at 25 feet bgs.

The spatial distribution of residential receptor risks are shown on Figure B-3. Risks are highest at the north end of LFU-2, in the vicinity of the Geriatrics buildings and the known VOC “hot spot” location. Significant risks are also posted in the ET area, near the other known VOC “hot spot” area. Risks in the remaining areas are near or below 1E-6. Copies of spreadsheets used to calculate Tier 2 risks and hazard quotients are provided in Attachment B-1.

Hazards estimated for each receptor at each land disposal area were below the hazard index of 1.0.

B3. Recommendations Regarding Constituents of Concern to be Included in Feasibility Study – Volume 1

The recommended COCs for FS – Volume 1 are:

- 1,2-dichloroethane, 1,2-dichloropropane, 1,3-butadiene, and chloroform in the ET;
- 1,3-butadiene in LFU-1;

- 1,2-dichloropropane, chloroform, and tetrachloroethene in LFU-2; and
- Formaldehyde in the WBH.

Chloroform, a common anesthetizing agent and solvent, was used at the Site. 1,2-Dichloroethane and 1,2-dichloropropane may be used as solvents or fumigants and are potentially associated with LEHR/OCL operations. 1,3-Butadiene is used in the production of synthetic rubber and could be present due to disposed gloves, pipette bulbs, or other synthetic rubber products. Formaldehyde was used at the Site; its common uses include tissue fixative, disinfectant, and embalming agent. The solvent tetrachloroethene is potentially associated with LEHR/OCL operations such as dissolving other organic chemicals or using it as a pesticide, but it is most commonly used in association with dry cleaning operations.

B4. Uncertainty

Uncertainties in this risk assessment are associated with data quality issues, limited toxicity data, the potential variability of attenuation from subsurface soil into indoor air, and changes in vapor intrusion guidance documents and toxicity factors.

B4.1 Data Quality

As shown in Table B-1, soil gas reporting limits varied by as much as three orders of magnitude, and the maximum reporting limits were above the screening criteria for several analytes. Detection limits can vary because of incomplete sample collection or laboratory dilution of samples to quantify analytes within the calibrated range. Incomplete sample collection can occur when low-permeability sediments do not allow for soil gas flow, and therefore, sampling must be terminated before the summa canister is filled. Analytes were possibly present at concentrations greater than the screening criteria in samples that had higher detection limits; however, the uncertainty related to samples with high detection limits is mitigated by the fact that, in most cases, other samples with low detection limits were collected from the same borehole.

The data validation chemist qualified 1,3-butadiene data for samples collected in the ET and ST areas. The laboratory originally did not report 1,3-butadiene results for these soil gas samples but was able to resubmit a revised report with the results. However, the laboratory's revised report did not provide calibration and raw sample data for 1,3-butadiene, and these data were therefore qualified because of the lack of verifiable quality control information. This uncertainty involves a lack of documentation and does not necessarily indicate accuracy issues with the 1,3-butadiene data.

B4.2 Limited Toxicity Data

Toxicity data (screening values) were not available in the Tier 1 evaluation for some analytes. Most of the analytes without toxicity data were not detected in soil gas except for 1,3-dichlorobenzene, 2-propanol, 4-ethyltoluene, and ethanol. The toxicity of 2-propanol is not an uncertainty issue because it was used as a tracer for leak detection during soil gas sampling. Ethanol was reportedly also a component of the leak detection mixture. The remaining two analytes without toxicity data, 1,3-dichlorobenzene and 4-ethyltoluene, were present in soil gas, but an evaluation of their potential vapor intrusion risk is not possible.

B4.3 Attenuation Variability

The use of soil gas data to estimate indoor air concentrations and inhalation risks is also a source of uncertainty. The US EPA reported poor correlation between soil gas and indoor air concentrations, based on its evaluation of the National Vapor Intrusion Database (US EPA, 2009). Reasons for the poor correlation include variability in building construction, ventilation, and underlying geology. For this evaluation, variability in building construction and ventilation is a source of uncertainty. The most likely vapor intrusion exposure scenario in the disposal units would occur at Building H-292. Part of this building is periodically occupied by on-Site workers, and the southern end of the building overlies LFU-2 (Figure B-1), which contains some of the greatest concentrations of VOCs in soil gas at the Site. The building has open screen windows (no glass) and ventilation occurs through natural circulation via roof vents (DOE, 1992). The commercial building ventilation rate from DTSC's *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (DTSC, 2005) was used to model Building H-292 (on-Site researcher risk estimates at LFU-2 only). Natural ventilation in Building H-292 is expected to be significantly higher than the default commercial value provided by DTSC, but no ventilation rate data are available for the building. Thus, the Tier 2 on-Site researcher calculated risks may overestimate exposure at LFU-2.

B4.4 Changes to Vapor Intrusion Guidance

Several exposure assumptions and model input values used in this vapor intrusion risk assessment were referenced to the Interim VI Guidance (DTSC, 2005). Since the vapor intrusion pathway was initially evaluated in this FS, the *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (Final VI Guidance) was issued by DTSC in 2011 (DTSC, 2011). As such, the exposure assumptions and model input values presented in the Interim VI Guidance (Section B2.1) were compared to those in the Final VI Guidance. Exposure assumptions and model input values used in this evaluation are consistent between the 2005 Interim VI Guidance and the 2011 Final VI Guidance, except for the soil gas to indoor air attenuation factor used in the preliminary screening (Section B1). The attenuation factor cited in the Final VI Guidance is an order of magnitude lower (less conservative) than the attenuation factor used in this risk assessment. Use of this attenuation factor would have eliminated formaldehyde and 1,3-butadiene as COPCs during the preliminary screening. However, use of the new value would not have impacted the overall scope or evaluation of the alternatives in this FS; therefore, corresponding COC changes have not been made. 1,3-Butadiene and formaldehyde should be eliminated as COCs in the Proposed Plan and ROD.

B4.5 Changes to Toxicity Factors

On February 10, 2012, the IRIS database was updated to include new toxicity values for cancer and non-cancer effects for tetrachloroethene. The new IRIS unit risk factor is 2.6×10^{-7} per microgram per cubic meter ($\mu g/m^3$). This risk assessment used a unit risk factor of 5.9×10^{-6} per $\mu g/m^3$ from OEHHA's database. Although the IRIS cancer toxicity value would result in a lower estimated unit risk, the California-specific toxicity value is more conservative; a query of the OEHHA database on March 29, 2012 showed the California-specific toxicity value was unchanged. No changes to the existing risk assessment conclusions are recommended.

