Pacific Gas and Electric Company

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT REPORT

Topock Compressor Station, Needles, California

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ACRONYMS AND ABBREVIATIONS

1×10^{-6}	1 in 1 million or 1 times 10 to the power of negative 6
1×10^{-5}	10 in 1 million or 1 times 10 to the power of negative 5
1×10^{-4}	100 in 1 million or 1 times 10 to the power of negative 4
1×10^{-3}	1,000 in 1 million or 1 times 10 to the power of negative 3
2×10^{-6}	2 in 1 million or 2 times 10 to the power of negative 6
2×10^{-5}	2 times 10 to the power of negative 5
5×10^{-6}	5 in 1 million or 5 times 10 to the power of negative 6
5×10^{-5}	50 in 1 million or 5 times 10 to the power of negative 5
8×10^{-5}	8 times 10 to the power of negative 5
95UCL	95% upper confidence limit on the mean
µg/dL	microgram per deciliter
µg/kg	microgram per kilogram
µg/L	microgram per liter
µg/m^3	microgram per cubic meter
ABSd	dermal absorption
ACA	Administrative Consent Agreement
ACM	asbestos-containing material
ADAF	age-dependent adjustment factor
ADD	average daily dose
AF	attenuation factor
AHR	aryl hydrocarbon receptor
Alisto	Alisto Engineering Group
AOC	area of concern
AOC4 TCRA Work Plan	Final Work Plan for Time-Critical Removal Action at AOC4 Debris Ravine
APE	Area of Potential Effects
ARAR	applicable or relevant and appropriate requirement
Arcadis	Arcadis U.S., Inc.
As	arsenic

AT	averaging time
atm-m^3/mol	atmosphere-cubic meter per mole
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
B(a)PEQ	benzo(a)pyrene equivalent
Background Tech Memo	Technical Memorandum – Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station
BAF	bioaccumulation factor
BCa	bias-corrected accelerated
BCW	Bat Cave Wash
BEF	bioaccumulation equivalency factor
bgs	below ground surface
BNSF	Burlington Northern Santa Fe
BRA	baseline risk assessment
bss	below sediment surface
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTV	background threshold value
BW	body weight
bw/d	body weight per day
CACA	Corrective Action Consent Agreement
CalEPA	California Environmental Protection Agency
CDFW	California Department of Fish and Wildlife
CDI	chronic daily intake
CDNPA	California Desert Native Plant Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH2M	CH2M Hill
chromium-3	trivalent chromium
chromium-6	hexavalent chromium
CLP	Contract Laboratory Program

CMS	Corrective Measures Study
CNRA	California Natural Resources Agency
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CR	contact rate
CSF	cancer slope factor
CSM	conceptual site model
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DLC	dioxin-like compound
DOI	U.S. Department of the Interior
DQO	data quality objective
DRO	diesel-range organic
DTSC	Department of Toxic Substances Control
DTSC-SL	DTSC-modified Screening Level
DUA	Data Usability Assessment
EC	exposure concentration
Eco-SSL	Ecological Soil Screening Level
ECV	ecological comparison value
ED	exposure duration
EE/CA	Engineering Evaluation/Cost Analysis
EF	exposure frequency
EIR	Environmental Impact Report
EPC	exposure point concentration
ERA	Ecological Risk Assessment
Field Procedures Manual	Sampling, Analysis, and Field Procedures Manual
Final RFI/RI Report Volume 1	Revised Final RCRA Facility Investigation/Remedial Investigation Report, Volume 1 – Site Background and History
Final Soil RFI/RI Work Plan	Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan

FIR	food ingestion rate
FMIT	Fort Mojave Indian Tribe
FOD	frequency of detection
FS	Feasibility Study
Galbraith	Galbraith Environmental Sciences LLC
GANDA	Garcia and Associates
GEAE	Generic Ecological Assessment Endpoint
GPS	global positioning system
GRO	gasoline-range organic
GWRA	Groundwater Risk Assessment
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEAST	Health Effects Assessment Summary Table
HERD	Human and Ecological Risk Division
HERO	Human and Ecological Risk Office
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HI	hazard index
HMW	high molecular weight
HNWR	Havasu National Wildlife Refuge
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HQ	hazard quotient
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
I-40	Interstate 40
ICS	inside the compressor station
ILCR	incremental lifetime cancer risk
IM	interim measure
IRIS	Integrated Risk Information System
ITRC	Interstate Technology and Regulatory Council
kg	kilogram

kg/day	kilogram per day
Konecny	Konecny Biological Services
LMW	low molecular weight
LOAEL	lowest observed adverse effects level
LOE	line of evidence
log Kow	octanol-water partitioning coefficient
m^3/kg	cubic meter per kilogram
MCL	maximum contaminant level
mg/day	milligram per day
mg/kg	milligram per kilogram
mg/kg-bw/day	milligram per kilogram of body weight per day
mg/m^3	milligram per cubic meter
mmHg	millimeter of mercury
MRL	Minimal Risk Level
msl	mean sea level
NCEA	National Center of Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	nondetect
ng	nanogram
ng/kg	nanogram per kilogram
ng/kg-bw/day	nanogram per kilogram of body weight per day
NOAEL	no observed adverse effect level
NOEL	no observed effects level
NORR	North of the Railroad
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
OCS	outside the compressor station
OEHHA	Office of Environmental Health Hazard Assessment
OHV	off-highway vehicle
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration

OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PBA	Programmatic Biological Assessment
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PDF	portable document format
PeCDD	pentachlorodibenzo-P-dioxin
PeCDF	pentachlorodibenzofuran
PEF	particulate emission factor
PG&E	Pacific Gas and Electric Company
pg/g	picogram per gram
PMP	Performance Monitoring Program
PPE	personal protective equipment
ppm	part per million
PPRTV	provisional peer-reviewed toxicity value
PRG	Preliminary Remediation Goal
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAO	remedial action objective
RAWP	Human Health and Ecological Risk Assessment Work Plan
RBA	relative bioaccessibility
RBC	risk-based concentration
RBRG	risk-based remedial goal
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
REL	Reference Exposure Level

RfC	reference concentration
RfD	reference dose
RFI/RI	RCRA Facility Investigation/Remedial Investigation
Risk Commission	Presidential/Congressional Commission on Risk Assessment and Risk Management
RL	reporting limit
RME	reasonable maximum exposure
RPD	relative percent difference
RSL	Regional Screening Level
RTC	response to comments
SFRWQCB	California Regional Water Quality Control Board, San Francisco Bay Region
SIR	soil ingestion rate
SSTPA	surface soil transport pathway analysis
STSC	Superfund Health Risk Technical Support Center
SUF	site use factor
SVOC	semivolatile organic compound
SWMU	solid waste management unit
T&E	threatened or endangered
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TCRA	time-critical removal action
TCS	Topock Compressor Station
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TPH	total petroleum hydrocarbon
TPHd	total petroleum hydrocarbon as diesel
TRV	toxicity reference value
TRW ALM	Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil
TW	Tarone-Ware
UA	Undesignated Area

UCL	upper confidence limit
URF	unit risk factor
USBLM	U.S. Bureau of Land Management
USBOR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UTL	upper tolerance limit
VF	volatilization factor
VOC	volatile organic compound
WHO	World Health Organization
WMW	Wilcoxon-Mann-Whitney
WOE	weight of evidence
ww	wet weight

EXECUTIVE SUMMARY

ES.1 Introduction

This Soil Human Health and Ecological Risk Assessment (HHERA) Report describes the potential risks to human health and ecological receptors that may contact soil impacted by historical discharges and operations at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS). The TCS is an active natural gas compressor station located in eastern San Bernardino County, approximately 15 miles southeast of Needles, California. The compressor station occupies approximately 15 acres of a 65-acre parcel of PG&E-owned land. The study area for investigative and remedial activities covers additional surrounding land including portions of a 100-acre parcel owned by the Fort Mojave Indian Tribe (FMIT) and land owned and/or managed by government agencies including the U.S. Bureau of Land Management (USBLM), U.S. Bureau of Reclamation (USBOR), U.S. Fish and Wildlife Service (USFWS), San Bernardino County, California Department of Transportation, and Burlington Northern Santa Fe (BNSF) Railroad. The TCS and the additional surrounding areas investigated together are referred to as the "site" in this report.

PG&E is conducting investigative and remedial activities at the site, including this HHERA, pursuant to the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Under CERCLA, the primary purpose of a baseline risk assessment (BRA) is to provide risk managers with an understanding of the potential adverse health effects (current or future) to human and ecological receptors posed by the release of hazardous substance from the site and in the absence of any actions to control or mitigate those releases. This information may be useful in determining whether a potential current or future threat to human health or the environment exists that warrants an action. This Soil HHERA, in conjunction with the Groundwater Risk Assessment (GWRA) (Arcadis 2009c), represent a BRA. The HHERA conducted for the TCS involved two primary components:

- Human health risk assessment (HHRA), which identifies potential human receptors and exposure pathways and presents the potential risks to human health that could result from exposure to constituents of potential concern (COPCs) in soil (discussed in Section 5 of the HHERA Report).
- Ecological risk assessment (ERA), which identifies potential ecological receptors and exposure pathways and presents the potential risks to ecological receptors that could result from exposure to constituents of potential ecological concern (COPECs) in soil (discussed in Section 6 of the HHERA Report).

The HHERA findings will be helpful in making risk management decisions. In accordance with the Human Health and Ecological Risk Assessment Work Plan (RAWP; Arcadis 2008a), specific objectives of the HHERA are twofold:

1. Help determine the need for remedial action with respect to soil conditions
2. Provide a basis for determining levels of constituents that can remain in soil at the site and still adequately protect public health and the environment (U.S. Environmental Protection Agency [USEPA] 1989).

The solid waste management units (SWMUs), areas of concern (AOCs), and additional surrounding areas investigated as part of the RCRA Facility Investigation/Remedial Investigation (RFI/RI) are those associated with the historical discharge to soil by operations and activities at the site. Site areas are organized into these two categories:

- Outside the TCS Fenceline – Evaluated for both potential human health and ecological impacts.
- Inside the TCS Fenceline – Evaluated for potential human health impacts only. Because this is an active operating facility, activities, and conditions inside the fenceline do not offer a suitable or attractive habitat for ecological populations at this time. All potential exposure pathways for ecological receptors are considered incomplete inside the TCS fenceline (Eichelberger 2006).

The HHERA evaluated all constituents detected in the soil during the RFI/RI and identifies those constituents that could potentially pose an unacceptable risk to either human health or the ecological environment using the methodology presented in the approved RAWP documents (Arcadis 2008a, 2009a, 2015) and California Environmental Protection Agency (CalEPA), Department of Toxic Substances Control (DTSC)-issued Directive Letter (DTSC 2017).

ES.2 Site History and Characteristics

ES.2.1 Site Historical Operations

The TCS began operations in December 1951 to compress natural gas supplied from the southwestern United States for transport through pipelines to PG&E's service territory in central and northern California. Current operations at the TCS are very similar to the operations that have occurred since 1951. The greatest use of chemical products at the facility involves treatment of cooling water, and the greatest volume of waste produced consists of untreated wastewater (or, blowdown) from the cooling towers.

From 1951 to 1964, untreated wastewater containing hexavalent chromium (used to inhibit corrosion, minimize scale formation, and control biological growth) was discharged to Bat Cave Wash (BCW), an ephemeral drainage that extends from the Chemehuevi Mountains to the north. From 1964 to 1969, PG&E treated the wastewater by converting hexavalent chromium to trivalent chromium. Beginning in May 1970, treated wastewater was discharged to an injection well (which is named PGE-08) located on PG&E property inside the TCS, and discharges to BCW generally ceased. Use of the injection well ceased in 1973 and wastewater was discharged exclusively to the four, single-lined evaporation ponds, located about 1,600 feet west of the TCS.

In the 1980s and 1990s, PG&E ended use of hexavalent chromium, removed the wastewater treatment system, and replaced the single-lined ponds with four new, Class 2 (double-lined) ponds. PG&E still uses the double-lined ponds, which are on USBLM property.

PG&E conducted soil investigations at six SWMUs, 29 AOCs, and seven additional investigation areas located inside and outside the TCS fenceline. The investigation areas carried forward into this HHERA are listed in the table titled Investigation Areas Carried Forward into the HHERA.

Investigation Areas Carried Forward into the HHERA

Location	Investigation Areas Carried Forward into the HHERA
Inside the TCS	• SWMU 5 (Sludge Drying Bed) • SWMU 6 (Chromate Reduction Tank) • SWMU 8 (Process Pump Tank) • SWMU 9 (Transfer Pump) • SWMU 11 (Former Sulfuric Acid Tanks) • AOC5 (Cooling Tower A) • AOC6 (Cooling Tower B) • AOC7 (Hazardous Materials Storage Area) • AOC8 (Paint Shed) • AOC13 (Unpaved Area Within the TCS) • AOC15 (Auxiliary Jacket Cooling Water Pumps) • AOC16 (Former Sandblast Shelter) • AOC17 (Onsite Septic System) • AOC18 (Combine Wastewater Transference Pipelines) • AOC19 (Former Cooling Liquid Mixing Area and Former Hotwell) • AOC20 (Industrial Floor Drains) • AOC21 (Round Depression Near Sludge Drying Bed) • AOC22 (Unidentified Three-Sided Structure) • AOC23 (Former Water Conditioning Building) • AOC24 (Stained Area and Former API Oil/Water Separator) • AOC25 (Compressor and Generator Engine Basements) • AOC26 (Former Scrubber Oil Sump) • AOC32 (Oil Storage Tanks and Waste Oil Sump) • AOC33 (Potential Former Burn Area Near AOC17) • Unit 4.3 (Oily Water Holding Tank) • Unit 4.4 (Oil/Water Separator) • Unit 4.5 (Portable Waste Oil Holding Tank) • Portions of AOC4 Inside the Fence Line • Perimeter Area

Location	Investigation Areas Carried Forward into the HHERA
Outside the TCS	• SWMU 1 (Former Percolation Bed) • TCS Well #4 (Capped Well) • AOC1 (Area Around the Percolation Bed) • AOC4 (Debris Ravine) • AOC9 (Southeast Fence Line) • AOC10 (East Ravine) • AOC11 (Topographic Low Areas) • AOC12 (Fill Areas) • AOC14 (Railroad Debris Site) • AOC27 (MW-24 Bench) • AOC28 (Pipeline Drip Legs) • AOC31 (Former Tea Pot Dome Oil Pit) • Undesignated Area 2 (UA-2) (Former 300B Pipeline Liquids Tank) • Perimeter Area • Storm Drain System

ES.2.2 Soil Investigations and AOC4 Interim Action

Investigative and remedial activities at the TCS date back to the 1980s when a RCRA Facility Assessment was completed, identifying a series of SWMUs at the site. The RFI began in 1996, and numerous phases of data collection and evaluation have been completed. Since 2005, investigative and remedial activities have been performed pursuant to both RCRA and CERCLA. The primary reports documenting these investigations are as follows in the table titled Primary Investigation Reports.

Primary Investigation Reports

Report Name	Notes
RFI/RI Report Volume 1 Site Background and History (CH2M Hill [CH2M] 2007a)	• Completed in August 2007. • Approved by CalEPA, DTSC (2007) and U.S. Department of the Interior (DOI 2007a).
RFI/RI Report Volume 2 Hydrogeologic Characterization and Results of Groundwater and Surface Water Investigation and Addendum (CH2M 2009)	• Report completed in February 2009. • Addendum completed in June 2009. • Approved by DTSC (2009b) and DOI (2009a).

Report Name	Notes
PG&E Topock Compressor Station Soil Investigation Data Package (PG&E 2018)	• PG&E TCS soil investigation data package transmittal to DOI, dated May 8, 2018.
RFI/RI Report Volume 3 Results of Soil and Sediment Investigation (forthcoming)	• Currently being prepared by Jacobs. • Includes final characterization data to complete the RFI/RI requirements for remaining TCS operations, including the results of soil investigations and the storm drain alignment investigation. • Data provided to DOI in the TCS soil investigation data package transmittal (PG&E 2018), will be included in the Draft RFI RI Report Volume 3, and form the basis for the risk evaluations in the Soil HHERA.
Time-Critical Removal Action (TCRA) at the AOC4 Debris Ravine Site (DOI 2009b)	• Result of DOI Action Memorandum that directed PG&E to initiate TCRA at AOC4. • Fill material and debris were believed to be deposited and trash reportedly was burned at AOC4. • Removed 11,799 tons of soil and debris from AOC4. • Based on confirmation dataset and installation of erosion control measures, substantial threat of release of contaminated material from AOC4 was stabilized and mitigated by the TCRA (Alisto Engineering Group [Alisto] et al. 2011).
Soil Background Investigations (Various reports/authors)	• Conducted to characterize the background conditions for the presence of metals, polycyclic aromatic hydrocarbon (PAHs), and dioxins/furans, and to establish background concentrations in soil. • Site-related concentrations of constituents were compared to background concentrations to assess whether the delineation of nature and extent of contamination in soils at investigation areas was adequate. • Results are provided in a series of reports (see Section 2.2.4 of the HHERA Report).

ES.2.3 Site Conditions and Characteristics

The site is located in the Mohave Valley, along the California-Arizona border in eastern San Bernardino County, California. The Chemehuevi Mountains are located to the south and the Colorado River is located to the east and north. The site occupies approximately 3 square miles of the north-sloping piedmont alluvial terrace and floodplain along the northern margin of the mountains.

ES.2.3.1 Physical and Ecological Characteristics

The tables in this section summarize the physical and ecological characteristics, and current and future land use at the site that are important for the HHERA.

Site Physical and Ecological Characteristics

Physical/ Ecological Characteristic	Description
Geology	• Geology of the landforms is characterized by alluvial terraces and incised drainage channels. • BCW is a prominent desert wash that crosses the Study Area from south to north. • Unconsolidated alluvial and fluvial deposits are underlain by the Miocene conglomerate and pre-Tertiary metamorphic and igneous bedrock. • In the upland area, the subsurface shallow aquifer zone consists of alluvial deposits.
Hydrology and Hydrogeology	• Site is situated at the southern extent of unconsolidated alluvial aquifer material in the Mohave groundwater basin. • Colorado River runs north to south through the basin. • Groundwater occurs under unconfined to semi-confined conditions beneath most of the site. • Saturated portion of the alluvial fan and fluvial sediments are collectively referred as the alluvial aquifer. • In the floodplain area adjacent to the Colorado River, the fluvial deposits interfinger with, and are hydraulically connected to, the alluvial fan deposits. • Unconsolidated alluvial and fluvial deposits are underlain by bedrock with very low permeability; therefore, groundwater movement occurs primarily in the overlying unconsolidated deposits, and groundwater flow is generally north to northeasterly. • Due to the variable topography at the site, the depth to groundwater ranges from as shallow as 5 feet below ground surface (bgs) in floodplain wells next to the river to approximately 170 feet bgs at the upland alluvial terrace areas.
Ecological Overview	• Site is located adjacent to and includes a portion of the 37,515-acre Havasu National Wildlife Refuge (HNWR) managed by USFWS. • Area is characterized by arid conditions and high temperatures and consists of a series of terraces divided by dry desert washes (CH2M 2007a). • Site is located either within the Mojave Desert province of California, the Colorado Desert, or the boundary between these two deserts (CH2M 2007a). Upland terrestrial habitats are typical of Mojave Desert uplands dominated by creosote bush scrub, with Mojave Wash, desert riparian, and tamarisk thicket.

Physical/ Ecological Characteristic	Description
	• BCW (AOC1/SWMU 1) is relatively barren of vegetation, consisting of sand, gravel, and cobblestone substrate (CH2M 2014); BCW is a primarily north-south-trending channel located west of the Colorado River; large volume surface flows are generally infrequent and occur only briefly in response to high intensity rainfall events, but remains dry throughout most of the year due to arid desert conditions (PG&E 2013, 2014). Dense vegetation is present in the Tamarisk Thicket area, located at the northern end of BCW. • East Ravine (AOC10) is 1,600 foot long and runs eastward toward the Colorado River. The ravine is bisected by three constructed berms and contains three drainage depression areas that are located behind these berms. AOC10 is relatively barren of vegetation; may periodically flood during stormwater runoff events but remains dry throughout most of the year due to arid desert conditions. Flooding events are periodic; on the frequency of one or two times a year and usually during the summer monsoon season. • Riparian corridors consisting of small patches of emergent vegetation exist along the banks of the Colorado River, with little to no submergent vegetation within the river. East of the Colorado River, the Action Area is a sand and salt cedar (Tamarisk) environment very similar to that found on the floodplain on the California side. Various wildlife and plant species are supported by the riparian habitat. Saturated sediments along the edge of the Colorado River that are ephemerally (temporarily) flooded are located at the mouth of BCW and at the mouth of East Ravine (east of AOC10). The ephemeral flooding is due to infrequent high flow in the wash or annual variations in stage along the Colorado River, the latter of which is not associated with the potential for transport of site-related materials.
Special-Status Species	• Programmatic Biological Assessments (PBAs; CH2M 2007b and 2014) and the reinitiations (PG&E 2017a, b) were conducted to evaluate potential impacts to species and habitats; concluded “may affect but likely to not adversely affect” for all the special-status species evaluated and their critical habitat for all terrestrial species for ongoing and planned activities at the site, including federally listed species. • No state- or federal-listed threatened or endangered (T&E) plant species are potentially present in the upland or riparian areas. • In the upland areas, special-status plant species are potentially present (CH2M 2017). California Desert Native Plant Act (CDNPA) or ethnobotanical plants include blue palo verde, catclaw acacia, desert smoke tree, and the western honey mesquite. California Rare Plants include mousetail suncup and the hillside palo verde. • No federal listed T&E wildlife species were observed at the site, except for a single observation of the southwestern willow flycatcher (federally listed T&E species) in 2009

Physical/ Ecological Characteristic	Description
	in the Tamarisk Thicket (Garcia and Associates [GANDA] 2017), which is not considered to be resident at the site. • Other federally listed species including de sert tortoise, yellow-billed cuckoo, and Yuma clapper rail were not directly observed at the site (CH2M 2014, Konecny Biological Services [Konecny] 2012). • Two large home-range species have been observed: the ring-tailed cat and Nelson's bighorn sheep. The ring-tailed cat is a California fully protected species. To be consistent with the GWRA (Arcadis 2009c) and observations made by a PG&E employee at the site Nelson's bighorn sheep was evaluated. • Bat surveys indicated presence of the cave myotis and pallid bat (state species of concern) at BCW (Harvey 2015). Townsend big-eared bats (a state species of concern) have not been directly observed at the site (CH2M 2015, Brown and Rainey 2015).

Site Land Use

Land Use	Description
Current – General	• Site is located in a sparsely populated, rural area. • Major gas utility and transportation corridor, BNSF Railroad (railroad-owned land), and Interstate 40 (I-40) (California Department of Transportation-owned land) are located within the site.
Current – TCS	• TCS in an active operation and occupies approximately 15 acres of a 65-acre parcel of PG&E-owned land. • The surrounding area includes land owned and/or managed by a number of government agencies, including USBLM, USBOR, USFWS, and San Bernardino County. • USBLM-managed lands within the area are owned by USBLM, San Bernardino County, and USBOR and are considered public; however, public use is not encouraged, as the Topock Maze, a culturally significant area for several Native American tribes, is located here.
Current – Tribes	• The Tribes indicated in a memorandum (FMIT 2012) and a letter (FMIT 2013) that the tribal use of the land in the area of the site including the Topock Maze is limited to: Tribal Group Activities several times a year for prayer and reflection; Tribal Education Activities for students and young people to visit the area to learn about its importance and spiritual significance; and Tribal Member Individual Visits to the Mojave Valley on a regular but infrequent basis for quiet time and reflection as part of religious practice and culture, to pay homage to the area and to honor their ancestors.

Land Use	Description
Current – Residential and Recreational	• Nearest residents are located 2,000 feet away across the river in Topock, Arizona, a seasonal community of about 20 (mostly retired senior citizens) in a small mobile home park near the Topock 66 Marina. • Few permanently occupied homes are located on the southern side of I-40, along the shoreline between the pipeline bridge and the I-40. • Moabi Regional Park is a recreational facility operated by the San Bernardino County Department of Parks and Recreation, which is located on land leased from USBLM. As a regional park, it has no permanent full-time residents.
Future	• PG&E plans to continue owning and operating the TCS and associated property as an industrial operation for the foreseeable future. The railroad and highway will also continue in their current use for the foreseeable future. Accordingly, the reasonably anticipated future use of these areas is the same as their current use, industrial operations. • The primary conservation mission of USFWS, as it applies to the HNWR, limits human use of HNWR property. Therefore, in the future, human use of HNWR property will continue to be restricted to recreational uses. • Similarly, future use of the USBLM-owned land at the site is likely to remain recreational. Nonetheless, as recommended by DOI, future uses of the USBLM-owned property could include seasonal residential use and year-round residential use for San Bernardino County staff at Park Moabi, and recreational (such as camping) use on the floodplain. • Although future residential use of the USBLM land is unlikely, DOI has specifically requested an evaluation of future residential use on USBLM property.

ES.2.3.2 Conceptual Site Model

The conceptual site model (CSM) for the site shows the relationships between a chemical source, exposure pathways, and potential receptors. The components that constitute the fate and transport portions of the CSM include potential sources, release mechanisms, and retention and transport media. These components apply to both the HHRA and ERA and are discussed in more detail in Section 2.5 of the HHERA Report.

For this site, several CSMs (Figures 2-2 through 2-7 of the HHERA Report) were prepared that illustrate the potential source-pathway-receptor relationships and provide the basis for the quantitative exposure assessment undertaken as part of the HHERA. Most sources for site-related compounds found both inside and outside the compressor station originated inside the compressor station or from associated activities, including incidental spills/releases from various processes and activities for the operating facility. Current data indicate that the primary site related constituents in soils are metals, primarily hexavalent chromium and trivalent chromium, as well as dioxins (CH2M 2007a).

Once constituents are in soil, the potential pathways through which the constituents may move from the soil to other environmental media include: transport and release through surface water runoff, leaching to groundwater, fugitive dust emissions, and volatilization of volatile organic compounds (VOCs) from soil and release into ambient/indoor air. For the HHRA, soil direct contact exposure pathways (that is, incidental ingestion, inhalation, and dermal contact) were the primary potentially complete exposure pathways evaluated. For the ERA, the primary potentially complete exposure pathways for soil are direct contact (plants and soil invertebrates) and incidental ingestion and uptake of constituents from soil into biota and subsequent ingestion of biota as part of the diet for wildlife (mammals and birds).

ES.3 Data Evaluation

During the HHERA, the data evaluation process analyzed site characteristics and analytical data to identify constituents that are potentially related to the site and for which there are data of sufficient quality to be used in a quantitative risk assessment (USEPA 1989). Data collected from 1997 through 2017 during multiple phases of site investigation were consolidated and used in the quantitative risk assessment.

The soil and soil gas data included in the HHERA are summarized in the table titled Overview of Data Included in the HHERA; Section 3 of the HHERA Report provides more details. Soil and soil gas sample locations for data evaluated in the HHERA are presented on Figures 3-1a and 3-1b for areas outside the TCS and on Figure 3-2 for the area inside the TCS.

Overview of Data Included in the HHERA

Media	Data Included in the HHERA
Soil	• Only Category 1 data are included in the datasets used in the quantitative risk assessment. Soil samples representative of soil that has been removed as part of a removal action were not included in the HHERA datasets. • Soil samples were analyzed for one or more of the following chemical analytical suites: o Metals o Contract Laboratory Program (CLP) inorganics o PAHs o Semivolatile organic compounds (SVOCs) and VOCs o Total petroleum hydrocarbons (TPHs) o General chemistry parameters o Pesticides o Polychlorinated biphenyls (PCBs) o Dioxins/furans. • Samples designated ‘white powder’ collected from AOC9, AOC10, AOC 14, and SWMU 1 are included in the datasets used in the quantitative risk assessment as a conservative measure assuming that contact would not differ significantly from exposure to surrounding soil.
Soil Gas	• Soil gas samples were collected in January 2016 and February 2017 at several locations inside the TCS fenceline at 3 or 6 feet bgs and analyzed for VOCs.

Additionally, data are available for sediment, porewater, and various debris materials. Sediment and porewater data, collected in 2003 and 2017 at the mouth of BCW and in East Ravine along the Colorado

River, were not used to estimate potential risk to human and ecological receptors in the HHERA because potential receptor exposures in the sediment areas were found to be insignificant based on a transport pathway evaluation and gradient analysis conducted as described in Section 2.5 of the HHERA Report.

ES 3.1 Data Usability

Data usability criteria identified by USEPA (1992) were used to confirm that the data were suitable for risk assessment. Data validation was conducted in accordance with the Quality Assurance Project Plan QAPP (CH2M 2004), and overall, the data were determined to be of acceptable quality (except where noted with appropriate flags), and the completeness objectives were accomplished. Section 3.2 of the HHERA Report discusses the data usability criteria and application to site data.

ES 3.2 Groupings of Data

As described in the RAWP documents (Arcadis 2008a, 2009a, 2015) and based on subsequent direction from DTSC (2017), areas at the site were identified for independent evaluation in the HHERA for potential human and/or ecological exposures. Data were grouped into datasets for each potential exposure area and evaluated for the relevant human and/or ecological receptors, as described in Section 3.3. Figure 3-3 presents the potential exposure areas based on individual AOCs/investigation areas evaluated in the HHERA for relevant human receptors, ecological communities (plants and soil invertebrates), and small home range wildlife (mammals and birds). Larger areas based on combined potential exposure areas were evaluated for relevant human receptors (Figure 3-4a) and large home range wildlife (mammals and birds) (Figure 3-4b). The potential exposure areas evaluated in the HHERA include the following areas listed in the tables titled Potential Exposure Areas Evaluated in the HHERA.

