Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels
Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)
PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
Dioxins and Furans (ng/kg)			
1,2,3,4,6,7,8-HpCDD	ng/kg	NE	Not Established
1,2,3,4,6,7,8-HpCDF	ng/kg	NE	Not Established
1,2,3,4,7,8,9-HpCDF	ng/kg	NE	Not Established
1,2,3,4,7,8-HxCDD	ng/kg	NE	Not Established
1,2,3,4,7,8-HxCDF	ng/kg	NE	Not Established
1,2,3,6,7,8-HxCDD	ng/kg	NE	Not Established
1,2,3,6,7,8-HxCDF	ng/kg	NE	Not Established
1,2,3,7,8,9-HxCDD	ng/kg	NE	Not Established
1,2,3,7,8,9-HxCDF	ng/kg	NE	Not Established
1,2,3,7,8-PeCDD	ng/kg	NE	Not Established
1,2,3,7,8-PeCDF	ng/kg	NE	Not Established
2,3,4,6,7,8-HxCDF	ng/kg	NE	Not Established
2,3,4,7,8-PeCDF	ng/kg	NE	Not Established
2,3,7,8-TCDD	ng/kg	8800	Topock-Specific Soil Ecological Risk-based Concentration (RBC)
2,3,7,8-TCDF	ng/kg	NE	Not Established
OCDD	ng/kg	NE	Not Established
OCDF	ng/kg	NE	Not Established
TEQ Avian	ng/kg	217	Topock-Specific Soil Ecological RBC
TEQ Human	ng/kg	83	Topock-Specific Soil Human Health RBC
TEQ Mammals	ng/kg	192	Topock-Specific Soil Ecological RBC
Metals (mg/kg)			
Aluminum	mg/kg	16,400	Topock-Specific Background Level
Antimony	mg/kg	2.8	Topock-Specific Soil Ecological RBC
Arsenic	mg/kg	18	Topock-Specific Soil Ecological RBC
Barium	mg/kg	410	Topock-Specific Background Level
Beryllium	mg/kg	10	Topock-Specific Soil Ecological RBC
Cadmium	mg/kg	5.9	Topock-Specific Soil Ecological RBC
Calcium	mg/kg	66,500	Topock-Specific Background Level
Chromium, Hexavalent	mg/kg	8.1	Topock-Specific Soil Ecological RBC
Chromium, total	mg/kg	57	Topock-Specific Soil Ecological RBC
Cobalt	mg/kg	13	Topock-Specific Soil Ecological RBC
Copper	mg/kg	70	Topock-Specific Soil Ecological RBC
Cyanide	mg/kg	0.9	Topock-Specific Soil Ecological RBC
Iron	mg/kg	29,303	Topock-Specific Soil Ecological RBC

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels
Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)
PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
Lead	mg/kg	36	Topock-Specific Soil Ecological RBC
Magnesium	mg/kg	12,100	Topock-Specific Background Level
Manganese	mg/kg	402	Topock-Specific Background Level
Mercury	mg/kg	0.1	Topock-Specific Soil Ecological RBC
Molybdenum	mg/kg	2	Topock-Specific Soil Ecological RBC
Nickel	mg/kg	27.3	Topock-Specific Background Level
Potassium	mg/kg	4,400	Topock-Specific Background Level
Selenium	mg/kg	1.47	Topock-Specific Background Level
Silver	mg/kg	52	Topock-Specific Soil Ecological RBC
Sodium	mg/kg	2,070	Topock-Specific Background Level
Thallium	mg/kg	4.56	Topock-Specific Background Level
Vanadium	mg/kg	52.2	Topock-Specific Background Level
Zinc	mg/kg	120	Topock-Specific Soil Ecological RBC
Pesticides (µg/kg)			
4,4-DDD	ug/kg	21	Soil Ecological Comparison Value (ECV)
4,4-DDE	ug/kg	10	Topock-Specific Soil Ecological RBC
4,4-DDT	ug/kg	10	Topock-Specific Soil Ecological RBC
Aldrin	ug/kg	39	EPA Residential RSL
alpha-BHC	ug/kg	86	EPA Residential RSL
alpha-Chlordane	ug/kg	4.3	Topock-Specific Soil Ecological RBC
beta-BHC	ug/kg	300	EPA Residential RSL
delta-BHC	ug/kg	300	EPA Residential RSL
Dieldrin	ug/kg	50	Topock-Specific Soil Ecological RBC
Endo sulfan I	ug/kg	450,000	DTSC Residential RSL
Endo sulfan II	ug/kg	450,000	DTSC Residential RSL
Endrin	ug/kg	19,000	EPA Residential RSL
Endrin aldehyde	ug/kg	19,000	EPA Residential RSL
Endrin ketone	ug/kg	19,000	EPA Residential RSL
gamma-BHC (Lindane)	ug/kg	570	EPA Residential RSL
gamma-Chlordane	ug/kg	4.3	Topock-Specific Soil Ecological RBC
Heptachlor	ug/kg	130	EPA Residential RSL
Heptachlor Epoxide	ug/kg	70	EPA Residential RSL
Methoxychlor	ug/kg	320,000	DTSC Residential RSL
Toxaphene	ug/kg	450	DTSC HHRA Note 3
Endosulfan sulfate	ug/kg	380,000	EPA Residential RSL

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)

PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
Polyaromatic Hydrocarbons (µg/kg)			
1-Methyl naphthalene	ug/kg	130,000	Topock-Specific Soil Human Health RBC
2-Methyl naphthalene	ug/kg	SC (1,900,000)	Topock-Specific Soil Human Health RBC
Acenaphthene	ug/kg	SC (67,000,000)	Topock-Specific Soil Human Health RBC
Acenaphthylene	ug/kg	SC (72,000,000)	Topock-Specific Soil Human Health RBC
Anthracene	ug/kg	SC (350,000,000)	Topock-Specific Soil Human Health RBC
B(a)P Equivalent	ug/kg	2,300	Topock-Specific Soil Human Health RBC
Benzo (a) anthracene	ug/kg	SC (36,000,000)	Topock-Specific Soil Human Health RBC
Benzo (a) pyrene	ug/kg	SC (43,000)	Topock-Specific Soil Human Health RBC
Benzo (b) fluoranthene	ug/kg	SC (21,000,000)	Topock-Specific Soil Human Health RBC
Benzo (ghi) perylene	ug/kg	SC (21,000,000)	Topock-Specific Soil Human Health RBC
Benzo (k) fluoranthene	ug/kg	SC (21,000,000)	Topock-Specific Soil Human Health RBC
Chrysene	ug/kg	SC (21,000,000)	Topock-Specific Soil Human Health RBC
Dibenzo (a,h) anthracene	ug/kg	SC (43,000)	Topock-Specific Soil Human Health RBC
Fluoranthene	ug/kg	SC (48,000,000)	Topock-Specific Soil Human Health RBC
Fluorene	ug/kg	SC (46,000,000)	Topock-Specific Soil Human Health RBC
Indeno (1,2,3-cd) pyrene	ug/kg	SC (21,000,000)	Topock-Specific Soil Human Health RBC
Napthalene	ug/kg	30,000	Topock-Specific Soil Human Health RBC
PAH High molecular weight	ug/kg	1,200	Topock-Specific Soil Ecological RBC
PAH Low molecular weight	ug/kg	10,000	Topock-Specific Soil Ecological RBC
Phenanthrene	ug/kg	SC (360,000,000)	Topock-Specific Soil Human Health RBC
Pyrene	ug/kg	SC (36,000,000)	Topock-Specific Soil Human Health RBC
Polychlorinated Biphenyls (µg/kg)			
Aroclor 1016	ug/kg	4,000	DTSC Residential RSL
Aroclor 1221	ug/kg	200	EPA Residential RSL
Aroclor 1232	ug/kg	170	EPA Residential RSL
Aroclor 1242	ug/kg	230	EPA Residential RSL
Aroclor 1248	ug/kg	230	EPA Residential RSL
Aroclor 1254	ug/kg	240	EPA Residential RSL
Aroclor 1260	ug/kg	240	EPA Residential RSL
Aroclor 1262	ug/kg	240	EPA Residential RSL
Aroclor 1268	ug/kg	240	EPA Residential RSL
Total PCBs	ug/kg	1,000	Topock-Specific Soil Ecological RBC
Semivolatile Organic Compounds (µg/kg)			
1,1´-Biphenyl	ug/kg	47,000	EPA Residential RSL