The new non-cancer reference concentration for tetrachloroethene listed in IRIS (0.04 mg/m^3) is approximately seven times more conservative than the value used in this risk assessment (0.27 mg/m^3) (US EPA, 2011a). Review of the risk assessment results indicated that the hazard quotients estimated for tetrachloroethene were more than a factor of seven below the hazard threshold of 1.0. Thus, incorporation of the new IRIS reference concentration would not change the risk assessment outcome for tetrachloroethene.

B5. References

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FIGURES

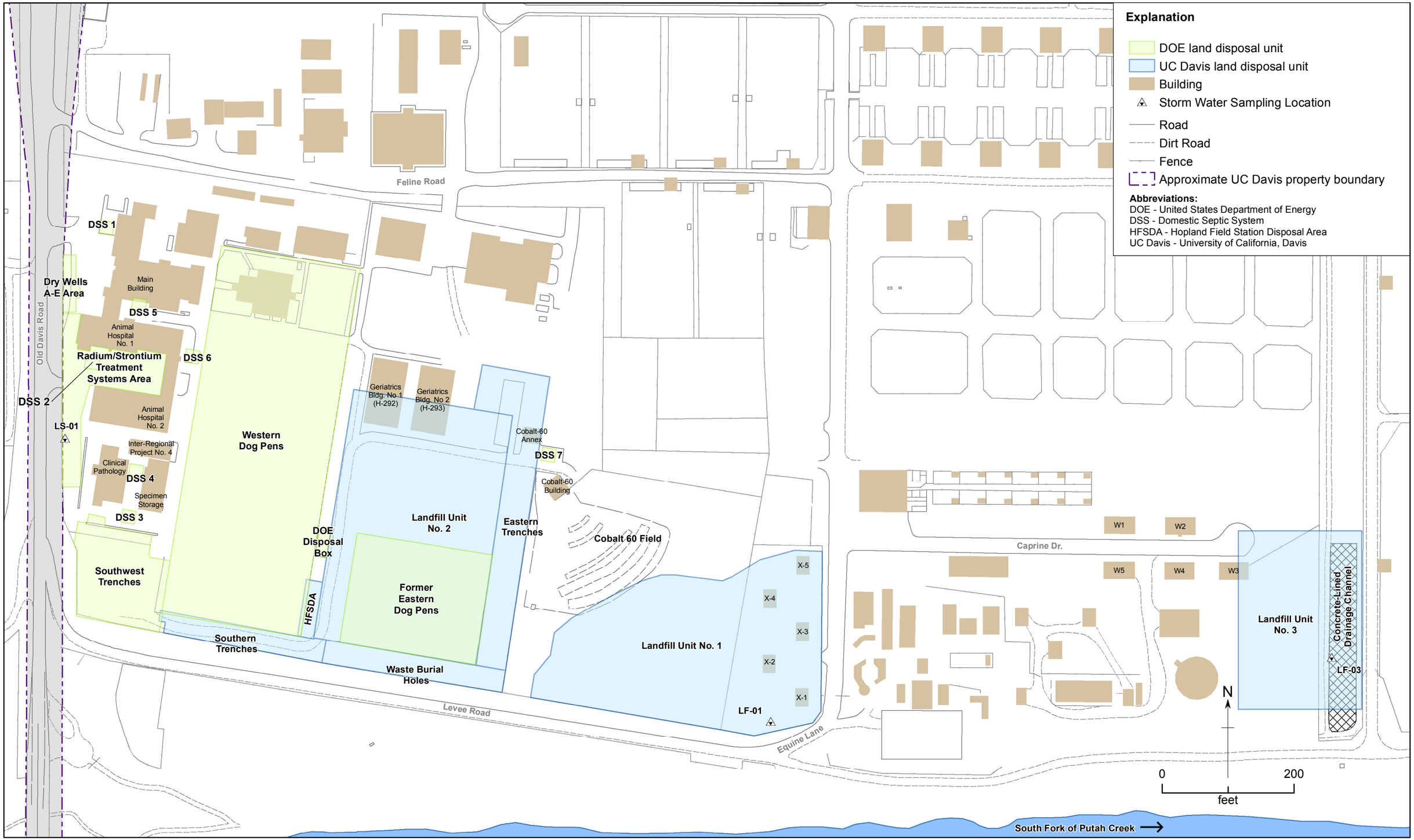

Figure B-1. Site Features - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

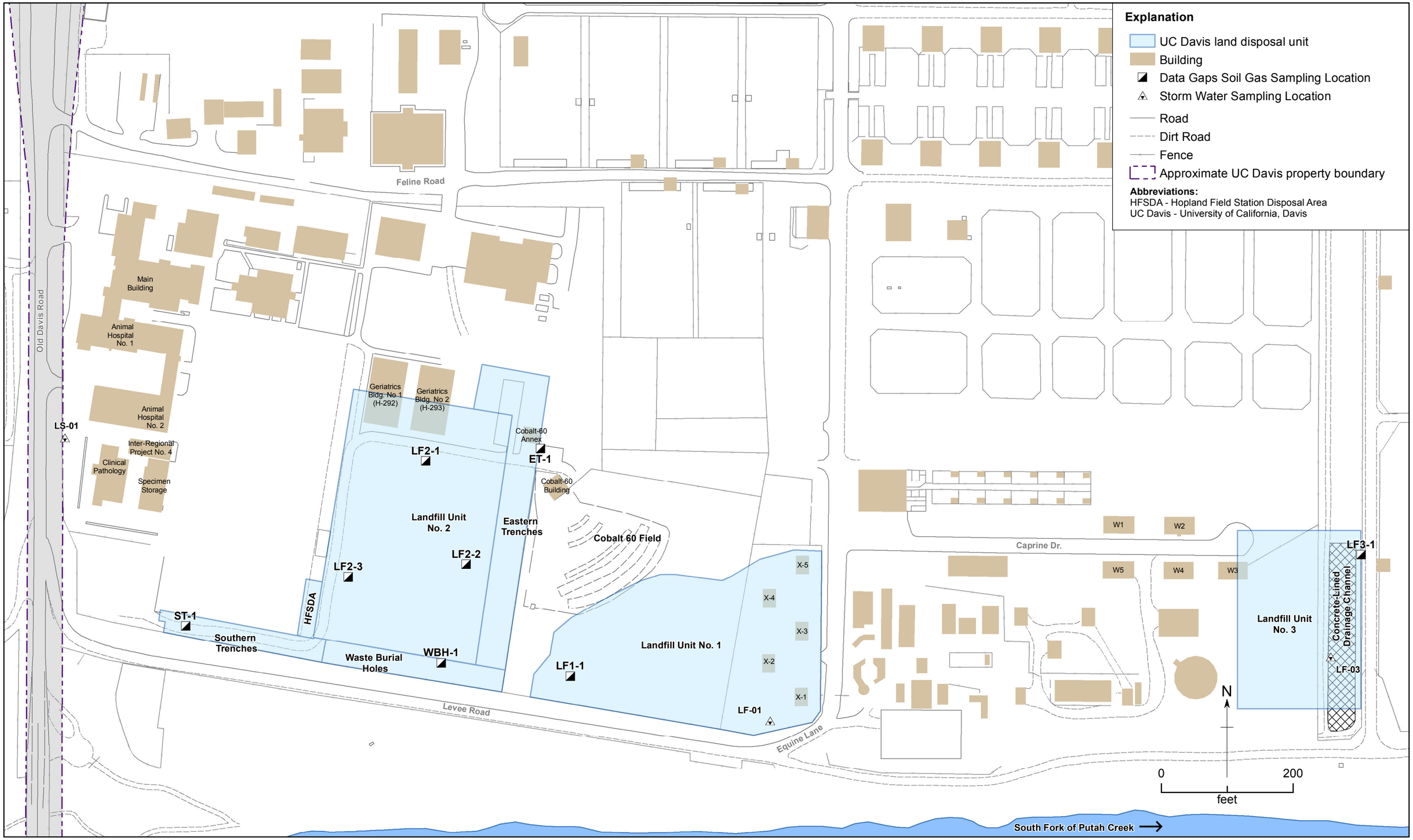

Figure B-2. Soil Gas Sample Locations Collected During the Feasibility Study Data Gaps Investigation - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

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2/17/2012

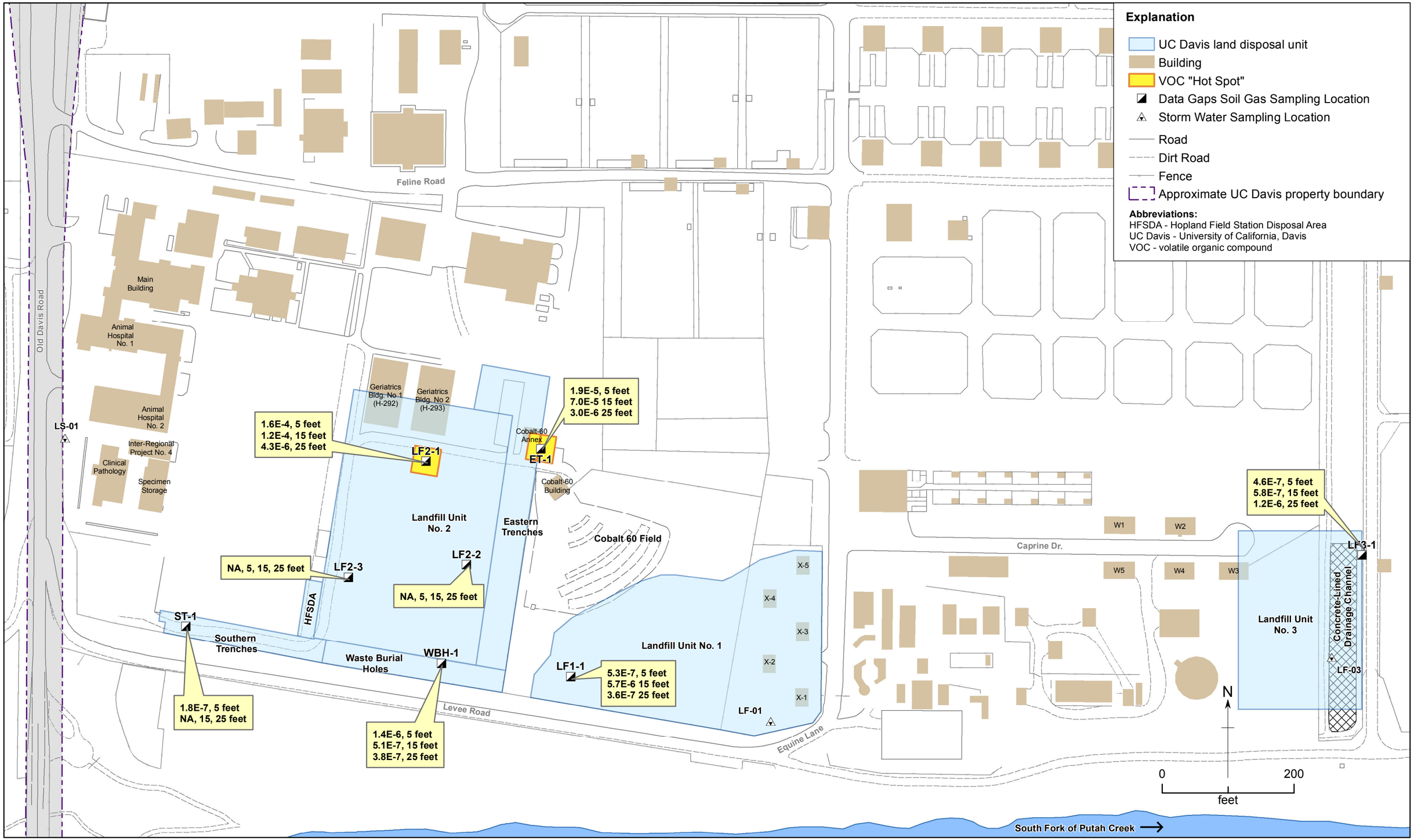

Figure B-3. Spatial Distribution of Vapor Intrusion Risk, Residential Receptor - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