Potential Exposure Areas Evaluated in the HHERA: Exposure Areas Based on Individual AOCs

Exposure Areas Based on Individual AOCs	Sample Locations Representative of:	HHRA	ERA
BCW	BCW (AOC1, AOC28d, SWMU 1, TCS-4, Tamarisk Thicket)	Evaluated	Evaluated
SWMU1	SWMU 1 and TCS-4	Evaluated	Evaluated
BCWxSWMU1	BCW excluding SWMU 1 and TCS-4	Evaluated	Evaluated
AOC4	AOC 4	Evaluated	Evaluated
AOC9	AOC 9 and AOC 10a	Evaluated	Evaluated
AOC10	AOC 10 and Subareas b, c, d	Evaluated	Evaluated
AOC11	AOC 11	Evaluated	Evaluated
AOC12	AOC 12	Evaluated	Evaluated
AOC14	AOC 14	Evaluated	Evaluated
AOC27	AOC 27	Evaluated	Evaluated
AOC28	AOC 28	Evaluated	Evaluated
AOC31	AOC 31	Evaluated	Evaluated
UA-2	UA-2	Evaluated	Evaluated

Exposure Areas Based on Individual AOCs	Sample Locations Representative of:	HHRA	ERA
TT	Tamarisk Thicket	Not Evaluated	Evaluated
NORR	AOC 1 North of the Railroad / USBLM Land	Evaluated	Not Evaluated
ICS	Inside the Compressor Station	Evaluated	Not Evaluated

Notes:

ICS = Inside the Compressor Station

NORR = North of the Railroad

TT = Tamarisk Thicket

Potential Exposure Areas Evaluated in the HHERA: Combined Exposure Areas

Combined Exposure Areas	Sample Locations Representative of:	HHRA	ERA
OCS	Outside the Compressor Station: All Soil Exposure Areas Outside the TCS	Evaluated	Evaluated
OCSxBCW	Outside the Compressor Station excluding BCW	Evaluated	Not Evaluated
BCW+AOC4	BCW and AOC 4	Not Evaluated	Evaluated
OCSxBCW+AOC4	Outside the Compressor Station excluding BCW and AOC4	Not Evaluated	Evaluated

Note:

OCS = Outside the Compressor Station

Data for each of these potential exposure areas were also grouped according to exposure depth intervals evaluated in the HHERA. For human health, the various potential receptors were assumed to contact soil from 0 to 10 feet bgs, with interim intervals defined for specific receptor activities (see Section 5.3 of the HHERA Report). For ecological populations, the various potential receptors were assumed to contact soil from 0 to 6 feet bgs with interim intervals defined for specific receptor activities (see Section 6.4 of the HHERA Report).

Additionally, for the two soil potential exposure areas encompassing wash areas (BCW and AOC10), two scouring scenarios were evaluated. The 2-foot scouring scenario assumes that the top 2 feet of soil is removed during potential future scouring resulting from surface runoff following heavy rainfalls. Similarly, in the 5-foot scouring scenario, 5 feet of soil is assumed to be removed during scouring. Datasets were adjusted so that potential exposures for the HHRA were from the 'new' surface to a depth of 10 feet bgs, and the ERA exposures were from the 'new' surface to 6 feet bgs.

ES 3.3 COPC/COPEC Selection

Selecting the COPCs/COPECs to be included in the risk assessments was a sequential process where compounds detected in site media were eliminated from further consideration based on either the concentration, if a constituent is deemed to be consistent with ambient background conditions, or their status as an essential nutrient. COPCs/COPECs were selected following appropriate guidance (DTSC 1997; USEPA 1989, 1997, 2000), according to the potential exposure areas previously described.

Using the agency-approved background soils datasets for inorganics, dioxins/furans, and PAHs, various statistical comparisons and tests were conducted to assess whether concentrations of constituents detected in the soil at the various potential exposures areas and depths are elevated above background levels. The statistical comparisons and tests conducted include: comparison of maximum observed values for each potential exposure area to a background threshold value (BTV); comparison of central tendency between potential exposure area data and background data; and comparison of upper quantiles of potential exposure area data and background data. Inorganics, dioxin/furans, and PAHs determined to be elevated above background levels were included as COPCs/COPECs in the risk assessments.

For essential nutrients determined to be elevated above background levels and where toxicity values were available, they were selected as COPCs to be evaluated further in the risk assessments. All other constituents detected in soil and soil gas were included in the quantitative HHRA.

ES.4 Estimation of Exposure Point Concentrations

An exposure point concentration (EPC) is the representative concentration of a constituent in an environmental medium that is potentially contacted by the potential receptor (USEPA 2002). In the HHERA, EPCs were calculated using depth-weighted data to account for variable depth profiles at each sampling location. For a given relevant exposure depth for the risk assessment, if only a single sample is available at a given location, that value was used to represent the concentration for the entire exposure depth. For locations with samples from multiple depths, the samples were weighted to account for the different lengths of the segments in the manner described in USEPA (1996).

Three types of EPCs were calculated based on the depth-weighted soil datasets: depth-weighted maximum, depth-weighted 95UCL (95% upper confidence limit on the mean), and depth- and area-weighted 95UCL (referred to as area-weighted EPCs for simplicity). USEPA's ProUCL v. 5.1 software was the basis for, and primary analytical tool used for, the statistical analyses conducted for soil and soil transitioning to sediments. For the depth-weighted 95UCL EPC, the ProUCL-recommended 95UCL method was selected as the representative EPC. Area-weighted EPCs were calculated using Thiessen polygons and the bias-corrected, accelerated (BCa) Bootstrap method, one of the nonparametric statistics provided in ProUCL.

If the soil dataset had fewer than four detected values (that is, concentrations reported above the detection limit) or fewer than eight total observations, the EPC defaulted to the maximum depth-weighted concentration in that dataset. In summary, the EPC for each soil dataset is either a 95UCL (UCL method recommended by ProUCL for depth-weighted EPCs, BCa Bootstrap UCL for area-weighted EPCs), or the maximum depth-weighted concentration.

For soil gas data, individual observations for each given chemical and exposure scenario, were treated as separate estimates of exposure; no 95UCL calculations were made for soil gas.

ES.5 Human Health Risk Assessment

The HHRA for soil evaluated the likelihood that constituents detected in soils at the various potential exposure areas of the site could adversely impact human health under the assumed set of current and reasonable future land-use scenarios. The results of the risk assessment also provide key information that assists risk managers with making health-protective site management and remedial decisions.

ES.5.1 Exposure Assessment

The exposure assessment estimated the intensity, frequency, and duration of potential human exposure to COPCs in environmental media at the site, such as soil, soil gas, and air. To quantify potential exposure to site constituents, in addition to EPCs for COPCs, these components are required:

1. Relevant current and future potential receptors and their associated site related activities
2. Potentially complete exposure pathways for each current and future potential receptor as they engage in site related activities
3. Quantitative exposure assumptions for pathway specific intake of soil constituents.

ES.5.1.1 Potentially Exposed Populations

The potential human receptors identified in the RAWP documents (Arcadis 2008a, 2009a, 2015) were evaluated in the HHRA as four main categories: worker, recreational user, tribal user, and hypothetical future resident. The potential soil exposure pathways evaluated for workers, recreational users, and the hypothetical future resident include ingestion and dermal contact with soil, as well as inhalation of particulates from ambient air and inhalation of VOCs that may volatilize from the soil. In addition to these potential soil exposure pathways, potential exposure to COPCs from consumption of home-produced food was also evaluated for the hypothetical future resident. The potential soil exposure pathways evaluated for tribal users include inhalation of particulates from ambient air and inhalation of VOCs that may volatilize from the soil.

Three types of workers were evaluated. The long- and short-term maintenance workers were assumed to conduct repair and maintenance activities both inside and outside the TCS fenceline. Their activities include intrusive work and they are assumed to contact surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs) subsurface 1 soil (0 to 6 feet bgs) and subsurface 2 soil (0 to 10 feet). The commercial worker is assumed to be involved in routine administrative and other non-intrusive activities consistent with commercial/industrial activities inside the fenceline only. Potential pathways for commercial worker exposure to soil include those listed above for soil as well as potential exposure to VOCs in soil gas via inhalation of indoor air. The commercial worker was evaluated using a screening approach, as described in Section 5.3.4.5.

Four types of potential recreational users were evaluated outside the TCS: camper, hiker, hunter, and off-highway vehicle (OHV) rider (OHVs also referred to as all-terrain vehicles [ATVs]). The adult and/or youth recreators were evaluated for potential exposure to surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs).

Tribal use and associated potential exposure are expected to occur at areas outside the TCS. The potential indirect pathway for exposure to soil for tribal use is the inhalation of dust arising from wind erosion and of

VOCs that may volatilize from the soil. The inhalation of dust was evaluated for surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs). and inhalation of VOCs volatized from subsurface 2 soil (0 to 10 feet bgs). The exposure assumptions for this exposure scenario were developed using site-specific input from the Tribes.

USBLM has specifically requested an evaluation of a hypothetical future residential user on their property (DOI 2007b), even though unrestricted residential use is highly unlikely (DOI 2014). The hypothetical future residential user is assumed to contact surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs) and subsurface 2 soil (0 to 10 feet bgs) via inhalation of particulates entrained in ambient air, incidental ingestion of soil, and dermal contact with soil. In addition, they are assumed to grow and consume vegetables, fruits, and poultry from the site (see Section 5.3.4.4 of the HHERA Report for exposure assumptions).

ES.5.1.2 Exposure Areas

The following two areas represent the upper bound potential exposure areas for the site-specific human receptors evaluated for this site – area outside the compressor station including BCW (OCS); and area inside the compressor station (ICS). For the purposes of risk management, the OCS and ICS potential exposure areas were considered most relevant to typical behaviour patterns anticipated for receptors and their activities. In addition, at the direction of DTSC, potential exposure areas based on individual AOCs outside TCS fenceline were evaluated in separate appendices as listed above in Section ES.3.2.

ES.5.1.3 Exposure Point Concentrations

As described above in ES.4, EPCs were calculated on a depth-weighted and area-weighted basis. EPCs were estimated for each of the soil intervals described above for each potential exposure area and the potentially exposed populations evaluated for that area. To ensure that the implications of averaging concentrations over one depth zone versus another are clearly understood, the Soil HHRA evaluated representative exposure concentrations for soils within the following depth categories:

- Surface soil (0 to 0.5 foot bgs)
- Shallow soil (0 to 3 feet bgs)
- Subsurface 1 soil (0 to 6 feet bgs)
- Subsurface 2 soil (0 to 10 feet bgs).

For the 2-foot and 5-foot scouring scenarios for BCW and AOC 10, datasets were adjusted to the revised surface level for the intervals. For example, for the 2-foot scouring scenario, the surface soil is adjusted to evaluate data collected from 2 to 3 feet bgs, while the shallow soil uses data from 2 to 6 feet bgs.

ES.5.2 Toxicity Assessment

The toxicity assessment was completed to characterize the relationship between the magnitude of assumed exposure to a constituent and the potential for adverse effects. More specifically, the toxicity assessment identifies or derives toxicity values that can be used to estimate the likelihood of adverse effects occurring in humans at different exposure levels. Consistent with regulatory risk assessment policy, adverse health effects resulting from constituent exposures are evaluated in two categories: carcinogenic effects and noncarcinogenic effects. Toxicity values to evaluate carcinogenic effects and noncarcinogenic effects were identified from available CalEPA and USEPA toxicity information databases and were selected for use in this HHRA in the RAWP documents (Arcadis 2008a, 2009a, 2015) and in accordance with DTSC (2015, 2014, 2018) and USEPA (1989, 2003) risk assessment guidance. In addition, the adverse health effects associated with potential exposure to lead are evaluated separately, using models developed by CalEPA DTSC and USEPA.

ES.5.3 Risk Characterization

Estimating incremental lifetime cancer risks (ILCRs) and noncancer HIs for potential exposures to constituents in soil and/or soil gas requires information regarding constituent concentrations in the soil and/or soil gas, the level of exposure to each constituent, and the relationship between exposure to the constituent and its toxicity. Cumulative incremental lifetime cancer risks (that is, sum of chemical-specific ILCRs) posed by a site are compared to a range of 1 in 1 million (1 x 10^{-6}) to 100 in 1 million (1 x 10^{-4}). As indicated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (which is 40 Code of Federal Regulations [CFR] Part 300), cancer risks between 1 in 1 million to 100 in 1 million probability of occurrence fall within a risk management range. This is generally referred to as the acceptable risk range. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. CalEPA DTSC point of departure for excess incremental lifetime cancer risk is 1 in 1 million, and risk management decisions may raise this criterion depending on site specific conditions. A cumulative non-cancer hazard index (HI) of less than or equal to 1 implies that the predicted exposure for a given population and chemical is not expected to result in adverse noncancer health effects for multi-chemical exposures (USEPA 1989).

ES.5.3.1 Methodology

The methodology used to derive the ILCRs and noncancer HIs for the selected COPCs is based principally on guidance provided in the regulatory documents and the equations listed in Sections 5.5.1 and 5.5.2 of the HHERA Report. These calculation methods were applied to relevant receptors for all potential exposure areas outside and inside the TCS fenceline.

ES.5.3.2 Results of the Cancer Risk and Noncancer Hazard Assessment

ILCRs and HIs were estimated for each HHRA potential exposure area and its associated receptors using the methods described above. A detailed description of the calculated risks/hazards, including the tables that provide the breakdown of risk/hazard by individual chemical and exposure pathway, is provided in the exposure area-specific appendices, which are provided as Appendices BCW through ICS, and summarized in Section 5.5.3 of the HHERA Report. It should be noted that risks/hazards calculated separately for individual AOCs are conservative and likely overestimate site risks/hazards.

The potential exposure areas for which estimated HIs less than or equal to 1 and ILCRs were at or below the *de minimis* point of departure for risk management of 1 in 1 million for cancer risk include BCWxSWMU1/TCS4, AOC12, AOC14, AOC27, AOC28, and AOC31.

The estimated ILCRs and HIs for the hunter and tribal user were at or below *de minimis* levels for all potential exposure areas evaluated in the HHRA. In addition, the estimated ILCRs and HIs for the short-term maintenance worker were at or below *de minimis* levels for the ICS potential exposure area.

This section summarizes the results for the two most representative upper-bound potential exposure areas, which are the OCS and ICS potential exposure areas. The risks/hazards estimated for the OCS potential exposure area are believed to provide a more appropriate representation of the potential exposures for the human populations that could be present in the areas outside of TCS, which are maintenance workers, recreational users, and tribal users, than the risks/hazards estimated for individual AOC/SWMU/UA potential exposure areas. In addition, potential risks/hazards for COPCs in soil in the NORR potential exposure area are estimated for hypothetical future residents, at the request of the agencies, although future unrestricted land use in this area is highly unlikely. The results of the HHRA for the OCS and ICS potential exposure areas support these findings.

OCS Potential Exposure Area Conclusions

The tables in this section summarize the results of the HHRA for the OCS potential exposure area.

OCS Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the OCS Potential Exposure Area

Potential Receptor	Estimated Cumulative ILCR less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR greater than $1x10^{-6}$ and less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR greater than $5x10^{-6}$ and less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR greater than $1x10^{-5}$ and less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR greater than $1x10^{-4}$	Estimated HI less than or equal to 1	Estimated HI greater than 1
Short-Term Maintenance Worker		Yes (depth- and area-weighted)				Yes (depth- and area-weighted)	
Long-Term Maintenance Worker			Yes (area-weighted)	Yes (depth-weighted)		Yes (depth- and area-weighted)	
Camper		Yes (depth- and area-weighted)				Yes (depth- and area-weighted)	
Hiker		Yes (area-weighted)	Yes (depth-weighted)			Yes (depth- and area-weighted)	
Hunter	Yes (depth- and area-weighted)					Yes (depth- and area-weighted)	

Potential Receptor	Estimated Cumulative ILCR less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR greater than $1x10^{-6}$ and less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR greater than $5x10^{-6}$ and less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR greater than $1x10^{-5}$ and less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR greater than $1x10^{-4}$	Estimated HI less than or equal to 1	Estimated HI greater than 1
OHV Rider			Yes (depth- and area-weighted)			Yes (depth- and area-weighted)	
Tribal User	Yes (depth- and area-weighted)					Yes (depth- and area-weighted)	

OCS Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the NORR Potential Exposure Area

Potential Receptor	Estimated Cumulative ILCR less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR greater than $1x10^{-6}$ and less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR greater than $5x10^{-6}$ and less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR greater than $1x10^{-5}$ and less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR greater than $1x10^{-4}$	Estimated HI less than or equal to 1	Estimated HI greater than 1
Hypothetical Future Resident			Yes (area-weighted)	Yes (depth-weighted)		Yes (area-weighted)	Yes (depth-weighted)
Hypothetical Future Resident – Consumer of Home-Produced Food					Yes (depth- and area-weighted)		Yes (depth- and area-weighted)

- **<u>Noncancer HIs</u>.** HIs for maintenance workers, recreational users, and tribal users were all less than or equal to 1. **Based on the results of the HHRA, the levels of COPCs in OCS soil are safe and protective of potential noncancer health effects for all receptors except the hypothetical residential user in NORR potential exposure area**.
- **<u>Lead</u>.** The depth- and area-weighted EPCs for lead in the OCS potential exposure area are not expected to result in an increase in blood lead levels above the Office of Environmental Health Hazard Assessment's (OEHHA's) benchmark value of 1 microgram per liter (µg/dL) for child receptors or the fetus of any of the adult receptors evaluated. **Based on the results of the OCS HHRA, the levels of lead in soil are safe and protective of all potential receptors evaluated.**

- **Tribal User and Hunter.** Estimated lifetime cancer risks for tribal users and hunters were at or below *de minimis* levels. **Based on the results of the HHRA, levels of COPCs in OCS soils are safe and protective of tribal users and hunters**.
- **Short-Term Maintenance Worker.** The depth- and area-weighted estimated cumulative ILCRs for the short-term maintenance worker for the OCS potential exposure area are above 1 in 1 million, the point of departure for risk management decisions, but below 5 in 1 million (5 x 10^{-6}); which is well within the risk-management range of range of 1 in 1 million to 100 in 1 million. Estimated ILCRs above 1 in 1 million are due primarily to hexavalent chromium via the inhalation of particulate pathway. However, with health and safety work practices in place that limit the amount of exposure to soil, estimated ILCRs for the short-term maintenance worker are overestimated and actual risks are likely at or below 1 in 1 million. **In sum, the overall weight of evidence (WOE) supports that the levels of COPCs in OCS soils are safe and protective of short-term maintenance workers.**
- **Long-Term Maintenance Worker.** The depth-weighted estimated cumulative ILCRs for the long-term maintenance worker for the OCS potential exposure area are above 1 in 1 million, the point of departure for risk management decisions, and slightly above 10 in 1 million (1 x 10^{-5}). The area-weighted estimated cumulative ILCRs for the long-term maintenance worker for the OCS potential exposure area are at 10 in 1 million, which is well within the risk-management range of 1 in 1 million to 100 in 1 million. Estimated ILCRs above 1 in 1 million are due primarily to hexavalent chromium via the inhalation of particulate pathway. However, with health and safety work practices in place that limit the amount of exposure to soil, the estimated ILCRs for the long-term maintenance worker are overestimated and actual risks are likely below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million. **In sum, the overall WOE supports that the levels of COPCs in OCS soils are safe and protective of the long-term maintenance worker.**
- **Recreational User – Camper.** The depth- and area-weighted estimated cumulative ILCRs for the camper for the OCS potential exposure area are slightly above 1 in 1 million, the point of departure for risk management decisions due primarily to hexavalent chromium and dioxin toxicity equivalent (TEQ) via the soil ingestion pathway. The ILCRs are within the risk-management range of 1 in 1 million to 100 in 1 million. The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for campers exposed to soils in the OCS potential exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ. **Based on the results of the OCS HHRA for campers, risks are within the risk management range of 1 in 1 million to 100 in 1 million. Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ in select locations, would be effective at reducing risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million**. No risk management or remediation would be necessary to reduce risks for the camper to levels below 10 in 1 million.
- **Recreational User – Hiker.** The depth- and area-weighted estimated cumulative ILCRs for the hiker for the OCS potential exposure area are at or slightly above 5 in 1 million, due primarily to hexavalent chromium and dioxin TEQ via the ingestion pathway. These estimated ILCRs are above 1 in 1 million, the point of departure for risk management decisions, but within the risk-management range of 1 in 1 million to 100 in 1 million. The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for hikers exposed to soils in the OCS potential

exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ. **Based on the results of the OCS HHRA for hikers, risks are within the risk management range of 1 in 1 million to 100 in 1 million**. **Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ in select locations, would be effective at reducing risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million.** No risk management or remediation would be necessary to reduce risks for the hiker to levels below 10 in 1 million.

- **Recreational User – OHV Rider**. The depth- and area-weighted estimated cumulative ILCRs for the OHV rider for the OCS potential exposure area are at 10 in 1 million and above 5 in 1 million, respectively due primarily to hexavalent chromium via the inhalation particulate pathway and dioxin TEQ via the ingestion pathway. These estimated ILCRs are above 1 in 1 million, the point of departure for risk management decisions, but within the risk-management range of 1 in 1 million to 100 in 1 million. The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for OHV riders exposed to soils in the OCS potential exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ. **Based on the results of the OCS HHRA for OHV riders, risks are within the risk management range of 1 in 1 million to 100 in 1 million**. **Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ in select locations, would TEQ would be effective at reducing risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million**. No risk management or remediation would be necessary to reduce risks for the OHV rider to levels below 10 in 1 million.
- **Hypothetical Future Resident.** The depth- and area-weighted estimated cumulative ILCRs and HIs associated with theoretical exposure to COPCs in soil and home-produced food in NORR potential exposure area for hypothetical future residents are above 1 in 1 million, the point of departure for risk management decisions and an HI of 1, respectively, due to hexavalent chromium, cobalt, total PCBs, dioxin TEQ, and/or TPHd. The estimated cumulative ILCRs associated with potential exposure to COPCs in soil and home-produced food are slightly above 10 in 1 million and at 1,000 in 1 million (1 x 10^{-3}), respectively. Note that risks/hazards estimated for NORR potential exposure area are not considered representative of the realistic or likely potential exposures for the human populations that could be present in this area or anywhere at the site. Specifically, it is highly unlikely that any area of the site will ever be used for residential purposes. However, the hypothetical future unrestrictive residential scenario was evaluated for the NORR potential exposure area at the request of the DOI. **The estimated risks and hazards presented for the hypothetical future resident in the NORR potential exposure area are provided for informational purposes only.**

In sum, **based on the results of the OCS HHRA, the levels of COPCs in OCS soils are safe and protective of short- and long-term maintenance workers, hunters, and tribal users.**

Recommendation for OCS: Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin, would be effective at reducing risks for the campers, hikers and OHV riders to levels below 1 in 1 million, the point of departure for risk management decisions. No risk management or remediation would be necessary to reduce risks for the the campers, hikers and OHV riders to levels below 10 in 1 million. The estimated risks and hazards presented for the hypothetical future resident in the NORR potential exposure area are provided for informational purposes only. However, the hypothetical future residential land use is not a reasonable anticipated future land use for the NORR area.

ICS Potential Exposure Area

The table in this section summarizes the results of the HHRA for the ICS potential exposure area.

Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the ICS Potential Exposure Area

Potential Receptor	Estimated Cumulative ILCR less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR greater than $1x10^{-6}$ and less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR greater than $5x10^{-6}$ and less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR greater than $1x10^{-5}$ and less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR greater than $1x10^{-4}$	Estimated HI less than or equal to 1	Estimated HI greater than 1
Commercial Worker			Yes [1] (depth- and area-weighted)			Yes [1] (depth- and area-weighted)	
Short-Term Maintenance Worker	Yes (depth-weighted)					Yes (depth-weighted)	
Long-Term Maintenance Worker		Yes (area-weighted)	Yes (depth-weighted)			Yes (depth- and area-weighted)	

Note:

[1] Represents the estimated cumulative ILCR and HI for the commercial worker associated with COPCs in soil and soil gas.

- **Noncancer HIs.** The depth- and area-weighted estimated cumulative HIs for commercial worker, short-term maintenance worker, and long-term maintenance worker for ICS potential exposure area are below an HI of 1. **Based on the results of the ICS HHRA, the levels of the levels of COPCs in ICS soil are safe and protective of potential noncancer health effects for all worker receptors evaluated.**
- **Lead.** The depth- and area-weighted EPCs for lead in ICS potential exposure area soils are not expected to result in an increase in blood lead levels above OEHHA's benchmark value of 1 µg/dL for the fetus of any of the workers. **Based on the results of the ICS HHRA, the levels of lead in soil are safe and protective for all worker receptors evaluated.**
- **Commercial Worker.** The depth- and area-weighted estimated cumulative ILCRs associated with potential exposure to COPCs in soil in the ICS potential exposure area for the commercial worker are above 1 in 1 million, the point of departure for risk management decisions, but at or below 10 in 1 million, which is well within the risk management range of 1 in 1 million to 100 in 1 million. However, the

active TCS facility has work practices in place that limit the amount of exposure to soil. The overly conservative assumption that all areas within the ICS potential exposure area are uncovered, overestimates ILCRs for the commercial worker and reasonable upper bound values are likely below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million. The estimated ILCRs and HIs associated with potential COPCs in soil gas in the ICS potential exposure area for commercial workers exposed via the inhalation of vapors in indoor air pathway is well below 1 in 1 million and an HI of 1, respectively. **In sum, the overall WOE supports that the conditions at the facility and levels of COPCs in soils and soil gas in ICS are safe and protective of the commercial worker.**

- **Short-Term Maintenance Worker.** The depth-weighted estimated cumulative ILCRs associated with potential exposure to COPCs in soil in ICS potential exposure areas for the short-term maintenance worker are below 1 in 1 million, the point of departure for risk management decisions. **Based on the results of the ICS HHRA, levels of COPCs in ICS soils are safe and protective of short-term maintenance workers.**
- **Long-Term Maintenance Worker.** The depth- and area-weighted estimated cumulative ILCRs associated with potential exposure to COPCs in soil in ICS potential exposure areas for the long-term maintenance worker are above 1 in 1 million, the point of departure for risk management decisions, but at or below 10 in 1 million which is well within the risk management range of 1 in 1 million to 100 in 1 million. However, with work practices in place that limit the amount of exposure to soil and the overly conservative assumption that all areas within the ICS potential exposure area are uncovered, estimated ILCRs for the long-term maintenance worker are overestimated and likely well below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million. **Based on the results of the ICS HHRA, the overall WOE supports that the levels of COPCs in soils ICS are safe and protective of the long-term maintenance worker.**

ES.5.4 HHRA Uncertainty Analysis

Many of the assumptions used in this HHRA are conservative, including representativeness of the sampling data, human exposures, fate and transport modeling, and chemical toxicity. Following agency guidance, the assumptions used reflect a 90th or 95th percentile UCL value, rather than a typical or average value. By using multiple conservative exposure assumptions or toxicity estimates, the risk estimates likely develop a conservative bias that may result in significant overestimation of potential risk and hazard.

In addition, as recommended by DOI (Arcadis 2015), it is assumed that each of the recreational activities could take place at any location on federal land. In reality, specific locations may be preferred for certain activities, while other locations may be less attractive or may have limited recreational options. No physical barrier (such as fencing) is present that would stop an individual recreational user from accessing any and all areas of the AOCs outside the TCS. Therefore, potential receptor populations would more likely be exposed randomly, over the course of a lifetime, to soils present across the OCS potential exposure area, rather than have a lifetime of contact limited to a potential exposure area based on an individual AOC (as evaluated in the area-specific appendices at the request of DTSC). Therefore, risk and/or hazards presented for individual potential exposure areas are not believed to be the most representative of the estimated health risks to humans potentially contacting the soil outside the TCS and are not recommended for remedial decision making. Section 5.6 of the HHERA Report discusses the uncertainties in the HHRA.

ES.6 Ecological Risk Assessment

A Phase I Predictive ERA was completed for the site and includes ERAs for 17 individual potential ecological exposure areas, which were evaluated for the ecological communities and small home-range wildlife receptors (Figure 3-3), and large home-range wildlife receptors (Figure 3-4b) listed in the table titled Potential Ecological Exposure Areas Evaluated in the ERA.

Potential Ecological Exposure Areas Evaluated in the Ecological Risk Assessment

Potential Ecological Exposure Areas	Evaluated in the Ecological Risk Assessment
Potential Terrestrial Exposure (Soil) for Plants, Soil Invertebrates, and Small Home-Range Wildlife Receptors (mammals and birds)	• BCW • SWMU 1 • BCW excluding SWMU 1 and AOC4 • AOC4 • AOC9 • AOC10 • AOC11 • AOC12 • AOC14 • AOC27 • AOC28 • AOC31 • UA-2 • Tamarisk Thicket
Potential Terrestrial Exposures (Soil) for Large Home-Range Wildlife Receptors (mammals and birds)	• OCS • BCW and AOC4 • OCS excluding BCW and AOC4

The overall goal of the ERA is to estimate potential unacceptable risk to potential ecological receptors from exposure to COPECs in soil. The results of the risk assessment also provide key information that assists risk managers with making site management and remedial decisions protective of ecological receptors.

ES.6.1 Problem Formulation

A problem formulation step was completed to identify societal or regulatory goals and assessment endpoints to evaluate potential impact to ecological populations from site constituents. The problem formulation relies on data collected during site investigations and incorporates features of the ecological setting, evaluation of the complete pathways in the CSM, and selection of the assessment and measurement endpoints.

ES.6.1.1 Ecological Conceptual Site Model

The ecological CSM is the framework for relating potential ecological receptors to chemically affected media and evaluating the potentially complete exposure pathways.

The primary terrestrial potential exposure pathways for soil are direct contact or incidental ingestion of surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs) and, for mammals and birds, uptake and subsequent ingestion of constituents in biota. [Note: Subsurface soil exposure intervals are defined as subsurface 1 soil (0 to 6 feet bgs) and subsurface 2 soil (0 to 10 feet bgs); subsurface soil 2 is considered in the human health risk assessment only.] Potential receptors evaluated include plants, soil invertebrates, birds, and mammals. Reptiles, while common in the Mojave Desert, were not evaluated quantitatively in the ERA because methods to evaluate exposure and toxicity to these receptors are generally unavailable. However, it was assumed that conservative assumptions used in the evaluation of risks for other species are protective of reptiles as well.

ES.6.1.2 Assessment and Measurement Endpoints

Assessment endpoints, which define the valued ecological resource (that is, ecological entity) and a characteristic of the resource to protect (that is, attributes), and measurement endpoints (measurable ecological characteristics that are related to the assessment endpoint) for each indicator receptor were selected in the RAWP documents (Arcadis 2008a, 2009a, 2015) and are presented in Table 6-1. The assessment endpoints included sufficient rates of survival, growth, and reproduction to sustain communities of plants and soil invertebrates and populations of mammals and birds.

ES.6.2 Exposure Assessment

The exposure assessment was completed to estimate exposure concentrations or doses based on receptor contact with COPECs in the potential exposure areas for the assumed complete and significant exposure pathways described in the CSM. The exposure assessment identified the assumptions necessary to estimate direct exposure EPCs (that is, soil concentrations) and EPCs used as the basis for estimating bioaccumulation and subsequent exposure of upper trophic-level receptors (that is, soil and biota tissue EPCs).

ES.6.2.1 Exposure Point Concentrations and Exposure Depths

The EPC is the representative concentration of a constituent in an environmental medium that is potentially contacted by the receptor (USEPA 1997). During the ERA, soil EPCs were estimated for each individual potential exposure area, as described above in Section ES.4. Biota tissue EPCs were calculated from soil EPCs using soil-to-biota uptake relationships for plants, invertebrates, and small mammals selected in the RAWP documents (Arcadis 2008a, 2009a, 2015).