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)

PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
1,2,4,5-Tetrachlorobenzene	ug/kg	17,000	DTSC Residential RSL
1,4-Dioxane	ug/kg	5,300	EPA Residential RSL
2,3,4,6-Tetrachlorophenol	ug/kg	1,900,000	EPA Residential RSL
2,4,5-Trichlorophenol	ug/kg	6,300,000	EPA Residential RSL
2,4,6-Trichlorophenol	ug/kg	7,800	DTSC Residential SL
2,4-Dichlorophenol	ug/kg	190,000	EPA Residential RSL
2,4-Dimethylphenol	ug/kg	34,900	Topock-Specific Soil Ecological RBC
2,4-Dinitrophenol	ug/kg	130,000	EPA Residential RSL
2,4-Dinitrotoluene	ug/kg	1,700	EPA Residential RSL
2,6-Dinitrotoluene	ug/kg	360	EPA Residential RSL
2-Chloronaphthalene	ug/kg	4,100,000	DTSC Residential SL
2-Chlorophenol	ug/kg	340,000	DTSC Residential SL
2-Methylphenol (o-Cresol)	ug/kg	3,200,000	EPA Residential RSL
2-Nitroaniline	ug/kg	630,000	EPA Residential RSL
3,3-Dichlorobenzidene	ug/kg	450	DTSC Residential SL
3-Nitroaniline	ug/kg	630,000	EPA Residential RSL
4,6-Dinitro-2-methylphenol	ug/kg	5,100	EPA Residential RSL
4-Chloro-3-methylphenol	ug/kg	6,300,000	EPA Residential RSL
4-Chloroaniline	ug/kg	2,700	EPA Residential RSL
4-Methylphenol (p-Cresol)	ug/kg	1,630,000	Topock-Specific Soil Ecological RBC
4-Nitroaniline	ug/kg	27,000	EPA Residential RSL
Acetophenone	ug/kg	6,000,000	DTSC-Residential SL
Atrazine	ug/kg	2,400	EPA Residential RSL
Benzaldehyde	ug/kg	46,000	DTSC Residential SL
Benzoic acid	ug/kg	250,000,000	EPA Residential RSL
Benzyl alcohol	ug/kg	6,300,000	EPA Residential RSL
Bis (2-chloroethoxy) methane	ug/kg	190,000	EPA Residential RSL
Bis (2-ethylhexyl) phthalate	ug/kg	29,000	Topock-Specific Soil Ecological RBC
Butyl benzyl phthalate	ug/kg	900,000	Topock-Specific Soil Ecological RBC
Caprolactam	ug/kg	31,000,000	EPA Residential RSL
Carbazole	ug/kg	790,000	Topock-Specific Soil Ecological RBC
Dibenzofuran	ug/kg	48,900	Topock-Specific Soil Ecological RBC
Diethyl phthalate	ug/kg	51,000,000	EPA Residential RSL
Dimethyl phthalate	ug/kg	51,000,000	EPA Residential RSL
Di-N-butyl phthalate	ug/kg	470	Topock-Specific Soil Ecological RBC

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels
Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)
PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
Di-N-octyl phthalate	ug/kg	630,000	EPA Residential RSL
Hexachlorobenzene	ug/kg	190	DTSC Residential SL
Hexachloroethane	ug/kg	1,800	EPA Residential RSL
N-Nitroso-di-n-propylamine	ug/kg	78	EPA Residential RSL
N-nitrosodiphenylamine	ug/kg	110,000	EPA Residential RSL
Pentachlorophenol	ug/kg	5.000	Topock-Specific Soil Ecological RBC
Phenol	ug/kg	19,000,000	EPA Residential RSL
Total Petroleum Hydrocarbons (mg/kg)			
TPH as diesel	mg/kg	SC (1,600)	Topock-Specific Soil Human Health RBC
TPH as gasoline	mg/kg	430	SF RWQCB ESL for direct exposure (Jan 2019)
TPH as motor oil	mg/kg	SC (150,000)	Topock-Specific Soil Human Health RBC
Volatile Organic Compounds (µg/kg)			
1,1,1,2-Tetrachloroethane	ug/kg	2,000	EPA Residential SL
1,1,1-Trichloroethane	ug/kg	1,700,000	DTSC Residential SL
1,1,2,2-Tetrachloroethane	ug/kg	600	EPA Residential SL
1,1,2-Trichloroethane	ug/kg	1,100	EPA Residential RSL
1,1,2-Trichlorotrifluoroethane (Freon 113)	ug/kg	6,700,000	EPA Residential RSL
1,1-Dichloroethane	ug/kg	3,600	EPA Residential SL
1,1-Dichloroethene	ug/kg	230,000	EPA Residential RSL
1,1-Dichloropropene	ug/kg	1,800	EPA Residential RSL
1,2,3-Trichlorobenzene	ug/kg	40,000	DTSC Residential SL
1,2,3-Trichloropropane	ug/kg	1.5	DTSC Residential SL
1,2,4-Trichlorobenzene	ug/kg	7,800	DTSC Residential SL
1,2,4-Trimethylbenzene	ug/kg	397,000	Topock-Specific Soil Ecological RBC
1,2-Dibromo-3-chloropropane	ug/kg	4.3	DTSC Residential SL
1,2-Dibromoethane	ug/kg	36	DTSC Residential SL
1,2-Dichlorobenzene	ug/kg	1,800,000	EPA Residential RSL
1,2-Dichloroethane	ug/kg	460	EPA Residential RSL
1,2-Dichloropropane	ug/kg	2,500	EPA Residential RSL
1,3,5-Trimethylbenzene	ug/kg	397,000	Topock-Specific Soil Ecological RBC
1,3-Dichlorobenzene	ug/kg	1,800,000	EPA Residential RSL
1,3-Dichloropropane	ug/kg	410,000	DTSC Residential SL
1,4-Dichlorobenzene	ug/kg	2,600	EPA Residential RSL
2,2-Dichloropropane	ug/kg	2,500	EPA Residential RSL
2-Chlorotoluene	ug/kg	470,000	DTSC Residential SL