TABLES

Table B-1. Results of Phase 1, Tier 1 Vapor Intrusion Risk Screening - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Analyte	Samples	Detects	Min Detect (µg/m^3)	Max Detect (µg/m^3)	Min Reporting Limit (µg/m^3)	Max Reporting Limit (µg/m^3)	CHHSL[a] (µg/m^3)	RSL/α[b] (µg/m^3)	COPC Flag	Rationale
1,1,1-Trichloroethane	25	3	0.91	58	2.7	410	991,000	520,000	no	BSL
1,1,2,2-Tetrachloroethane	25	0			2.6	510	na	4.2	no	ND
1,1,2-Trichloroethane	25	0			2.7	410	na	15	no	ND
1,1-Dichloroethane	**25**	**7**	**19**	**1,600**	**2**	**300**	**na**	**150**	**YES**	**ASL**
1,1-Dichloroethene	25	5	3.1	390	2	300	na	21,000	no	BSL
1,2,4-Trichlorobenzene	25	0			3.7	2,200	na	210	no	ND
1,2,4-Trimethylbenzene	25	12	0.96	88	2.5	370	na	730	no	BSL
1,2-Dibromoethane	25	0			3.9	570	na	0.41	no	ND
1,2-Dichlorobenzene	25	0			3	450	na	21,000	no	ND
1,2-Dichloroethane	**25**	**2**	**43**	**330**	**2**	**300**	**49.6**	**9.4**	**YES**	**ASL**
1,2-Dichloropropane	**25**	**6**	**32**	**1,900**	**2.3**	**340**	**na**	**24**	**YES**	**ASL**
1,3,5-Trimethylbenzene	25	7	0.31	27	2.5	370	na	na	no	NTX
1,3-Butadiene	**13**	**4**	**4.4**	**74**	**2.6**	**160**	**na**	**8.1**	**YES**	**ASL**
1,3-Dichlorobenzene	25	2	34	79	3	450	na	na	no	NTX
1,4-Dichlorobenzene	25	3	0.7	16	3	450	na	22	no	BSL
1,4-Dioxane	13	0			17	1,100	na	32	no	ND
2,2,4-Trimethylpentane	13	0			5.6	350	na	na	no	ND, NTX
2-Butanone (Methyl Ethyl Ketone)	25	13	1.4	61	1.5	220	na	520,000	no	BSL
2-Hexanone	25	0			2.1	1,200	na	3,100	no	ND
2-Propanol	25	23	0.8	11,000	5	730	na	730,000	no	BSL
3-Chloropropene	13	0			15	930	na	41	no	ND
4-Ethyltoluene	25	7	0.81	62	2.5	370	na	na	no	NTX
4-Methyl-2-pentanone	25	8	0.34	80	2.1	300	na	310,000	no	BSL
Acetone	25	20	28	3,900	6	710	na	3,200,000	no	BSL
Benzene	25	12	1.9	14	1.6	240	36.2	31	no	BSL
Benzyl Chloride	25	0			2.6	380	na	5	no	ND
Bromodichloromethane	25	0			3.4	500	na	6.6	no	ND

Table B-1. Results of Phase 1, Tier 1 Vapor Intrusion Risk Screening - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Analyte	Samples	Detects	Min Detect (µg/m^3)	Max Detect (µg/m^3)	Min Reporting Limit (µg/m^3)	Max Reporting Limit (µg/m^3)	CHHSL[a] (µg/m^3)	RSL/α[b] (µg/m^3)	COPC Flag	Rationale
Bromoform	25	0			5	770	na	220	no	ND
Bromomethane	25	0			2	290	na	520	no	ND
cis-1,2-Dichloroethene	25	0			2	300	15,900	na	no	ND
cis-1,3-Dichloropropene	25	0			2.3	340	na	61	no	ND
Carbon Disulfide	25	12	0.33	140	3.7	520	na	73,000	no	BSL
Carbon Tetrachloride	25	1	0.42	0.42	3.2	470	25.1	41	no	BSL
Chlorobenzene	25	0			2.3	340	na	5,200	no	ND
Chloroethane	25	0			1.3	200	na	1,000,000	no	ND
Chloroform	**25**	**13**	**0.57**	**16,000**	**2.5**	**360**	**na**	**11**	**YES**	**ASL**
Chloromethane	25	3	1.9	10	2.1	620	na	9,400	no	BSL
Cumene	13	0			5.8	370	na	42,000	no	ND
Cyclohexane	13	0			4.1	260	na	630,000	no	ND
Dibromochloromethane	25	0			4.3	630	na	9.0	no	ND
Ethanol	13	8	14	400	9	560	na	na	no	NTX
Ethylbenzene	25	10	0.94	88	2.2	320	na	97	no	BSL
Formaldehyde	**21**	**21**	**45.8**	**175**	**30**	**30**	**na**	**19**	**YES**	**ASL**
Freon 11	25	6	1.1	2.6	2.8	420	na	73,000	no	BSL
Freon 113	25	0			3.8	570	na	3,100,000	no	ND
Freon 114	25	0			3.5	520	na	na	no	ND, NTX
Freon 12	25	6	2.5	5	2.5	370	na	10,000	no	BSL
Heptane	13	0			4.9	300	na	na	no	ND, NTX
Hexachlorobutadiene	25	0			5.5	3,200	na	11	no	ND
Hexane	13	1	12	12	4.2	260	na	73,000	no	BSL
Methyl tert-butyl ether	25	0			1.8	270	4,000	940	no	ND
Methylene Chloride	25	1	1.6	1.6	1.8	260	na	520	no	BSL
o-Xylene	25	10	0.79	100	2.2	320	315,000	10,000	no	BSL
m,p-Xylene	25	11	2.3	220	2.2	320	317,000	10,000	no	BSL

Table B-1. Results of Phase 1, Tier 1 Vapor Intrusion Risk Screening - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Analyte	Samples	Detects	Min Detect (µg/m^3)	Max Detect (µg/m^3)	Min Reporting Limit (µg/m^3)	Max Reporting Limit (µg/m^3)	CHHSL[a] (µg/m^3)	RSL/α[b] (µg/m^3)	COPC Flag	Rationale
Propylbenzene	13	0			5.8	370	na	100,000	no	ND
Styrene	25	6	0.79	2.2	2.2	320	na	100,000	no	BSL
trans-1,2-Dichloroethene	25	0			2	300	31,900	6,300	no	ND
trans-1,3-Dichloropropene	25	0			2.3	340	na	61	no	ND
Tetrachloroethene	**25**	**14**	**1.6**	**2,600**	**3.4**	**500**	**180**	**41**	**YES**	**ASL**
Tetrahydrofuran	13	0			3.5	220	na	na	no	ND, NTX
Toluene	25	21	8.4	8,000	1.9	280	135,000	520,000	no	BSL
Trichloroethene	25	0			2.7	400	528	43	no	ND
Vinyl Acetate	12	0			9	590	na	21,000	no	ND
Vinyl Chloride	25	0			1.3	190	13.3	16	no	ND