As described in the CSM, potential receptor exposure to soil varies by receptor type. The ERA evaluated up to three relevant exposure depths for direct contact/incidental ingestion and biota uptake of soil for each receptor. The soil depths evaluated included surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs). EPCs were developed for each soil exposure interval for each potential exposure area. Ecological receptors were evaluated for potential exposure to soil, as listed in the table titled Soil Uptake Evaluations.

Soil Uptake Evaluations

Exposure	Soil Uptake Evaluations
Assumed Direct Contact / Incidental Ingestion	• Plants – based on the highest EPCs from surface, shallow, and subsurface 1 soil • Soil invertebrates – based on surface soil EPCs • Granivorous, insectivorous, carnivorous birds, and invertivorous small mammals (non-burrowing) – EPCs from surface soil • Granivorous and carnivorous mammals (burrowing) – EPCs based on the highest EPCs from surface, shallow, and subsurface 1 soil • Herbivorous mammals (Nelson's desert bighorn sheep) – although not a burrowing receptor, soil EPCs based on the highest EPCs from surface, shallow, and subsurface 1 soil were conservatively selected for this special-status receptor
Assumed Biota Uptake	• Plant tissue as food – based on the highest EPCs from surface, shallow, and subsurface 1 soil • Soil invertebrate tissue as prey – based on surface soil EPCs • Small mammal tissue as prey – based on surface soil EPCs

Additionally, EPCs for the soil exposure intervals were estimated for scouring scenarios in BCW and AOC 10 in the table titled EPCs for Soil Exposure Intervals for Scouring Scenarios.

EPCs for Soil Exposure Intervals for Scouring Scenarios

Baseline Scenario	2-Foot Scouring	5-Foot Scouring
Surface soil (0 to 0.5 foot bgs)	Surface soil (2 to 3 feet bgs)	Surface soil (5 to 6 feet bgs)
Shallow soil (0 to 3 feet bgs)	Shallow soil (2 to 6 feet bgs)	Shallow soil (5 to 10 feet bgs)
Subsurface 1 soil (0 to 6 feet bgs)	Subsurface 1 soil (2 to 10 feet bgs)	Subsurface 1 soil (5 to 15 feet bgs)

ES.6.2.2 Exposure Concentrations and Exposure Dose Models

For ecological communities (plants and soil invertebrates), potential exposures are expressed as soil concentrations, in units of milligram per kilogram (mg/kg) or nanogram per kilogram (ng/kg).

For potential wildlife receptors (mammals and birds), route-specific and food-web or dietary exposure models were used to estimate exposure doses in milligram per kilogram body weight per day (mg/kg-bw/day). To calculate exposure doses for wildlife receptors, soil data and receptor-specific parameters were used in the dose equations.

Consistent with DTSC guidance (1996), modelled exposure doses were estimated using both the maximum and 95UCL concentrations for each COPEC in soil. In most cases, an area-weighted 95UCL was also used to refine exposure doses when data were sufficient for that calculation. Risk estimates are presented for all EPC scenarios, however, risk conclusions presented in the ERA rely predominately on the exposure doses using an area-weighted 95UCL, as they are more resistant to sampling bias potentially present using depth-weighted EPCs.

For dietary dose modeling, species-specific values used for the terrestrial receptors were selected, and include body weight, dietary composition, ingestion rate, and home range. For terrestrial birds and mammals, risks were evaluated using two site-specific use factor (SUF) scenarios: a generic SUF of 1 and a SUF based on a species- and site-specific home range (referred to as the site-specific SUF for simplicity) compared to the total area of each exposure area. For each area, COPECs with HQs greater than 1 using the depth-weighted EPCs were identified for further evaluation using refined exposure and effects assumptions, including site-specific SUFs. For ecological receptor populations exposed to COPECs in soil, risk conclusions were ultimately characterized based on HQs that were calculated using refined exposure and effects assumptions associated with a higher level of confidence in predicting risks (area-weighted EPCs, site-specific SUF, and selected TRVs) and supporting lines of evidence (LOEs). To estimate bioaccumulation in animal tissue or uptake into plants soil-to-biota uptake factors were developed as either regression equations or bioaccumulation factors (BAFs). Uptake regressions and BAFs that were selected in the RAWP (Arcadis 2008a) and technical memoranda (Arcadis 2007, 2008b, 2009b) were used to estimate concentrations of COPECs in biota and food item tissue (that is, prey) from soil.

For dioxin TEQ, the selected BAFs are based on uptake of a single congener: 2,3,7,8- tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Because of the uncertainty associated with use of a single congener based BAF to estimate uptake for all 17 dioxin/furan congeners included in the dioxin TEQ mixture, dioxin TEQ uptake was evaluated using two congener-specific BAF approaches. Although the uptake regression for dioxin TEQ (based on 2,3,7,8-TCDD uptake) was used to estimate risk (that is, to calculate hazard quotients [HQs]) to potential ecological receptors at the site, the alternate and more robust BAFs approaches for dioxin TEQ based on congener-specific uptake are recommended for developing risk-based remediation goals (RBRGs) when considering risk management decisions.

ES.6.3 Effects Assessment

For the ERA, media-based screening levels for ecological communities of plants and soil invertebrates and dose-based toxicity reference values (TRVs) for wildlife (mammals and birds) were selected in the RAWP documents (Arcadis 2008a, 2009a, 2015) with review and/or input from the DTSC and USFWS. Screening levels and TRVs were updated with current values since the submission of the RAWP (Arcadis 2008a) and are presented in Table 6-6 of the HHERA Report.

For plants and soil invertebrates, screening levels are generic benchmarks obtained from publicly available guidance documents and other sources commonly used in ERAs.

For wildlife, range of risks were estimated using the no-observed adverse effects level (NOAEL)-based TRVs and lowest-observed adverse effects level (LOAEL)-based TRVs presented in the RAWP (Arcadis 2008a) and supporting technical memoranda (Arcadis 2007, 2008b, 2009b). These selected TRVs were primarily based on the TRVs used to develop USEPA's Ecological Soil Screening Levels (EcoSSLs; USEPA 2008); other sources included the Toxicological Benchmarks for Wildlife from the Oak Ridge

National Laboratory (Sample et al. 1996) and the USEPA Region 6's ERA Guidance (USEPA 1999). In addition, a second set of NOAEL- and LOAEL-TRVs based on the Navy/Biological Technical Assistance Group (BTAG) TRVs (California DTSC 2002, 2009b) were also used for COPECs, where available. Following DTSC guidance (1996, 2000), TRVs were adjusted when the differences in body weight between the site-specific potential wildlife receptor and the laboratory animals used in the studies to develop the TRVs were significant (greater than two orders of magnitude).

No avian TRVs were proposed in the RAWP documents (Arcadis 2008a, 2009a, 2015) to evaluate potential risk to birds from hexavalent chromium at the site, as published TRVs were unavailable. Avian NOAEL- and LOAEL-based TRVs for hexavalent chromium were developed for the ERA (2.5 mg/kg-bw/day and 25 mg/kg-bw/day, respectively), based on a literature search for recent studies. Uncertainty associated with these TRVs is discussed in Section 6.7.5 of the HHERA Report.

For dioxin TEQ, the selected mammalian and avian TRVs for the ERA were based on TRVs presented in the RAWP documents (Arcadis 2008a, 2009a, 2015), and are based on the lowest available TRVs. Following the approach used by USEPA in developing TRVs for the EcoSSLs (USEPA 2008), alternate and more robust dioxin TEQ TRVs were developed for mammals and birds based the geometric mean of the reproduction and growth endpoints for the NOAEL and LOAEL effect levels, respectively. Although the dioxin TEQ TRVs selected in the RAWP (Arcadis 2008a) were used to estimate risk (that is, to calculate HQs) to potential ecological receptors at the site, the alternate and more robust TRVs for dioxin TEQ based on more recent data are recommended for developing RBRGs when considering risk management decisions.

ES.6.4 Risk Characterization

The ERA risk characterization integrated the results of the exposure assessment and toxicity assessment and includes two major components: risk estimation and risk description. Following the approach described in the RAWP documents (Arcadis 2008a, 2009a, 2015), HQs were estimated for each potential receptor population in each potential exposure area using EPCs for each COPEC and appropriate soil exposure depth.

HQs only account for a single LOE. Following USEPA guidance (1998) guidance, risk estimates for each potential receptor and COPEC within a potential exposure area were interpreted based on a semi-quantitative WOE approach using multiple LOE. LOE could include but are not limited to the following: supporting statistical and site use information (such as the frequency of detection [FOD]), basis of the exposure concentrations (maximum versus 95UCL), confidence in the toxicity values, the direction of uncertainty in the risk estimates, consideration of special-status species at the site, and spatial extent of elevated concentrations. The WOE assessment, including the HQs based on the most refined exposure assumptions (area-weighted EPC and site-specific SUF) and supporting LOE, was used to evaluate the assessment endpoints, reduce uncertainty, and ultimately draw risk conclusions. These components comprise the risk description.

ES.6.4.1 Approach

Risks to potential ecological receptors from COPECs in soil were estimated for all 17 potential ecological exposure areas by calculating HQs for each receptor and COPEC. For plants and soil invertebrates, risks

(HQs) were estimated by comparing the soil EPCs for each COPEC with respective screening levels and these HQs were compared to the target HQ of 1. For wildlife, HQs are an expression of the ratio of an exposure estimated dose (ADD_t) to an effects dose (that is, TRV). ADD_t for indicator species were compared to the NOAEL-based (low) and LOAEL-based (high) TRVs, and these HQs were compared to the target HQ of 1.

For wildlife, HQs represent potential risk to individual receptors and potential risk to populations must be extrapolated from these HQ values following a standard HQ equation (USEPA 1997). For wildlife, risks were estimated using a generic SUF of 1 and also using site-specific SUFs. Following the RAWP (Arcadis 2008a), area-weighted EPCs were calculated only if risks based on depth-weighted EPCs suggested potential risk to ecological receptors (that is, HQ greater than 1 for any COPEC).

The ERAs for each potential ecological exposure area are presented in detail in the exposure area-specific appendices, including risk calculations based on depth-weighted and area-weighted EPCs (when calculated) for all COPECs, and the WOE conclusions. At the conclusion of each potential exposure area ERA, risk drivers were identified based on those COPECs for which unacceptable community/population level risk (that is, HQs greater than 1 for plants and soil invertebrate communities and LOAEL-based HQs for wildlife populations [or LOAEL-based HQs greater than 10 for dioxin TEQ]) was predicted using the most refined exposure and effects assumptions (which are selected TRVs, area-weighted EPCs, and site-specific SUF) and additional supporting LOE. For T&E species and other species of concern observed onsite (ring-tail cat and bats, respectively), a qualitative assessment was completed based on surrogate and representative receptors.

ES.6.4.2 Results of the ERA

As noted above, risk conclusions are based on HQs calculated using refined exposure and effects assumptions associated with a higher level of confidence in predicting risks (area-weighted EPCs, site-specific SUF, and selected TRVs) and the supporting LOEs. The HQs, LOEs, and risk conclusions are summarized in Table 6-11 of the HHERA Report (see exposure area-specific appendices for details).

In summary, based on the WOE ap proach, there were no potentially unacceptable risks identified for T&E species potentially present at the site. In addition, no potentially unacceptable risk was identified for most ecological receptors, including granivorous small mammals, small home range birds, and all large home range receptors, for any of the potential exposure areas evaluated.

The potential for unacceptable risk was identified only for three ecological receptors in four potential exposure areas located along the TCS fenceline. These potential exposure areas, risk-driving COPECs, and potential receptors are presented in the table titled Potential Exposure Areas, Risk-Driving COPECs, and Potential Receptors and summarized in the following sections.

Potential Exposure Areas, Risk-Driving COPECs, and Potential Receptors

Exposure Area	Risk Driver	Plants	Invertebrates	Shrew
BCW	Dioxin TEQ	No	No	Yes
SWMU1	Hexavalent Chromium	Yes	Yes	No
SWMU1	Total Chromium	No	Yes	Yes
SWMU1	Dioxin TEQ	No	No	Yes
AOC9	Hexavalent Chromium	Yes	Yes	No
AOC9	Total Chromium	No	Yes	Yes
AOC9	Copper	Yes	Yes	Yes
AOC9	Dioxin TEQ	No	No	Yes
AOC10	Hexavalent Chromium	Yes	Yes	No
AOC10	Total Chromium	No	Yes	No
AOC10	Dioxin TEQ	No	No	Yes

For ecological communities of plants and soil invertebrates, only generic risk-based screening levels were available to estimate HQs. As discussed in Section 6.7, screening levels for the risk-driving COPECs are often below BTVs and there is low confidence in their ability to predict risk at the site. The screening levels are published values based on toxicity data that have limited relevance for the site and are designed for use in conservative screening level risk assessments and for site-characterization purposes. Therefore, use of these generic screening levels can result in significant uncertainty in the risk estimates. For plants, observations of plant communities made during floristic surveys were also used as a key LOE.

BCW

For the baseline scenario, and based on a WOE approach, no potentially unacceptable risk was identified for: plants, soil invertebrates, granivorous mammals and birds, or insectivorous birds. Area-weighted HQs for plants and soil invertebrates and LOAEL-based HQs for wildlife were greater than 1 for some COPECs and receptors; however, the WOE supports the conclusion that unacceptable risk is unlikely for: antimony and thallium for plants; hexavalent chromium and total chromium for soil invertebrates; total chromium, mercury, and dioxin TEQ for cactus wren; antimony for desert shrew; and dioxin TEQ for Merriam's kangaroo rat. Potential for unacceptable risk was identified only for dioxin TEQ for invertivorous mammals (desert shrew) with risk-driving locations primarily within SWMU 1 in the BCW potential exposure area.

The risk conclusions for the 2-foot scouring scenario are similar to the baseline scenario, with the same risk drivers and associated receptors showing potentially unacceptable risk. In the 5-foot scouring scenario, the potential for unacceptable risk to desert shrew is no longer present, indicating that the concentrations of concern for dioxin TEQ are not within the surface soil interval following scouring (5 to 5.5 feet bgs) evaluated in this scenario.

As discussed previously, SWMU 1 is located within the BCW potential exposure area. The ERA conducted for the BCW excluding SWMU 1 and TCS-4 (BCWxSWMU1) potential exposure area identified no potentially unacceptable risk for any receptor or COPEC evaluated. This supports the observation that the potentially unacceptable risks identified for BCW were due to COPEC concentrations present in SWMU 1 soil.

SWMU 1

For the baseline scenario, and based on a WOE approach, no potentially unacceptable risk was identified for granivorous mammals and birds, or insectivorous birds. Unacceptable risks were driven by: hexavalent chromium for plants; hexavalent chromium and total chromium for soil invertebrates; and total chromium and dioxin TEQ for invertivorous mammals (desert shrew).

AOC9

For the baseline scenario, and based on a WOE approach, no potentially unacceptable risk was identified for granivorous mammals and birds, or insectivorous birds. Potentially unacceptable risks were driven by: hexavalent chromium and copper for plants; hexavalent chromium, total chromium, and copper for soil invertebrates; and total chromium, copper, and dioxin TEQ for invertivorous mammals (desert shrew) at locations along the TCS fenceline.

AOC10

For the baseline scenario, and based on a WOE approach, no potentially unacceptable risk was identified for granivorous mammals and birds, or insectivorous birds. Potentially unacceptable risks were identified for: hexavalent chromium for plants; hexavalent chromium and total chromium for soil invertebrates; and dioxin TEQ for invertivorous mammals (desert shrew). Elevated concentrations of hexavalent chromium and dioxin TEQ are present in a few locations, primarily located within the drainage depressions (which are subareas AOC10b, c, and d) behind the berms at AOC10. The risk conclusions are similar for the 2-foot scouring scenario, although total chromium also was noted as a risk driver for the desert shrew in the 2-foot scouring scenario. For the 5-foot scouring scenario, potential for unacceptable risk was identified only for dioxin TEQ and the desert shrew.

ES.6.5 ERA Uncertainty Analysis

Sources of uncertainty that influenced the ERA risk characterization included uncertainties in the analytical results, data evaluation, problem formulation, CSM, exposure point concentrations, exposure assessment, effects assessment, and interpretation of the risk estimates. Because of these approaches and other protective assumptions made throughout the ERAs, risk estimates are expected to be overestimated rather than underestimated.

Similar to the uncertainties in the HHRA, many of these sources of uncertainty are generic in nature and inherent in the risk assessment process. Site-specific uncertainties are also discussed.

ES.7 Conclusions and Recommendations

This section summarizes the conclusions of the HHRA and ERA for COPCs/COPECs in soil at the site and provides recommendations for constituents of concern (COCs) to be addressed in the Soil Corrective Measure Study/Feasibility Study (CMS/FS). For purposes of this HHERA, COCs refers to those chemicals that most significantly contribute to estimates of unacceptable risk (also referred to as 'risk drivers') and that are recommended to be the focus of future remedial planning.

ES.7.1 HHRA Conclusions and Recommendations

The results of the HHRA for the OCS and ICS potential exposure areas support the following findings:

Conclusions for the HHRA

- The depth- and area-weighted EPCs for lead in all potential exposure areas evaluated are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for child receptors or the fetus of any of the adult receptors evaluated. **Based on the results of the HHRA, the levels of lead in soil are safe and protective for all potential receptors evaluated.**
- The HHRA results for the ICS potential exposure area support that the levels of COPCs in ICS soil and/or soil gas are safe and protective of commercial and short- and long-term maintenance workers for current and anticipated future operational conditions and practices.
- While **AOC-specific evaluations provide useful information regarding limited areas or areas of highest impact, they are not suitable as the sole basis for the conclusions of the HHRA** or risk management decisions going forward. Assuming lifetime soil contact is limited to these specific individual potential exposure areas is not representative of either the potential receptors evaluated, or the likely future land use for the site.
- **The OCS potential exposure area is considered the most representative baseline scenario for potential human exposures and associated risks for soil contact outside TCS.** Human populations that could be present at the site would more likely be exposed randomly, over the course of a lifetime, to soil present in all areas located outside the TCS, rather than have a lifetime of contact limited to a single AOC/SWMU/UA.
- HIs for maintenance workers, recreational users, and tribal users were all less than or equal to 1 for both depth- and area-weighted EPCs for the OCS potential exposure area. **Based on the results of the HHRA, the levels of COPCs in OCS soil are safe and protective of potential noncancer health effects.**
- Estimated lifetime cancer risks for tribal users and hunters were at or below *de minimis* levels for the OCS potential exposure area. **Based on the results of the HHRA, levels of COPCs in soil are safe and protective of tribal users and hunters.**
- The HHRA results of the OCS potential exposure area support that the **levels of COPCs in OCS soil are safe and protective of short- and long-term maintenance workers** for current and anticipated future operational conditions and practices.

- **For all potential human receptors evaluated, COPCs in soil driving risks or hazards above *de minimis* levels are hexavalent chromium and dioxin TEQ, located predominately in the top 3 feet of soil.** Soil risk drivers appear to be predominately located in SWMU 1/TCS 4 and AOC9.
- **The ILCR and HI estimates for the hypothetical future resident are likely highly overestimated.** Multiple conservative factors contributing to this overestimation include: the use of maximum depth-weighted concentrations to estimate exposure to PCBs and TPH as diesel and several conservative assumptions associated with food uptake modeling for hexavalent chromium and TPH as diesel.
- **The hypothetical future resident is not representative of likely future land use on DOI land or other areas of the site.** This evaluation is included in the HHRA for informational purposes only. As stated in DOI (2015) Land Use Memo, "DOI will not utilize a future residential scenario on Federal lands within the project area when evaluating cleanup options in the Feasibility Study phase."

Recommendations for the HHRA

- For this HHRA, the OCS potential exposure area evaluation is the most representative scenario for the basis of HHRA conclusions and recommendations for the protection and safety of potential human receptors outside the fenceline.
- Based on the estimated cumulative ILCRs calculated for the HHRA, for the protection of human health, COPCs to be carried forward for developing RBRGs for soil are hexavalent chromium and dioxin TEQ.
- RBRGs for the potential recreational users are the most appropriate benchmarks for the protection of human health and associated risk management decisions going forward.
- Risks are within the risk management range of 1 in 1 million to 100 in 1 million. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. This approach to response actions at the site is consistent with the NCP (40 CFR 300). Some targeted form of risk management or remediation, addressing elevated soil levels of hexavalent chromium and dioxin TEQ would be effective at reducing risks for the potential camper, hiker, and OHV rider to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million. No risk management or remediation would be necessary to reduce risks for the potential camper, hiker and OHV rider to levels below 10 in 1 million.

ES.7.2 ERA Conclusions and Recommendations

Potential for unacceptable risk was identified for a certain few receptors (plants, soil invertebrates, and invertivorous small mammals) based on estimated exposure to a small number of COPECs (primarily hexavalent chromium, total chromium, dioxin TEQ) in three potential exposure areas near the TCS: SWMU1, AOC9, and AOC10. Potentially unacceptable risk to invertivorous small mammal populations from risk drivers at BCW is due to elevated concentrations within the SWMU 1 potential exposure area. Copper was also identified as a risk driving COPEC for plants, soil invertebrates, and invertivorous small mammals in the AOC9 potential exposure area. The risk driving COPECs are associated with known historical site releases and/or activities at or adjacent to the TCS (Section 2 of the HHERA Report).

Potential for unacceptable risk was not expected (based on HQs less than 1) or considered unlikely (based on the WOE) for all other potential receptors including granivorous small mammals, small home range birds, and all large home range receptors. Additionally, unacceptable risk was not expected or was considered unlikely in all remaining potential exposure areas more distant from the TCS. Based on the conservative assumptions incorporated in ERA, these risk conclusions likely overestimate potential for unacceptable risk at the site.

Some targeted form of risk management or remediation, addressing elevated concentrations of the following risk drivers in the following potential exposure areas would be effective at reducing potential exposures and thus risks to acceptable levels:

- Dioxin TEQ in SWMU1 – Targeted soil remediation for these risk drivers would be effective at reducing potential exposures and thus risks to acceptable levels within BCW (the potential exposure area considered to be the reasonable exposure area for receptor populations [and not SWMU 1]).
- Hexavalent chromium, total chromium, copper, and dioxin TEQ in AOC9 – Targeted soil remediation for these risk drivers at locations along the TCS fenceline would be effective at reducing potential exposures and thus risks to acceptable levels within AOC9.
- Hexavalent chromium, total chromium, and dioxin TEQ in AOC10 – Targeted soil remediation for these risk drivers at locations within the AOC10c subarea (which is the drainage depression behind the middle berm in East Ravine), would be effective at reducing potential exposures and thus risks to desert shrew (which is an invertivorous small mammal) to acceptable levels within AOC10.

ES.8 Risk-Based Remedial Goals for Risk Drivers

As stated in the RAWP (Arcadis 2008a), risk management decisions to be made in the CMS/FS step of the regulatory process will be focused on COPCs/COPECs that contribute most significantly to risk and/or that exceed *de minimis* risk levels for soil for the potential receptors being evaluated (that is, COCs). RBRGs are concentrations at or below which COCs do not present potentially unacceptable risk to human health and ecological receptors. These values can be used in upcoming remedial planning including the CMS/FS to identify those COCs and areas of the site that may warrant some form of remedial or risk management action. RBRGs are proposed health protective target cleanup concentrations that can be used, in combination with other factors such as background concentrations, as a starting point for making risk management decisions. Consistent with the HHERA approach, RBRGs are applied based on the potential exposure area of interest (that is, the 95UCL for the exposure area should be less than or equal to the RBRG).

ES.8.1 Human Health RBRGs

RBRGs were calculated for hexavalent chromium and dioxin TEQ, those compounds driving cancer risk estimates to greater than *de minimis* levels for the camper, hiker, and OHV rider exposure scenarios.

ES.8.1.1 Methodology and Calculated RBRG Values

The methodology used to develop the RBRGs for the COPCs in soil at the site is based on USEPA and CalEPA guidance and the specific equations provided in the guidance documents (USEPA 1989, 1991; DTSC 1992, 2015). Exposure, transport, and toxicity assumptions remain unchanged from those described and used in the HHRA risk characterization (Section 5.0). Rearranging the equations used to estimate the

ILCRs and noncancer hazards and using the CalEPA DTSC point of departure for the target ILCR of 1 in 1 million (and 10 in 1 million for dioxin TEQ) and the target noncancer HQ of 1, the concentration of each risk driver associated with the target ILCR and HQ levels was determined. Note that as indicated in the NCP (40 CFR 300), cancer risks between 1 in 1 million to 100 in 1 million fall within a risk management range. This is generally referred to as the acceptable risk range. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. The CalEPA DTSC point of departure for excess incremental lifetime cancer risk is 1 in 1 million, and risk management decisions may raise the target criterion above 1 in 1 million, depending on site specific conditions.

RBRGs protective of potential human receptors are summarized in the table titled Risk-Based Remediation Goals Protective of Potential Human Receptors. RBRGs are a tool and not intended as a ”bright line” for remediation.

Risk-Based Remediation Goals Protective of Potential Human Receptors

Risk Drivers for Potential Recreational Users	Human Health RBRG	RBRG Basis
Hexavalent chromium	3.1 mg/kg	OHV rider at 1 x 10^{-6} risk
Hexavalent chromium	31 mg/kg	OHV rider at 1 x 10^{-5} risk
Hexavalent chromium	310 mg/kg	OHV rider at 1 x 10^{-4} risk
Dioxin TEQ	100 ng/kg	Hiker at 1 x 10^{-6} risk
Dioxin TEQ	1,000 ng/kg	Hiker at 1 x 10^{-5} risk
Dioxin TEQ	10,000 ng/kg	Hiker at 1 x 10^{-4} risk

ES.8.1.2 Locations Driving Risk for the HHRA

The following discussion of the locations driving risk for the HHRA OCS potential exposure area is provided as an example of one method that can be used to apply the RBRGs and assist with identifying remedial design possibilities. This is not intended to substitute for actual remedial design and comprises part of the set of tools available to risk managers to make site-specific decisions regarding risk.

The lowest recreational user RBRGs for hexavalent chromium and dioxin TEQ are 3.1 mg/kg (for OHV rider at 1 in 1 million risk level) and 0.00010 mg/kg (or 100 ng/kg; for hiker at 1 in 1 million risk level), respectively (Table 8-1). Depth-weighted concentrations of the risk drivers, hexavalent chromium and dioxin TEQ, were ranked and the highest concentrations were iteratively removed from the baseline soil dataset. Then residual depth-weighted EPCs were calculated for the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths and compared with respective RBRGs. This process was repeated until the resulting residual depth-weighted 95UCL for the OCS potential exposure area was at or below the RBRG. To achieve this outcome, the following soil locations were identified as driving risks. When they were removed, the RBRG was achieved by the 95UCL for the remaining data.

- SWMU 1
  - SWMU1-25 to meet the RBRG of 100 ng/kg for dioxin TEQ based on target cancer risk of 1 in 1 million for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths; no sample data needs to be removed to meet the RBRG of 1,000 ng/kg for dioxin TEQ based on target cancer risk of 10 in 1 million for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths.
- AOC9
  - AOC10-20 to meet the RBRG of 3.1 mg/kg for hexavalent chromium for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths
  - #10 to meet the RBRG of 3.1 mg/kg for hexavalent chromium for the 0- to 3-foot bgs exposure depth.
- AOC10
  - MW-58BR_S to meet the RBRG of 3.1 mg/kg for hexavalent chromium for the 0- to 3-foot bgs exposure depth.

ES.8.2 Ecological RGRGs

The ERA identified the following risk drivers and potential exposure areas as presenting an unacceptable risk to one or more potential ecological receptors:

- BCW (baseline) –dioxin TEQ for small mammals
- AOC9 – hexavalent chromium and copper for plants; hexavalent chromium, total chromium, and copper for invertebrates; total chromium, copper, and dioxin TEQ for small mammals
- AOC10 – hexavalent chromium and total chromium for plants; total chromium for invertebrates; and total chromium and dioxin TEQ for small mammals.

ES.8.2.1 Methodology and Calculated RBRG Values

For potential ecological communities of plants and soil invertebrates, only generic risk-based screening levels are available, and there is low confidence in their ability to predict risk at the site. Therefore, these generic screening levels for plants and soil invertebrates are not recommended for use as RBRGs at the site. Because the key risk drivers for plants and soil invertebrates (hexavalent chromium and total chromium) tend to be co-located, risk-management or remedial actions considered for the protection of wildlife receptors potentially exposed to total chromium will also reduce risk to plants and invertebrates.

For potential wildlife receptors, RBRGs based on protection of wildlife populations (that is, based on LOAEL-based TRVs) were derived for invertivorous small mammals (desert shrew), the only potential wildlife receptor identified with the potential for unacceptable risk associated with exposure to COPECs in soil at this site. The RBRGs (Table 8-3 of the HHERA Report) for small home range invertivorous mammals (desert shrew) were derived using the dietary dose model used to estimate HQs in the predictive ERAs (Sections 6.4 and 6.6). The RBRGs were calculated using Microsoft® Excel Solver™ software that determines the soil concentration for a target HQ equal to 1.

For dioxin TEQ, a range of RBRGs were calculated using the alternate and more robust BAF and TRV approaches/values. The congener-specific BAFs (USEPA 1999, Fagervold et al. 2010) and a recommended mammalian dioxin TRV developed in HHERA Report Section 6.7.5 of 30 ng/kg-bw/day derived using the USEPA EcoSSL approach were used to calculate the RBRGs protective of invertivorous small mammals. Ecological RBRGs are summarized in the table titled Ecological Risk-Based Remediation Goals.

Ecological Risk-Based Remediation Goals

Risk Driver for Shrew	BAF	LOAEL-Based Mammalian TRV	Ecological RBRG
Total Chromium	ERA / RAWP	ERA / RAWP	145 mg/kg
Copper	ERA / RAWP	ERA / RAWP	145 mg/kg
Dioxin TEQ	USEPA (1999)	30 ng/kg-day (geomean of rodent studies)	190 ng/kg
Dioxin TEQ	Fagervold et al. (2010)	30 ng/kg-day (geomean of rodent studies)	360 ng/kg

Note:
ng/kg-day = nanograms per kilogram per day

ES.8.2.2 Locations Driving Risk for the ERA

The following discussion of the locations driving risk for the ERA is provided as an example of one method that can be used to apply the RBRGs and assist with identifying remedial design possibilities. This is not intended to substitute for actual remedial design and comprises part of the set of tools available to the risk manager to make site-specific decisions regarding risk.

For each potential exposure area, depth-weighted concentrations of the risk-driving COPECs were ranked and the highest concentrations were iteratively removed from the baseline soil dataset. Then residual depth-weighted EPCs were calculated for the 0- to 0.5-foot bgs exposure depth and compared with respective RBRGs for the risk driving compounds. This process was repeated until the resulting residual depth-weighted 95UCL for the potential exposure area was at or below the relevant RBRG. To achieve this outcome, the following soil locations were identified as driving risks. When they were removed from the dataset, the RBRG was achieved by the 95UCL for the remaining data. Details of the exact samples and sampling locations included in each potential exposure area are presented in the Data Evaluation and COPC/COPEC Selection section (Section 2) of each exposure area-specific appendix.