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels
Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)
PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
2-Hexanone	ug/kg	200,000	EPA Residential RSL
4-Isopropyltoluene	ug/kg	1,900,000	EPA Residential RSL
Acetone	ug/kg	8,856,000	Topock-Specific Soil Ecological RBC
Acrolein	ug/kg	140	EPA Residential RSL
Acrylonitrile	ug/kg	250	EPA Residential RSL
Benzene	ug/kg	330	DTSC Residential SL
Bis (2-chloroethyl) ether	ug/kg	100	DTSC Residential SL
Bis (2-chloroisopropyl) ether	ug/kg	2,000,000	DTSC Residential SL
Bromobenzene	ug/kg	290,000	EPA Residential RSL
Bromochloromethane	ug/kg	150,000	EPA Residential RSL
Bromodichloromethane	ug/kg	290	DTSC Residential SL
Bromoform	ug/kg	19,000	DTSC Residential SL
Bromomethane	ug/kg	2,400	Topock-Specific Soil Ecological RBC
Carbon disulfide	ug/kg	770,000	EPA Residential RSL
Carbon tetrachloride	ug/kg	650	EPA Residential RSL
Chlorobenzene	ug/kg	280,000	EPA Residential RSL
Chloroethane	ug/kg	14,000,000	EPA Residential RSL
Chloroform	ug/kg	7,262,000	Topock-Specific Soil Ecological RBC
Chloromethane	ug/kg	SC (2,700,000)	Topock-Specific Soil Human Health RBC
cis-1,2-Dichloroethene	ug/kg	18,000	DTSC Residential SL
cis-1,3-Dichloropropene	ug/kg	1,800	EPA Residential RSL
Cyclohexane	ug/kg	6,500,000	EPA Residential RSL
Dibromochloromethane	ug/kg	940	DTSC Residential SL
Dibromomethane	ug/kg	24,000	EPA Residential RSL
Dichlorodifluoromethane	ug/kg	87,000	EPA Residential RSL
Ethylbenzene	ug/kg	51,543,000	Topock-Specific Soil Ecological RBC
Hexachlorobutadiene	ug/kg	1,200	DTSC Residential SL
Hexachlorocyclopentadiene	ug/kg	1,800	EPA Residential RSL
Isophorone	ug/kg	5,500,000	Topock-Specific Soil Human Health RBC
Isopropylbenzene	ug/kg	397,000	Topock-Specific Soil Ecological RBC
m,p-Xylenes	ug/kg	100	Topock-Specific Soil Ecological RBC
Methyl acetate	ug/kg	5,500,000	Topock-Specific Soil Human Health RBC
Methyl ethyl ketone	ug/kg	809,625,000	Topock-Specific Soil Ecological RBC
Methyl isobutyl ketone	ug/kg	33,000,000	EPA Residential RSL
Methyl tert-butyl ether (MTBE)	ug/kg	47,000	EPA Residential RSL

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)

PG&E Topock Compressor Station, Needles, California

[Group] Analyte	Unit	Soil Management Screening Level [a]	Screening Level Source [a]
Methylcyclohexane	ug/kg	5,500,000	DTSC Residential SL
Methylene chloride	ug/kg	8,856,000	Topock-Specific Soil Ecological RBC
N-Butylbenzene	ug/kg	2,400,000	DTSC Residential SL
Nitrobenzene	ug/kg	5,100	EPA Residential RSL
N-Propylbenzene	ug/kg	3,800,000	EPA Residential RSL
o-Xylene	ug/kg	100	Topock-Specific Soil Ecological RBC
p-Chlorotoluene	ug/kg	440,000	DTSC Residential SL
sec-Butylbenzene	ug/kg	2,200,000	DTSC Residential SL
Styrene	ug/kg	5,600,000	DTSC Residential SL
tert-Butylbenzene	ug/kg	2,200,000	DTSC Residential SL
Tetrachloroethene	ug/kg	590	DTSC Residential SL
Toluene	ug/kg	39,740,000	Topock-Specific Soil Ecological RBC
trans-1,2-Dichloroethene	ug/kg	130.000	DTSC Residential SL
trans-1,3-Dichloropropene	ug/kg	1,800	EPA Residential RSL
Trichloroethene	ug/kg	940	EPA Residential RSL
Trichlorofluoromethane (Freon 11)	ug/kg	1,200,000	DTSC Residential SL
Vinyl chloride	ug/kg	8.2	DTSC Residential SL
Xylenes, total	ug/kg	397,000	Topock-Specific Soil Ecological RBC

Notes:

This table presents a reference list of analytes and associated soil management screening levels that are applicable for making decisions related to disposition of displaced site materials at the Topock site. The specific analytes and soil management levels applicable for characterization of displaced material will be determined based on the origin of the material and potential disposition locations.

[a] Soil Management Screening Levels – The screening levels are the higher of the lowest Topock-specific ecological risk-based concentration (as presented in the Soil HHERA Errata Table RBC-3.1 or as recommended in Table 3 of the technical memorandum titled "*Risk-Based Concentrations for VOCs and SVOCs in Soil, Topock Compressor Station, Needles, California*") or the Topock-specific soil background level, when available. However, if a Topock-specific background level and/or ecological risk-based concentration is not available, then the lowest Topock-specific human health risk-based concentration (excluding residential scenarios) as presented in the Soil HHERA Table RBC-2.1 is used. If a Topock-specific soil background level, human health risk-based concentration, and ecological risk-based concentration are not available, then the lesser of the US EPA residential regional screening level (RSL) or the DTSC HHRA Note 3 Screening Level for residential soil is used. DTSC HHRA Note 3 Screening Levels include toxicity factors from Appendix I of California OEHHA Toxicity Criteria, September 2018 (22 CCR, Section 69021 and 69022).

Background = Final Soil Background Investigation at Pacific Gas and Electric Company Topock Compressor Station, Needles, California (CH2M HILL 2009c) and Determination of Thallium Ambient/Background Concentration at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California (Jacobs August 13, 2019).