Notes:
Detected concentrations above Tier 1 screening values shown in **bold**
[a] Residential Soil Gas CHHSLs (Cal EPA, 2005 and 2009)
[b] US EPA Region 9 residential indoor air RSL (US EPA, 2011) divided by soil-to-indoor-air attenuation factor (α) of 0.01 (DTSC, 2005)

Acronyms/Abbreviations:
ASL - above screening level
BSL - below screening level
Cal EPA – California Environmental Protection Agency
CHHSL - California Human Health Screening Level
COPC - constituent of potential concern
DTSC – California Department of Toxic Substances Control
na - not available
ND - not detected
NTX - no toxicity information
RSL - Regional Screening Level
RSL/α - US EPA Region 9 Regional Screening Level, attenuation factor adjusted
US EPA - United States Environmental Protection Agency
µg/m^3 - micrograms per cubic meter

Table B-1. Results of Phase 1, Tier 1 Vapor Intrusion Risk Screening - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

References:

California Environmental Protection Agency (Cal EPA), 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties*, January, 2005.

Cal EPA, 2009. *Soil-Gas-Screening Numbers for Volatile Chemicals below Buildings Constructed without Engineered Fill below Sub-slab Gravel*, http://www.oehha.ca.gov/risk/chhsltbl091709.html, September 17.

California Department of Toxic Substances Control (DTSC), 2005. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*, December 15, 2004, (Revised February 7, 2005).

United States Environmental Protection Agency (US EPA), 2011. *Regional Screening Levels for Chemical Contaminants at Superfund Sites (Formerly PRGs)*, http://www.epa.gov/region9/superfund/prg/, November.

Table B-2. Results of Phase 2, Tier 1 Vapor Intrusion Risk Screening - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

			Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**CHSSL[a] (µg/m^3)**	**RSL/α [b] (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**	**5 feet (µg/m^3)**	**15 feet (µg/m^3)**	**25 feet (µg/m^3)**
1,1-Dichloroethane	na	150	< 28	< 12	< 300	**890**	**1,600**	58	< 64	< 230	< 9.4	28	**550**	19	< 6.9	< 2	< 4	< 39	< 46	< 38
1,2-Dichloroethane	49.6	9.4	< 28	< 12	< 300	< 67	< 130	< 41	< 64	< 230	< 9.4	< 9.2	**330**	**43**	< 6.9	< 2	< 4	< 39	< 46	< 38
1,2-Dichloropropane	na	24	< 31	< 14	< 340	**910**	**260**	**32**	< 73	< 270	< 11	**43**	**1,900**	**220**	< 7.9	< 2.3	< 4.6	< 45	< 53	< 43
1,3-Butadiene	na	8.1	< 15	**74**	< 160	4.4	< 8.3	< 86	< 35	< 130	**12**	**17 J [c]**	<176 UJ [c]	6.8 J [c]	<19 UJ [c]	1.8 J [c]	1.9 J [c]	**43**	< 25	< 20
Chloroform	na	11	< 33	< 15	< 360	**9,600**	**16,000**	**920**	< 77	< 280	< 11	**1,400**	**13,000**	**710**	**12**	0.85	0.57	< 47	< 56	< 45
Formaldehyde	na	19	**57.8**	**68.5**	**69.7**	**72**	**123**	**175**	**50.2**	**80.2**	**121**	**45.8**	**58.8**	**61.7**	na	na	na	**46.3**	**70.2**	**71.2**
Tetrachloroethene	180	41	< 46	24	< 500	**2,600**	**1,500**	**770**	< 110	< 390	< 16	22	**130**	6.8	5	1.6	2.4	< 66	< 78	< 63

Notes:

Detected concentrations above Tier 1 screening values shown in bold

[a] Residential Soil Gas CHHSLs (Cal EPA, 2005 and 2009)

[b] US EPA Region 9 residential indoor air RSL (US EPA, 2011) divided by soil-gas-to-indoor-air attenuation factor (α) of 0.01 (DTSC, 2005)

[c] Absence of supporting quality control information in laboratory report

Acronyms/Abbreviations:

Cal EPA - California Environmental Protection Agency
CHHSL - California Human Health Screening Level
COPC - constituent of potential concern
DTSC – California Department of Toxic Substances Control
J - concentration is approximate
na - not available
RSL - Regional Screening Level
RSL/α - US EPA Region 9 Regional Screening Level, attenuation factor adjusted
UJ - quantitation limit is approximate
US EPA – United States Environmental Protection Agency
µg/m^3 - micrograms per cubic meter

References:

California Environmental Protection Agency (Cal EPA), 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties*, January, 2005.
Cal EPA, 2009. *Soil-Gas-Screening Numbers for Volatile Chemicals below Buildings Constructed without Engineered Fill below Sub-slab Gravel*, http://www.oehha.ca.gov/risk/chhsltbl091709.html, September 17.
California Department of Toxic Substances Control (DTSC), 2005. *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*, December 15, 2004, (Revised February 7, 2005).
United States Environmental Protection Agency (US EPA), 2011. *Regional Screening Levels for Chemical Contaminants at Superfund Sites (Formerly PRGs)*, http://www.epa.gov/region9/superfund/prg/, November.

