Appendix C
Spreadsheets for Table 13

Table X
Hypothetical Groundwater User Noncarcinogenic Hazard Characterizations from Groundwater Exposure
Caltrans TO 23
Modesto, California

$$\text{Hazard Quotient}_{oral} = (ADD_{ing} + ADD_{skin}) / RfD_{oral}$$
$$\text{Hazard Index} = \Sigma\text{Hazard Quotients}_{oral}$$

ADD values are from Table F-11
RfD values are from Table F-13

COPC	ADD_{ing} mg/kg-day	ADD_{skin} mg/kg-day	RfD_o mg/kg-day	Oral Hazard Quotient*
Barium	2.6E-02	1.7E-04	0.200	0.13
Chromium	#N/A	#N/A	#N/A	#N/A
Cobalt	1.9E-04	5.1E-07	0.020	0.01
Copper	4.0E-04	2.6E-06	0.040	0.01
Lead	2.2E-04	1.4E-07	Calculated Using Lead Spread	
Molybdenum	8.9E-04	5.9E-06	0.005	0.18
Nickel	4.5E-04	6.0E-07	0.020	0.02
Selenium	1.9E-04	1.3E-06	0.005	0.04
Vanadium	2.2E-03	1.4E-05	0.007	0.31
Zinc	9.6E-04	3.8E-06	0.300	0.00
Hazard Index				#N/A

TABLE

Lead Risk Assessment Spreadsheet
California Department of Toxic Substances Control
Human Health Risk Assessment
Caltrans TO 23, Groundwater
Modesto, California

USER'S GUIDE to version 7

INPUT	
MEDIUM	LEVEL
Lead in Air (µg/m3)	0.028
Lead in Soil/Dust (µg/g)	150.0
Lead in Water (µg/l)	3.4
% Home-grown Produce	0%
Respirable Dust (µg/m3)	1.5

OUTPUT

	Percentile Estimate of Blood Pb (µg/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(µg/g)	(µg/g)
BLOOD Pb, ADULT	0.6	1.1	1.3	1.6	1.8	3110	4496
BLOOD Pb, CHILD	1.9	3.4	4.0	4.9	5.6	359	539
BLOOD Pb, PICA CHILD	2.9	5.3	6.3	7.7	8.7	180	271
BLOOD Pb, OCCUPATIONAL	1.1	2.0	2.4	2.9	3.3	3468	5452

EXPOSURE PARAMETERS

	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (µg/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	µg/cm2	70	200
Dermal uptake constant	(µg/dl)/(µg/day)	0.00011	
Soil ingestion	kg/day	50	100
Soil ingestion, pica	kg/day		200
Ingestion constant	(µg/dl)/(µg/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(µg/dl)/(µg/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	µg/kg	3.1	
Lead in produce	µg/kg	67.5	

PATHWAYS

ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	4.2E-5	0.01	1%	1.5E-5	0.00	0%
Soil Ingestion	8.8E-4	0.13	22%	6.3E-4	0.01	1%
Inhalation1		0.05	8%		0.03	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.19	31%		0.84	75%
Food Ingestion1		0.23	38%		0.23	21%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	µg/dl	percent	PEF	µg/dl	percent
Soil Contact	6.1E-5	0.01	0%		0.01	0%
Soil Ingestion	7.0E-3	1.06	57%	1.4E-2	2.11	72%
Inhalation1	1.5E-6	0.00	0%		0.00	0%
Inhalation		0.04	2%		0.04	1%
Water Ingestion		0.22	12%		0.22	7%
Food Ingestion, child		0.54	29%		0.54	19%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

Table X
Toxicity and Dermal Absorption Criteria
Caltrans TO 23
Modesto, California

Chemical	Soil Dermal Absorption[a]	Carcinogenic Slope Factors				Noncarcinogenic Factors			
		CSF_{oral} $(mg/kg\ day)^{-1}$	Source	CSF_{inh} $(mg/kg\ day)^{-1}$	Source	RfD_{oral} (mg/kg day)	Source	RfD_{inh} (mg/kg day)	Source
Acenaphthylene[b]	0.15					0.06	IRIS		
Benzo(a)pyrene	0.15	12	OEHHA	3.9	OEHHA				
Benzo[b]fluoranthene	0.15	1.2	OEHHA	0.39	OEHHA				
Benzo(g,h,i)perylene	0.15					0.03	IRIS		
Chrysene	0.15	0.12	OEHHA	0.039	OEHHA				
Fluoranthene	0.15					0.04	IRIS	0.04	Route
Phenanthrene[b]	0.15					0.03	IRIS		
Pyrene	0.15					0.03	IRIS	0.03	Route
Antimony	0.01					4.00E-04	IRIS		
Arsenic	0.03	9.45	OEHHA	12	OEHHA	3.00E-04	IRIS	8.57E-06	OEHHA
Barium	0.01					0.2	IRIS	0.02	Route
Beryllium	0.01			8.4	PRG	0.002	IRIS	2.00E-06	OEHHA
Chromium III	0.01					1.5	IRIS		
Chromium VI	0.01			510	OEHHA	0.003	IRIS	5.71E-05	OEHHA
Cobalt	0.01			9.8	PRG	0.02	PRG	5.70E-06	PRG
Copper	0.01					0.04	HEAST		
Lead	0.01								
Manganese	0.01					0.14	IRIS	1.00E-05	IRIS
Mercury	0.01					3.00E-04	IRIS	2.60E-05	OEHHA
Molybdenum	0.01					0.005	IRIS		
Selenium	0.01					0.005	PRG	0.01	OEHHA
Nickel	0.01			0.91	OEHHA	0.02	IRIS	1.40E-05	OEHHA
Vanadium	0.01					0.007	HEAST		
Zinc	0.01					0.3	IRIS		