ECV = Ecological Comparison Values; ECV were calculated as needed for constituents detected during the Part A Phase I sampling (Arcadis 2008)

NE = not established

SC () = The risk-based concentrations presented in the parentheses represent an RBC that is greater than the theoretical soil saturation limit for that compound or the theoretical ceiling limit of 100,000 mg/kg (US EPA 2018). The theoretical soil saturation limit is the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Calculated soil saturation limits are shown in Table 5-4 of the Soil Human Health and Ecological Risk Assessment report (Arcadis 2020). The theoretical ceiling limit of 100,000 mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this contaminant concentration (or higher), the assumptions for soil contact may be violated (e.g., soil adherence and wind-borne dispersion assumptions) due to the presence of the foreign substance itself.

mg/kg = milligrams per kilogram ng/kg = nanograms per kilogram

µg/kg = micrograms per kilogram

Table 2.4-1 Reference List of Potentially Applicable Analytes and Associated Screening Levels Management Protocol for Handling and Disposition of Displaced Material (rev. April 2022)

PG&E Topock Compressor Station, Needles, California

References:

Arcadis. 2022. Risk-Based Concentrations for VOCs and SVOCs in Soil, Topock Compressor Station, Needles, California. March 10.

DTSC. April 8, 2022. Technical Memorandum from Michael Garland, Associate Toxicologist, Ecological Risk Assessment Section (ERAS) Human and Ecological Risk Office (HERO), to Aaron Yue, Project Manager, Site Mitigation and Restoration Program (SMRP).

DTSC Appendix I. California OEHHA Toxicity Criteria - September 2018. <https://www.dtsc.ca.gov/LawsRegsPolicies/Regs/upload/Final-Toxicity-Criteria-Rule-Rule-Text-Appdx-2018-09-04-clean.pdf>

DTSC Note 3 Update - April 2019. <https://www.dtsc.ca.gov/AssessingRisk/upload/HHRA-Note-3-Tables-April-2019.xlsx>

HHRA Note 2. DTSC Human Health Risk Assessment (HHRA) Note 2: Soil Remedial Goals for Dioxins and Dioxin-like Compounds for Consideration at California Hazardous Waste Sites – (April 2017).

United States Environmental Protection Agency (USEPA). 2020. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May. <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>

Department of Toxic Substances Control

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MEMORANDUM

TO: Aaron Yue, Project Manager
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DATE: 8 April 2022

SUBJECT: RISK-BASED CONCENTRATIONS FOR VOCS AND SVOCS IN SOIL, TOPOCK COMPRESSOR STATION, NEEDLES, SAN BERNARDINO COUNTY, CALIFORNIA

Project Code: DTSC540015-48 Activity Code: 22120 MPC: HHAR

Document(s) Reviewed:

Risk-Based Concentrations for VOCs and SVOCs in Soil, Topock Compressor Station, Needles, California, 10 March 2022 [Tech Memo].
Prepared by: Arcadis U.S., Inc. (San Francisco, California) (Arcadis).
Prepared for: Pacific Gas and Electric Company (PG&E).
Received electronically by ERAS via EnviroStor on 17 March 2022.

Background Information:

The PG&E Topock Compressor Station is located 15 miles south of Needles, California, and occupies 15 acres of a 65-acre parcel owned by PG&E. The study area for investigative and remedial action (Site) spanned 100 acres and included properties owned and/or managed by PG&E, Fort Mojave Indian Tribe, and various government agencies. Soil constituent risk-based concentrations (RBCs) were derived in Appendix C of the Human Health and Ecological Risk Assessment (HHERA) and were based on the lowest receptor-specific RBC value. For many constituents, including volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), the lowest receptor-specific RBCs are based on ecological screening values (ESVs) for soil invertebrates.

The soil invertebrate ESVs used in the HHERA are generic risk-based screening values that are often extrapolated from experimental conditions that significantly differ from Site conditions. Consequently, they have a relatively high degree of uncertainty compared to Site-specific wildlife ESVs. For many organic constituents where empirical toxicity data for soil invertebrate is lacking, including VOCs and SVOCs, the ESVs may be based on aquatic toxicity studies. The rationale for this approach is that soil porewater is assumed to contain the bioavailable fraction of organic constituents found in soil. The porewater fraction of organic constituents is assumed to be in an equilibrium with the fraction bound to organic matter in soils, the latter of which is presumably not bioavailable.

The Tech Memo describes the equilibrium partitioning (EqP)-based approach for modeling toxicity of VOCs and SVOCs to soil invertebrates as recommended by the United States Environmental Protection Agency Region 4 (USEPA 2018). This approach is for use in circumstances where empirical toxicity data for VOCs and SVOCs are lacking. Notably, the EqP-based approach for deriving ESVs was originally intended for sediments and therefore relies on no-effect values that are considered safe for aquatic rather than soil invertebrates. The Tech Memo describes the limitations and uncertainties of this approach, derives alternative ESVs for soil invertebrates using USEPA (2018) guidance, and ultimately recommends the use of Site-specific wildlife ESVs in place of soil invertebrate ESVs as Site RBCs for management decision-making.

Scope of the Review:

ERAS reviewed the Tech Memo for consistency with relevant and recommended guidance for evaluating ecological risk. Minor grammatical, editorial, or stylistic issues that do not affect the interpretation of the text were not noted.

General Comments:

1. Derivation of Alternative Soil Invertebrate ESVs: Regarding the original soil invertebrate ESVs, the Tech Memo states that "the Arcadis Risk Assessment Team could not reproduce many of these values using the equation and the assumptions provided by USEPA (2018) for VOCs and SVOCs identified at the Site". ERAS has not attempted to derive the original ESVs and therefore cannot verify the claim regarding their lack of reproducibility. However, ERAS did evaluate the EqP methodology for deriving an alternative ESV provided in the case study for acetone and confirmed that the approach followed USEPA (2018) guidance.

2. Use of Wildlife ESVs as RBCs: The Tech Memo does not propose using the alternative soil invertebrate ESVs as RBCs for the Site; rather, it proposes that ESVs for Site-specific wildlife are used per the recommendation of the HHERA. Given the uncertainties described within the Tech Memo associated with soil invertebrate ESVs, ERAS concurs with this recommendation.

Conclusion:

ERAS concurs with use of Sites-specific wildlife ESVs as RBCs in place of those for soil invertebrates.

Reference:

USEPA. 2018. Supplemental Guidance to ERAGS: Region 4, Ecological Risk Assessment, originally published November 1995. Accessed March 2022.

Reviewed by: Edward A. Fendick, Ph.D.
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Memo

SUBJECT
Risk-Based Concentrations for VOCs and SVOCs in Soil, Topock Compressor Station, Needles, California

TO
Curt Russell, PGE

DATE
March 10, 2022

FROM
Arcadis Ecological Risk Assessment Team:
Erin Osborn, PhD (Arcadis)
Mala Pattanayek (Integral Consulting)

Introduction

Soil constituent risk-based concentrations (RBCs) derived in Appendix C of the Final Soil Human Health and Ecological Risk Assessment (HHERA; Arcadis 2019, 2020) are based on the lowest receptor-specific RBC value. For many analytes detected in soil at the Topock Compressor Station, Needles, California (the Site), including volatile and semi-volatile organic compounds (VOCs and SVOCs), the soil RBCs are based on protection of soil invertebrates as presented in Table 3-1 of the HHERA Errata (Arcadis 2020).