Table B-3. Exposure Point Concentrations, Tier 2 - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

COPC	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)	5 feet ($\mu g/m^3$)	15 feet ($\mu g/m^3$)	25 feet ($\mu g/m^3$)
1,1-Dichloroethane	na	na	na	890	1,600	na	na	na	na	na	550	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	330	43	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	910	260	32	na	na	na	43	1,900	220	na	na	na	na	na	na
1,3-Butadiene	na	74	na	na	na	na	na	na	12	17 J [a]	na	na	na	na	na	43	na	na
Chloroform	na	na	na	9,600	16,000	920	na	na	na	1,400	13,000	710	12	na	na	na	na	na
Formaldehyde	57.8	68.5	69.7	72	123	175	50.2	80.2	121	45.8	58.8	61.7	na	na	na	46.3	70.2	71.2
Tetrachloroethene	na	na	na	2,600	1,500	770	na	na	na	na	130	na	na	na	na	na	na	na

Notes:
[a] Absence of supporting quality control information in laboratory report

Acronyms/Abbreviations:
COPC - constituent of potential concern
J - concentration is approximate
na - not applicable
$\mu g/m^3$ - micrograms per cubic meter

Table B-4. Summary of Site-Specific Soil Parameters Used in Tier 2 Risk Calculations - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Location	Depth/s (feet)	Vadose zone soil dry bulk density (g/cm^3)	Vadose zone soil total porosity (cm^3/cm^3)	Vadose zone soil water-filled porosity (cm^3/cm^3)	Soil Type	Representative Site Sample	Rationale for Representative Site Sample Selection
Eastern Trenches	5, 15, and 25	1.45	0.45	0.17	Silty Sand	SSET-2-20	Silty sand was recorded in the 0 to 6 feet depth interval and 18 to 27 feet depth interval at the Eastern Trenches. Sandy/clayey silt was recorded in the 6 to 18 feet depth interval but parameters for this soil type were not used because they are less conservative.
Landfill Unit No. 1	5	1.9	0.29	0.042	Sandy Gravel	GEO1	Sandy gravel was recorded in the 0 to 6 feet depth interval. Sample GEO1collected from the Southwest Trenches is representative of this soil type.
Landfill Unit No. 1	15 and 25	1.45	0.45	0.17	Silty Sand	SSET-2-20	Silty sand was recorded in the 6 to 15 feet depth interval. Sample SSET-2-20 collected from the Eastern Trenches is representative of silty sand near Landfill Unit No. 1. Sandy clay and silty clay were recorded between 15 and 25 feet, but silty sand was conservatively selected to represent conditions at the depth of 25 feet.
Landfill Unit No. 2	5 and 15	1.9	0.29	0.042	Sandy Gravel	GEO1	Sandy gravel was recorded in the 0 to 14 feet depth interval. Sample GEO1 collected from the Southwest Trenches is representative of this soil type.
Landfill Unit No. 2	25	1.45	0.45	0.17	Silty Sand	SSET-2-20	Silt and silty sand were recorded in the 14 to 27 feet depth interval at Landfill Unit No. 2. Sample SSET-2-20 collected from the Eastern Trenches is representative of silty sand.
Landfill Unit No. 3	5	1.9	0.29	0.042	Sandy Gravel	GEO1	Sandy gravel was recorded in the 0 to 10 feet depth interval. Sample GEO1 collected from the Southwest Trenches is representative of this soil type.
Landfill Unit No. 3	15 and 25	1.45	0.45	0.17	Silty Sand	SSET-2-20	Silty sand was recorded in the 10 to 15 feet depth interval. Sample SSET-2-20 collected from the Eastern Trenches is representative of silty sand. Silty clay was recorded between 15 and 25 feet, but silty sand was conservatively selected to represent conditions at 25 feet.
Southern Trenches	5	1.9	0.29	0.042	Sandy Gravel	GEO1	Sandy gravel was recorded in the 0 to 5 feet depth interval. Sample GEO1 collected from the Southwest Trenches is representative of this soil type.
Waste Burial Holes	5	1.72	0.35	0.271	Silty Gravel Fill	SSWBH-3-5	Silty gravel was recorded in the 0 to 6 feet depth interval. Sample SSWBH-3-5 data were selected because the sample is representative of silty gravel unique to the Waste Burial Holes.
Waste Burial Holes	15 and 25	1.45	0.45	0.17	Silty Sand	SSET-2-20	Silty sand was recorded in the 6 to 17 feet depth interval. Sample SSET-2-20 collected from the Eastern Trenches is representative of silty sand. Silty clay was recorded between 17 and 25 feet, but silty sand was conservatively selected to represent conditions at 25 feet.

Acronyms/Abbreviations:
cm^3/cm^3 - volume ratio in cubic centimeters
g/cm^3 - grams per cubic centimeter

Table B-5. Carcinogen Toxicity Values - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

COPC	URF_{adult} $(\mu g/m^3)^{-1}$	Source	URF_{child} [1] $(\mu g/m^3)^{-1}$
1,1-Dichloroethane	1.6E-06	(a)	3.7E-06
1,2-Dichloroethane	2.6E-05	(b)	6.1E-05
1,2-Dichloropropane	1.0E-05	(a)	2.3E-05
1,3-Butadiene	1.7E-04	(a)	4.0E-04
Chloroform	2.3E-05	(b)	5.4E-05
Formaldehyde	1.3E-05	(b)	3.0E-05
Tetrachloroethene	5.9E-06	(a)	1.4E-05

Notes:
(a) URF_{adult} from OEHHA database (Cal EPA, 2011)
(b) URF_{adult} from IRIS database (US EPA, 2011)
[1] $URF_{child} = URF_{adult} \times (IR_{a,c} / IR_{a,a}) \times (BW_a / BW_c)$

Acronyms/Abbreviations:
BW_a - body weight, adult (70 kilogram)
BW_c - body weight, child (15 kilogram)
Cal EPA - California Environmental Protection Agency
COPC - constituent of potential concern
$IR_{a,a}$ - inhalation rate, adult (20 cubic meters per day)
$IR_{a,c}$ - inhalation rate, child (10 cubic meters per day)
IRIS - Integrated Risk Information System
OEHHA - Office of Environmental Health Hazard Assessment
URF_{adult} - unit risk factor based on adult body weight and inhalation rate
URF_{child} - unit risk factor based on child body weight and inhalation rate
US EPA - United States Environmental Protection Agency
$\mu g/m^3$ - micrograms per cubic meter

References:
California Environmental Protection Agency (Cal EPA), 2011. OEHHA Toxicity Criteria Database, http://oehha.ca.gov/risk/ChemicalDB/index.asp, most recent toxicity update from "OEHHA History/Changes made to Toxicity Criteria Database" dated March 17, 2010, website visited May 11, 2011.
United States Environmental Protection Agency (US EPA), 2011, IRIS Database, http://www.epa.gov/IRIS/, webpage update shown as April 20, 2011, website visited May 11, 2011.