To summarize, these include removal of soil the following locations:

- BCW:
  - SWMU1-25 to meet the RBRG of 190 ng/kg for dioxin TEQ at 0 to 0.5 foot bgs. No sample data were removed to meet the RBRG of 360 ng/kg for dioxin TEQ.
- AOC9:
  - AOC10-21 to meet the RBRG of 145 mg/kg for copper at 0 to 0.5 foot bgs

  - AOC10-20 to meet the RBRG of 145 mg/kg for total chromium at 0 to 0.5 foot bgs
  - PA-20, AOC10-23, and PA-21 to meet the RBRG of 190 ng/kg for dioxin TEQ at 0 to 0.5 foot bgs; and PA-20 and AOC10-23 to meet the RBRG of 360 ng/kg for dioxin TEQ at 0 to 0.5 foot bgs.
- AOC10:
  - AOC10c-4 to meet the RBRG of 190 ng/kg for dioxin TEQ at 0 to 0.5 foot bgs. No sample data were removed to meet the RBRG of 360 ng/kg for dioxin TEQ.

ES.9 Key Findings

Overall, the HHERA conducted herein found no potentially unacceptable risk to most human and ecological receptors potentially exposed to COPCs/COPECs in soil at the site, both within the TCS (ICS potential exposure area) and potential exposure areas outside the TCS. No unacceptable risk was identified for all relevant potential exposure areas for the following receptors:

- Potential Human Receptors:
  - Tribal users
  - Hunter
  - Workers (commercial and short- and long-term maintenance workers).
- Potential Ecological Receptors
  - Special-status species, including ring-tailed cat (California fully protected species), cave myotis (California species of concern), and pallid bats (California species of concern)
  - Large home-range receptors (desert kit fox, Nelson's desert bighorn sheep, and red-tailed hawk)
  - Herbivorous and insectivorous birds (Gambel's quail and cactus wren)
  - Herbivorous small mammals (Merriam's kangaroo rat).

For the remaining potential receptors (camper, hiker, OHV rider, and desert shrew), the potential for unacceptable risk was identified as being driven by a limited number of compounds (that is, dioxin TEQ and hexavalent chromium for human health; dioxin TEQ, total chromium, and copper for ecological receptors) in areas within SWMU 1, AOC9, and/or AOC10.

The RBRGs calculated for the risk drivers and relevant human and ecological receptors, were used in an example of applying the RBRGs to identify locations driving risk above acceptable levels for both human and ecological populations. That process revealed a total of nine locations in three potential exposure areas (SWMU 1, AOC9, and AOC10) as associated with unacceptable risk. Those locations are as follows:

- Protection of potential human recreators (four total locations for all potential exposure depth intervals [0- to 3-foot bgs depth interval]):
  - Dioxin TEQ: SWMU1-25 in OCS / SWMU1
  - Hexavalent chromium: AOC10-20, #10 in AOC9, and MW-58BR_S in AOC10 for the 0- to 3-foot bgs depth interval.
- Protection of desert shrew (up to seven total locations for the 0- to 0.5-foot bgs depth interval):

- Dioxin TEQ (based on RBRG of 190 ng/kg): SWMU1-25 in BCW; PA-20, AOC10-23, and PA-21 in AOC9; and AOC10c-4 in AOC10
  - Based on dioxin TEQ RBRG of 360 ng/kg: PA-20 and AOC10-23 in AOC9
- Total chromium: AOC10-20 in AOC9
- Copper: AOC10-21 in AOC9.

The overall results of the HHERA support that focusing remedial planning on limited specific locations should be effective in reducing overall risks to levels that are protective of human health and ecological receptors.

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1 INTRODUCTION

This Soil Human Health and Ecological Risk Assessment (HHERA) Report describes the potential risks to human health and ecological receptors that may contact soil impacted by historic discharges related to various site activities at the Pacific Gas and Electric Company (PG&E) Topock Compressor Station (TCS). PG&E is conducting investigative and remedial activities at the site, including this HHERA, pursuant to the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Under CERCLA, the primary purpose of a baseline risk assessment (BRA) is to provide risk managers with an understanding of the potential adverse health effects (current or future) to human and ecological receptors posed by the release of hazardous substance from the site in the absence of any actions to control or mitigate those releases. This information may be useful in determining whether a potential current or future threat to human health or the environment exists that warrants an action. This Soil HHERA, in conjunction with the Groundwater Risk Assessment (GWRA; Arcadis 2009c), represent a BRA. The HHERA conducted for the TCS involved two primary components:

- Human health risk assessment (HHRA), which identified potential human receptors and exposure pathways (discussed in Section 5)
- Ecological risk assessment (ERA), which identified potential ecological receptors and exposure pathways (discussed in Section 6).

The TCS is an active natural gas compressor station located in the southern portion of the Mohave Valley, along the California/Arizona border in eastern San Bernardino County, California. It is located in eastern San Bernardino County, approximately 15 miles southeast of Needles, California (Figure 1-1). The compressor station facility is fenced and occupies approximately 15 acres of a 65-acre parcel of PG&E-owned land. However, the study area for investigative and remedial activities covers additional surrounding land including portions of a 100-acre parcel owned by the Fort Mojave Indian Tribe (FMIT), and land owned and/or managed by a number of government agencies including the U.S. Bureau of Land Management (USBLM), U.S. Bureau of Reclamation (USBOR), U.S. Fish and Wildlife Service (USFWS), San Bernardino County, California Department of Transportation, and the Burlington Northern Santa Fe (BNSF) Railroad (Figure 1-2). The TCS and the additional surrounding areas investigated together are referred to as the “site” in this report.

FMIT owns a 100-acre parcel of land located 0.25 mile north of the site (Figure 1-2). The nearest communities are mobile home parks in Topock, Arizona, and Moabi Regional Park, California. Topock is located on the Arizona (or eastern) side of the Colorado River, about 0.5 mile east-northeast of the TCS. Moabi Regional Park is located on the California (or western) side of the Colorado River approximately 1 mile northwest of the compressor station. The community of Golden Shores, Arizona, the largest nearby community, is located approximately 5 miles north of the TCS on the east side of the Colorado River.

A complete description of the site background can be found in the Revised Final RCRA Facility Investigation/Remedial Investigation Report, Volume 1 – Site Background and History (Final RFI/RI Report Volume 1; CH2M HILL [CH2M] 2007a).

1.1 Objectives and Overview of the HHERA

The HHERA is part of a larger environmental program at the TCS and is one of the regulatory steps being taken to be consistent with both CERCLA and RCRA (see Section 1.2 for more information on the regulatory framework). The ultimate goal of this phase of the environmental program at the TCS is to remediate the soil, if needed, to protect public health and the environment. The HHERA was conducted to provide valuable information about potential human health and ecological risks posed by contact with soil impacted by historical operations and activities at the TCS. The findings and conclusions of the HHERA will be considered during development of the corrective measures study/feasibility study (CMS/FS) for the site to identify and evaluate remedial alternatives that are protective of potential human and ecological receptors. Ultimately, the conclusions reached in the HHERA along with RFI/RI information will be used to establish an overall site risk management strategy. These objectives are consistent with the U.S. Environmental Protection Agency's (USEPA's) defined functions of a risk assessment (USEPA 1989, 1997a). In accordance with the Human Health and Ecological Risk Assessment Work Plan documents (RAWP; Arcadis U.S., Inc. [Arcadis] 2008a, 2009a, 2015), specific objectives of the HHERA are to:

- Help determine the need for remedial action with respect to soil conditions
- Provide a basis for determining the levels of constituents that can remain in soil at the site and still adequately protect public health and the environment (USEPA 1989).

Information and sampling data collected for the site and reported in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs) form the basis of information used in the HHERA. At the request of the California Environmental Protection Agency (CalEPA) Department of Toxic Substance Control (DTSC 2017a) and U.S. Department of the Interior (DOI 2017), this HHERA is being submitted for regulatory review before the RFI/RI Report Volume 3 is finalized. The data in the Draft RFI/RI Report Volume 3 and the HHERA have been submitted to the agencies, and the agencies gave approval for the risk assessment to proceed, before publication of Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

The solid waste management units (SWMUs), areas of concern (AOCs), and other areas being investigated at the site are those associated with past discharges to soil due to historical operations and activities at TCS. These SWMUs, AOCs, and other investigation areas are described in more detail in Section 2.1, and were evaluated according to the RAWP (Arcadis 2008a) by separating them into the following two categories:

- Outside the TCS Fenceline – Evaluated for both potential human health and ecological impacts.
- Inside the TCS Fenceline – Evaluated for potential human health impacts only. Because the TCS is an active operating facility, activities and conditions inside the fenceline do not offer a suitable or attractive habitat for ecological populations at this time. All potential exposure pathways for ecological receptors are considered incomplete inside the TCS fenceline (Eichelberger 2006).

The forthcoming Draft RFI/RI Report Volume 3 will summarize the soil characterization data collected to date for each of the SWMUs, AOCs, and other investigation areas, provide an evaluation of the data against data quality objectives (DQOs) for completeness, and identify remaining data gaps, if any, to be addressed in the CMS/FS and/or interim measure(s) (IMs). In addition, the forthcoming Draft RFI/RI

Report Volume 3 (currently being prepared by Jacobs) will recommend soil constituents of concern to be carried forward to into the CMS/FS, if needed, based on the results of the HHERA.

The HHERA evaluated all constituents detected in the soil as presented in the soil investigation data packages provided to DOI (PG&E 2018) and identifies those constituents that could pose an unacceptable risk to either human health or the ecological environment.

1.2 Regulatory Framework

Consistent with the RFI/RI requirements, RCRA/CERCLA process, and agency requirements for this site, this HHERA was conducted to identify the constituents in the soil that are related to historical site operations and activities at the TCS that could pose potential human health and ecological risk above acceptable levels and should be carried forward to the CMS/FS.

The DTSC is the lead state agency charged with directing investigation and remedial activities at the site in accordance with RCRA. In February 1996, PG&E and DTSC entered into a Corrective Action Consent Agreement (CACA) pursuant to Section 25187 of the California Health and Safety Code (DTSC 1996a).

The DOI is the lead federal agency on land under its jurisdiction, custody, or control and is responsible for oversight of response actions being conducted by PG&E pursuant to CERCLA. Portions of the site affected by operations at the TCS are on land managed by the USBLM, USFWS, and USBOR (collectively the “federal agencies”). In July 2005, PG&E and the federal agencies entered into an Administrative Consent Agreement (ACA; DOI 2005) to implement response actions at the site as set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300).

Under the terms of the CACA and the ACA, PG&E agreed to conduct an RFI and an RI to identify and evaluate the nature and extent of hazardous waste and constituent releases at the site. The HHERA relied on information and analytical data collected for the site and together with the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs), will complete the final element of the RFI/RI process for the SWMUs, AOCs, and other areas being investigated at the site.

The approach, methods, and assumptions used in the HHERA are consistent with standard regulatory guidance under CERCLA, RCRA, and DTSC as described the RAWP (Arcadis 2008a), RAWP Addendum (Arcadis 2009a), and RAWP Addendum 2 (Arcadis 2015). DTSC and DOI reviewed and approved these three risk assessment documents (DTSC 2009a, 2015a; DOI 2009a, 2015a), and DTSC issued a subsequent Directive Letter instructing PG&E to include additional risk evaluations (DTSC 2017a). That Directive Letter required, among other things, in addition to the evaluations described in the RAWP documents, separate quantitative baseline risk assessments must also be conducted for individual SWMUs, AOCs, and other investigation areas outside the fenceline. As directed by DTSC, the additional evaluations detailed in the Directive Letter have been included in this HHERA.

1.3 Report Organization

After this introductory section, the remainder of this HHERA Report is organized as follows:

Section 2: Site History and Characteristics – This section describes the historical operations, previous and recent investigations, and physical characteristics of the site including the conceptual site model (CSM) which describes the potential sources of impact, and the primary and secondary mechanisms through which impacts can be transported form one environmental media to another.

Section 3: Data Evaluation – This section describes the available dataset for soil, soil gas, sediment, and porewater and the steps taken in determining the usability of the data for risk assessment purposes. It also describes the approach used in developing representative potential exposure areas and datasets, and the methodology for selection of constituents of potential concern (COPCs) and constituents of potential ecological concern (COPECs) to be included in the quantitative risk evaluations.

Section 4: Estimation of Exposure Point Concentrations – This section describes the data groupings and methods used to estimate exposure point concentrations (EPCs) for both potential human and ecological receptor populations for each of the defined potential exposure areas.

Section 5: Human Health Risk Assessment – This section describes the potential receptors, potential exposure pathways, and methods of evaluation (including toxicity assessment and risk characterization). It also summarizes the risk results presented in the area-specific appendices, and discusses key uncertainties associated with the quantitative soil HHRA.

Section 6: Ecological Risk Assessment – This section describes the potential receptors, potential exposure pathways, methods of evaluation, summary of the risk results and key uncertainties associated with the soil ERA. It also summarizes the risk results presented in the area-specific appendices, and discusses key uncertainties associated with the quantitative soil ERA.

Section 7: Conclusions – This section presents the conclusions of both the HHRA and the ERA.

Section 8: Risk-Based Remedial Goal – This section describes the methods and results for estimating risk-based remedial goals (RBRGs) for the potential risk drivers for the protection of human and ecological populations.

Section 9: Summary of Key Findings – This section summarizes the key findings based on the results and conclusions of both the HHRA and the ERA.

Section 10: References – This section presents the references cited in the HHERA document.

Appendices: Statistical outputs for the COPC/COPEC selection proc ess and EPC calculations, details of the sediment transport analysis and HHRA-related air modeling approach, and exposure area-specific HHRAs and ERAs are presented in the appendices. The detailed HHRA and ERA for each identified potential exposure area are presented in separate exposure area-specific HHERA appendices. To facilitate review, the title of each HHERA appendix is the name of the potential exposure area (e.g., Appendix AOC4 contains the detailed HHERA for the AOC4 potential exposure area; Appendix OCS contains the detailed HHERA for all areas combined outside the TCS fenceline; etc.) and associated tables, figures, and attachments use acronyms of the exposure area name (e.g., Figure AOC4-1.1, Table OCS-1.1, Table AOC4-A1, etc.).

Furthermore waste material sample summary tables and figures (Appendix WMS), soil management plan risk-based concentrations (RBCs) for groundwater remedy (Appendix RBC), a human health acute hazard evaluation (Appendix AHE), and response to comment (RTC) and final resolution table for the Draft Soil HHERA (Appendix RTC) are included in the appendices to this HHERA Report.

2 SITE HISTORY AND CHARACTERISTICS

This section presents information on historical and current operations and discusses previous and recent investigations with information obtained primarily from the Final RFI/RI Report Volume 1 (CH2M 2007a), the Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan (Final Soil RFI/RI Work Plan; CH2M 2013), and communications with Jacobs. The physical and ecological characteristics of the site were also obtained from the Final RFI/RI Report Volume 1 (CH2M 2007a) and the Programmatic Biological Assessment Reports (PBA Reports; CH2M 2007b, 2014a).

2.1 Site Historical Operations

In December 1951, the TCS began operations to compress natural gas supplied from the southwestern United States for transport through pipelines to PG&E's service territory in central and northern California. The state of California owned the property on which the compressor station was built. From 1951 to 1965, PG&E leased the property from the state. In 1965, PG&E purchased the property from the state (CH2M 2007a). FMIT owns a 100-acre parcel of land located 0.25 mile north of the site (Figure 1-2).

Current TCS operations are very similar to the operations that occurred from the start of facility operations in 1951, including these six major activities:

- Compression of natural gas
- Cooling of the compressed natural gas and compressor lubricating oil
- Water conditioning
- Wastewater treatment
- Facility and equipment maintenance
- Miscellaneous operations.

The greatest use of chemical products at the TCS involves the treatment of cooling water, and the greatest volume of waste produced consists of blowdown from the cooling towers, which is water that is routinely removed from the towers to prevent chemical buildup and scale formation.

Historically, hexavalent chromium (chromium-6) was added to cooling water to inhibit corrosion, minimize scale formation, and control biological growth. From 1951 to 1964, untreated wastewater containing chromium-6 was discharged to the Bat Cave Wash (BCW), an ephemeral drainage that extends from the Chemehuevi Mountains to the north. From 1964 to 1969, PG&E treated the wastewater by converting the chromium-6 to trivalent chromium (chromium-3). In 1969, the process was expanded to two steps that converted chromium-6 to chromium-3 (Step 1), and then removed chromium-3 via precipitation (Step 2). Beginning in May 1970, treated wastewater was discharged to an injection well (PGE-08) located on PG&E property inside the TCS, and discharges to BCW generally ceased. A description of BCW is presented later in Section 2.4.3 and in Appendix BCW.

In 1971, after wastewater discharge to BCW ceased, four single-lined evaporation ponds were constructed, and in 1985, PG&E discontinued use of hexavalent chromium in its cooling water. In 1989, the single-lined ponds were replaced with four new, Class 2 (double-lined) ponds, located approximately

1.2 miles northwest of the former single-lined ponds. The wastewater treatment system and the single-lined ponds were physically removed and clean-closed between 1988 and 1993. The four, Class 2 double-lined ponds are still in use and are operated under jurisdiction of the Regional Water Quality Control Board, Colorado River Basin Region (CH2M 2007a).

2.1.1 Investigation Areas

The SWMUs, AOCs, and other investigation areas included in the HHERA include six SWMUs, 29 AOCs, and seven additional investigation areas located inside and outside the TCS fenceline. All investigation areas that have not received regulatory closure are included in the risk assessment. The closure process and criteria for those investigation areas that have already received regulatory closure are described in Section 5 of the Final RFI/RI Report Volume 1 (CH2M 2007a).

Six SWMUs (SWMUs 2, 3, 4, 7, and 10 and Unit 4.6) and two AOCs (AOCs 2 and 3) have already been closed and require no further investigation (CH2M 2007a).

The RAWP documents (Arcadis 2008a, 2009a, 2015) included AOCs 29 and 30 for evaluation based on preliminary information available in the Final RFI/RI Report Volume 1 (CH2M 2007a). However, as reported in the Final Soil RFI/RI Work Plan (CH2M 2013), sampling from these two AOCs was not proposed and investigation of these AOCs is scheduled to be conducted as part of the decommissioning and removal activities for these AOCs. Additionally, as reported in the Final Soil RFI/RI Work Plan (CH2M 2013), analytical data were not collected from the Potential Pipeline Disposal Area (also referred to as Undesignated Area -1 [UA-1]). Therefore, AOCs 29 and 30 and UA-1 were not evaluated in the HHERA. The Former 300B Pipeline Liquids Tank area (also referred to as Undesignated Area -2 [UA-2]), located outside the TCS, has already been closed (CH2M 2007a). However, DTSC (2007a) requested additional investigation; therefore, UA-2 data were evaluated in the HHERA.

In addition to the investigation areas described previously, other areas investigated outside the TCS not included in the RAWP are the perimeter area, the storm drain system, and TCS Well #4 (TCS-4; located in AOC1). The perimeter area is defined as the area immediately outside the TCS to the bottom of the slope. The storm drain system consists of active and inactive storm drain inlets and pipes that originate within the TCS and flow to discharge points outside the TCS fenceline. Additional investigation areas inside TCS are Units 4.3, 4.4, and 4.5.

The investigation areas identified in the Final Soil RFI/RI Work Plan (CH2M 2013), RAWP documents (Arcadis 2008a, 2009a, 2015), and the recent DTSC Directive Letter (2017a) that have been carried forward into this HHERA are discussed in this section.

2.1.1.1 Outside the Topock Compressor Station

The investigation areas outside the TCS are discussed in this section and are shown on Figure 2-1a. The areas included in the HHERA evaluations are:

- SWMU 1
- TCS Well-4
- AOC1

- AOC4
- AOC9
- AOC10 a, b, c, d
- AOC11 a, b, c, d, e, f, g
- AOC12 a, b, c
- AOC14
- AOC27
- AOC28 a, b, c, d
- AOC31
- UA-2.

Based on the information provided in the Final Soil RFI/RI Work Plan (CH2M 2013), in this section provides summaries of the location, site uses, and potential sources of contamination for each of the investigation areas located TCS.

SWMU 1

SWMU 1, also referred to as the Former Percolation Bed, is located outside the TCS fenceline in the bed of BCW, (Figure SWMU1-1.1, Appendix SWMU1). Managed by the USFWS, SWMU 1 is surrounded by AOC1 (see description in this section) and located on the PG&E and Havasu National Wildlife Refuge (HNWR) property. The southern boundary of SWMU 1 is roughly in line with the water treatment system in the lower yard of the TCS, and the northern boundary of SWMU 1 is near the access road leading from the lower yard into BCW.

The primary source of contamination for SWMU 1 is historical direct discharge of untreated wastewater containing chromium (cooling tower blowdown) into BCW and the Former Percolation Bed. Between 1964 and 1971, the chromium-containing wastewater was combined with a small quantity (approximately 5%) of treated water discharged from the station oily water treatment system.

Because chromium-containing wastewater from the TCS was discharged to BCW and topography surrounding the wash confined wastewater and surface water flows to the bed of the wash, the potential lateral extent of soil contamination associated with discharges to SWMU 1 is constrained within the boundaries of BCW (contamination outside SWMU 1 is addressed in this section under AOC1).

Contamination associated with SWMU 1 may also exist on the eastern sidewall of BCW based on results of samples collected from white powder material observed on this sidewall. Two possible sources of the white powder include residual mineral salts from the percolation pond and water-conditioning sludge (lime treatment) from the sludge drying beds. Lime treatment includes the addition of calcium hydroxide and soda ash and sometimes other flocculants to remove calcium and magnesium ions (hardness) from water. The water conditioning sludge produced contains calcium carbonate and smaller amounts of magnesium hydroxide, both being poorly soluble at normal pH.

If released, volatile organic compounds (VOCs) in surface soil would be expected to have been degraded by heat and light and are likely not present in significant quantities. Potential sources of dioxins/furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a).

Historically, contaminants in surface soil in SWMU 1 may have been eroded and entrained in stormwater/surface water runoff during flow events and may have been subsequently re-deposited downstream in BCW. A 2006 storm event resulted in substantial erosion and deposition in portions of the wash in SWMU 1, and a January 2010 storm event resulted in the movement of large gravel and cobbles from south of SWMU 1/ AOC1 to the area near where the Debris Ravine (AOC4) enters BCW and as far north as near SSB-1 (see Figure BCW-1.1a, Appendix BCW).

Based on a site reconnaissance conducted following the 2006 event, data from surface and near-surface soil sample locations collected prior to the 2006 storm event may no longer be representative of site conditions. However, deeper soil samples (below 2 to 3 feet below ground surface [bgs]) did not appear to be affected by the 2010 storm event, are still considered reliable, and were used in the data gaps evaluation in the Final Soil RFI/RI Work Plan (CH2M 2013) Based on the visual reconnaissance of BCW, most of the soil samples collected during the 2008 Phase 1 investigation are still considered to be representative of site conditions.

TCS Well-4

In July 2013, a capped well (Well TCS-4) was located in BCW along with a steel pipe leading into the well. Historical reports indicate that the steel pipe may have led from a water treatment chamber at the former sludge drying bed area to an “abandoned water well” in the bottom of the wash. This location corresponds to the location of “Well #4” (now referred to as Well TCS-4). The well was decommissioned in 2016 in accordance with the Decommissioning Plan for Topock Compressor Station Well Number 4 (TCS-4) (CH2M 2015a).

AOC1

AOC1 is located outside the TCS fenceline west of the compressor station and within BCW. BCW is a prominent desert wash that crosses the site from south to north and lies to the west and outside the TCS fenceline. AOC1 comprises a portion of BCW adjacent to the station and surrounding SWMU 1 and TCS-4 (see separate descriptions provided previously), as well as the portion of BCW extending to the north toward the Colorado River from SWMU 1. The AOC1 investigation area is located partially on PG&E property, partially on the HNWR, partially on Bureau of Reclamation property (managed by USBLM), partially on BNSF Railroad land, and partially on FMIT property.

For AOC1, the primary source of contamination is historical direct discharge of untreated wastewater containing chromium (cooling tower blowdown) into BCW and potential overflow or discharges from the SWMU 1 percolation bed. Between 1964 and 1971, the chromium-containing wastewater was combined with a small quantity (approximately 5%) of treated water discharged from the station oily water treatment system. Therefore, surface soil in AOC1 is the primary source medium.

Other potential sources of contamination to BCW are:

- Discharge from the Debris Ravine (AOC4). Contaminants in fill/debris and surface soil in AOC4 could have been entrained in surface water runoff and deposited in the southern portion of BCW south of SWMU 1.

- Incidental spills and stormwater runoff from the western side of the TCS (storm drains and/or sheet flow).
- Stormwater runoff from Interstate 40 (I-40) and the railroad (from culverts discharging to BCW) could have resulted in the release of total petroleum hydrocarbons (TPHs), polycyclic aromatic hydrocarbons (PAHs), dioxins/furans (from vehicle and train exhaust), lead, and wear metals (including barium, chromium, copper, nickel, and zinc) into BCW.
- Stormwater runoff from AOC 14 north of I-40.
- Historical dumping and military activities near BCW.
- Runoff from the former Workman's Roadhouse and service station near the mouth of BCW.

Historically, constituents in surface soil in BCW may have been eroded and entrained in stormwater/surface water runoff during flooding events and may have been subsequently re-deposited downstream (further north) in BCW. Repeated erosion and deposition of soil at BCW may have resulted in mixing of surface and near-surface soil in this unit. The primary source medium at BCW is surface soil.

The thick vegetation, widening of the channel near the end of BCW, and blockage of flow by National Trails Highway greatly reduces the energy of flow in this area during runoff events, resulting in deposition of entrained soil within the vegetated area near the mouth of BCW. This heavily vegetated portion of BCW is a long-term depositional area that has existed since before the TCS was built.

Periodic storm (high runoff) events occur in BCW, making it difficult to assess the precise nature of erosion and deposition patterns. A 2006 storm event resulted in substantial erosion in portions of the wash near the TCS, and a January 2010 storm event resulted in the movement of large gravel and cobbles from the southern area of BCW to the area near where AOC4 enters BCW and as far north as in the vicinity of SSB-1 (Figure BCW-1.1a, Appendix BCW). North of the pipeline overcrossing, there appeared to be limited scouring and deposition in the wash and limited erosion of the wash walls within SWMU 1/AOC1.

Based on a site reconnaissance conducted following the 2006 event, data from surface and near-surface soil sample locations collected prior to the 2006 storm event may no longer be representative of site conditions. However, deeper soil samples (below 2 to 3 feet bgs) did not appear to be affected by the 2010 storm event, are still considered reliable and were used in the data gaps evaluation in the Final Soil RFI/RI Work Plan (CH2M 2013). Based on this visual reconnaissance of BCW, most of the soil samples collected during the 2008 Phase 1 are still considered to be representative of site conditions.

AOC4

AOC4, also known as the Debris Ravine, is located immediately south and outside the TCS fenceline (Figure 2-1a). Located on PG&E and HNWR property, AOC4 is a narrow, steep-sided arroyo that drains into BCW at the southwest corner of the compressor station. Laterally, the western edge of AOC4 extends from the toe of the western slope of the ravine at a point directly south of the water tanks to the junction with BCW. The eastern edge extends from the water tanks north along the access road to a line parallel with the southern-most fenceline of the TCS, and west along the fenceline to the edge of the slope above BCW. AOC4 includes the slope between the eastern and western boundaries to a point directly downslope of the southwestern corner of the facility fenceline.

The operational history at AOC4 is not well documented; however, over the years, fill material, trash, and debris had been deposited on the northern and eastern slopes, with some debris accumulating in the bottom of the ravine. A piece of debris was observed on the hillside east of and below the water tanks. A sample of that debris was collected (AOC4-tar) and analyzed for the suite of constituents of concern (COCs). Dioxins were detected, but this small debris sample would not be characterized as a ”possible source of dioxins”. No other buried debris was observed at this location. It appears that burning of trash occurred within AOC4. Potential sources of dioxins/furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a). The primary source medium at AOC4 is surface soil.

In June 2009, DOI issued a memorandum for a time-critical removal action (TCRA) at the AOC4 – Debris Ravine (DOI 2009b) and directed PG&E to initiate activities necessary to implement and perform TCRA activities at AOC4. Approximately 11,800 tons of waste were removed from the AOC4 – Debris Ravine, and the removal action achieved the TCRA objectives. The AOC4 TCRA, completed in 2010, is expected to be consistent with and contribute to any subsequent remedial action selected to respond to contaminated soils that are the subject of the ongoing RFI/RI. More TCRA details are presented in Implementation Report for the Time-Critical Removal Action at AOC4 (Alisto Engineering Group [Alisto] et al. 2011). Based on the confirmation dataset and installation of erosion control measures, the substantial threat of release of contaminated material from AOC4 has been stabilized and mitigated.

AOC9

AOC9, also referred to as the Southeast Fenceline, is located immediately outside the TCS fenceline on the east side of the compressor station, south of the visitor parking lot on a steep slope (Figure 2-1a). In accordance with the RAWP (Arcadis 2008a), and due to proximity and topography, AOC10a has been included as part of the AOC9 evaluation for the HHERA to coincide with the direction from DTSC (2017a) for the ERA. AOC9 is located entirely on property owned by PG&E.

The primary source of contamination for AOC9 is historical liquid discharge from a broken storm drain to shallow soil. In 2000, a broken stormwater drainage pipe and stained soil were found in the area, and stained soil was removed. The staining most likely originated from incidental leaks near the Auxiliary Building that entered a pipe trench leading to a storm drain. The stained soil was excavated, a new stormwater drainage pipe was installed, and the area was backfilled with 1 to 2 feet of clean soil.

In 2011, a PG&E employee indicated a second storm drain might have been located in this area. The exact location of the former storm drain line is uncertain, and in 2012 the footprint of AOC9 was extended to 100 feet to the north to ensure it addresses both potential locations. The primary source medium is surface and shallow soil. If released, VOCs in surface soil would be expected to have been degraded by heat and light and are likely not present in significant quantities. Potential sources of dioxins and furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a).

Sub area 10a, now part of AOC9, was noticed during a site visit in May 2006. A storm drain was noted leading from the southeastern portion of the compressor station and discharging into the East Ravine. A small area, approximately 3 feet by 3 feet, of stained soil (possibly old hydrocarbon staining) was noted at the discharge of the storm drain, as shown on Figure AOC9-1.1 as Subarea 10a. While discharge from the steam-cleaning area has always been directed to the oily water treatment system, this storm drain may have captured some runoff from the steam-cleaning area before the steam-cleaning area was fully bermed (CH2M 2006a). Dark soil—what appears to be stained soil—is present along the west side of AOC9 in a May 19, 1955 aerial photograph.