As noted in the HHERA (Arcadis 2019, 2020), only generic risk-based screening levels are available for soil invertebrates, and these are below laboratory detection limits in some cases. Typically, published screening levels are based on toxicity data (often using agriculturally important produce or crop species and conducted in laboratory settings) that carry limited relevance for the Site. The United States Environmental Protection Agency (USEPA) Region 4 (2018) has also developed soil screening levels for some organic compounds, not based on specific toxicity studies, but based on soil no-effect concentrations modeled using an equilibrium partitioning (EqP) approach. As discussed below in this memorandum, the EqP approach used by USEPA (2018) to derive soil screening levels is considered highly uncertain, especially for this Site, and the modeled values are not reproducible.

Consistent with the recommendations made in the HHERA (Arcadis 2019, 2020), RBCs based on protection of site-specific wildlife receptors are recommended instead of using generic and/or uncertain soil screening levels selected for plants and soil invertebrates. We propose using the lowest wildlife-based RBCs to support decisions for the handling, management, and storage of potentially contaminated and displaced soil during implementation of the groundwater remedy at the Site to address contamination in groundwater.

The remainder of this memorandum provides an assessment of the EqP derived values for VOCs and SVOCs present at the Site and listed in the USEPA Region 4 guidance (2018). The basis of the acetone soil invertebrate RBC of 0.04 milligram per kilogram (mg/kg) is presented as a case study.

Curt Russell
PGE
March 10, 2022

Equilibrium Partitioning Approach for Derivation of Soil Invertebrate Risk Based Concentrations

The EqP approach, used by USEPA (2003a, 2008) to evaluate potential toxicity of sediments, assumes that potential toxicity associated with organic compounds in sediment is due to the dissolved fraction in porewater, which represents the bioavailable fraction for benthic invertebrates and fish. The fraction of organic compounds bound to sediment (most often assumed to be bound to sediment organic carbon) is assumed to be unavailable for uptake, and therefore not able to elicit adverse effects in sediment-associated organisms. To derive a sediment screening value, a safe concentration in water (e.g., Water Quality Criterion) is used, along with sediment organic carbon partitioning coefficients from the literature and a conservative assumption for sediment organic carbon content, to calculate a sediment concentration that would result in dissolved-phase concentrations equal to the safe concentration in water. The EqP approach for sediments has been demonstrated to be predictive of sediment toxicity and is a commonly used approach for evaluating potential risk of organic compounds in sediment (Di Toro et al. 2000; McGrath and Di Toro 2009; Burgess et al. 2013; Redman et al. 2014; USEPA 2003a, 2008).

To develop soil screening values for some organic compounds lacking empirical toxicity testing data, USEPA (2018) modified the EqP equations for use in soil. Similar to sediment, USEPA (2018) assumes that toxicity of organic compounds in soil is due to the dissolved fraction in soil porewater, which represents the bioavailable fraction for soil invertebrates. Organic compounds bound to soil organic carbon or present in interstitial air would not be available for uptake, and therefore could not cause adverse effects to soil invertebrates. USEPA (2018) presents the following equation for calculation of the EqP-based soil screening values for soil invertebrates:

Equation 1:

$$ESV_{soil\ inverts} = WQB \times \left[f_{oc} \times K_{oc} + \frac{\theta_w}{\rho_b} + \left(\frac{\theta_a}{\rho_b}\right) \times H'\right]$$

Where:

$ESV_{soil\ inverts}$ = soil screening value (mg/kg)

WQB = water quality benchmark from ECOSAR (milligram per liter [mg/L])

f_{oc} = fraction of organic carbon assumed to be 1 percent (dimensionless)

K_{oc} = organic carbon partitioning coefficient (liter per kilogram [L/kg])

θ_w = volumetric water content of soil (0.198 cubic centimeter per cubic centimeter [cm^3/cm^3])

$\theta_{a=}$ aeration porosity of soil (0.284 cm^3/cm^3)

ρ_b = soil bulk density (1.37 grams per cubic centimeter [g/cm^3])

H' = Henry's Law constant (dimensionless)

The soil parameters ($\theta_w, \theta_a, \rho_b$) depend on soil texture, and USEPA (2018) selected default values for a silty clay loam soil texture and default assumption of 1 percent organic carbon.

Sixteen VOCs and nine SVOCs have been detected on site (Arcadis 2019). Of these, USEPA (2018) uses the equation above to calculate a soil invertebrate soil screening values for 11 VOCs and seven SVOCs as shown in

Attachment 1 of this memorandum. Note that chloromethane, methyl acetate, N-butylbenzene, N-propylbenzene, sec-butyl benzene, and isophorone were detected at the Site, but were not included in the USEPA (2018) guidance. The soil RBCs for these analytes were based on protection of wildlife. Additionally, pentachlorophenol was listed in the USEPA (2018) guidance, but the soil invertebrate screening level is based on empirical toxicity data (i.e., the EqP approach was not needed) and is not discussed in this memorandum.

The Arcadis Risk Assessment Team could not reproduce many of these values using the equation and the assumptions provided by USEPA (2018) for VOCs and SVOCs identified at the Site. To reproduce these values, the Henry's Law Constant and K_{oc} values for each chemical were obtained from the physiochemical property databases in EPISuite (USEPA 2012). Both the USEPA (2018) chronic freshwater screening values derived from Table 1a of the guidance and the minimum chronic freshwater modeled toxicity values from ECOSAR (USEPA 2012) were used as water quality benchmark (WQB) values. The USEPA (2018) guidance recommends that the chronic screening values be used for the WQB value when applying the EqP approach to sediments but recommends that the minimum chronic ECOSAR values be used when applying the EqP approach to soils. These values, along with the suggested default parameters for soil, were entered into Equation 1 to recalculate the Ecological Screening Values (ESVs) for soil invertebrates. The recalculated ESVs were compared to the soil invertebrate screening levels presented by USEPA (2018).

Attachment 1 summarizes the recalculated values and a comparison to the ESVs provided by USEPA. Using the USEPA (2018) chronic freshwater screening values, recalculated ESVs for seven VOCs/SVOCs, including acetone, bromomethane, dichloromethane, methyl ethyl ketone (2-butanone), 4-methylphenol, and butylbenzyl phthalate, were at least two-fold greater than the soil screening levels reported by USEPA (2018). The recalculated ESV for acetone was seven-fold greater than the USEPA (2018) ESV for soil invertebrates. The ECOSAR-based approach yielded recalculated ESVs that ranged from 2.6-fold to 3,000-fold greater than the soil screening levels reported by USEPA (2018), except for bis(2-ethylhexyl) phthalate, which was 36-fold lower. For the phthalates, the minimum ECOSAR modeled values were based on fish. The relevance of using fish as a basis to derive a soil screening level is uncertain, as the similarity between phthalate sensitivity in fish and soil invertebrates is unknown.

The acetone ESV reported by USEPA (2018) and the basis of the RBC in Appendix C of the HHRA (Arcadis 2020) are further evaluated below.