Table B-6. Non-Carcinogen Toxicity Values - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

COPC	RfC_{adult} (mg/m^3)	Source	RfC_{child} [1] (mg/m^3)
1,1-Dichloroethane	na	(d)	na
1,2-Dichloroethane	0.007	(e)	0.003
1,2-Dichloropropane	0.004	(b)	0.0017
1,3-Butadiene	0.002	(b)	0.00086
Chloroform	0.3	(a)	0.13
Formaldehyde	0.009	(a)	0.0039
Tetrachloroethene	0.27	(c)	0.12

Notes:
(a) RfC_{adult} from OEHHA database (Cal EPA, 2011)
(b) RfC_{adult} from IRIS database (US EPA, 2011a)
(c) ATSDR RfC via Region 9 RSLs (US EPA, 2011b)
(d) No IRIS, OEHHA, PPRTV, or ATSDR RfC data found. RfC values are present in DTSC VI Spreadsheet, but their source is not evident.
(e) RfC_{adult} from PPRTV database (US EPA, 2012)
[1] $RfC_{child} = RfC_{adult} \times (IR_{a,a} / IR_{a,c}) \times (BW_c / BW_a)$

Acronyms/Abbreviations:
ATSDR - United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry
BW_a - body weight, adult (70 kilogram)
BWc - body weight, child (15 kilogram)
Cal EPA - California Environmental Protection Agency
COPC - constituent of potential concern
DTSC - California Department of Toxic Substances Control
$IR_{a,a}$ - inhalation rate, adult (20 cubic meters per day)
$IR_{a,c}$ - inhalation rate, child (10 cubic meters per day)
IRIS - Integrated Risk Information System
OEHHA - Office of Environmental Health Hazard Assessment
PPRTV - Provisional Peer Reviewed Toxicity Value
RfC_{adult} - reference concentration, adult
RfC_{child} - reference concentration, child
RSL - Regional Screening Level
mg/m^3 - milligrams per cubic meter
na – not applicable
VI - vapor intrusion
US EPA - United States Environmental Protection Agency

References:
California Environmental Protection Agency (Cal EPA), 2011. OEHHA Toxicity Criteria Database, http://oehha.ca.gov/risk/ChemicalDB/index.asp, most recent toxicity update from "OEHHA History/Changes made to Toxicity Criteria Database" dated March 17, 2010, website visited May 11, 2011.
US EPA (United States Environmental Protection Agency), 2011a. IRIS Database, http://www.epa.gov/IRIS/, webpage update shown as April 20, 2011, website visited May 11, 2011.
US EPA, 2011b. *Regional Screening Levels for Chemical Contaminants at Superfund Sites (Formerly PRGs)*, http://www.epa.gov/region9/superfund/prg/, November.
US EPA, 2012. *Provisional Peer Reviewed Toxicity Values (PPRTV) for Superfund Database*, hhpprtv.ornl.gov/index.html, February.

Table B-7. Indoor Researcher Risk Summary, Tier 2 - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Risks

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	7.1E-08	8.5E-08	na	na	na	na	na	6.6E-08	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	8.6E-07	7.3E-08	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	4.6E-07	8.9E-08	5.8E-09	na	na	na	8.6E-08	**1.5E-06**	1.1E-07	na	na	na	na	na	na
1,3-Butadiene	na	**2.5E-06**	na	na	na	na	na	na	2.8E-07	**1.1E-06**	na	na	na	na	na	1.6E-07	na	na
Chloroform	na	na	na	**1.2E-05**	**1.4E-05**	4.6E-07	na	na	na	**7.7E-06**	**3.0E-05**	**1.1E-06**	8.5E-08	na	na	na	na	na
Formaldehyde	2.5E-07	2.4E-07	1.7E-07	5.4E-08	6.9E-08	1.2E-07	2.2E-07	2.8E-07	3.0E-07	2.6E-07	2.0E-07	1.5E-07	na	na	na	5.0E-07	2.4E-07	1.8E-07
Tetrachloroethene	na	na	na	7.5E-07	2.9E-07	7.7E-08	na	na	na	na	5.6E-08	na	na	na	na	na	na	na
Risk Sum	2.5E-07	**2.7E-06**	1.7E-07	**1.3E-05**	**1.5E-05**	6.6E-07	2.2E-07	2.8E-07	5.8E-07	**9.1E-06**	**3.3E-05**	**1.4E-06**	8.5E-08	na	na	6.6E-07	2.4E-07	1.8E-07

Hazard Quotients

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	NTX	NTX	na	na	na	na	na	NTX	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	1.3E-02	1.1E-03	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	3.2E-02	6.2E-03	4.0E-04	na	na	na	6.0E-03	1.1E-01	7.7E-03	na	na	na	na	na	na
1,3-Butadiene	na	2.0E-02	na	na	na	na	na	na	2.3E-03	8.8E-03	na	na	na	na	na	1.3E-03	na	na
Chloroform	na	na	na	4.9E-03	5.9E-03	1.9E-04	na	na	na	3.1E-03	1.2E-02	4.3E-04	3.4E-05	na	na	na	na	na
Formaldehyde	6.0E-03	5.6E-03	4.1E-03	1.3E-03	1.6E-03	2.8E-03	5.2E-03	6.6E-03	7.2E-03	6.1E-03	4.8E-03	3.7E-03	na	na	na	1.2E-02	5.8E-03	4.2E-03
Tetrachloroethene	na	na	na	1.3E-03	5.1E-04	1.4E-04	na	na	na	na	9.9E-05	na	na	na	na	na	na	na
Hazard Sum	6.0E-03	2.6E-02	4.1E-03	4.0E-02	1.4E-02	3.5E-03	5.2E-03	6.6E-03	9.5E-03	2.4E-02	1.4E-01	1.3E-02	3.4E-05	na	na	1.3E-02	5.8E-03	4.2E-03

Notes:
Risks above 1 in 1,000,000 shown in **bold**

Acronyms/Abbreviations:
COPC - constituent of potential concern
na - not applicable
NTX - no toxicity data

Table B-8. Age-Adjusted Adult Risk Summary, Tier 2 – Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Risks