Notes:
a: dermal absorption factors are from the Preliminary Endangerment Assessment Manual (DTSC, 1999)
b: No toxicity factors available for these analytes (IRIS, OEHHA, PRGs)
IRIS = U.S. Environmental Protection Agency Integrated Risk Information System, searched December 2005
OEHHA = California Office of Environmental Health Hazard Assessment Toxicity Criteria Database, searched December 2005
PRG = U.S. Environmental Protection Agency Preliminary Remediation Goals Toxicity Values, October 2004
Route: Indicates a exposure route to exposure route extrapolation toxicity factors
HEAST, NCEA, Provisional, and Route-to-Route extrapolation (Route) are from the 2004 Preliminary Remediation Goals Documentation

Table X
Exposure Parameters
Caltrans TO 23
Modesto, California

	A	B	C	D	E	F	H	I	J	K
3	Parameter	Definition	Units	Current and Future Off-Site Resident and Trespasser [a]			Construction	Hypothetical Groundwater User		
4				Child	Adult	Age-Weighted [d]	Worker	Child	Adult	Age-Weighted [d]
5	SA_{GW}	Exposed Skin Surface Area - Groundwater Contact	cm^2/day [e]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	6600	18000	15720
6	SA_{soil}	Exposed Skin Surface Area - Soil	cm^2/day [f]	2900	5700	5140	5700	2800	5700	5120
9	t_{event}	Event Time for Groundwater Contact	hours/day [e]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	0.58	0.664
13	EF	Exposure Frequency - Groundwater/Soil Ingestion	days/year	350	350	350	Not Applicable	350	350	350
15	EF_{const}	Exposure Frequency - Construction	days/year [h]	60	60	60	60	Not Applicable	Not Applicable	Not Applicable
17	ED	Exposure Duration	years	6	24	30	Not Applicable	6	24	30
18	ED_{cons}	Exposure Duration During Construction	years	1	1	1	1	Not Applicable	Not Applicable	Not Applicable
20	ET_{air}	Exposure Time	hours/day	24	24	24	Not Applicable	24	24	24
22	ET_{const}	Exposure Time - Construction	hours/day	10	10	10	10			
24	SI	Site Soil Ingestion Rate	kg/day	0.0002	0.0001	0.00012	0.00033	Not Applicable	Not Applicable	Not Applicable
25	IR	Inhalation Rate [b]	m^3/hour	0.35	0.83	0.73	2	Not Applicable	Not Applicable	Not Applicable
26	GWI	Groundwater (Drinking Water) Ingestion Rate	L/day	Not Applicable	Not Applicable	Not Applicable	Not Applicable	1	2	1.8
27	SWI	Stormwater Incidental Ingestion Rate	L/day	0.05	0.05	0.05	Not Applicable	Not Applicable	Not Applicable	Not Applicable
29	AT_n	Averaging Time - Noncarcinogen	days	2190	Not Applicable	Not Applicable	365	2190	Not Applicable	Not Applicable
30	AT_c	Averaging Time - Carcinogen	days	Not Applicable	Not Applicable	25550	25550	Not Applicable	Not Applicable	25550
31	AT_{cons}	Averaging Time - Noncarcinogen During Construction	days	365	365	365	365	Not Applicable	Not Applicable	Not Applicable
33	BW	Body Weight	kg	15	70	59	70	15	70	59
35	AF	Adherence Factor	kg soil/ cm^2skin	2.0E-07	7.0E-08	9.6E-08	3.E-07	2.0E-07	7.0E-08	9.6E-08

Sources

a Unless otherwise noted, the source of the parameter value is EPA (2001a). Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft EPA OSWER 9344.4-25 http://www.epa.gov/superfund/resources/soil/ssgmarch01.pdf

b Respiration rate for a child is based on 8.3 m^3/day that EPA recommends as the default value for children between 3 and 5. EPA. 2002. Child-Specific Exposure Factors Handbook. EPA 600-P-00-002B http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=55145

c EPA (2001b). Source for residential values is Risk Assessment Guidance for Superfund, Volume 1 (Human Health Evaluation Manual: Part E, Supplemental Guidance for Dermal Risk Assessment. Interim EPA 540/R/99/005 (RAGS, Part E) http://www.epa.gov/superfund/programs/risk/ragse/introduction.pdf

d Exposure parameters were age-weighted as follows
Age Weighted Value = [(6 years/30 years) * child value] + [(24 years/30 years) * adult value]

e Based on complete skin contact, value is adult skin surface area for RAGS, Part E, for the work day

f Based on partial skin contact, for child and adult, arms, hands, feet, lower legs. Value is child skin surface area for RAGS, Part E, 2 hours per day

g Exposure freqency to stormwater puddle based on number of days in Modesto (1931 - 2006) with a minimum of 0.1 inch of rain fall, Western Regional Climate Center, wrcc@dri.edu

h Exposure freqency for construction worker is based on 2 excavators removing 2000 cubic yards of soil per day which equals 60 days to remove all soil