Case Study: Acetone RBC for Soil Invertebrates

The acetone RBC for soil invertebrates was selected as an example for further discussion because this compound was recently detected in soil sampled at the Area of Concern 4 (AOC4) gabion, and the current soil RBC for acetone (based on the soil invertebrate EqP value from USEPA [2018]) differs substantially from its recalculated ESV. Additional detail related to the acetone RBC for soil invertebrates is presented below.

Basis of the Acetone RBC for Soil Invertebrates

The soil invertebrate RBC of 0.04 mg/kg for acetone presented in the Soil HHERA (Arcadis 2020) was obtained from the Region 4 Soil Screening Values for Hazardous Waste Sites (USEPA 2018). As described above, the acetone screening value was derived using the EqP approach, which was modified by USEPA (2018) for use in soil. Additionally, the final integrated acetone soil screening level (recommended value based on consideration of screening levels for plants, soil invertebrates, birds, and mammals) selected by USEPA (2018) is 1.2 mg/kg based on protection of mammals (the lower soil invertebrate value was not selected).

Note that USEPA (2018) reports a freshwater sediment screening value of 38 mg/kg using the EqP approach, which is orders of magnitude greater than the soil screening value for soil invertebrates.

Site Data

Acetone was recently detected in soil sampled at the AOC4 gabion. A four-point composite was collected from soil at a depth of 2 feet below ground surface (ft bgs) on June 17, 2021. This sample contained an acetone concentration of 0.062 mg/kg, above the Topock Ecological RBC of 0.04 mg/kg (based on soil invertebrates). On August 5, 2021, GWP and Jacobs re-sampled the AOC4 gabion soil and sent the samples to three labs (Asset, Eurofins Calscience, and Enthalpy) for acetone analysis. Each lab received a soil sample, a duplicate soil sample, and a trip blank. The labs were requested to re-analyze the sample immediately if acetone was detected at a concentration above 0.04 mg/kg. Acetone concentrations in the original and field duplicated samples collected on August 5, 2021 ranged from 0.017 to 0.13 mg/kg; concentrations in the re-analyzed samples ranged from 0.024 to 0.10 mg/kg. The laboratory detection limits for these samples ranged from 0.028 mg/kg to 0.1 mg/kg.

Because the acetone RBC is near the detection limit and within the range of detected acetone concentrations in the AOC4 gabion soil samples, the acetone RBC was further evaluated to ensure that the screening value is considered appropriate, defensible, and likely to predict the potential for adverse effects in soil invertebrates at the Site.

Published Soil Screening Values for Acetone

The Risk Assessment Information System (RAIS) database (Oak Ridge National Laboratory [ORNL] 2021), which includes a compilation of commonly referenced screening value for soil and other media, was queried for additional published acetone screening values for soil invertebrates. However, no other published values were located specific to soil invertebrates. Soil screening values for acetone retrieved from the RAIS database are summarized in Table 1.

Table 1. Acetone Soil Screening Values Available in RAIS.

Source	Plants	Soil Invertebrates	Birds	Mammals
USEPA Region 4 (2018)	NA	0.04	7.5	1.2
USEPA Region 5 (2003b)	2.5			
LANL No Effect ESLs (2017)	NA	NA	7.5 – 66,000	1.2- 7,800
LANL Low Effect ESLs (2017)	NA	NA	75 – 660,000	6.3 – 39,000

Notes:
All units in mg/kg.
ESL = ecological screening level
LANL = Los Alamos National Laboratory
NA = Not available

For comparison purposes, soil invertebrate screening values are available from ORNL (Efroymson et al. 1997) for several VOCs and SVOCs. Soil screening values based on earthworm toxicity data are available for 26 VOCs and SVOCs (primarily chlorinated and/or nitrogen-containing organics) and range from 2 mg/kg for chloroacetamide to 700 mg/kg for 1,2-dichloropropane. These values for other VOCs and SVOCs indicate that the soil invertebrate screening level of 0.04 mg/kg for acetone is orders of magnitude below screening values based on empirical toxicity data for other similar compounds.

A screening assessment for acetone conducted by Environment Canada reported toxicity data as concentrations in soil pore water (median effective concentration [EC50] > 3,000 mg/L) but not in soil concentrations (Environment Canada 2014).

Calculated Soil Invertebrate Screening Values for Acetone

No relevant toxicity data were located for soil invertebrates and soil exposures in the ECOTOX database (USEPA 2021a). As published toxicity data are lacking, a soil invertebrate screening value could not be derived using empirical data.

Because no other published screening values or empirical toxicity data for soil invertebrates were located, the USEPA (2018) equation was used to calculate a soil invertebrate soil screening value based on the EqP approach. Acetone-specific inputs were selected from EPISuite (USEPA 2012) and were used with the default soil texture assumptions selected by USEPA (2018) to calculate a soil invertebrate screening value of 19.8 mg/kg using Equation 1 (above) and the following inputs:

$WQB =$ water quality benchmark from ECOSAR (minimum chronic value for aquatic life [118 mg/L] based on green algae)

$f_{oc} =$ fraction of organic carbon assumed to be 1 percent (dimensionless)

$K_{oc} =$ organic carbon partitioning coefficient (2.364 L/kg)

$\theta_w =$ volumetric water content of soil (0.198 cm^3/cm^3)

$\theta_{a=}$ aeration porosity of soil (0.284 cm^3/cm^3)

$\rho_b =$ soil bulk density (1.37 g/cm^3)

$H' =$ Henry's Law constant (2.02×10^{-3}; dimensionless)

The minimum chronic value predicted using the ECOSAR module in EPISuite (USEPA 2012) is identified by USEPA (2018) as the relevant water quality benchmark for calculation of EqP-based soil screening values. The minimum chronic value for acetone estimated using the ECOSAR model for neutral organic compounds is 118 mg/L and is based on toxicity to green algae. The similarity between acetone sensitivity in green algae and soil invertebrates is unknown. Due to physiological differences between freshwater algae and terrestrial invertebrates, the modeled value for green algae may not accurately represent toxicity to soil invertebrates. ECOSAR also provides modeled aquatic toxicity values for two other common test species: an aquatic invertebrate (Daphnia chronic value = 123 mg/L) and earthworms (14d median lethal concentration [LC50] = 172 mg/L). Additionally, acute (15 mg/L) and chronic (1.7 mg/L) water quality criterion (WQC) values (USEPA 2020) are available for acetone. Unlike the ECOSAR modeled toxicity values for specific test organisms, the WQC values are derived using methods intended to protect 95 percent of aquatic fish and invertebrate species. These alternate WQB values were also used in Equation 1 to calculate a range of soil invertebrate screening values, as presented in Table 2.

Table 2. Acetone Soil Screening Levels Calculated Using the EqP Approach and Alternate Water Quality Benchmarks.