AOC10

AOC10, also known as the East Ravine, is the ravine located on the southeast side of the facility, outside the TCS fenceline (on Figure 2-1a). The ravine is 1,600 feet long and runs eastward toward the Colorado River. The ravine is bisected by three constructed berms built between 1916 and the 1950s. Located on property owned by PG&E and the HNWR, AOC10 contains three drainage depression areas referred to as AOC10 subareas b, c, and d that are located behind these berms (facing eastward). Per the RAWP (Arcadis 2008c), subarea 10a is being included in AOC9 due to proximity and topography (see AOC9). The primary potential sources of contamination are:

- Runoff from the TCS, the access road to the TCS (a curb was installed along the access road in 2006), and AOC9
- Discharge from stormwater drain pipes
- Surface debris disposed of on the slopes of the ravine
- Incidental overflows of chromium-containing wastewater via the former trench drain at the top of the station access road.

If released, VOCs in surface soil would be expected to have been degraded by heat and light and are likely no longer present. Potential sources of dioxins and furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a).

Potential releases would primarily have been in liquid form and would have affected surface soil. Releases from debris, whether consisting of solid particles or dissolved constituents, would also have affected surface soil. Accordingly, the primary source medium is surface soil.

AOC11

Located on PG&E and HNWR property, AOC11 is also known as the Topographic Low Areas. Low areas 11a, 11b, 11c, and 11d are located on the northeast side of the TCS (Figure 2-1a) on HNWR property, and 11e is located on PG&E property. The primary source of contamination to AOC11 is runoff from surrounding areas.

Multiple storm drains discharge to this area, and several former TCS storm drains are believed to have discharged to this area in the past. In addition, portions of AOC11 also receive discharge from the station access road. An employee reported that a burn area formerly existed in the southern portion of this unit near the station access road. AOC11 also includes the topographic low area (AOC11e) north of the plant access road near the Old Route 66 sign. This area receives run-off from the station access road. A stormwater pipe that captures runoff from I-40 and National Trails Highway also discharges into AOC11 north of AOC11a immediately south of the I-40 overcrossing. Stormwater runoff from I-40 could have resulted in the release of TPHs and metals to this area (CH2M 2013).

The primary source of contamination to AOC11 is runoff from the TCS, the access road to the TCS, potential railroad debris below the station access road (asphalt, a metal sign, refractory bricks, ceramic plates, glass resistors, and concrete were observed during 2008 field activities), the Transwestern Meter Station area, and I-40. Additionally, stormwater runoff from the TCS could have entered the stormwater drains that discharge to AOC11.

If released, VOCs in surface soil would be expected to have been degraded by heat and light and are likely not present in significant quantities. Potential sources of dioxins and furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a).

Based on employee interviews conducted in late 2009/early 2010 and subsequent additional site reconnaissance, two new topographic low areas, a potential burn area, and a small new white powder area were identified for AOC11, as follows:

- Two new topographic low areas that may receive runoff from the TCS were identified. Subarea 11f consists of the drainage area beginning near the current decontamination pad and Transwestern Meter Station and extending downslope to the low area across from AOC11b. It captures a portion of runoff originating from the TCS that flows down the TCS access road. The other topographic low area (Subarea 11g) is located between the TCS access road and the Colorado River west of the Route 66 sign. This area may have also received runoff from the access road.
- According to former PG&E employee interviews, fire training exercises were conducted near the location of the current decontamination pad and Transwestern Meter Station and involved burning primarily scrap wood. Fire drills were also held and reportedly expanded to include extinguishing diesel fires in a 55-gallon drum. This potential burn area is located in the potential drainage area for Subarea 11f.
- A small new white powder area was identified upslope of AOC11e following the January 2010 rain event. Located on the steep slope below the northeastern portion of the compressor station, this area is not accessible by equipment and likely represents a native evaporite deposit. The white powder is no longer present.

After storm events, water pools in AOC11a (the largest topographic low area) and does not readily infiltrate. Historically, water may have also pooled behind the two check berms in AOC11c and AOC11e; while these structures have been breached and no longer retain water, accumulated fine-grained soils are present behind the berm at AOC11c. Laterally, contaminants in soil would generally be expected to be limited to the area along the topographic drainages. With the exception of subarea 11g, all of the low points within this unit are terminal low points, and flow cannot exit AOC11. Runoff from the station access road periodically reaches Subarea 11g. It is possible some flow may result in runoff over the 11g bank and down the slope toward the Colorado River. Soil samples collected from this area indicate minimal impacts to soil in Subarea 11g.

At these low points, contaminants could potentially be driven deeper and potentially could reach groundwater.

AOC12

AOC12, also known as the Fill Areas, includes three subareas (AOCs 12a, b, and c) located near the Transwestern gas pipeline meter station, east of the TCS (Figure 2-1a). AOCs 12a and b are located on property owned by HNWR, while AOC12c is located on both HNWR and PG&E property. The three areas were identified through employee interviews as locations that may contain buried debris (CH2M 2013).

AOC12a was reportedly a disposal area for construction-related debris. A few small pieces of concrete are visible at the surface in the area identified as AOC12a. The exact nature of the materials placed into this area and the date(s) of placement are unknown. Initially, AOC12a was the only disposal area initially identified in AOC12 (CH2M 2006a).

Two potential disposal locations were subsequently identified from interviews with former employees, as described in the Soil Part A Phase 1 Work Plan (CH2M 2006a). There is no visible debris at these two sites. These two locations are adjacent to the northwestern corner (AOC12b) and southwestern corner (AOC12c) of the Transwestern Meter Station.

AOC12b reportedly was used to bury asbestos-containing material and two drums of unused unknown chemicals. AOC12c was apparently a small ravine (about 6 feet deep) that was reportedly used to bury asbestos-containing material (ACM) and possibly other debris. Geophysical surveys and trenching in the areas did not encounter drums or ACM. Soil samples collected from AOC12 were analyzed for inorganics and organics and several chemicals were detected as described in detail in the Final Soil RFI/RI Work Plan (CH2M 2013; Appendix A Subappendix C6). Asbestos was not detected or not present in any of the samples.

Chemicals, if present in fill material and buried waste, may have affected subsurface soil underneath the debris and laterally in the immediate vicinity of the debris. Subsurface soil would therefore be the primary source medium.

AOC14

AOC14, also known as the Railroad Debris Site, is located approximately 1,000 feet north of the TCS and is currently bounded by the BNSF railroad tracks to the north, I-40 to the south, BCW to the west, and a former access road to the east. The primary plateau of AOC14 is approximately 100 feet above the bottom of BCW. AOC14 is located on property owned by the HNWR, BNSF Railroad, USBLM, and Caltrans.

Aerial photos dated from 1947 to 1955 depict materials and debris scattered in this area. Former PG&E employees reported that water softening (lime) sludge was disposed of in this area. An asbestos removal action was completed in 1999, and sampling detected no remaining asbestos. DTSC field observations in 2009 identified scattered debris and a potential burn layer (visible in the I-40 road cut) in the southwest corner of AOC14. During additional employee interviews conducted by PG&E in late 2009 and early 2010, a former PG&E TCS employee reported periodic burning of primarily office garbage on the western edge of the AOC14 bench area, as shown on Figure AOC14-1.1, Appendix AOC14. The employee reported that AOC14 was used for dumping and garbage burning until the freeway was built in the 1960s (PG&E 2010). Potential sources of dioxins and furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a). This area may also have contributed run-off to BCW.

Because some material is buried, constituents could also have affected shallow and subsurface soil in the immediate vicinity of the debris, water softening sludge, and/or residual burned material. Constituents released from debris located in the higher (eastern) portion of AOC14 could also have been transported to the lower portions of the unit through surface runoff. Primary source media therefore consist of surface, shallow, and subsurface soil.

AOC27

AOC27, also known as MW-24 Bench, is located outside the fenceline north of the lower yard of the TCS and south of I-40 (Figure 2-1a), on property owned by PG&E and HNWR. The primary source of contamination at AOC27 is disposal of debris. As summarized in the Final Soil RFI/RI Work Plan (CH2M 2013), during interviews conducted by PG&E in late 2009 and early 2010, a former PG&E employee indicated this area was used as a potential waste disposal area. Before the construction of I-40, this area was contiguous with AOC14 – Railroad Debris Site. Miscellaneous construction debris is present in AOC 27.

In January 2008, during trenching activities in the MW-24 bench area associated with installation of a control panel related to the upland in-situ pilot test, debris consisting mostly of treated wood, concrete, and scrap steel/tin (including a possible fragment of a storage tank) were encountered at a depth of approximately 3 feet bgs. During the 2011 site walk with DTSC and DOI, discolored soil was noted in the embankment of an unpaved access road leading from the MW-24 Bench to BCW. In 2011, DTSC identified potential burn waste in the eastern edge of the road cut on the road from AOC27 to BCW. Potential sources of dioxins and furans near the TCS may include historical industrial activities as well as other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a).

Constituents present in these debris materials could have been deposited on surface soil as particulates or could have entered surface soil as dissolved constituents through infiltration of rainfall. Because some material is buried, constituents could also have affected shallow and subsurface soil in the immediate vicinity of the debris. Primary source media, therefore, consist of surface, shallow, and subsurface soil.

AOC28

AOC28, also known as Pipeline Drip Legs, consists of four drip legs associated with 300A and 300B pipelines (Figure 2-1a). Three of these legs are located east of the TCS, and a drip leg for the 300B pipeline is downstream of the TCS in BCW. A drip leg is designed to collect pipeline liquids by gravity. Each drip leg is connected to a valve used to drain the pipeline liquids to a portable tank. AOC28 is located on PG&E and HNWR property.

All drip legs are currently drained to portable tanks on a monthly basis. A historical procedure for draining pipeline drips confirms this frequency (PG&E 1989) is consistent with past practices. It is possible that some spillage could occur or may have historically occurred during the transfer process. All potential releases at the drip legs would be surface releases of liquids, and the releases would be confined to a very small area in the immediate vicinity of the drip legs. If released, VOCs in surface soil would be expected to have been degraded by heat and light and are likely no longer present. Surface soil is therefore the primary source medium.

After PG&E discovered the presence of polychlorinated biphenyls (PCBs) in some pipeline liquids from Transwestern at Topock in the late 1990s, PG&E installed protective equipment and cleaned portions of the pipeline system to remove PCB contamination. Subsequently, PG&E implemented a monthly PCB monitoring program along the entire downstream Line 300 gas pipeline system. Since the initiation of this testing protocol, only low levels of PCBs have been detected in the downstream pipelines.

AOC31

AOC31, also known as the Former Tea Pot Dome Oil Pit, is located on the northeast side of the TCS, just outside the fenceline (on Figure 2-1a). It is located within and overlaps with the Perimeter Area investigation. AOC31 is located on property owned by PG&E.

The primary source of contamination in AOC31 is potential historical leaks or spills from a reported oil pit. There are two sampling locations within AOC31: PA-OS1 and PA08. Former employees indicated that they had been told that the Teapot Dome restaurant provided oil changes, and that oil from vehicles was dumped into a pit. Potential wastes in this area pre-date the construction of the compressor station. Any constituents released would have been in liquid form and released to surface soil, or leaks from the bottom of the pit to subsurface soil. Surface soil and subsurface soil are therefore the primary source media.

UA-2

UA-2, also known as Former 300B Pipeline Liquids Tank area, is located southeast of the TCS on a shelf in the hill next to old Route 66 (Figure 2-1a), on HNWR property.

In 1994, an investigation found oil-stained soil in a small area underneath and adjacent to this aboveground tank formerly used to collect pipeline liquids from the 300B natural gas pipeline. In 1995, the tank was removed, and a cleanup was implemented in 1996. Soil was excavated to a depth of 5.5 feet. Confirmation samples indicated that the closure plan requirements were met. The soil excavation and sampling results are documented in the Closure Certification Report (Trident Environmental and Engineering 1996).

The primary sources of contamination in UA-2 consisted of potential historical spills while filling or emptying the tank, and potentially historical leaks from the tank. Any constituents released would have been released in liquid form and released to surface soil. If released, VOCs in surface soil would be expected to have been degraded by heat and light and are likely no longer present. The majority of the affected soil has been removed, as documented by post-remediation confirmation sampling. Surface soil is therefore the primary source medium.

Perimeter Area

The Perimeter Area is defined as the area immediately outside the TCS fenceline to the bottom of the slope. Perimeter sampling locations were identified in areas with visible discoloration or other potential direct impacts, and/or as areas that may experience or have experienced surface water runoff through sheet flow. The majority of the TCS is currently bermed or curbed. Some of the areas that are currently bermed with soil are known to be, or were likely to have been, unbermed in the past. While berms and curbs are currently present along most of the TCS fenceline, historical sheet flow pathways could have been different than current pathways along the perimeter. DTSC and DOI, therefore, directed PG&E to collect samples along the entire perimeter, regardless of the location of current or historical berms/curbs (CH2M 2013). The primary source medium in the Perimeter Area is surface soil.

Storm Drain System

The storm drain system consists of active and inactive storm drain inlets and pipes that originate within the TCS and flow to discharge points outside the TCS fenceline. DTSC directed PG&E to conduct a comprehensive evaluation of the facility storm drain system in 2010. Prior investigations associated with the storm drain system had been limited to AOC9, AOC10a, and low areas that received stormwater runoff outside the TCS fenceline. A goal of the storm drain investigation was to assess and identify alignments of various storm drain lines and collect soil data along storm drain alignments outside the fenceline. In addition, data were needed to characterize potential discharges from storm drains to soil, to assess potential risk to human health and the environment. An additional goal was to ensure that sufficient information is available to evaluate the potential for offsite migration via the storm drains to assist with the development of the CMS/FS, remedial design, and/or IMs. The primary transport pathway associated with the storm drain system would be discharge of contaminants into the storm drains, followed by runoff from the storm drains to areas outside the fenceline. It is also possible that discharge could have occurred at joints or breaks in the storm drain lines. The primary source medium for the storm drain system is surface or subsurface soil where drainage or discharge may have occurred.

2.1.1.2 Inside the Topock Compressor Station

The TCS is fenced and occupies approximately 15 acres of a 65-acre parcel of PG&E-owned land. The investigation areas inside the TCS included in the risk assessment are presented on Figure 2-1b. The specific investigation areas inside the TCS addressed in the HHERA include:

- SWMU 5 (Sludge Drying Bed)
- SWMU 6 (Chromate Reduction Tank)
- SWMU 8 (Process Pump Tank)
- SWMU 9 (Transfer Pump)
- SWMU 11 (Former Sulfuric Acid Tanks)
- AOC5 (Cooling Tower A)
- AOC6 (Cooling Tower B)
- AOC7 (Hazardous Materials Storage Area)
- AOC8 (Paint Shed)
- AOC13 (Unpaved Area Within the TCS)
- AOC15 (Auxiliary Jacket Cooling Water Pumps)
- AOC16 (Former Sandblast Shelter)
- AOC17 (Onsite Septic System)

- AOC18 (Combine Wastewater Transference Pipelines)
- AOC19 (Former Cooling Liquid Mixing Area and Former Hotwell)
- AOC20 (Industrial Floor Drains)
- AOC21 (Round Depression Near Sludge Drying Bed)
- AOC22 (Unidentified Three-Sided Structure)
- AOC23 (Former Water Conditioning Building)
- AOC24 (Stained Area and Former API Oil/Water Separator)
- AOC25 (Compressor and Generator Engine Basements)
- AOC26 (Former Scrubber Oil Sump)
- AOC32 (Oil Storage Tanks and Waste Oil Sump)
- AOC33 (Potential Former Burn Area Near AOC17)
- Unit 4.3 (Oily Water Holding Tank)
- Unit 4.4 (Oil/Water Separator)
- Unit 4.5 (Portable Waste Oil Holding Tank)
- Portions of AOC4 Inside the TCS Fenceline
- Perimeter Area.

The primary sources of contamination inside the TCS are likely to be historical incidental spills during operations (CH2M 2006a, 2013). The quantity of spills released, if any, is unknown but is expected to be relatively small. Any spills or incidental leaks would have quickly been addressed due to the inherent hazards associated with chemical spills. It is unknown if a large release occurred, that could have reached the storm drain system and been discharged outside the TCS fenceline. Large portions of the area inside the TCS are paved or covered by buildings or gravel. Until approximately 1964, cooling-water blowdown containing hazardous constituents was directly discharged to BCW. The primary source media in inside the TCS is surface soil.

2.1.1.3 Known Groundwater Plume

Groundwater data indicate that the hexavalent chromium plume (greater than California's maximum contaminant level [MCL] of 50 micrograms per liter [µg/L]) is confined to the alluvial aquifer and extends over a distance of approximately 2,800 feet from the southern edge of the Alluvial Aquifer (upper BCW) to the Colorado River floodplain, covering about 90 acres (refer to Figure 2-2 from the Draft CMS/FS Work Plan [CH2M 2007c]). At the northern and eastern limits of the plume, reducing conditions are observed in groundwater. In this area, hexavalent chromium reverts to trivalent chromium and is strongly sorbed to aquifer materials or precipitates. This natural reducing condition significantly limits the movement of hexavalent chromium and results in a sharp decrease in hexavalent chromium concentrations in groundwater in the floodplain (CH2M 2007a).

Beginning in 2004, DTSC directed PG&E to undertake certain measures, known as IMs, to ensure hexavalent chromium in the groundwater did not reach the Colorado River. IM-1, IM-2, and IM-3, collectively, involved the construction of treatment facilities and installation of four extraction wells to pump contaminated water out of the aquifer for treatment and disposal. More importantly, these IMs were designed to pull contaminated groundwater away from the Colorado River until a permanent remedy could be selected and implemented (DTSC 2010).

Currently, PG&E is implementing IM-3 at the site. IM-3 facilities include a groundwater extraction system, conveyance piping, a groundwater treatment plant, and an injection well field for the discharge of the treated groundwater. The groundwater treatment system is a continuous, multistep process that involves reduction of hexavalent chromium to the less soluble trivalent form; precipitation and removal of precipitate solids by clarification and microfiltration; and lowering the naturally occurring total dissolved solids using reverse osmosis. Treated groundwater is returned to the aquifer through an injection system consisting of two injection wells (IW2 and IW3). The IMs Performance Monitoring Program (PMP) evaluates the performance of IM-3 to achieve the prescribed performance standard. The results of the IMs PMP are published in routine monitoring reports. The performance standard has been achieved for all monitoring periods since the current standard was established in February 2005

In a coordinated effort, DOI and the DTSC selected the groundwater remedy to address chromium in groundwater at SWMU 1/AOC1 and AOC10. The DOI decision is presented in the Record of Decision (DOI 2010), which is presented in a decision package that includes the certification of the Final Environmental Impact Report (EIR), the Final Statement of Basis, the Statement of Decision, and the Resolution of Approval (DTSC 2011a, b). The Revised Groundwater Corrective Measure Implementation/Remedial Design Work Plan for SWMU 1/AOC1 and AOC10 was subsequently completed in November 2011 (CH2M 2011) and approved by DOI (2011).

2.2 History of Investigations and Interim Measures

TCS investigative and remedial activities date back to the 1980s with the identification of SWMUs through a RCRA Facility Assessment. Closure activities associated with former hazardous waste management facilities and the former oily water treatment system at the TCS were performed between 1988 and 1993. The RFI began in 1996 with the signing of the CACA, and numerous phases of data collection and evaluation have been completed under the CACA. Since 2005, investigative and remedial activities (RFI/RI) have been performed pursuant to both RCRA corrective action and CERCLA for groundwater and soil.

To date, major portions of the RFI/RI have been completed, several IMs have been implemented, and a groundwater remedy has been selected/approved, and construction of the remedy was started in October 2018. This HHERA was performed to assist with risk management decision making regarding the potential need for soil remediation. The status of the investigative and remedial activities is summarized in this section.

2.2.1 RCRA Facility Investigation/Remedial Investigation

As directed by DTSC (2006), the Final RFI/RI Report Volume 1 (CH2M 2007a) is separated into three volumes to efficiently manage the large amount of information associated with the RFI/RI and accelerate site remediation by allowing earlier remediation of the groundwater plume. Each volume of the Final RFI/RI Report is described as follows:

- **RFI/RI Report Volume 1 — Site Background and History**. Volume 1 was completed in August 2007 (CH2M 2007a) and approved by DTSC (2007a) and DOI (2007a) in 2007. Volume 1 identifies the 20 SWMUs, AOCs, and other undesignated areas at the site to be carried forward in the Final RFI/RI. An addendum to the RFI/RI Report Volume 1 was completed in May 2014 (CH2M 2014b) and provides additional site background and history information for SWMUs and AOCs that were identified subsequent to the original RFI. The addendum was approved by DTSC (2014a) and DOI (2014a) in 2014.
- **RFI/RI Report Volume 2 — Hydrogeologic Characterization and Results of Groundwater and Surface Water Investigation.** Volume 2 and its addendum were completed in February and June 2009, respectively (CH2M 2009a, b), and approved by DTSC (2009b) and DOI (2009c). This volume completes the RFI/RI requirements for groundwater impacts associated with the past discharge of wastewater to BCW (SMWU 1/AOC1) and injection well PGE8 (SWMU 2). It contains information on the hydrogeologic characterization and results of groundwater, surface water, pore water, and river sediment investigations to evaluate and characterize the nature and extent of groundwater contamination resulting from past discharge of wastewater from the TCS.
- **RFI/RI Report Volume 3 — Results of Soil and Sediment Investigation.** Volume 3 of the RFI/RI Report is forthcoming (currently being prepared by Jacobs), and includes final characterization data to complete the RFI/RI requirements for remaining TCS operations, including the results of soil investigations and the storm drain alignment investigation. Data described and presented in that report are the basis of the evaluations in the Soil HHERA.

2.2.2 Soil Interim Measures

In June 2009, the DOI issued a memorandum for a TCRA at the AOC4 - Debris Ravine at the site (DOI 2009b) this memorandum directed PG&E to initiate activities necessary to implement and perform TCRA activities at AOC4. The TCRA was conducted in accordance with CERCLA and, as an IM, was intended to stabilize and mitigate the threat of release of contaminated material. The history of previous investigations and agency direction leading up to the AOC4 TCRA are described in the approved Final Work Plan for Time-Critical Removal Action at AOC4 - Debris Ravine (AOC4 TCRA Work Plan) (Alisto et al. 2009).

Located in the southern portion of the TCS on PG&E property (except for a small portion of the westernmost end that extends onto the HNWR), AOC4 is a narrow, steep-sided arroyo that drains into BCW at the southwestern corner of the TCS. While the operational history at AOC4 is not well documented, it is known that over the years, fill material and debris were deposited in the ravine and trash was burned within AOC4. COPCs and COPECs for AOC4 identified in the RFI/RI Report Volume 1 (CH2M 2007a) and the Final Soil RFI/RI Work Plan (CH2M 2013) include Title 22 metals, hexavalent chromium, PAHs, asbestos, dioxins/furans, and PCBs.

TCRA activities were performed at AOC4 from December 2009 through December 2010 in compliance with the AOC4 TCRA Work Plan (Alisto et al. 2009). During the TCRA, work was conducted in safely accessible areas of AOC4 and approximately 11,799 tons of waste were removed. The AOC4 TCRA, completed in 2010, is expected to be consistent with and contribute to any subsequent remedial action selected to respond to contaminated soils that are the subject of the ongoing RFI/RI. The excavation, screening, and confirmation approach followed the AOC4 TCRA Work Plan (Alisto et al. 2009). Based on the confirmation dataset and installation of erosion control measures installed as part of the TCRA, the substantial threat of release of contaminated material from AOC4 has been stabilized and mitigated (Alisto et al. 2011).

The TCRA was not intended as a substitute for additional investigative or remedial activities required under RCRA, or to be the final remedy for AOC4. Rather, the TCRA was intended to be a complement to any subsequent remedial action in this area.

On October 30, 2018, the DOI issued an Engineering Evaluation/Cost Analysis (EE/CA) Approval Memorandum and directed PG&E to conduct an EE/CA to evaluate the need for a non-time critical removal action to address contaminated soil (DOI 2018). The DOI Approval Memorandum identified five of the 11 AOCs/SWMUs located on or adjacent to federal land for evaluation in the EE/CA.

2.2.3 Groundwater Risk Assessment

A comprehensive GWRA (Arcadis 2009c) was conducted, in accordance with the agency-approved RAWP (Arcadis 2008a) and RAWP Addendum (Arcadis 2009a) and additional comments received from DTSC’s Human and Ecological Risk Division (HERD) and DOI. The GWRA provided information about potential health threats and ecological risks posed by groundwater impacted by chemical releases from SWMU 1/AOC1 and SWMU 2 and to assist risk management decision making (USEPA 1989, 1997a). The GWRA concluded that potential transport of constituents in groundwater to the Colorado River represents an insignificant transport pathway and quantitative human health and ecological risk assessments of surface water were not warranted. In addition, there were no current direct or indirect exposure pathways for contact with site groundwater for ecological or human receptors.

The GWRA (Arcadis 2009c) concluded no significant ecological exposure pathway for contact with impacted site groundwater and there are no ecological receptors currently at risk of adverse effects due to the presence of COPCs in the groundwater. Therefore, there is no added risk to ecological receptors from groundwater.

The potentially exposed human populations evaluated in the quantitative GWRA included “future hypothetical residential groundwater users” who may be exposed to COPCs in groundwater in a residential setting (Arcadis 2009c). Based on the results of the quantitative estimates of risk for future hypothetical groundwater users presented in the GRA and the findings of the RFI/RI Volume 2 and RFI/RI Volume 2 Addendum (CH2M 2009a,b), hexavalent chromium was identified as the only COC to be carried forward in the CMS/FS for risk management considerations because it was the only COPC that was: (1) determined to be present in site groundwater at levels of potential concern to future human health or the environment; and (2) likely associated with groundwater at SWMU 1/AOC1 or SWMU 2.

In addition to hexavalent chromium, the RFI/RI Volume 2 and RFI/FI Volume 2 Addendum (CH2M 2009a, b) identified three other COPCs as potentially associated with SWMU 1/AOC1: selenium, nitrate as nitrogen, and molybdenum. Selenium, nitrate as nitrogen, and molybdenum were thoroughly evaluated in the GWRA. The WOE for these three compounds suggests that they would not be expected to pose a significant risk/noncancer hazard to future hypothetical groundwater users at the site. Although the risk assessment concludes that these three compounds are not believed to be a source of significant risk/noncancer hazard and, thus, would not be considered COCs, because each exceeds an HI of 1 at one or more wells, DTSC directed PG&E to carry selenium, nitrate as nitrogen, and molybdenum forward into the CMS/FS.

2.2.4 Groundwater Corrective Measures Study/Feasibility Study

In 2009, a groundwater CMS/FS for SWMU 1/AOC1 and AOC10 was completed to identify remedial action objectives (RAOs) and alternatives for the groundwater remedial action (CH2M 2009b). During the CMS/FS, nine remedial alternatives were identified and evaluated against RCRA and CERCLA criteria. In addition, the DOI identified the applicable or relevant and appropriate requirements (ARARs) for the groundwater remedy. Based on the alternatives evaluation, In-situ Treatment with Fresh Water Flushing (Alternative E) was recommended based on its ability to provide a balance of advantages and tradeoffs. DTSC approved the CMS/FS in December 2009 (DTSC 2009c).

2.2.5 Soil Background Investigations

As part of the site investigation activities, selected soil sampling studies were conducted to characterize the background conditions for the presence of inorganic compounds, PAHs, and dioxins/furans. Establishing background concentrations in soil helps to facilitate the comparison of site concentrations of constituents to background concentrations to assess whether the delineation of nature and extent of contamination in soil at the various investigation areas is adequate. The background data were used in the HHERA to identify those constituents present above background levels, that therefore, per the RAWP (Arcadis 2008a) are included in the quantitative risk evaluation. The background dataset is also used in the evaluation of the potential for inorganic constituents to leach to groundwater. Each study is briefly described in this section and the background data summary tables and sample location figures from the technical memos (CH2M 2009c, 2017a) are provided in an attachment in Appendix BKG.

2.2.5.1 Soil Background Investigation

As described in the RFI/RI Soil Investigation Work Plan Part A (CH2M 2006a), the purpose of the soil background investigation was to collect additional background soil samples to augment the existing background dataset and establish background concentrations of inorganic constituents and PAHs. The approaches used to select background sample locations, analytical methods used, data quality review, data evaluation procedures for defining the background dataset, and derivation of the background threshold values (BTVs) are presented in the Technical Memorandum – Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station (Background Tech Memo) (CH2M 2009c).

For the purposes of this Soil HHERA, the additional information on background arsenic concentrations provided in Subappendix C9 of the Final Soil RFI/RI Work Plan (CH2M 2013) is important:

> "…. the arsenic concentrations detected at UA 2 may represent a different background population from the sample population used to establish background comparison concentrations. UA 2 is located on bedrock, whereas the majority of the samples comprising the background dataset were collected from alluvial material. The potential for

> the arsenic concentrations detected at this unit to represent background concentrations was evaluated statistically and visually via probability plots, see Section 2.4 of this sub-appendix for more information. The lateral and vertical extents of arsenic concentrations exceeding the interim [background] screening level have been defined to natural boundaries (i.e., dirt road to the north, bedrock at 5.5 feet bgs, bedrock outcropping to the east and south, and steep slope to the west)."

Background values for inorganics, but not PAHs, were developed and presented in the Background Tech Memo (CH2M 2009c). The Topock background samples were collected from areas away from the TCS, I-40, former Route 66, and the BNSF railroad tracks—all of which are potential sources of PAHs, hence PAHs in the samples collected for this background study were not detected above the laboratory reporting limits (RLs).

2.2.5.2 Ambient Dioxin and Furan Study

As described in the Technical Memorandum – Ambient/Background Study of Dioxins and Furans at the Pacific Gas and Electric Topock Compressor Station (CH2M 2017a), potential sources of dioxins and furans near the TCS may include historical industrial activities such as fire suppression exercises and burning of garbage. Other sources may include unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains. Assessing ambient concentrations of dioxins and furans is helpful when completing risk assessments and making risk management decisions. Ambient concentrations for most of the lower chlorinated dioxins and all furan congeners in site soil are in the low nanogram per kilogram (ng/kg) range, whereas concentrations of octachlorodibenzo-p-dioxin (OCDD) range from 12 to 980 ng/kg and heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD) concentrations range from 1.5 to 120 ng/kg. These ambient soil concentrations result in calculated total mammalian toxic equivalent quotients (TEQ; using full RL for nondetects [NDs]) concentrations of 0.17 to 4.4 ng/kg and total avian TEQ concentrations ranging from 0.24 to 4 ng/kg. Summary statistics for individual congeners and calculated total mammalian and avian TEQ are presented in Appendix BKG. In addition to assessing ambient concentration of dioxins and furans, this study evaluated ambient concentrations of PAHs, which can be formed via similar anthropogenic mechanisms as dioxins and furans. PAHs were detected at low concentrations in several of the 2017 background study samples and in most RFI/RI soil investigation units at the site.