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	7.7E-07	6.1E-07	na	na	na	na	na	1.4E-07	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	**1.9E-06**	1.5E-07	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	**5.1E-06**	6.5E-07	3.4E-08	na	na	na	1.8E-07	**3.2E-06**	2.4E-07	na	na	na	na	na	na
1,3-Butadiene	na	**5.2E-06**	na	na	na	na	na	na	5.9E-07	**2.2E-06**	na	na	na	na	na	3.5E-07	na	na
Chloroform	na	na	na	**1.4E-04**	**1.2E-04**	**2.9E-06**	na	na	na	**1.6E-05**	**6.4E-05**	**2.2E-06**	1.8E-07	na	na	na	na	na
Formaldehyde	5.3E-07	5.0E-07	3.6E-07	6.6E-07	5.7E-07	9.2E-07	4.6E-07	5.8E-07	6.3E-07	5.5E-07	4.3E-07	3.3E-07	na	na	na	**1.1E-06**	5.1E-07	3.8E-07
Tetrachloroethene	na	na	na	**8.3E-06**	**2.1E-06**	4.5E-07	na	na	na	na	1.2E-07	na	na	na	na	na	na	na
Risk Sum	5.3E-07	**5.7E-06**	3.6E-07	**1.6E-04**	**1.2E-04**	**4.3E-06**	4.6E-07	5.8E-07	**1.2E-06**	**1.9E-05**	**7.0E-05**	**3.0E-06**	1.8E-07	na	na	**1.4E-06**	5.1E-07	3.8E-07

Hazard Quotients

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	NTX	NTX	na	na	na	na	na	NTX	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	6.2E-02	5.2E-03	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	7.9E-01	1.0E-01	5.3E-03	na	na	na	2.8E-02	5.0E-01	3.6E-02	na	na	na	na	na	na
1,3-Butadiene	na	9.4E-02	na	na	na	na	na	na	1.1E-02	4.0E-02	na	na	na	na	na	6.2E-03	na	na
Chloroform	na	na	na	1.3E-01	1.0E-01	2.6E-03	na	na	na	1.4E-02	5.6E-02	2.0E-03	1.6E-04	na	na	na	na	na
Formaldehyde	2.7E-02	2.6E-02	1.9E-02	3.4E-02	3.0E-02	4.8E-02	2.4E-02	3.0E-02	3.3E-02	2.9E-02	2.3E-02	1.7E-02	na	na	na	5.6E-02	2.7E-02	2.0E-02
Tetrachloroethene	na	na	na	3.1E-02	7.8E-03	1.7E-03	na	na	na	na	4.5E-04	na	na	na	na	na	na	na
Hazard Sum	2.7E-02	1.2E-01	1.9E-02	9.8E-01	2.4E-01	5.8E-02	2.4E-02	3.0E-02	4.4E-02	1.1E-01	6.4E-01	6.0E-02	1.6E-04	na	na	6.2E-02	2.7E-02	2.0E-02

Notes:
Risks above 1 in 1,000,000 shown in **bold**

Acronyms/Abbreviations:
COPC - constituent of potential concern
na - not applicable
NTX - no toxicity data

Table B-9. Resident Child Risk Summary, Tier 2 - Vapor Intrusion Risk Assessment, UC Davis LEHR/OCL

Risks

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	2.8E-07	2.2E-07	na	na	na	na	na	5.2E-08	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	6.8E-07	5.7E-08	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	**1.9E-06**	2.4E-07	1.2E-08	na	na	na	6.6E-08	**1.2E-06**	8.5E-08	na	na	na	na	na	na
1,3-Butadiene	na	**1.9E-06**	na	na	na	na	na	na	2.2E-07	8.4E-07	na	na	na	na	na	1.3E-07	na	na
Chloroform	na	na	na	**5.3E-05**	**4.3E-05**	**1.1E-06**	na	na	na	**6.1E-06**	**2.4E-05**	8.4E-07	6.7E-08	na	na	na	na	na
Formaldehyde	1.9E-07	1.8E-07	1.3E-07	2.4E-07	2.1E-07	3.4E-07	1.7E-07	2.1E-07	2.3E-07	2.0E-07	1.6E-07	1.2E-07	na	na	na	3.9E-07	1.9E-07	1.4E-07
Tetrachloroethene	na	na	na	**3.1E-06**	7.8E-07	1.7E-07	na	na	na	na	4.5E-08	na	na	na	na	na	na	na
Risk Sum	1.9E-07	**2.1E-06**	1.3E-07	**5.9E-05**	**4.4E-05**	**1.6E-06**	1.7E-07	2.1E-07	4.5E-07	**7.2E-06**	**2.6E-05**	**1.1E-06**	6.7E-08	na	na	5.2E-07	1.9E-07	1.4E-07

Hazard Quotients

	Landfill Unit No. 1			Landfill Unit No. 2			Landfill Unit No. 3			Eastern Trenches			Southern Trenches			Waste Burial Holes		
COPC	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**	**5 feet**	**15 feet**	**25 feet**
1,1-Dichloroethane	na	na	na	NTX	NTX	na	na	na	na	na	NTX	na	na	na	na	na	na	na
1,2-Dichloroethane	na	na	na	na	na	na	na	na	na	na	4.3E-02	3.6E-03	na	na	na	na	na	na
1,2-Dichloropropane	na	na	na	5.5E-01	7.0E-02	3.7E-03	na	na	na	2.0E-02	3.5E-01	2.5E-02	na	na	na	na	na	na
1,3-Butadiene	na	6.6E-02	na	na	na	na	na	na	7.4E-03	2.8E-02	na	na	na	na	na	4.3E-03	na	na
Chloroform	na	na	na	8.9E-02	7.1E-02	1.8E-03	na	na	na	1.0E-02	3.9E-02	1.4E-03	1.1E-04	na	na	na	na	na
Formaldehyde	1.9E-02	1.8E-02	1.3E-02	2.4E-02	2.1E-02	3.3E-02	1.7E-02	2.1E-02	2.3E-02	2.0E-02	1.6E-02	1.2E-02	na	na	na	3.9E-02	1.9E-02	1.4E-02
Tetrachloroethene	na	na	na	2.1E-02	5.4E-03	1.2E-03	na	na	na	na	3.1E-04	na	na	na	na	na	na	na
Hazard Sum	1.9E-02	8.4E-02	1.3E-02	6.8E-01	1.7E-01	4.0E-02	1.7E-02	2.1E-02	3.0E-02	7.8E-02	4.5E-01	4.2E-02	1.1E-04	na	na	4.3E-02	1.9E-02	1.4E-02

Notes:
Risks above 1 in 1,000,000 shown in **bold**

Acronyms/Abbreviations:
COPC - constituent of potential concern
na - not applicable
NTX - no toxicity data

ATTACHMENT B-1

TIER 2 VAPOR INTRUSION SPREADSHEETS
See 'Appendix_B/Attachment_B-1' folder on CD