Water Quality Benchmark Source	Water Quality Benchmark Value (mg/L)	Soil Invertebrate Screening Level (mg/kg)
ECOSAR (Chronic Value; Green Algae)	118	19.8
ECOSAR (Chronic Value; Daphnia)	123	20.7
ECOSAR (14-d LC50; Earthworm)	172	29.0
Acute Tier II WQC	15	2.53
Chronic Tier II WQC	1.7	0.29

Considerations

All values calculated using the EqP approach are greater than 0.04 mg/kg. However, an alternate soil invertebrate screening level may not be appropriate as the final soil RBC for use in at the Site for several reasons:

- Acetone toxicity data for soil invertebrates are unavailable, and modeled toxicity results are available only for aquatic exposures to earthworms, neither of which are likely to be present at the Site due to the arid prevailing conditions.
- The relevance of soil invertebrate screening values based on EqP for predicting toxicity at the Site is questionable because site soils are primarily sands with very low organic carbon content. Additionally, due to the arid nature of the Site, soil porewater content is expected to be quite low, especially in surficial soil depths where soil invertebrates are more likely to be present.
- Acetone is unlikely to be present in surface soil other than transiently. Like other compounds with a high vapor pressure, acetone will rapidly volatize from surface soils. Because most soil invertebrates are found only in surface soil, the potential for soil invertebrate contact with soil containing acetone is low and is expected to be short in duration, if occurring.

Summary and Recommended RBCs for VOCs and SVOCs

Published soil invertebrate screening values for majority of the VOCs and SVOCs detected at the Site are lacking. Based on the most currently available compendia (e.g., USEPA 2018) and databases (e.g., LANL, RAIS), empirical toxicity data appear to be unavailable for most of the VOCs and SVOCs detected at the Site to derive soil screening values. Additionally, modeled soil screening values based on EqP are uncertain and carry questionable relevance for the Site. Soil invertebrate exposure to VOCs and SVOCs is likely to be temporal in nature, if present at all, due to the rapid volatilization, especially in the case of VOCs, from surface soil where invertebrates are potentially present. Furthermore, as stated in the HHERA, screening levels for plants and invertebrates are often below background threshold values, and there is low confidence in their ability to predict risk. Therefore, ecological RBCs for plants and soil invertebrates are not recommended for soil management decisions at the Site.

Consistent with the approach recommended in the HHERA (Arcadis 2019, 2020) and by USEPA (2018) for acetone, final soil lowest observed adverse effect level (LOAEL)-based RBCs based on protection of wildlife are recommended instead. For example, for acetone, the lowest site-specific wildlife RBC of 8,856 mg/kg, calculated

in the Soil HHERA (Arcadis 2020) based on protection of Nelson's bighorn sheep, is recommended as the minimum relevant acetone RBC for use at the Site. Similarly, for the remaining VOCs and SVOCs that have available wildlife-based RBCs, those are recommended as soil RBCs as presented below in Table 3. If a chemical did not have a wildlife-based RBC reported in the Soil HHERA (Arcadis 2020) but a suitable surrogate wildlife RBC is available in the Soil HHERA, the Soil HHERA wildlife RBC for the surrogate chemical was selected. If a suitable surrogate RBC was not available in the Soil HHERA, a wildlife LOAEL-based RBC was selected from the LANL (2017) ECORISK Database or from the USEPA (2003b) guidance. These wildlife-based screening levels are based on values for the specific constituent, if available, or a suitable surrogate chemical.

Table 3. Recommended Soil RBCs for VOCs and SVOCs.

Analyte	Soil RBC (mg/kg)	Basis
VOCs		
1,2,4-Trimethylbenzene	397	Nelson's desert bighorn sheep (based on total xylenes [Arcadis 2020])
1,3,5-Trimethylbenzene	397	Nelson's desert bighorn sheep (based on total xylenes [Arcadis 2020])
2-Butanone (Methyl Ethyl Ketone)	809,625	Nelson's desert bighorn sheep (Arcadis 2020)
Acetone	8,856	Nelson's desert bighorn sheep (Arcadis 2020)
Bromomethane (methyl bromide)	2.4[a]	Meadow vole (USEPA 2003b)
Dichloromethane (Methylene chloride)	8,856	Nelson's desert bighorn sheep (Arcadis 2020)
Ethylbenzene	51,543	Nelson's desert bighorn sheep (Arcadis 2020)
Isopropylbenzene (Cumene)	397	Nelson's desert bighorn sheep (based on total xylenes [Arcadis 2020])
Toluene	39,740	Nelson's desert bighorn sheep (Arcadis 2020)
Trichloromethane (chloroform)	7,262	Nelson's desert bighorn sheep (Arcadis 2020)
Xylenes (total)	397	Nelson's desert bighorn sheep (Arcadis 2020)
SVOCs		

Analyte	Soil RBC (mg/kg)	Basis
2,4-Dimethylphenol	34.9[a]	Masked shrew (based on methylphenols [3-methylphenol]; USEPA 2003b)
4-Methylphenol (Cresol, p-)	1,630[a]	Masked shrew (USEPA 2003b)
Bis(2-ethylhexyl) phthalate	29	Cactus wren (Arcadis 2020)
Butylbenzyl phthalate	900[a]	Montane shrew (LANL 2017)
Carbazole	790	Deer mouse (LANL 2017)
Dibenzofuran	48.9	Desert shrew (Arcadis 2020)
Di-n-butyl phthalate	0.47	Cactus wren (Arcadis 2020)

Notes:
[a] Lowest adverse effect level RBC estimated using 10 times the no adverse effect level RBC.

References

Arcadis. 2019. Final Soil Human Health and Ecological Risk Assessment, Topock Compressor Station, Needles, California. October.

Arcadis 2020. Errata - Soil Human Health and Ecological Risk Assessment, Topock Compressor Station, Needles, California. February 19.

Burgess, R.M., Berry, W.J., Mount, D.R., and D.M. Di Toro. 2013. Mechanistic sediment quality guidelines based on contaminant bioavailability: Equilibrium partitioning sediment benchmarks. Environ. Toxicol. Chem. 32:102-114.

Di Toro, D.M., McGrath, J.A., and D.J. Hansen. 2000. Technical basis for narcotic chemicals and polycyclic aromatic hydrocarbon criteria. I. Water and Tissue. Environ. Toxicol. Chem. 19:1951-1970

Efroymson RA, ME Will, and GWS II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process. U.S. Department of Energy.

Environment Canada. 2014. Screening Assessment Acetone Chemical Abstracts Service Registry Number 67-64-1. September. Available online at: https://www.ec.gc.ca/ese-ees/default.asp?lang=En&n=CB62CB1D-1#toc84.

Los Alamos National Laboratory (LANL). 2017. ECORISK Database. Los Alamos National Laboratory (Release 4.1). LA-UR-17-26376, Los Alamos National Laboratory, Los Alamos, New Mexico, September.

McGrath, J.A. and D.M. Di Toro. 2009. Validation of the target lipid model for toxicity assessment of residual petroleum constituents: Monocyclic and polycyclic aromatic hydrocarbons. Environ. Toxicol. Chem. 28:1130-1148.

Oak Ridge National Laboratory. 2021. Risk Assessment Information System. Available online at: https://rais.ornl.gov/.