Additionally, as discussed in the Appendix C of the Final Soil RFI/RI Work Plan (CH2M 2013), lead and PAHs have been detected in soil samples collected across the site. Many natural and anthropogenic sources of lead and PAHs exist. Particulate lead is commonly found in surface soil near roadways as a result of leaded gasoline use in vehicles until the 1970s. Former Route 66 and I-40 are nearby, and most of the PAHs are ubiquitous in both urban and rural environments. The most notable natural and anthropogenic sources of PAHs are from combustion of fossil fuels, wildfires, volcanic activities, industrial facilities, petroleum oils, asphalt binders, and vehicle exhaust.

2.2.6 Sediment Investigations

Sediment and porewater sediment data are defined as sample results collected from areas that are typically inundated with water even in the absence of storm events (Arcadis 2008a). Two sediment investigation study areas are present along the Colorado River. These areas include both saturated sediments along the edge of the Colorado River that are ephemerally (temporarily) flooded. The ephemeral flooding is due to infrequent high flows in the wash or annual variations in stage along the Colorado River, the latter of which is not associated with the potential for transport of site-related materials. One sediment area is located at the mouth of BCW, northeast of AOC1 between National Trails Highway and the Colorado River. The other sediment area is located at the mouth of East Ravine (east of AOC10).

As part of the RFI/RI, sediment samples were collected from the mouth of BCW and sediment and porewater samples were collected from the mouth of East Ravine (AOC10) to define the horizontal extent of contamination in surface soil. At the mouth of BCW, sediment samples were collected in 2003 and analyzed for inorganics. In 2016, DOI requested sampling and analysis of dioxins/furans from two sediment locations, as these constituents were not previously analyzed (DOI 2016). At the mouth of East Ravine, sediment and porewater samples were collected in 2016 and analyzed for all constituents. Details of the East Ravine sediment and porewater sampling are presented in Attachment C4-1 of the Final Soil RFI/RI Work Plan (CH2M 2013).

Sediment samples were also collected from locations in the river (as shown on Figure 2-1 of the RFI/RI Report Volume 2 [CH2M 2009a]). These samples were collected primarily to assess if the geochemical conditions in shallow sediments below the river favor chromium reduction. The sampling results from these sediment samples are described in the Porewater and Seepage Study Report (CH2M 2006b).

2.3 Site Physical Characteristics

The site is located in the Mohave Valley, along the California-Arizona border in eastern San Bernardino County, California. The Chemehuevi Mountains are located to the south and the Colorado River is located to the east and north. The site occupies approximately 3 square miles of the north-sloping piedmont alluvial terrace and floodplain along the northern margin of the mountains. A detailed description of the site geology and hydrogeology can be found in the Final RFI/RI Report Volume 1 (CH2M 2007a); the following sections briefly describe the site physical characteristics from that report. Figures associated with the descriptions in this section were presented in the RAWP (Arcadis 2008a).

2.3.1 Geology

Alluvial terraces and incised drainage channels characterize the landforms. BCW is a prominent desert wash that crosses the site from south to north. Floodplains lie adjacent on each side of the Colorado River, though they do not flood due to flow regulations of the Davis Dam, approximately 40 miles north of the site. On the study area side, the floodplain is approximately 500 feet in width. Topography ranges from 450 feet above mean sea level (msl) to 1,200 feet msl within 1 mile of the Colorado River (CH2M 2007a).

The site is in the Basin and Range geomorphic province, with parallel fault-block mountains separated by alluvial valleys. The Chemehuevi Mountains are the dominant geologic feature in the site vicinity, a metamorphic and plutonic basement core complex exposed in southeastern California and western Arizona. A prominent geologic structural feature is a Miocene-age, low-angle normal fault that forms the northern boundary of the mountains (CH2M 2007a). The TCS lies upon the north-sloping piedmont terrace along the northern margin of the mountains.

In the floodplain area, the unconsolidated alluvial and fluvial deposits are underlain by the Miocene conglomerate and pre-Tertiary metamorphic and igneous bedrock. In the upland area, the subsurface shallow aquifer zone consists of alluvial deposits. These unconsolidated deposits are up to 400 feet thick in the area of the site where wells have been installed. Up to 340 feet of the unit is saturated. Lithologic logs and hydraulic testing suggest that the alluvial materials undergo facies changes across the site. Additionally, some interfingering of coarser material is observed throughout the sediments (CH2M 2007a).

Furthermore, dredging of river sediments has occurred near the site. The historical aerial photographs for the study area (included in Section 3.3 of the Final RFI/RI Report Volume 1, CH2M, 2007a) provide information on the general timeframes and locations of dredging, as evidenced by the extensive sand dune areas present in the historical photographs on both the western and eastern shorelines of the Colorado River. Sources of dredge sand were along main river channel and may include Topock Marsh (Arizona side near Marina) as well as CA side Park Moabi.

2.3.2 Hydrology and Hydrogeology

The site is located within the Sonoran Desert region of the Basin and Range geomorphic province and is situated at the southern end of the Mojave groundwater basin (Anderson 1995, Anderson et al. 1992). The mountains are roughly parallel north/south and separated by alluvial basins. The Colorado River runs north to south through the basin. The site is located at the southern extent of unconsolidated alluvial aquifer material in the Mohave groundwater basin (CH2M 2007a).

Groundwater occurs under unconfined to semi-confined conditions within the alluvial fan and fluvial sediments beneath most of the Topock site. The saturated portion of the alluvial fan and fluvial sediments are collectively referred as the Alluvial Aquifer. In the floodplain area adjacent to the Colorado River, the fluvial deposits interfinger with, and are hydraulically connected to, the alluvial fan deposits. The unconsolidated alluvial and fluvial deposits are underlain by the Miocene Conglomerate and pre-Tertiary metamorphic and igneous bedrock with very low permeability; therefore, groundwater movement occurs primarily in the overlying unconsolidated deposits.

Water chemistry is generally dominated by sodium and chloride, and total dissolved solids vary considerably. Generally, groundwater flow is north to northeasterly, in contrast to the southerly flow of the majority of the Mohave Valley (CH2M 2007a). Groundwater moving south down Mohave Valley is diverted to an easterly-northeasterly direction by the low-permeability bedrock of the Chemehuevi Mountains. The measured saturated thickness of the alluvial aquifer at the site ranges from as little as 30 feet in the southern floodplain area (at MW32) to 260 feet in the IM 3 injection area and 340 feet in the northern floodplain area (MW-49) (CH2M 2007a7).

Reducing conditions have been documented in most shallow to mid- depth fluvial wells and sediments near and underlying the river. South of the railroad tracks, these reducing conditions are also encountered in deep wells near and beneath the river. The observed reducing conditions are characterized by the presence of organic carbon, dissolved iron, dissolved manganese, and ammonia in groundwater samples. Under non-pumping conditions, as chromium-6 migrates in groundwater from non-reducing conditions in the alluvial and deep fluvial sediments to reducing conditions near and beneath the river, it undergoes chemical reduction and reverts to chromium-3 which is immobilized in the sediments.

The fluvial sediments in the floodplain are relatively recent in origin and contain abundant organic material from several sources. Following the construction of Parker Dam in 1938, the river channel near Topock began to accumulate silt. The river level rose approximately 27 feet, and the channel near Topock became a braided stream. Organic material, probably from vegetation in the Topock marsh area, was incorporated into the fluvial sediments. Some of these organic-rich sediments were deposited directly on the floodplain. In addition, dredging operations resulted in placement of additional organic-rich river bottom materials on the floodplain. The reducing conditions observed in the floodplain sediments are likely caused by microbial breakdown of the organic carbon present (regardless of the source) in these shallow fluvial deposits. These reducing conditions in the fluvial deposits play a key role in the attenuation of chromium-6.

A detailed groundwater CSM was presented in the Final RFI/RI Report Volume 2 (CH2M 2009a). The integration of the groundwater CSM in relation to the soil CSM will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

2.4 Ecological Habitat Characteristics

The site is located adjacent to the 37,515-acre HNWR managed by USFWS. The area is characterized by arid conditions and high temperatures and consists of a series of terraces divided by dry desert washes (CH2M 2007a). The site is located either within the Mojave Desert province of California, the Colorado Desert, or the boundary between these two deserts (CH2M 2007a). The biological characteristics of the Action Area (was previously referred to as the Area of Potential Effects [APE]) have been investigated and surveyed in great detail over the years. The following sections provide a general overview of the reports relevant to the ERA and includes a summary of the biological assessments and ecological characteristics for upland, BCW, and riparian habitats. This information has been excerpted from the PBA documents (CH2M 2007b, 2014a), reinitiation requests for the PBAs (PG&E 2017a, b), Wetland and Other Waters of the U.S. reports (PG&E 2013, 2014), floristics reports (CH2M 2017b), Draft Soil EIR (DTSC 2014b), Final Groundwater Remedy EIR (DTSC 2011a), Revised Final RFI/RI Report Volume 1 (CH2M 2007a), and others as referenced in this section; these documents should be consulted for additional information.

2.4.1 Programmatic Biological Assessments

The PBA for the PG&E TCS remedial and investigative actions (CH2M 2007b) and the PBA for the final groundwater remedy (CH2M 2014a) were prepared to evaluate the potential effect on species protected under the federal Endangered Species Act resulting from past, present, or planned remedial and investigative activities up to the selection and implementation of the final remedy. The primary purpose of the PBAs was to put into context the status and management of Endangered Species Act species within or near the Action Area and to better evaluate the effects of current and future proposed activities on those species and habitats. The Action Area term is defined as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02).” The Action Area is approximately 1,434 acres and includes land in California and Arizona, separated by the Colorado River and open water and makes up approximately 157 acres.

On November 30, 2017, PG&E requested a reinitiation of informal consultation with USFWS under Section 7 of the Endangered Species Act for the 2007 PBA (PG&E 2017a) and on December 1, 2017, PG&E requested a reinitiation of informal consultation with USFWS under Section 7 of the Endangered Species Act for the 2014 PBA (PG&E 2017b).

The PBA (CH2M 2007b, 2014a) and the reinitiations for the PBAs (PG&E 2017a,b) concluded an effects determination of “may affect but is likely to not adversely affect” for all the special-status species evaluated and their critical habitat for ongoing and planned activities at the site, including federally listed species: southwestern willow flycatcher (*Empidonax traillii extimus*), Western yellow-billed cuckoo (*Coccyzus americanus occidentalis)*, Agassiz’s desert tortoise (*Gopherus agassizii*), Yuma clapper rail (*Rallus longirostris yumanensis)*, Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus)* and bonytail chub (*Gila elegans)*.USFWS concurred with these conclusions in 2018 (USFWS 2018a, b). The USFWS stated that a listing for Morafkai’s desert tortoise (*Gopherus morafkai*) was not warranted and consultation on this species is no longer required (USFWS 2018a). Additionally, U SFWS stated that a review for the northern Mexican garter snake (*Thamnophis eques megalops*) was not required based on the determination of “no effect” (USFWS 2018a). The Morafkai’s desert tortoise and northern the Mexican garter snake were not addressed in the reinitiation of consultations.

Three additional special-status species that were addressed in the Draft Soil EIR (DTSC 2014b), but had not been represented in the Final Groundwater Remedy EIR (DTSC 2011a), include a California fully protected species, ring-tailed cat (*Bassaricus astutus*), -and Nelson’s desert bighorn sheep (*Ovid canadensis nelsonii*), which is not formally listed. One plant species, mouse-tail suncup (*Chylisima arenaria*), is a California rare plant but is not formally listed. In addition, one species of bat, Townsend’s big-eared bat (*Corynorhinus [Plecotus] townsendii*), a state species of concern, was not considered in either the Draft Soil EIR (DTSC 2014b) or in the Final Groundwater Remedy EIR (DTSC 2011a). Because none of these species are federally listed, none of these species are discussed in the PBA documents (CH2M 2007b, 2014a; PG&E 2017a, b; USFWS 2018a, b), but they were discussed in a 2015 technical memorandum CH2M (2015b) and the Statement of Decision and Resolutions of Approval for the Final Groundwater Remediation Project Subsequent Environmental Impact Report (DTSC 2018a). These species have been observed at or close to the site (see discussions in this section). The 2015 technical memorandum (CH2M 2015b) concluded that that implementation of corrective measures on a program-wide basis would ensure that any potential project impacts to these species would remain at a less than significant level.

2.4.2 Uplands/Terrestrial Areas

The terrestrial habitats are typical of Mojave Desert uplands, and the plant communities consist of creosote bush scrub (*Larrea tridentate*), tamarisk thicket (*Tamarisk spp*.), arrow weed thickets (*Pluchea sericea*), blue verde woodlands (*Parkinsonia florida*), catclaw acacia thorn scrub (*Accacia greggi*), hillside palo verde (*Parkinsonia microphylla*), allscale scrub dominated by the cattle saltbush (Atriplex polycarpa), quailbrush scrub (*Atriplex lentiformis*), western honey mesquite bosque (*Prosopis glandulosa*), and screwbean mequite bosque (*Prosopis pubescens*). Creosote bush scrub is the dominant upland plant community (CH2M 2014a, 2017b). The area is sparsely vegetated with widely distributed creosote bushes. The creosote bush and saltbush scrub plant communities comprise approximately 974 acres within the Action Area. Tamarisk thicket is found primarily on the east side of the Oatman-Topock Highway in the Sacramento Wash and along the low sandy terraces adjacent to the Colorado River and the inlet to Park Moabi Slough. Arrow weed thicket is found on the low sandy terraces along the Colorado

River and Park Moabi Slough. Blue palo verde woodland occurs along the edges and throughout the channel bottoms of the larger ephemeral washes in the dissected alluvial terraces south of the Colorado River. Catclaw acacia thorn scrub is limited to the bottoms of moderate-sized ephemeral washes in the dissected terraces south of the National Trails Highway. Hillside palo verde scrub is restricted to a small area east of the compressor station along the slopes of the Chemehuevi Mountains. Allscale scrub is most common along the National Trails Highway south of the Park Moabi Slough and Colorado River confluence. Quailbush scrub is dominated by big saltbush (*Atriplex lentiformis*) and occurs on low-lying alkaline or saline soils, most common in Arizona. Western honey mesquite bosque is mostly found on the low sandy terraces along the Colorado River in California north of I-40 and in Arizona north of the Topock Marsh Inlet. Screwbean Mesquite bosque is almost entirely restricted to the low terraces along the California side of the Colorado River where it is concentrated in three relatively small areas from Moabi Regional Park to the I-40 bridge. Upland plant species observed in the Action Area and/or with in the Topock site during the March 2017 pre-construction survey and reported in the 2017 Floristic Report (CH2M 2017b) are listed in Table 2-1.

Terrestrial wildlife diversity is considered low because of the disturbed nature of the land and the incomplete wildlife corridor (CH2M 2014a). Representative upland avian, mammalian, and reptilian species that can potentially be present or have been observed during surveys or incidentally are listed in Table 2-2.

2.4.3 Bat Cave Wash

BCW is one of the largest ephemeral drainages within the Action Area. The BCW is a primarily north-south-trending channel located west of the Colorado River, in the Mojave Wash habitat. This wash remains dry throughout most of the year due to arid desert conditions. Large volume surface flows are generally infrequent and occur only briefly in response to high intensity rainfall events. BCW is a tributary of the Colorado River and storm water flows are conveyed directly into the river under a bridge along the National Trails Highway (PG&E 2013).The upper reaches is confined by steep rocky slopes and has an approximately 30-foot-wide gravel-cobble floodplain (PG&E 2013, 2014) and relatively barren of vegetation, consisting of scattered shrubs such as Anderson's box-thorn (*Lycium andersonii*), catclaw (*Senegalia greggii*), and desert lavender (*Hyptis emoryi)* (CH2M 2014a, 2017b). As the wash continues down slope, the channel broadens to over 190 feet wide in some areas and multiple low-flow channels are present throughout the active floodplain. Vegetation cover also increases down slope with blue palo verde (*Parkinsonia florida*) and tamarisk saltcedar (*Tamarix ramosissima*) trees scattered throughout the active floodplain. Other common shrubs on or immediately adjacent to the active floodplain include brittlebush (*Encelia farinosa*), creosote bush (*Larrea tridentata*), white bur-sage (*Ambrosia dumosa*), sweetbush (*Bebbia juncea*), and white rhatany (*Krameria bicolor*) (PG&E 2013, 2014). In the Tamarisk Thicket area, palustrine scrub-shrub temporarily flooded wetland vegetation consists of dense stands of tamarisk and salt cedar that is present west of National Trails Highway (PG&E 2013). At the far east of the Tamarisk Thicket on the west side of National Trails Highway, ponded water is typically present in a small area. Excluding this small pond, the wash sediments in the AOC1/BCW area (including the Tamarisk Thicket) are typically dry, except during seasonal rain events that can cause ephemeral flooding in this area. These dry wash soils transitioning to sediments were evaluated as part of the upland/terrestrial areas.

2.4.4 Riparian Corridor

The Colorado River is the primary aquatic habitat near the site and is located approximately 1,300 feet east of the TCS. Upstream of the I-40 bridge, the river channel ranges from approximately 600 to 740 feet wide. Downstream of the bridge, the river traverses the exposed bedrock of the Chemehuevi Mountains, and the channel width narrows to approximately 435 feet (PG&E 2013). The channel banks along the Arizona side of the river north of the Topock Marina are characterized by steep slopes that have been armored with large boulders. The elevation at the top of the bank is approximately 466 feet above msl. The banks along the inlet to the Topock Marina are characterized by narrow sandy beaches and eroded sandy banks at elevations ranging from around 460 to 463 feet above msl. Low sandy beaches are also present along the Arizona side of the river south of the Topock Marina and the BNSF railroad bridge. Steep sandy banks with dense vegetation are present along most of the channel on the California side of the river, with narrow sandy beaches occurring in scattered locations.

The riparian areas within or adjacent to the Topock site is described in the Jurisdictional Areas report (PG&E 2014) and summarized here. Riparian vegetation includes areas of emergent vegetation along the edges of the Colorado River, trees and shrubs growing immediately adjacent to the Colorado River and adjacent wetlands that have a direct hydrologic connection with the Colorado River. Vegetated areas along the low terraces located above the high-water limit of the Colorado River, that are not subject to occasional flooding were not considered to be riparian habitat as reported in the Jurisdiction Areas report (PG&E 2014). Riparian habitat associated with the Colorado River include scattered patches of southern cattail (*Typha domingensis*), California bulrush (*Schoenoplectus californicus*), common reed (Phragmites australis) and giant reed (*Arundo donax*) growing along the edges of the Colorado River. Most of these areas occur below the ordinary high water line or on low terraces that are likely subject to regular flooding. Patches of emergent vegetation are less common along the Colorado River and occur in scattered locations along the south/west bank as well as in the vicinity of the Topock Marina. Also included are areas with California bulrush along the mouth of BCW and areas with broad-leaved cattail (*Typha latifolia*) in the mouth of the East Ravine. Much of the riparian vegetation associated with the rocky banks adjacent to the water's edge is characterized by scattered patches of saltcedar and arrow weed (*Pluchea sericea*), with some locally dense areas of honey mesquite.

Various wildlife and plant species are supported by the riparian habitat and representative species lists are presented in Tables 2-3 and 2-4.

Riparian areas consist of saturated sediments and sediments data are defined as sample results collected from areas that are typically inundated with water even in the absence of storm events. As mentioned previously in Section 2.2.5, two sediment investigation study areas are present along the Colorado River. The areas include both saturated sediments along the edge of the Colorado River that are ephemerally (temporarily) flooded. One sediment area is located at the mouth of BCW, northeast of AOC1 between National Trails Highway and the Colorado River. The other sediment area is located at the mouth of East Ravine (east of AOC10). Per the RAWP (Arcadis 2008a), these sediment areas would be evaluated if transport pathways of surface soil entrained in runoff are identified as complete and significant. The horizontal extent of contamination in surface soil and, thereby, the potential for surface soil entrained in runoff to reach the sediment (and eventually the river) were evaluated for BCW and AOC 10/East Ravine as described in Section 2.5.2.

2.4.5 Special-Status Species

Habitat exists for special-status species including threatened or endangered (T&E) species (federal- and state-listed) as discussed in the PBA (CH2M 2007b, 2014a), reinitiation requests for the PBAs (USFWS 2018a,b), and other reports (DTSC 2018a; CH2M 2015b).

No federal- or state-listed T&E plants or candidates for listing were found at the site. Culturally sensitive species (ethnobotanical plants) under the California Desert Native Plant Act (CDNPA) have been observed at the site or within the Action Area including blue palo verde, catclaw acacia, desert smoke tree, and the western honey mesquite. Mousetail suncup and the hillside palo verde are California Rare Plants. The largest population of mousetail suncup (with approximately nine individuals) is located on a vertical conglomerate rock wall above BCW (CH2M 2014a). Single individuals also occur on conglomerate rocks above the wash south of I-40 and on a granitic rock face at the southern end of the wash. It also occurs on a steep rocky slope next to the BNSF railroad tracks. These populations represent a significant range extension for the species as they are over 90 miles northeast of previously recorded populations in California. Hillside palo verde was found in areas to the south of I-40 on the rocky north-facing slopes of the Chemehuevi Mountains. The number of individuals in this population is approximately 150 trees.

Several wildlife species are known to occur or have potential to occur on or near the site. No federal listed T&E species were observed at the Topock site, except for a single observation of the federally listed T&E species, the southwestern willow flycatcher (as discussed in this section). Other federally listed species including desert tortoise, yellow-billed cuckoo, and Yuma clapper rail were not directly observed at the site (CH2M 2014a, Konecny Biological Services [Konecny] 2012). Two large home range species have been observed at the site (BCW): the ring-tailed cat and Nelson's desert bighorn sheep. The ring-tailed cat is a California fully protected species. To be consistent with the GWRA (ARCADIS 2009b) and observations made by PG&E employees at the site, Nelson's desert bighorn sheep was evaluated. Bat surveys indicated presence cave myotis and pallid bat (state species of concern) at BCW (Harvey 2015). Townsend big-eared bats (a state species of concern) have not been directly observed at the site (Brown and Rainey 2015). Yuma myotis have also been observed onsite, although they are not listed species or species of concern. Special status species include state- and federal-listed fully protected T&E species, state and federal species of concern, and traditionally culturally significant plants; however, protection at the no observed adverse effect level (NOAEL) level is warranted only for fully protected species.

The Tamarisk Thicket area, located on the northern end of BCW is considered a potential habitat for the southwestern willow flycatcher, which is listed as a federal and state endangered species. Details of the special-status species potentially present in the Tamarisk Thicket area is presented in Appendix TT and summarized here. Garcia and Associates (GANDA) have conducted protocol-level surveys of the suitable southwestern willow flycatcher habitats within and adjacent to the Topock site from 2005 to 2017. [Note: Annual protocol surveys were conducted between 2006 and 2010, then biennial surveys were conducted after 2012-2014, and currently are being done every 3 years; the latest survey was completed in 2017.] In the Tamarisk Thicket potential exposure area, a southwestern willow flycatcher was observed in 2009 but not observed in subsequent surveys (CH2M 2014a; GANDA 2014, 2017). To date, no active nests of any migratory birds have been documented during these surveys or by protocol-level surveys conducted up to 2017. During the most recent survey in 20177 (GANDA 2017), five southwestern willow flycatchers were observed, but none in the Tamarisk Thicket area. Based on the single detections for each observation, it was concluded that they were most likely transient rather than nesting birds (GANDA 2014, 2017).

Tables 2-1 through 2-4 provide a lists of upland and riparian species with relevant habitat, feeding guild, and potential presence or absence based on site conditions.

2.5 Conceptual Site Model

The CSM for the site is used to show the relationships between a chemical source, potential exposure pathway, and potential receptor. The fate and transport components of a CSM include:

- Potential sources
- Release mechanisms
- Retention and transport media.

These components constitute the fate and transport portions of the CSM and apply to both the HHRA and ERA. The CSM also includes exposure routes and potential receptors, which are discussed in Sections 5.3 and 6.3 of the HHRA and ERA, respectively.

The source-pathway-receptor relationships illustrated on the CSM figures (Figures 2-2 through 2-7) provide the basis for the quantitative exposure assessment. CSMs for the HHRAs are presented on Figures 2-2 through 2-6, as follows:

- Figure 2-2 presents a CSM for BCW (i.e., SWMU 1/TCS-4, AOC1, and AOC28d).
- Figure 2-3 presents a CSM for the hypothetical future resident on USBLM land north of the railroad (excluding FMIT land).
- Figure 2-4 presents a CSM for all other AOCs (excluding BCW) located outside the TCS.
- Figure 2-5 presents a CSM for all AOCs (including BCW) located outside the TCS.
- Figure 2-6 presents a CSM for areas inside the TCS.

The CSM for the ERAs is presented on Figure 2-7.

2.5.1 Sources of Soil Contamination

The CSMs (Figures 2-2 through 2-7) show the types of activities and events inside and outside the compressor station that could be potential sources of site-related constituents in the soil. Most sources for site-related compounds found both inside and outside the TCS originated from inside the TCS or from associated activities, including potential incidental spills/releases from the following potential areas: tanks, sumps, and pipelines; sludge drying beds; sandblasting area; auxiliary jacket water cooling pumps; cooling water treatment products; former cooling liquid mixing area; floor drains inside the TCS; hazardous materials storage building and paint locker; and the septic system. The primary sources of soil contamination in areas outside the TCS, excluding BCW, are disposal of debris, burning activities (AOCs 4, 11, 14, and 27), potential leaks from the aboveground tanks, potential leaks from the pipeline disposal area, and potential incidental discharges/runoff from the TCS. As previously described, the BCW area was the primary receiving area of past discharges of untreated wastewater and cooling water to surface soil. From 1951 to 1964, untreated cooling tower blowdown water containing hexavalent chromium was discharged to BCW near the TCS. Treated wastewater was released to BCW from 1964 to 1969. Beginning in May 1970, treated wastewater was also discharged to an injection well (PGE-08) located on PG&E property, and discharges to the BCW generally ceased (CH2M 2007a).

Current data indicate that the primary site related constituents in soil are metals, with the primary compound being hexavalent chromium (CH2M 2007a). In addition to metals, potential sources of dioxins and furans near the TCS may include historical industrial activities such as fire suppression exercises and burning of garbage. Other sources of dioxins and furans may include unauthorized dumping and pruning; regional wildfires; combustion of diesels and deaded gas; and exhaust from cars, trucks and trains.

2.5.2 Potential Transport Mechanisms

Once constituents are in soil, the potential pathways through which the constituents may move from the soil to other environmental media include surface water runoff, leaching to groundwater, fugitive dust emissions, and volatilization of VOCs from soil and release into ambient/indoor air. The following sections summarize the primary potential transport pathways that are considered viable and could conceivably carry a significant flux of constituents away from the constituent source areas.

2.5.2.1 Surface Water Runoff

Surface water runoff is a primary mechanism by which constituents bound to soil can be transported away from the original area of release. The topography at the TCS site is highly variable. For example, the TCS is a high point for the area, with the lower yard below the main level, but still higher than the adjacent BCW (SWMU 1/AOC1) and the Debris Ravine (AOC4). Transport of constituents adsorbed to soil particulate matter that move with surface water runoff and overland flow is a potential migration pathway for constituents detected in surface soil. Runoff eventually discharges into low-lying depositional areas where compounds may be redeposited in the surface soil. As described in Section 2.5.2.5, although it is possible for constituents detected in surface soil from potential source areas to be transported into low-lying depositional (i.e., sediment) areas, the surface soil transport analysis supports that deposition in sediment areas is insignificant for constituents entrained in surface soil run-off. Section 2.5.2.5 provides additional discussion of potential surface soil transport analysis.

2.5.2.2 Leaching to Groundwater

Leaching of constituents by infiltrating soil pore waters to deeper levels of the vadose zone and to the groundwater is a potential migration pathway for constituents that may not remain bound to soil. Constituent migration in soil and water is governed not only by the physical attributes of the environment, such as evapotranspiration rates, but also by compound-specific physical/chemical properties, including solubility and soil adsorbency. The significance of the leaching pathway will be evaluated in the Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs). The preliminary results of the threat to groundwater evaluation supports that site related compounds in soil do not pose a threat to groundwater at any of the investigation units.

2.5.2.3 Fugitive Dust Emissions

Because of the arid conditions of the site, the potential exists for constituents to be adsorbed to soil particulates and those particulate emissions to be released to the surrounding air during wind erosion of soil with no vegetative cover. In addition, particulate emissions may occur if the soil were to be disturbed. Accordingly, potential exposure to fugitive dusts is evaluated in the Soil HHERA for site-related constituents present above background.

2.5.2.4 Volatilization of VOCs in Soil and Soil Gas into the Outdoor and Potential Indoor Air

Soils inside the TCS and at select locations outside the TCS were analyzed for VOCs. Additionally, as required by DTSC, soil gas samples were collected at five locations within the TCS to evaluate the significance of some potential TPH releases, particularly in areas where the release was deep, and/or where access for soil borings was extremely limited. Although VOCs were detected very infrequently in soil samples (less than 2% of all soil samples collected outside the TCS; less than 3% of all soil samples collected inside the TCS), and at low concentrations in both soil and soil gas samples, these VOCs have the potential to migrate up through the soil and be released into outdoor air and indoor air (inside the compressor station, where buildings exist). Accordingly, potential exposure to VOCs in outdoor and indoor air (inside the TCS only) is evaluated in the Soil HHRA.

2.5.2.5 Surface Soil Transport Pathway Analysis (SSTPA) for BCW and AOC10

BCW is a wash extending from AOC1/SWMU1 in the south and running north toward the Colorado River. AOC10, also referred to as the East Ravine area, is a small ravine located on the southeast side of the TCS and the ravine runs eastward toward the Colorado River (Figure 2-1a). The potential for surface soil entrained in runoff to reach the sediment areas along the river's edge (and eventually the river) was evaluated following the gradient analysis approach outlined in the RAWP (Arcadis 2008a). Gradient analyses were completed to evaluate this transport pathway for BCW and AOC10. The three possible outcomes for this evaluation are to find this migration pathway: (1) potentially complete and significant; (2) potentially complete and insignificant; or (3) incomplete. If the pathway is deemed to be potentially complete and significant, then a quantitative risk characterization for sediment would be included in the H HERA. If the pathway is found to be potentially complete and insignificant, or incomplete, then a quantitative evaluation of potential sediment exposure in these depositional areas is not warranted.

For the analyses of BCW and AOC10, concentrations of COPCs/COPECs considered to be site-related based on site history and use, as reported in the Final Soil RFI/RI Work Plan (CH2M 2013), were used as indicator chemicals representative of the potential transport pathway. Indicator chemicals included hexavalent chromium, total chromium, and dioxins/furans. For dioxins/furans, the dioxin TEQs were not used for the gradient analyses. TEQs are weighted and summed concentrations which include modifying factors for relative congener toxicity and method RLs for NDs. Therefore, TEQs are not appropriate for evaluating concentration trends (see Section 5.5.1 for further discussion of TEQ). Instead, the individual dioxin/furan congeners were used for the gradient analyses. [Note: To focus the analyses for dioxins/furans, the hepta- and octa- dioxin/furan congeners were not included in the analyses as these constituents contribute less significantly to the total TEQ and are more frequently associated with background sources of dioxins/furans. Only the tetrachlorodibenzo-p-dioxin (TCDD)/F, hexa-, and penta-congeners were evaluated.]

For the gradient analyses, concentrations of the indicator chemicals in surface soil (0 to 1 foot bgs) were plotted across the site gradient in an orientation starting from the upland/upgradient locations and going downgradient towards the river. [Note: Surface soil for the risk assessment was defined as soil from 0 to 0.5 foot bgs, but for this evaluation, samples with end depths of 1 foot were included to increase the sample size for the trend analysis. These included data with sampling bottom depths of 1 foot from 45 locations at BCW and 14 locations at AOC 10.] Concentrations of indicator chemicals in surface soil along this gradient were compared to background (BTVs and range of background concentrations when available; Table 3-6 series; CH2M 2009c, 2013, 2017a). If concentrations of indicator chemicals in site soil decreased downgradient and became below the RLs or within the range of background before reaching sediment in the riparian area, this pathway was interpreted to be insignificant. If the gradient analysis indicated potential for a complete and significant transport pathway, further evaluation of the sediment areas was considered.

The approach and conclusions of the gradient analyses for BCW and AOC10 are presented in this section. Detailed discussions of the indicator chemical trends (gradient plots) used for evaluating the surface soil transport pathway for BCW and AOC10 are presented in Appendix SSTPA.

2.5.2.5.1 Gradient Analysis Approach

Surface soil data (0 to1 foot bgs) from BCW and AOC10 were used in this transport pathway analysis; these data and the corresponding sample location figures for BCW and AOC10 are presented in Appendix SSTPA. For the gradient analysis, concentrations of an indicator chemical in surface soil were plotted along an axis defined by the orientation of potential runoff flow in the wash/ravine for each exposure area (BCW and AOC10) separately. The gradient plots for BCW and AOC10 are presented in Appendix SSTPA. Landmarks were selected for each exposure area as points of reference along the x-axis of the gradient plots.

In the gradient plots, concentrations of indictor chemicals in surface soil were color-coded to distinguish between detected and ND results. ND results are represented as the RLs. Each figure also presents the BTV, for comparison. Additionally, the shaded range in each figure represents the range of concentrations from the background soil datasets, when available.

Historically, constituents in surface soil in BCW may have been eroded and entrained in stormwater/ surface water runoff during flooding events and may have been subsequently re-deposited in downgradient areas, including potentially in the Tamarisk Thicket area. The thick vegetation, widening of the channel near in the northern part of BCW (Tamarisk Thicket area) and blockage of flow by National Trails Highway greatly reduces the energy of flow during runoff events, resulting in deposition of entrained soil within the vegetated area in the Tamarisk Thicket area. This heavily vegetated portion of BCW is a long-term depositional area that has existed since before the compressor station was built (CH2M 2013).

Surface water, when present in BCW, flows from south to north, with the upgradient southern sampling locations representing areas closest to the TCS and the northern downgradient sampling locations in the Tamarisk Thicket, the northernmost area of BCW before it transitions to sediment east of National Trails Highway. For orientation of BCW and potential downstream movement during flow events, please see

Figures C2-3 and C2-4 of the Final Soil RFI/RI Work Plan (CH2M 2013), Appendix A Subappendix C, the CSM for AOC1 South and AOC1 North, respectively (for ease of review, these figures are included as Attachment A in Appendix SSTPA). For BCW gradient plots, the Y-global positioning system (GPS) coordinate (northing) was used as an indicator of the relative position of a soil sample along the x-axis and the surface soil concentration was plotted on the y-axis of each gradient plot.

As mentioned previously, AOC10 is approximately 1,600 feet long and is bisected by three constructed berms (one constructed berm and two dirt roads, also constructed berms). The eastern berm is the only berm that contains a culvert. Due to the berms, surface flow from most of the length of this ravine (west of the eastern berm that forms the eastern boundary of AOC10d) does not typically reach the Colorado River (CH2M 2013). The drainage for this ravine includes runoff from the compressor station access road (a curb was installed along the access road in 2006), runoff from the mountains to the south, and runoff from the TCS itself.

Surface water, when present at AOC10, flows from west to east, with the upgradient western sampling locations representing areas closest to the TCS and the eastern downgradient sampling locations within or adjacent to subarea AOC10d (i.e., the drainage depression area west of the easternmost berm closest to the service road), before it transitions to sediment along the Colorado River. For orientation of AOC10 and potential downstream movement during flow events, please see Figure C4-2 of the Final Soil RFI/RI Work Plan (CH2M 2013), Appendix A Subappendix C, the CSM for AOC10, and Figure C4-2, the CSM cross section for AOC10 (for ease of review, these figures are included as Attachment A in Appendix SSTPA). For AOC10, the X-GPS coordinate (easting) was used as an indicator of the relative position of the soil samples along the x-axis and the surface soil concentration was plotted on the y-axis of each gradient plot.

2.5.2.5.2 Conclusions for the Gradient Analyses

For BCW, the gradient analyses indicate that concentrations of indicator chemicals decrease moving from upland and potential source areas down the wash to concentrations below the RLs or within the range of background in the downgradient area (Tamarisk Thicket area) before reaching sediment in the mouth of BCW.

Based on the gradient analyses and the physical characteristics of BCW, specifically the Tamarisk Thicket area, potential transport of indicator chemicals and other constituents from surface soil entrained in runoff from upland areas at BCW to downgradient locations may potentially be complete; however, this pathway is not considered significant based on the low concentrations and NDs in the northernmost BCW soil locations west of the National Trails Highway, before soil transitions to sediment. Therefore, a quantitative risk evaluation of the BCW sediment area, east of the National Trails Highway was not required, as subsequent sediment exposure pathways would likewise be insignificant. This conclusion is further supported by data showing that concentrations of the indicator chemicals (and dioxin TEQ) are low (below the BTVs) or not detected in the BCW sediment area.

For AOC10, the gradient analyses indicate that concentrations of indicator chemicals decrease moving from upland and potential source areas down the ravine to concentrations below the RLs or within the range of background in the eastern most locations sampled prior to reaching sediment in the mouth of the East Ravine.

Based on the gradient analysis and the physical characteristics of AOC10, potential transport of indicator chemicals and other constituents from surface soil entrained in runoff from upland areas at AOC10 to downgradient locations may potentially be complete; however, this pathway is not considered significant based in the low concentrations and NDs in the eastern most locations of AOC10, before soil transitions to sediment. Therefore, a quantitative risk evaluation of the East Ravine sediment area was not conducted, as subsequent sediment exposure pathways in the area would likewise be insignificant. This conclusion is further supported by the data that show concentrations of the indicator chemicals (and dioxin TEQ) are low or not detected in the East Ravine sediment area.

Potential impacts of localized hots spots will be completed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs); the impacts will be evaluated in light of potential HHERA impacts, and the HHERA will be revisited if the analysis warrants.

2.6 Land Use

Current uses of the site and the surrounding areas, as well as the reasonably anticipated future land uses, are described in this section.

2.6.1 Current Land Use

The TCS is located in a sparsely populated, rural area. The surrounding area has important spiritual meaning to the FMIT and other lower Colorado River Indian tribes. The TCS occupies approximately 15 acres of a 65-acre parcel of PG&E-owned land. FMIT owns a 100-acre parcel located about 0.25 mile north of the TCS, currently being used to facilitate IMs. In addition to the 100-acre parcel owned by FMIT, the surrounding area includes land owned and/or managed by a number of government agencies, including the USBLM, USBOR, USFWS, San Bernardino County, California Department of Transportation, and BNSF Railroad (Figure 1-2). Industrial or commercial developments within a 1-mile radius include the TCS and IM 3 treatment plant facility. Current land use does not include residential use in any part of the site. The nearest residents are located 2,000 feet way across the river in Topock, Arizona, a community of about 20 people in a small mobile home park near the Topock Gorge Marina. Most of the residents in Topock are retired senior citizens who live in the area part of the year, typically from late fall through spring. A few permanent homes that are occupied all year are located on the southern side of I-40, along the shoreline between the pipeline bridge and I-40.

The largest nearby community is Golden Shores, Arizona (population of about 3,000 people), located approximately 8 miles to the northeast and on the opposite side of the Colorado River from the TCS. The city of Needles, California, with a population of about 4,800 people, is located approximately 15 miles northwest of the facility.

Moabi Regional Park is a recreational facility operated by the San Bernardino County Department of Parks and Recreation. It is located on land leased from USBLM, approximately 1 mile northwest of the TCS on the west shore of the Colorado River. The park encompasses approximately 1,050 acres, includes a boat marina and 105 campsites, and provides access to the river for various sport and recreational activities. The park is located on a side channel of the Colorado River, approximately 1 mile west of the main river channel. The mobile homes are used primarily as weekend residences. As a regional park, it has no full-time residences. No year-round residents live here because campers are limited to 5-month stays. The park does not keep records of residency; therefore, the number of people at the park at any given time is unknown.

Due to the openness of the federal land and limited restrictions to site access, recreational access is potentially present across much of the site. As indicated by DOI (2014b), recreational land use can encompass a variety of activities including (but not limited to) hiking, camping, hunting, visiting historic Route 66, and riding off-highway vehicles (OHVs also known as all-terrain vehicles [ATVs]).

The USBLM-managed lands within the area are owned by USBLM, San Bernardino County, and USBOR. These lands are considered public. However, public use is discouraged, as the Topock Maze, a culturally significant area for several Native American tribes is located here.

The Tribes indicated in a memorandum (FMIT 2012) and a letter (FMIT 2013) that the tribal use of the land in the area of the site including the Topock Maze is limited to the following:

- Tribal Group Activities several times a year for prayer and reflection
- Tribal Education Activities for students and young people to visit the area to learn about its importance and spiritual significance
- Tribal Member Individual Visits to the Mojave Valley on a regular but infrequent basis for quiet time and reflection as part of religious practice and culture, to pay homage to the area and to honor their ancestors.

A major gas utility and transportation corridor is located within the site, including PG&E's two natural gas transmission pipelines, four natural gas transmission pipelines operated by other companies, BNSF railroad tracks, and the I-40 freeway. Other developed land uses within the site include the National Old Trails Highway, former Route 66, and various unnamed access roads. In addition, numerous groundwater well clusters, related to the ongoing groundwater investigation activities, are located throughout the site.

The HNWR is land that is managed by USFWS and encompasses approximately 37,515 acres along the Colorado River in Mojave and La Paz Counties, Arizona, and in San Bernardino County, California. Most of the HNWR extends from the upper end of the Topock Marsh southward, to the head of Lake Havasu on the Arizona side of the Colorado River. A small portion of the refuge borders the TCS. Recreational activities at the HNWR include sightseeing, bird watching, fishing, hunting, camping, and canoeing.

Figure 1-2 presents a map depicting the current owners and managers of the land in the area surrounding the TCS.

2.6.2 Future Land Use

PG&E plans to continue owning and operating the TCS and associated property inside and outside the fenceline as an industrial operation for the foreseeable future. Accordingly, the reasonably anticipated future use of the TCS is for ongoing industrial operations.

Similarly, it is reasonable to assume that land that is owned by BNSF Railroad and land that is leased by the California Department of Transportation will continue in the future to be used for the railroad and interstate highway, respectively.

As indicated previously, and as depicted on Figure 1-2, a large portion of the land near the TCS is owned and/or managed by the USBLM and HNWR. Based on information provided by DOI, current and future land use on national wildlife refuges is guided by the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (USFWS Organic Act; DOI 2007b). The USFWS Organic Act describes the mission of the National Wildlife Refuge System (the System) as the administration of:

> "…a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

In addition to outlining the conservation mission, the USFWS Organic Act details requirements for the management and use of a refuge and has requirements for land-use planning at each refuge, focusing on the preparation of a comprehensive conservation plan for each refuge and detailed compatibility determinations for each refuge.

According to information presented by DOI, the primary conservation mission of USFWS as it applies to the HNWR and articulated in the USFWS Organic Act, the conservation management plans, and appropriate use and compatibility policies, limits human use of HNWR property and reduces the likelihood of transferring HNWR property out of federal ownership (DOI 2007b). According to DOI, this supports that human use of the HNWR property will continue, in the future, to be restricted to recreational uses consistent with these statutory, regulatory, and policy guidelines.

San Bernardino County has requested that the USBLM allow them to expand the leased premises into the Topock site, stretching along the floodplain from the currently leased property south to the railroad bridge. The purpose of the proposed expansion included a variety of seasonal residential and recreational uses, including mobile homes, expansion of tent camping and recreational vehicle areas, a hotel, and reconstruction of an old restaurant. According to DOI, the requested expansion by San Bernardino County would allow for new pull-through recreational vehicle camping sites and tent camping areas. These areas would be located south and east of the BCW, west of the beach area, east of old Route 66, and north of the railroad. It would seem that use of the floodplain area for camping would be considered an undertaking and would require the USBLM to determine whether camping would create any visual impacts to the Topock Maze or other eligible properties, and whether these uses are compatible with the objective of preserving these resources for the future (DOI 2007). However, according to DOI, the continuing development of adjacent property combined with USBLM's broad land management leave open the possibility that the USBLM land may be transferred out of federal ownership.

In sum, future use of the USBLM-owned land at the site, as recommended by DOI, should take into consideration the following three factors:

- It is reasonably foreseeable that the land may be transferred out of federal ownership.
- Human use of Park Moabi-leased portion will continue to include both seasonal use by the public and year-round residential use by a limited number of San Bernardino county staff.
- It is reasonably foreseeable that camping on the floodplain will occur under either San Bernardino's proposed expansion or USBLM's future use of non-leased areas.

Future unrestricted residential use of the site is highly unlikely (DOI 2014b). However, DOI (2015b) believes, for the purposes of the baseline risk assessment, that the evaluation of potential risks associated with exposure to contaminants on BLM-managed land must be conservative and include unrestricted use, typified through an evaluation of the hypothetical future residential scenario. Risk assessment, however, is a distinctly different process from risk management. In the risk management process, the results of the risk assessment are integrated with other considerations to reach decisions regarding the need for, and practicability of, cleanup actions. For the PG&E Topock remediation project, these considerations include the intrinsic value of the biological, historical and cultural resources of the Topock area. In particular, DOI (2015b) acknowledges that this area is considered a Traditional Cultural Property and that a cleanup that would allow for unrestricted use could result in significant impacts to sensitive resources. In light of these factors, DOI (2015b) will not utilize a future residential scenario on Federal lands within the project area when evaluating cleanup options in the FS phase.

3 DATA EVALUATION

Data evaluation is the process of analyzing site characteristics and analytical data to identify constituents that are potentially related to the site and for which there are data of sufficient quality to be used in a quantitative risk assessment (USEPA 1989). This section summarizes the data available for the site (PG&E 2018), the data usability criteria used to confirm that the soil dataset are suitable for risk assessment (which will be presented in the forthcoming Draft RFI/RI Report Volume 3 currently being prepared by Jacobs), the approach used in developing representative exposure areas and datasets, and the methodology for selection of COPCs and COPECs.

3.1 Summary of Data Included in the Risk Assessment

As discussed in Section 2.2, PG&E's activities in support of the RFI/RI began in 1996 with the signing of the CACA (DTSC 1996a). Since 1996, multiple phases of investigation have been conducted at the site to collect data to fulfill the objectives of the RFI/RI. This section summarizes the analytical data collected for inclusion in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs) and the soil and soil gas data evaluated in this HHERA. The sample locations for the soil and soil gas data evaluated in the HHERA are presented on Figures 3-1a and 3-1b for areas outside the TSC and on Figure 3-2 for the area inside the TCS.

3.1.1 Soil

As previously mentioned, multiple phases of investigation have been conducted at the site, from which soil data have been collected, dating back to 1997 and up through to 2017. Soil data collected during these site investigations were considered for inclusion into the soil datasets used in the quantitative risk assessment. Data from samples characterized as soil transitioning to sediment collected from BCW during these site investigations are included in the soil datasets used in the quantitative risk assessment. Soil data for the site consist of the following validated datasets provided to DOI in a soil investigation data package (PG&E 2018):

- Historical data collected prior to 2008. Historical data collected prior to the Soil RFI/RI were evaluated in the Final Data Usability Assessment for Soil and Sediment (CH2M 2008).
- Part A, Phase 1 soil investigation data (2008). These data were collected in 2008 during implementation of the RFI/RI Soil Investigation Work Plan Part A (CH2M 2006a). These data were validated as presented in the Soil Investigation Part A Phase 1 Data Gaps Evaluation Report (CH2M 2012).
- RFI/RI and data gap investigation data (2009 to 2017). These data were collected between 2009 and 2017 during the implementation of the Final Soil RFI/RI Work Plan (CH2M 2013) and subsequent data gap work plans (CH2M 2016a, b, c). The results of the validation will be presented in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

The resulting combined dataset spans a wide range of dates, analytical parameters, and data quality. During data validation, the data were classified using three data categories based on data quality:

- Category 1 – Data are suitable for all uses, including risk assessment and remedial action decisions.
- Category 2 – Data are suitable for use in characterization of the COPCs at the TCS and to help define the nature and extent of contamination.
- Category 3 – Data are suitable only for use in qualitative characterization of the nature and extent of contamination.

As indicated in the RAWP (Arcadis 2008a), only Category 1 data are included in the datasets used in the quantitative risk assessment. Soil samples representative of soil that has been removed as part of a removal action were not included in the HHERA datasets.

Soil sample were analyzed for the one or more of the following chemical analytical suites:

- Metals
- Contract Laboratory Program (CLP) inorganics
- PAHs
- Semivolatile organic compounds (SVOCs) and VOCs
- TPHs
- General chemistry parameters
- Pesticides
- PCBs
- Dioxins and furans.

In addition, soil samples were collected and analyzed for asbestos at four AOCs (AOCs 1, 4, 9, and 12) from various depths ranging from surface down to 15 feet bgs in September and October 2008 during the 2008 RFI Part A Investigation. Asbestos was detected (either report as a ‘percent’ or just ‘present’) in 21 of 121 samples (i.e., 17% of the samples). Asbestos in soil will not be evaluated in the quantitative risk assessment. Asbestos soil data will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

3.1.2 Soil Gas

Soil gas vapor probes were installed inside the TCS fenceline at locations AOC13-5, AOC13-6, and AOC 13-11 to assess AOC25 (Compressor and Generator Engine Basements), and at location AOC13-16 to assess AOC32 (Oil Storage Tanks and Waste Oil Sump), where soil sampling was not feasible. Soil gas samples were collected from AOC13-5, AOC13-6, and AOC13-11 at 3 feet bgs, and AOC13-16 at 6 feet bgs and analyzed for VOCs. Soil gas samples were collected from each of these locations in January 2016 and February 2017.

Soil gas samples were collected from AOC26-1 to characterize impacts at depth from the former scrubber sump. A multi-depth soil gas vapor sampling probe was installed in the former sump area within the boundary of AOC26 at 5 feet bgs (near the surface), 25 feet bgs (near the depth of contamination), and

50 feet bgs (below the depth of contamination). Soil gas samples were collected from this location in January 2016 and February 2016 and analyzed for VOCs.

All soil gas data are included in the dataset for the quantitative risk assessment for the inside the compressor station (ICS) potential exposure area.

3.1.3 Sediment

Historical sediment samples were collected in 2003 from 18 sample locations in the mouth of BCW and along the banks of the Colorado River upstream and downstream of the mouth of BCW. These samples were collected at 1 and 2 feet below sediment surface (bss) and analysed for Title 22 metals, CLP metals, hexavalent chromium, general chemistry parameters, and field parameters. As part of the data gap investigation and as directed by DOI (2016), four sediment samples were collected in 2017 at two locations at surface and 2 feet bss near the confluence of the wash with the river and analysed for dioxins and furans.

Implementation of the Final Soil RFI/RI Work Plan (CH2M 2013) included sediment sampling at the mouth of east ravine where it enters into the Colorado River. Thirty-five sediment samples were collected from the vicinity of the mouth of the East Ravine. Sediment samples collected between 0 and 2 feet bss were analyzed for Title 22 metals, hexavalent chromium, PAHs, SVOCs, dioxins/furans, and PCBs. Sediment samples collected between 5.5 and 6 feet bss were analyzed for chromium total, hexavalent chromium, molybdenum, PAHs, SVOCs, and PCBs.

The results of the gradient analysis, detailed in Section 2.5.3, concluded that potential transport of indicator chemicals and other constituents from surface soil entrained in runoff from upland areas at BCW and AOC10 to sediment depositional areas may potentially be complete; however, this pathway is not considered significant. Therefore, an evaluation of the BCW and East Ravine sediment area in the HHERA was not conducted, as subsequent potential exposure pathways would be insignificant.

3.1.4 Porewater

Implementation of the Final Soil RFI/RI Work Plan (CH2M 2013) included porewater sampling at the mouth of East Ravine where it enters into the Colorado River. Sixteen porewater samples were collected from 10 locations. Porewater samples were collected from 1 and 6 feet bss and analyzed for Title 22 metals, hexavalent chromium, general chemistry parameters, and field parameters. As concluded in Section 2.5.2.5, the potential transport of indicator chemicals and other constituents from surface soil entrained in runoff from upland areas at AOC10 to the East Ravine sediment area may potentially be complete; however, this pathway is not considered significant. Therefore, an evaluation of the porewater data collected at the mouth of the East Ravine in the HHERA was not conducted, as subsequent potential exposure pathways would be insignificant.

3.1.5 Other Material

Samples from matrices other than soil such as debris, tar, and white powder were collected during site investigations. The sample designated as ‘white powder’ collected from AOC9, AOC10, AOC14, and SWMU 1 are included in the datasets used in the quantitative risk assessment as a conservative measure assuming that potential exposure to material described as ‘white powder’ would not differ significantly from potential exposure to surrounding soil. Other matrices such as debris and tar are not included in the datasets used in the quantitative risk assessment because these materials are generally larger in particle size and potential exposures to these materials would not be expected to be similar to potential exposures to surrounding soil. The waste material samples not included in the quantitative risk assessments are presented in Appendix WMS.

White powder samples were analyzed for one or more of the following chemical analytical suite:

- Metals
- CLP inorganics
- PAHs
- SVOCs and VOCs
- TPHs
- General chemistry parameters
- Pesticides
- PCBs
- Dioxins and furans.

3.2 Data Usability

As stated in the RAWP (Arcadis 2008a), the data usability criteria used to confirm that the dataset are suitable for risk assessment (USEPA 1992) include:

- Data sources
- Documentation
- Analytical methods and detection limits
- Data review
- Data quality indicators.

The evaluation of the analytical data with respect to these data usability criteria will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs). The following sections contain a brief discussion of the data usability criteria. Additionally, the specific approaches for the management of field duplicate samples and multiple analytical methods for a constituent are also presented in this section.

3.2.1 Data Sources

The data source review evaluates the analytical methods performed on the samples with respect to site-use information. The objective of the data source review is to ensure that the appropriate analytical methods were used to identify all relevant and significant constituents for the environmental media of interest. As previously mentioned, the soil data for the site include historical data collected prior to 2008, Part A Phase I site investigation data collected in 2008, and RFI/RI and data gap investigation data collected between 2008 and 2017.

The historic data collected prior to the Final Soil RFI/RI Work Plan (CH2M 2013) were evaluated in the Final Data Usability Assessment for Soil and Sediment (CH2M 2008) for use in supporting the conclusions of the RFI/RI as they relate to identification of SWMUs, AOCs, and other investigation areas. The results of the evaluation indicated that the majority of the data collected prior to 2008 are suitable for use in supporting project objectives including risk assessment, site characterization, site closure, and informational purposes.

Part A, Phase 1, RFI/RI, and data gap investigation data were collected by PG&E and its consultants between 2008 and 2017 in accordance with agency-approved plans and procedures and in conformance with data quality control (QC) programs. All work plans and sampling/analysis plans were developed specifically to understand the nature and extent of impacts that could have resulted from historical operations and incorporated the appropriate available analytical methods to achieve such objectives. Accordingly, the sampling and analysis of the soil and sediment, which has been conducted between 2008 and 2017 under the direction of DTSC and DOI, have appropriately targeted the constituents of interest with the appropriate analytical methods.

The entire PG&E Topock analytical program was specifically designed to ensure that field investigation data collected are of the appropriate quality required to support decision making in the RFI/RI. The frequency, quantity, and type of analyses required to achieve the DQOs are specified in the program specific work plans, work plan amendments, and additional specific sampling and analysis plans, all of which were approved by the agencies prior to the initiation of the investigations.

PG&E Topock analytical program, designed to ensure that field investigation data are of the appropriate quality to support decision making in the RFI/RI, will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs). Data that are found to lack the appropriate quality are rejected (R-flagged) during the data evaluation process and are excluded from the quantitative risk assessment. The quality of the soil datasets for the site are discussed in the following documents:

- Historical data collected prior to 2008 – Final Data Usability Assessment for Soil and Sediment (CH2M 2008)
- Part A, Phase 1 soil investigation data (2008) – Soil Investigation Part A Phase 1 Data Gaps Evaluation Report (CH2M 2012)
- RFI/RI and data gap investigations (2009-2017) – Final Soil RFI/RI Work Plan (CH2M 2013) and the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

The Quality Assurance Project Plan (QAPP) and QAPP Addendum (CH2M 2004, 2005a) document the quality assurance/quality control (QA/QC) activities that have been used in generating analytical data for the soil sampling program and further define the analytical requirements for the Topock analytical program. The quality of the data is evaluated by criteria that include precision, accuracy, representativeness, completeness, and comparability.

3.2.2 Documentation

The documentation review evaluates the manner in which samples were managed by the field sampling teams and receiving laboratories. The objective of this review is to ensure that analytical results can be associated with specific sampling locations and that the appropriate procedures were used to collect the environmental samples. As previously mentioned, the soil data for the site include historical data collected prior to 2008, Part A Phase I site investigation data collected in 2008, and RFI/RI and data gap investigation data collected between 2008 and 2017.

Historical data collected before the Final Soil RFI/RI Work Plan (CH2M 2013) were reviewed for documentation. The results were presented in the Final Data Usability Assessment for Soil and Sediment (CH2M 2008) and are as follows:

- The data associated with the 2004 Draft RFI (E&E 2004) was considered to be Category 1 data, sufficient documentation available to demonstrate that the data meet all probable end use objectives including risk assessment, site characterization, site closure, and informational purposes.
- The datasets from Mittelhauser Corporation (1990a, 1992), were considered to be Category 2 data, incomplete documentation available. Based on the uncertainty associated with these data, use of these data is limited to future site characterization, screening, or informational purposes only.
- The datasets from Brown and Caldwell (1988), Mittelhauser Corporation (1990b), Environmental Profiles (1993), Allwaste (1993), Alisto (1994), and Trident Environmental and Engineering (1996) were assigned to Category 3**.** These results were not accompanied by sufficient QC results to determine the level of uncertainty associated with these data and use of these data is for future screening or informational purposes only.

Part A, Phase 1, RFI/RI, and data gap investigation data were collected by PG&E and its consultants between 2008 and 2017 in accordance with agency-approved plans and procedures and in conformance with data QC programs. The specific protocols for sampling, equipment decontamination, handling of investigation-derived wastes, sample handling and storage, chain-of-custody requirements, and field QC are all discussed in the Sampling, Analysis, and Field Procedures Manual (Field Procedures Manual; CH2M 2005b). Requirements for laboratory analyses, data handling, data evaluation and assessment performance evaluations, corrective actions, and preventive maintenance of equipment are specified in the QAPP documents (CH2M 2004, 2005a). Accordingly, there is a high degree of confidence that the results obtained from these sampling programs can be associated with the sampling locations specified in the work plans and reports; and that the appropriate procedures, specified in the Field Procedures Manual and the QAPP documents, were followed.

3.2.3 Analytical Methods and Reporting Limits

Data evaluated in the HHERA were compared to background concentrations (BTVs) (CH2M 2009c, 2017a) and applicable risk-based screening values to evaluate whether the existing dataset is adequate to make health-protective decisions in the risk assessment.

The HHERA data include primarily soil analytical data (soil transitioning to sediment, white powder, and unconsolidated debris material evaluated in the HHERA are included in the soil evaluations presented in this section), as described previously in Section 3.1. Evaluation of analytical method RLs for soil gas data used in the HHERA were also evaluated as described in this section.

3.2.3.1 Soil

Soil data evaluated in the HHERA were collected inside and outside the TCS. Analytical method RLs for these data were evaluated for use in risk assessment as described in this section. Based on the evaluations presented in this section, the analytical RLs in the HHERA soil dataset are adequate to make health protective decisions for human health or ecological receptors evaluated in the HHERA.

3.2.3.1.1 Comparison of Analytical Reporting Limits to Background Threshold Values

The background screening evaluation of analytical RLs in the soil dataset was conducted separately for ICS locations (Table 3-1) and outside the compressor station (OCS) locations (Table 3-2), as these two areas are evaluated differently in the HHERA. The tables identify the following:

- Number of samples for each constituent in soil that were reported as NDs (not present above the analytical RL)
- Number of ND samples that have an RL greater than the BTV.

As indicated in Table 3-1, beryllium, cadmium, hexavalent chromium, molybdenum, and benzo(a)pyrene equivalent (B(a)PEQ) were the only COPCs/COPECs for which at least one ND result inside the TCS had RLs greater than the BTV. Therefore, for the inside the TCS dataset, there is uncertainty with respect to beryllium, cadmium, hexavalent chromium, molybdenum, and B(a)PEQ regarding the ability to assess whether these COPCs/COPECs are present at concentrations equivalent to background.

As indicated in Table 3-2, beryllium, cadmium, hexavalent chromium, copper, molybdenum, selenium, and B(a)PEQ were the only COPCs/COPECs for which at least one ND result outside the TCS had RLs greater than the BTV. Therefore, for the outside the TCS dataset, there is uncertainty with respect to beryllium, cadmium, hexavalent chromium, copper, molybdenum, selenium, and B(a)PEQ regarding the ability to assess whether these COPCs/COPECs are present at concentrations equivalent to background.

A more detailed discussion on the potential implications of RLs that exceed BTVs on the COPCs/ COPECs selection process is provided in the uncertainties section of this HHERA (Section 5.6).

This evaluation only applies to constituents for which BTVs are available (metals, PAHs, and dioxin/furans). Other constituents (SVOCs, VOCs, PCBs, and pesticides) were selected as COPCs/ COPECs and included in the HHERA if detected in any soil sample. Many of these constituents without BTVs were never detected in soil either inside or outside the TCS, and most (e.g., VOCs and SVOCs) are not known to be site-related. For the reasons stated previously, the potential for uncertainty associated with the evaluation of constituents that were never detected at the site (and therefore not selected as COPCs/COPECs in the HHERA) is considered to be low.