Redman, A.D., Parkerton, T.F., Paumen, M.L., and J.A. McGrath. 2014. Extension and validation of the target lipid model for deriving predicted no-effect concentrations for soils and sediments. Environ. Toxicol. Chem. 33:2679-2687.

USEPA. 2003a. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures. EPA-600- R-02-013. Office of Research and Development, Washington, D.C

USEPA. 2003b. RCRA Ecological Screening Levels. August 22.

USEPA. 2008. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics. EPA-600- R-02-016. Office of Research and Development, Washington, D.C.

USEPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.

USEPA. 2018. Supplemental Guidance to ERAGS: Region 4, Ecological Risk Assessment, Originally published November 1995. March.

USEPA. 2020. Great Lakes Initiative (GLI) Clearinghouse. <web page> Located at: epa.gov/clearinghouse. December.

USEPA. 2021a. ECOTOX Database. Available online at: https://cfpub.epa.gov/ecotox/.

Enc. [Enclosures]

Attachment 1
Comparison of Ecological Screening Values for Volatile and Semi-Volatile Organic Comounds in Soil

Chemical	CAS	USEPA Soil Screening Level (mg/kg)	Ref.	Receptor	USEPA Soil Invertebrate Screening Level (mg/kg)	Ref.	Koc (L/kg)[a]	Henry's Law Constant (H')[a]	Water Quality Benchmark (mg/L)[b]	Recalculated ESV soil invertebrate (mg/kg)	Fold difference (Recalculated ESV/Soil Invert SL)	ECOSAR Min Chronic Value[e] (mg/L)	ECOSAR Species Basis	Recaluclated ECOSAR ESV (mg/kg)	Fold difference (ECOSAR ESV/Soil Invert SL)
VOCs															
1,2,4-Trimethylbenzene	95-63-6	0.09	d	All	0.09	d	6.1E+02	2.5E-01	0.015	0.095	1.1	0.329	Daphnid	2.1	23
1,3,5-Trimethylbenzene	108-67-8	0.16	d	All	0.16	d	6.0E+02	3.6E-01	0.026	0.16	1.0	0.329	Daphnid	2.1	13
2-Butanone (Methyl Ethyl Ketone)	78-93-3	1.0	d	All	1.0	d	4.5E+00	2.3E-03	22	4.2	4.2	65.7	Daphnid	12	12
Acetone	67-64-1	1.2	c	M, A	0.04	d	2.4E+00	1.4E-03	1.7	0.29	7.2	118	Green algae	20	495
Bromomethane (methyl bromide)	74-83-9	0.002	d	All	0.002	d	1.3E+01	3.0E-01	0.016	0.0054	2.7	17.8	Daphnid	6.0	3016
Dichloromethane (Methylene chloride)	75-09-2	0.21	d	All	0.21	d	2.2E+01	1.3E-01	1.5	0.58	2.8	12.0	Daphnid	4.7	22
Ethylbenzene	100-41-4	0.27	d	All	0.27	d	4.5E+02	3.2E-01	0.061	0.29	1.1	0.820	Daphnid	3.8	14
Isopropylbenzene (Cumene)	98-82-8	0.04	d	All	0.04	d	7.0E+02	4.7E-01	0.0048	0.035	0.9	0.453	Daphnid	3.3	82
Toluene	108-88-3	0.15	d	All	0.15	d	2.3E+02	2.7E-01	0.062	0.16	1.0	1.66	Daphnid	4.2	28
Trichloromethane (chloroform)	67-66-3	0.05	d	All	0.05	d	3.2E+01	1.5E-01	0.14	0.069	1.4	12.4	Daphnid	6.1	122
Xylenes (total)	1330-20-7	0.1	d	All	0.1	d	3.8E+02	2.7E-01	0.027	0.11	1.1	0.745	Daphnid	3.0	30
SVOCs															
2,4-Dimethylphenol	105-67-9	0.04	d	SI	0.04	d	4.9E+02	3.9E-05	0.015	0.076	1.9	0.441	Daphnid	2.2	56
4-Methylphenol (Cresol, p-)	106-44-5	0.08	d	All	0.08	d	3.0E+02	4.1E-05	0.053	0.17	2.1	0.660	Daphnid	2.1	26
Bis(2-ethylhexyl) phthalate	117-81-7	0.02	c	All	8.4	d	1.2E+05	1.1E-05	0.0080	9.6	1.1	0.000190	Fish	0.23	0.027
Butylbenzyl phthalate	85-68-7	0.59	d	All	0.59	d	7.2E+03	5.2E-05	0.023	1.6	2.8	0.0377	Fish	2.7	4.6
Carbazole	86-74-8	0.07	d	All	0.07	d	2.5E+03	4.8E-06	0.0040	0.10	1.4	0.917	Daphnid	23	331
Dibenzofuran	132-64-9	0.15	d	All	0.15	d	9.2E+03	8.7E-03	0.0040	0.37	2.4	0.402	Daphnid	37	246
Di-n-butyl phthalate	84-74-2	0.011	c	All	0.22	d	1.2E+03	7.4E-05	0.019	0.22	1.0	0.0484	Fish	0.6	2.6

Notes:

Ecological Screening Values (ESVs) listed in the Topock HHERA (Arcadis 2019) with soil invertebrate screening levels derived using USEPA Region 4 (2018) Equilibrium Partitioning (EqB) approach.

Gray highlight indicates greater than 2-fold difference in the recalulated ESV using the EqP approach and the USEPA (2018) soil invertebrate screening level EqP calculation.

a: Koc and Henry's Law values based on USEPA EPISuite parameters except for carbazole, which was derived from the USEPA CompTox Chemcial Dashboard. https://comptox.epa.gov/dashboard/

b: Water Quality Benchmark (WQB) used for calculation of ESVs obtained from USEPA Region 4 (2018) chronic freshwater screening values.

c: Los Alamos National Laboratory (LANL). 2017. ECORISK Database Release 4.1. September 2017. http://www.lanl.gov/environment/protection/eco-risk-assessment.php

d: Derived using the USEPA Region 4 EqP soil model (USEPA 2018, Section 6.3.)

e: Derived from the minimum chronic freshwater value from the USEPA ECOSAR Program in EPISuite (USEPA 2012).

All - ESV for protection of all receptors

SI - ESV for protection of soil invertebrates

A - ESV for protection of avians

M - ESV for protection of mammals

Acronyms and Abbreviations:

CAS - Chemical Abstract Service

HHERA - Human Health and Ecological Risk Assessment

Koc - organic carbon absorption

L/kg - liter per kilogram

mg/kg - milligram per kilogram

mg/L - milligram per liter

SL - screening level

SVOC - semi-volatile organic compound

VOC - volatile organic compound

References:

Arcadis. 2019. Final Soil Human Health and Ecological Risk Assessment, Topock Compressor Station, Needles, California. October.

USEPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. United States Environmental Protection Agency, Washington, DC, USA.

USEPA Region 4. 2018. Supplemental Guidance to ERAGS: Region 4, Ecological Risk Assessment, Originally published November 1995. March.