3.2.3.1.2 Comparison of Analytical Reporting Limits to Risk-Based Screening Values

Based on the results of the data quality assessment (presented in the forthcoming Draft RFI/RI Report Volume 3 currently being prepared by Jacobs), sample data were of appropriate quality and adequate to make health protective decisions in the risk assessment. Sample data were further evaluated to assess the adequacy of the analytical RLs for use in the risk assessment by comparing RLs for each ND soil sample to applicable risk-based screening levels. Additional discussion on the adequacy of the analytical RLs and potential impacts of elevated RLs included in the risk assessment is presented in Section 5.6.

Tables 3-3 and 3-4 present a comparison of risk-based screening levels to analytical RLs for constituents detected in soil in the areas inside and outside the TCS, respectively. These tables identify:

- Number of samples for each constituent in soil that were reported as NDs (not present above the analytical RL)
- Number of ND samples that have an RL greater than the minimum applicable risk-based screening level.

The applicable risk-based screening levels include ecological comparison values (ECVs; Arcadis 2008b, 2009b) protective of ecological receptors (applicable to only area outside the TCS) and Commercial/ Industrial Regional Screening Levels (RSLs; USEPA 2018a) protective of human receptors (applicable to areas inside and outside the TCS).

Inside the TCS dataset (Table 3-3), arsenic has RLs greater than the RSL for more than 50% of the ND results. Arsenic was ND in 5% of soil samples collected within ICS. It is unlikely that RLs above the RSL in 5% of arsenic results would lead to significant uncertainty in the ability to conservatively assess risk to human receptors using the existing arsenic soil data.

For the outside the TCS dataset (Table 3-4), eight metals (antimony, arsenic, cadmium, lead, mercury, nickel, selenium, and zinc) have RLs greater than the minimum risk-based screening level for more than 50% of the ND results. Arsenic, lead, nickel, and zinc all had at least 90% frequency of detection (FOD), and therefore, it is unlikely that RLs above risk-based screening levels for a small number of samples would lead to significant uncertainty in the evaluation of risk for these metals. Antimony, cadmium, mercury, and selenium have a FOD of 6% or lower in the outside the TCS dataset. For these constituents, there may be uncertainty regarding the ability to conservatively assess risk to human and/or ecological receptors. Note that for antimony, cadmium, lead, mercury, nickel, selenium, and zinc, the maximum RLs do not exceed the RSL, indicating that risks to human receptors can be adequately evaluated using the existing data. For arsenic, the maximum RLs do not exceed the ECV, indicating that risk to ecological receptors can be adequately evaluated using the existing data. Additional discussion on the adequacy of the analytical RLs and potential impacts of elevated RLs for COPCs/COPECs for which the maximum RL exceeds the risk-based screening levels is presented in the uncertainties section of the risk assessment (Section 5.6).

3.2.3.2 Soil Gas

Soil gas data evaluated in the HHERA were only collected from inside the TCS.TCS analytical RLs in these data were evaluated for use in risk assessment.

For soil gas, because BTVs are unavailable, all detected constituents were selected as COPCs. Many VOCs were never detected in soil gas sample collected from inside the TCS or in soil sampled collected from either inside or outside the TCS, and most are not known to be site-related. For the reasons stated previously, the potential for uncertainty associated with the evaluation of constituents that were never detected at the site (and therefore not selected as COPCs in the HHRA) is considered to be low.

3.2.3.2.1 Comparison of Analytical Reporting Limits to Indoor Air Criteria

Table 3-5 compares risk-based soil gas screening levels to analytical RLs for the soil gas dataset. This table identifies:

- Number of samples for each constituent in soil gas that were reported as NDs (not present above the analytical RL)
- Number of ND samples that have an RL greater than the minimum applicable risk-based screening level.

The applicable soil gas screening levels are the Commercial/Industrial RSLs for ambient air (USEPA 2018a) adjusted to soil gas concentrations using the DTSC default attenuation factor (AF) for existing commercial buildings (0.001; DTSC 2011c).

The RLs for VOCs detected in soil gas were below applicable soil gas screening levels, indicating that risk to human receptors can be adequately evaluated using the existing data.

3.2.4 Data Review

Data validation was performed to ascertain the quality of the analytical data generated for the RFI/RI, the results of which will be presented in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs). All (100%) of the data for the RFI/RI Report were validated. The overall completeness requirement was met, and no other systematic protocol errors were identified during the monitoring of the field or laboratory efforts. This, along with the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) evaluation, demonstrate that the overall quality of the analytical program and laboratory are sufficient to meet the project data quality objectives. The QAPP documents (CH2M 2004, 2005a) document the QA/QC activities that have been used in generating analytical data and further defines the analytical requirements for the Topock analytical program. Specifically, these documents outline the procedures used to validate data, which include the following:

- Review of the data package for completeness
- Review of chain-of-custody records for discrepancies that might degrade data quality
- Review for compliance with holding time and QC frequency requirements
- Evaluation of all calibration and QC summary results against the project requirements
- Verification of analyte identification and calculations for at least 10% of the data
- Qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations
- Initiation of corrective actions, as necessary, based on the data review findings.

Occasionally, data required qualifying for analytical uncertainties, which included but are not limited to:

- The precision and accuracy limits were not achieved.
- The analysis exceeded the sample holding time.
- The field duplicate exceeded relative percent difference criteria.
- Calibration requirements were not met.
- Low-level laboratory or field contamination occurred.

Data that did not meet QC requirements were qualified during data validation to alert data users to the uncertainty associated with the result.

As will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs), soil data included in the HHERA are of acceptable quality, except where noted, and the completeness objectives were accomplished. Data that were rejected through the data validation process were not included in the quantitative risk assessment; however, only approximately 0.3% of the data collected at the site were actually rejected. Such a low overall rejection rate is a strong indication that the overall data quality assessment and QC requirements set forth in the QAPP (CH2M 2005a) are being met, resulting in a large and very robust dataset that meets the DQOs set forth for the project.

Of the data incorporated into this HHERA (summarized in Attachment A of the individual AOC appendices), approximately 5% of the soil [and soil transitioning to sediment] data are qualified with J flags; a J flag indicates that the value reported for a constituent is an estimated value (and could be an underestimate or overestimate of the actual value). As stated in the RAWP (Arcadis 2008a), and consistent with standard risk assessment guidance (USEPA 1989), all J-flagged values are used in the quantitative risk assessment. However, because the number of J-flagged data represents a relatively small percentage of the data as a whole, it is unlikely that use of the very limited number of estimated analytical results in this HHERA introduces material uncertainty into the overall conclusions of this HHERA.

3.2.5 Data Quality Indicators-Representativeness, Completeness and Comparability

As described in the RAWP (Arcadis 2008a), data representativeness is the degree to which sample data accurately reflect the characteristics of a population of samples. Representativeness is generally achieved through a well-designed sampling program (e.g., appropriately placing samples to reveal potential releases and analyzing for all constituents potentially related to site activities) using standardized sampling strategies, techniques, and analytical procedures. Factors that can affect representativeness include site homogeneity, sample homogeneity at a single location, and available information around which the sampling program is designed. Representativeness for the RFI/RI data was maintained by using a well-designed sampling program developed based on available historical data with input and approval from the relevant regulatory agencies, and by using standardized analytical methods and consistent field procedures.

Completeness relates to whether enough sample results are retained after validation to adequately characterize the investigational unit. Completeness refers to the amount of valid measurements compared to the total amount generated for each method, matrix, and analyte combination. The completeness of the data collected for the RFI/RI is documented through reports and/or data quality evaluation memos. The completeness goal for soil samples for the project, as specified in the QAPP (CH2M 2004), is 90%. The completeness goal of greater than 90% was met for all analyte/methods as listed in Appendix A of the Quality Evaluation Report, Table A9, with the exception of 1,1'-biphenyl, which was 89% complete (an appendix of the forthcoming Draft RFI/RI Report currently being prepared by Jacobs).

Comparability expresses the confidence with which data are considered to be equivalent. Combined datasets are regularly used to develop quantitative estimates of risk. In the RFI/RI, soil and sediment data collected prior 2008 by various consultants are combined with data collected since 2008 by CH2M. Typical issues to consider in determining analytical comparability include questions regarding the analytical methodologies, detection limits, laboratories, and units of measurement. As described in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs), historical data collected prior to 2008 and Part A Phase 1, RFI/RI and data gap investigation data collected between 2008 and 2017 were evaluated using the data quality criteria specified in the QAPP (CH2M 2004) and QAPP Addendum (CH2M 2005a) and the majority of the data were found to meet data quality criteria. For these reasons, data collected over the course of the 20-year investigation period are generally considered to be comparable, within the general limitations expressed during the individual data validation efforts. Additionally, as stated in the Data Quality Evaluation Report (an appendix of the forthcoming Draft RFI/RI Report currently being prepared by Jacobs), there is confidence that comparability is assured because standard analytical methods and approved sampling techniques were used. The overall strengths and weaknesses of the dataset for individual constituents/exposure area are discussed in the risk characterization and uncertainties sections in the individual AOC appendices.

3.2.6 Project-Specific Data Usability Assessment

As stated in the RAWP (Arcadis 2008a), DTSC and PG&E have agreed on project-specific requirements for the preparation of a data quality assessment (CH2M 2008) following USEPA guidance. The data quality assessment, requested by DTSC, was developed to provide supporting information to the RFI/RI regarding the ability to use the existing soil and soil transitioning to sediment data for site evaluation and closure decisions. As will be discussed in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs), data quality assessment was considered best applied as a Data Usability Assessment (DUA), resulting in the assignment of usability codes to the analyte results for all soil and sediment data. The DUA prepared by PG&E (CH2M 2008) is based on generally accepted data quality indicators rather than site-specific DQOs. The following general data quality categories are proposed in the DUA:

- Category 1: Sufficient documentation is available to demonstrate that the data meet all probable end-use objectives including risk assessment, site characterization, site closure, and informational purposes. The data may be used with confidence for all purposes.
- Category 2: Incomplete documentation is available. The data may be used for site characterization, screening, or informational purposes; however, the quantitative results should not be used for future critical decision-making purposes.

- Category 3: Insufficient documentation is available. The data may be used for screening or informational purposes only (qualitatively); however, the quantitative results should not be used for future critical decision-making purposes.

Specifically, all soils and soil transitioning to sediment data were identified according to the three categories listed previously. Quantitative evaluation in the risk assessments will use only Category 1 data, consistent with the DUA. Further, as discussed in the DUA, although not categorized separately, data considered not to be acceptable for any project purposes due to significant quality and or/applicability deficiencies were rejected and removed from further consideration in the RFI/RI and the risk assessments. The descriptions and identification of all data that are considered useable for the quantitative risk assessment will be presented in the forthcoming Draft RFI/RI Report Volume 3 (currently being prepared by Jacobs).

One of the primary uses of the data is to determine what constituents are present, where they are located, and at what concentrations. Other considerations include whether site concentrations are greater than background, whether potential exposure areas have been adequately characterized, and if there will be adequate data to calculate EPCs for use in the risk assessments. As described in the DUA, and consistent with the USEPA guidance (1989), the limitations of the data and the uncertainty introduced into the risk assessments based on the particular limitations of the data, are presented and discussed in the risk assessments for the individual potential exposure areas. The results of the DUA, including the determination that the potential exposure areas are adequately characterized and the data are sufficient for calculating EPCs for use in the risk assessment, will be presented in the forthcoming Draft RFI/RI Report Volume 3 Report (currently being prepared by Jacobs). As directed by DOI (2017) and DTSC (2017a), PG&E was to proceed with the Soil RA since the field work conducted in accordance with the agency-approved RFI/RI work plan and associated data gap work plans for soil investigation has been completed.

3.2.7 Management of Field Duplicate Data and Data from Multiple Analytical Methods

As stated in the RAWP (Arcadis 2008a), for cases where a field duplicate sample is present, a single representative concentration for the sample was selected generally consistent with USEPA guidance regarding data verification, data validation, and data quality assessment (USEPA 1992, 2002a). These procedures included the following:

- If there were detections in both samples, the higher concentration was selected.
- If there was a detection in one sample but not the other, the detected concentration was selected.
- If there was not a detection in either sample, the lowest method detection limit was selected and appropriate techniques for handling ND data were applied in calculating statistics (see Sections 3.4 and 4).

3.3 Groupings of Data

As described in the RAWP documents (Arcadis 2008a, 2009a, 2015) and based on subsequent direction from DTSC (2017a), areas at the site were identified for independent evaluation in the HHERA for potential human and/or ecological exposures. These potential exposure areas are based on investigation areas historically associated with facility use or known releases and incorporate locations where additional sampling has been conducted to define the nature and extent of potential contamination associated with the investigation area. Data were grouped into datasets for each potential exposure area and evaluated for the relevant potential human and/or ecological receptors, as described in this section. Figure 3-3 presents the potential exposure areas evaluated based on individual AOCs evaluated in the HHERA for potential human receptors, ecological communities, and small home-range wildlife. Larger areas based on combined potential exposure areas were evaluated for potential human receptors (Figure 3-4a) and large home-range wildlife (Figure 3-4b). The potential exposure areas evaluated in the HHERA include:

Potential Exposure Areas Based on Individual AOCs Evaluated in the HHERA

Potential Exposure Areas Based on Individual AOCs	Sample Locations Representative of:	HHRA	ERA
BCW	BCW (AOC1, AOC28d, SWMU1, TCS-4, Tamarisk Thicket)	Yes	Yes
SWMU1	SWMU 1 and TCS-4	Yes	Yes
BCWxSWMU1	BCW, excluding SWMU 1 and TCS-4	Yes	Yes
AOC4	AOC4	Yes	Yes
AOC9	AOC9 and AOC10a	Yes	Yes
AOC10	AOC10 and Subareas b, c, d	Yes	Yes
AOC11	AOC11	Yes	Yes
AOC12	AOC12	Yes	Yes
AOC14	AOC14	Yes	Yes
AOC27	AOC27	Yes	Yes
AOC28	AOC28	Yes	Yes
AOC31	AOC31	Yes	Yes
UA-2	UA-2	Yes	Yes
TT	Tamarisk Thicket	No	Yes
NORR	AOC1 North of the Railroad / USBLM Land	Yes	No
ICS	Inside the Compressor Station	Yes	No

Notes:
NORR = North of the Railroad
TT = Tamarisk Thicket

Potential Combined Exposure Areas Evaluated in the HHERA

Potential Combined Exposure Areas	Sample Locations Representative of:	HHRA	ERA
OCS	Outside the Compressor Station: All soil exposure areas outside the TCS	Yes	Yes
OCSxBCW	Outside the Compressor Station excluding BCW	Yes	No
BCW+AOC4	BCW and AOC4	No	Yes
OCSxBCW+AOC4	Outside the Compressor Station excluding BCW and AOC4	No	Yes

In some cases, sample locations along or just outside the investigation area-specific boundaries were included in the potential exposure area dataset because the samples were collected as part of the nature and extent investigations for that specific investigation area or because there is potential for transport of soil into the exposure area. For example, as part of the AOC4 TCRA, soil sampling was conducted at the mouth of AOC4 where it enters BCW at the south end of BCW. During the installation of the gabions near the mouth of AOC4, soil excavation was conducted and some soil was removed. Soil samples collected at four locations (AOC4-GB10, AOC4-GB11, AOC4-GB12, and AOC4-1) are the only sample locations remaining in that area after the TCRA. These samples were evaluated as part of BCW and also as part of AOC4. Details of the exact samples and sampling locations included in each potential exposure area are presented in the Data Evaluation and COPC/COPEC Selection section (Section 2) of each exposure area-specific appendix. A comprehensive list of the sample locations that were analyzed in more than one AOC-based exposure area are included in the table titled Sample Locations Included in Exposure Areas.

Sample Locations Included in Exposure Areas

Sample Location	AOC1	AOC4	AOC11	AOC14	AOC27	ICS	OCS
AOC4-GB10	Yes	Yes					
AOC4-GB11	Yes	Yes					
AOC4-GB12	Yes	Yes					
AOC4-1	Yes	Yes					
RR-1	Yes			Yes			
AOC16-5	Yes		Yes		Yes	Yes	Yes
PA-01	Yes		Yes		Yes	Yes	Yes
PA-07	Yes		Yes		Yes	Yes	Yes
PA-13	Yes		Yes		Yes	Yes	Yes
PA-14	Yes		Yes		Yes	Yes	Yes
PA-15	Yes		Yes		Yes	Yes	Yes
PA-16	Yes		Yes		Yes	Yes	Yes
PA-17	Yes		Yes		Yes	Yes	Yes

In addition to the sample locations listed in this table, the Tamarisk Thicket potential exposure area and the SWMU 1 potential exposure area are both a subarea of the BCW potential exposure area; therefore, all of the samples included in each of these potential exposure areas are also included in BCW. The discussion of uncertainty related to the evaluation of sample locations in more than one potential exposure area will also be added to Section 5.6.1.4.2.

Historically, contaminants in surface soil in SWMU 1 may have been eroded and entrained in stormwater/surface water runoff during flow events and may have been subsequently re-deposited downstream in BCW. Based on a site reconnaissance conducted following a 2006 storm event in SWMU 1, data from surface and near-surface soil sample locations collected prior to the 2006 storm event may no longer be representative of site conditions. However, soil samples collected before 2006 were included in the HHERA datasets for EPC calculations and the depths for these samples were not adjusted to account for the 2006 storm event because no information is available to accurately make this adjustment.

3.3.1 Potential Human Health Exposure Areas and Depths

Potential human exposure to soil was evaluated for four main potential exposure areas, as presented in the RAWP documents (Arcadis 2008a, 2009a, 2015): BCW, OCS, OCSxBCW, and ICS. The BCW exposure area is based on the individual AOC1 investigation area and downgradient areas in BCW. For OCS, OCSxBCW, and ICS, these exposure areas are based on combined individual investigation areas, as shown in Figure 3-4a. Note that unsampled areas outside the individual investigation areas were not included in the aerial extent of the combined exposure areas. USBLM land within BCW NORR was also evaluated. At the direction of DTSC (2017a), 10 additional potential exposure areas associated with individual investigation areas (AOC4, AOC9, AOC10, AOC11, AOC12, AOC14, AOC27, AOC28, AOC 31, and UA-2) and two potential exposure areas related to SWMU1/TSC-4 (SWMU1 and BCWxSWMU1/TSC-4) were evaluated for potential human exposures. The specific potential human receptors and relevant exposure depths for each receptor are presented in detail in Section 5.3. In these areas, potential exposure to soil in the 0- to 10-foot bgs interval was possible for one or more receptors.

Additionally, for the two potential soil exposure areas encompassing wash areas (BCW and AOC10), two scouring scenarios were evaluated. The 2-foot scouring scenario assumes that the top 2 feet of soil is removed during potential future scouring resulting from surface runoff following heavy rainfalls. In the 2-foot scouring scenario, data in the 2- to 12-foot bgs interval in are evaluated for potential human exposures. Similarly, in the 5-foot scouring scenario, 5 feet of soil is assumed to be removed during scouring and therefore data in the 5- to 15-foot bgs interval are evaluated for potential human exposures. The selection of these exposure depths in the scouring scenarios is described in detail in the RAWP (Arcadis 2008a).

Datasets for these potential exposure areas and depth intervals were used to select COPCs (Section 3.4) and estimate risks and hazards for potential human receptors, as summarized in the HHRAs (Section 5.5).

Surface sediment and surface porewater data from the two riparian areas were not quantitatively evaluated in the HHERA, as surface transport of site-related constituents to sediments was determined to be an insignificant exposure pathway (Section 2.5).

3.3.2 Potential Ecological Exposure Areas and Depths

As described in the RAWP documents (Arcadis 2008a, 2009a, 2015), potential exposure of ecological receptors to soil was evaluated for two types of receptors. Relatively immobile (terrestrial plants and soil invertebrates) wildlife receptors with small home ranges (cactus wren, Gambel's quail, desert shrew, and Merriam's kangaroo rat) were evaluated for potential exposure areas associated with individual investigation areas (BCW, AOC4, AOC9, AOC10, AOC11, AOC12, AOC14, AOC27, AOC28, AOC31, and UA-2). At the direction of DTSC (2017a), three additional potential exposure areas (SWMU1, BCWxSWMU1, and TT) were evaluated for potential ecological receptor exposures. Potential wildlife receptors with large home ranges (desert kit fox, red-tailed hawk, and Nelson's desert bighorn sheep) were evaluated for exposure to larger exposure areas representing combinations of the individual investigation area-based potential exposure areas (OCS, BCW+AOC4, and OCSxBCW+AOC4). Similar to the approach for combined human health exposure areas, the OCS and OCSxBCW+AOC4 potential exposure areas are based on combined individual investigation areas, as shown in Figure 3-4b. Note that unsampled areas outside the investigation areas were not included in the aerial extent of the combined exposure areas. The specific ecological receptors and relevant exposure depths for each potential receptor are presented in detail in Section 6.3. In these areas, potential exposure to soil in the 0- to 6-foot bgs interval was possible for one or more receptors.

Similar to the evaluation for human health, the two soil scouring scenarios were evaluated in the BCW and AOC10 potential exposure areas. In the 2-foot scouring scenario, data in the 2- to 10-foot bgs interval are evaluated for potential ecological exposures. In the 5-foot scouring scenario, data in the 5- to 15-foot bgs interval are evaluated for potential ecological exposures. The selection of these exposure depths in the scouring scenarios is described in detail in the RAWP (Arcadis 2008a).

Datasets for these potential exposure areas and depth intervals were used to select COPECs (Section 3.4) and estimate risks and hazards for ecological receptors in the ERA (Section 6).

As noted previously for the HHRA, the soil transport pathway to sediment/porewater in the two riparian areas was found to be insignificant in the gradient analysis (Section 2.5). Sediment and porewater exposures were not evaluated in the ERA.

3.4 COPC/COPEC Selection

After reviewing and grouping the data, COPCs and COPECs were selected for each medium that was included in the quantitative risk assessment. The process used for identifying those constituents is described in this section, along with the final list of COPCs and COPECs selected for the HHRA and ERA.

3.4.1 Process for Identifying COPCs/COPECs

Selecting the COPCs/COPECs to be included in the risk assessments was a sequential process where compounds detected in site media may be eliminated from further consideration based on either the concentration if a constituent is deemed to be consistent with ambient background conditions or their status as an essential nutrient. COPCs/COPECs were selected following appropriate guidance (DTSC 1997; USEPA 1989, 1997a, 2000a), according to the potential exposure areas previously described previously in Section 3.3 and in greater detail in this section. Data for each medium (soil and soil gas) were used in the selection process as described in this section.

For the HHERA, all data that met the data usability criteria as described in Section 3.2 were combined and evaluated to identify the COPCs/COPECs to be carried through the risk assessments.

During the data quality evaluation and usability evaluation, sample results that reflected laboratory contamination were identified for all datasets for all media, as summarized in Section 3.2. If compounds are determined to be associated with laboratory contamination, they can be excluded from the list of final COPCs and COPECs, according to current USEPA guidance on data evaluation (USEPA 1989, 1992). However, based on the results of the data quality evaluation, no constituents were excluded as COPCs or COPECs because they were determined to be associated with laboratory contamination.

3.4.1.1 Soil

Prior to selecting the COPCs/COPECs in soil, the constituent dataset was grouped based on depth, as appropriate. As previously discussed in Section 3.3, soil sampling data for 0 to15 feet bgs were included in the evaluation for the BCW and AOC10 potential exposure areas as these areas include scouring scenarios down to 15 feet bgs. Soil sampling data for 0 to 6 feet bgs were included in the ERA for the tamarisk thicket exposure area. Soil sampling data for 0 to 10 feet bgs was evaluated for all remaining AOC-specific outside TCS potential exposure areas and for the ICS potential exposure area. For the combined OCS potential exposure area, the datasets as previously specified for the AOC-specific outside TCS potential exposure areas were combined into one dataset for the COPCs/COPECs selection process. Soil datasets from each of these potential exposure areas were compared to background datasets as described in this section.

3.4.1.1.1 Comparison to Background

Current DTSC guidance (1997) allows inorganic compounds to be eliminated from a risk assessment if it can be demonstrated that they do not exceed local background levels. Methods comparable to this guidance are also commonly used in risk assessment to evaluate whether ubiquitous anthropogenic compounds such as dioxins/furans and PAHs are present at a site at levels that exceed background concentrations (DTSC 2009d). Accordingly, the general methodology recommended by state regulatory guidance (DTSC 1997, 2009d) was used to determine whether inorganic compounds, dioxins/furans and PAHs detected in the soil at the site are present at concentrations that are elevated above background levels. As discussed in Section 2.2.3, the background samples collected from in and around the site were analyzed for essential nutrients, Title 22 metals, dioxins/furans, and PAHs. The results of the soil background sampling and the statistical analyses describing the characteristics, uses, and limitations of the background soil dataset were submitted separately from the risk assessments as soil background technical memoranda (CH2M 2009c, 2013, 2017a) for review and approval by state and federal agencies. The agencies approved the background datasets presented in the following technical memoranda for inorganics, dioxins/furans, and PAHs for background comparisons:

- Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. (CH2M 2009c)

- Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California, Appendix A, Subappendix E: Additional Inorganic Compounds – Soil Background Evaluation. (CH2M 2013)
- Technical Memorandum. Ambient/Background Study of Dioxins and Furans at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. (CH2M 2017a).

Using the approved background soil dataset, a series of statistical comparisons and tests were conducted to assess whether concentrations of constituents detected in the soil at the various potential exposure areas and depths are elevated above background levels. The comparisons and tests included:

- Comparison of maximum observed values for each potential exposure area to a BTV
- Comparison of central tendency between potential exposure area data and background data
- Comparison of upper quantiles of potential exposure area data and background data.

Each of these methods is discussed in this section.

Comparison to BTV

For a given potential exposure area and constituent, the maximum detected concentration was compared to a BTV, defined as the 95% upper tolerance limit (UTL) of the 95th percentile of the background soil dataset. These BTVs were presented for each of the constituents in soil in the soil background technical memoranda [CH2M 2009c, 2013, 2017a]). The UTL is a standard statistic and is recommended by USEPA (1989). It represents a confidence level for a given quantile of a population. Here, it is the 95-95 UTL, which bounds with 95% confidence on the upper value for the 95th percentile of the background population.

Constituents in soil in a potential exposure area for which the maximum detected concentration was below the BTV were considered within background levels and excluded as COPCs and/or COPECs within that potential exposure area. Constituents for which the maximum detected concentration exceeded the BTV were further evaluated (i.e., distributional comparisons), as described in this section, if the dataset contained at least 10 observations (minimum based on ProUCL guidance [USEPA 2015a]). For those potential exposure area datasets with fewer than 10 samples, the constituent was included as a COPC and a COPEC. Constituents detected in potential exposure area samples that did not have corresponding BTVs – either because those constituents were not analyzed for or not detected in the background samples – were carried through to the exposure area-specific quantitative risk assessments as COPCs and COPECs.

Distributional Comparisons

Consistent with state and federal guidance (DTSC 1997; USEPA 2000a), additional comparison tests were completed to distinguish between constituents that may be site-related versus those that are likely the result of ambient conditions. For each potential exposure area, the set tests compare the concentrations of constituents in soil from sample locations within a potential exposure area to those from background locations to test whether concentrations within a potential exposure area tend to be consistently higher than background levels.

Two statistical tests were employed for comparing data distributions for a potential exposure area to background: a comparison of the central tendency of the populations (i.e., means or medians) and a comparison of upper quantiles. The Wilcoxon-Mann-Whitney test (WMW) or the Tarone-Ware (TW) and Gehan tests were used as the statistic test of central tendency. The WMW, TW, and Gehan tests were performed using ProUCL 5.1 (USEPA 2016).

For datasets with 100% detections (i.e., no ND observations) in both the potential exposure area and background datasets, the WMW test was used for determining whether a difference exists between the potential exposure area and the background population distributions. The WMW test is a nonparametric test that can be used to test whether or not measurements from one population consistently tend to be larger (or smaller) than those from the other population. The main advantage of the WMW test is that the two datasets are not required to be from a known type of distribution. The WMW test can be used with datasets with a single value detection limit. When using the WMW test on a dataset with multiple detection limits, all observations (detects and NDs) below the largest detection limit need to be considered as NDs (Gilbert 1987). This in turn tends to reduce the power and increase uncertainty associated with test. USEPA (2015a) recommends other tests, such as the Gehan and TW tests, for datasets that have multiple censoring points and detection limits. The Gehan and TW tests typically yield comparable test results (USEPA 2015a), and these tests were used for those datasets with multiple detection limits.

The test hypotheses for the WMW, Gehan, or TW test are:

- H_0: potential exposure area mean/median less than or equal to background mean/median
- H_A: potential exposure area mean/median greater than background mean/median.

If the H_0 is rejected, H_A is accepted, the constituent is assumed to be present at concentrations above background levels, and the constituent was included as a COPC and/or COPEC in the HHERA. If H_0 is not rejected, a Quantile test is then used to compare the upper tails of the data distribution for a potential exposure area to background.

The Quantile test is a nonparametric test which evaluates if the upper tails of the distributions are comparable, or if one of the populations has a higher proportion of samples in the upper quantile than the other population (USEPA 2000a). It is used to supplement the conclusions of the WMW, Gehan, or TW tests. The Quantile test is useful in detecting differences in the highest concentrations of the distribution. The Quantile test was performed using ProUCL 4.1 (USEPA 2010) for smaller datasets where an alpha was calculated in the statistical program. For larger datasets, an alpha was not calculated in the Quantile test in ProUCL 4.1 statistical program (i.e., the calculated alpha was reported as "N/A" in the Quantile test output for site datasets with greater than 116 observations).

As recommended by USEPA (2015a), a R script (R Core Team 2017) was used to perform the Quantile test for larger datasets. [Note: As noted in the ProUCL Version 5.1.002 Technical Guide (USEPA 2015a), the Quantile test is available in ProUCL 4.1 for smaller datasets. In the past, some users incorrectly used this test for larger datasets. Due to the lack of USEPA resources, this test has not been expanded for datasets of all sizes. Therefore, to avoid confusion and its misuse for larger datasets, the Quantile test was not included in ProUCL 5.0 and ProUCL 5.1.] Specifically, the R script for the Quantile test was used for potential exposure area datasets with greater than 116 observations. The Quantile test could not be completed in the ProUCL 4.1 statistical program for constituents where the detection limits of the potential exposure area dataset were elevated and contributed to a large portion of the upper end of the distribution of that dataset. This was often the case for constituents with low detection frequency and elevated detection limits (i.e., for cadmium, molybdenum, and selenium). In these instances, a two-sample Test of Proportions was performed using R script (R Core Team 2017) to compare whether the portion of detections in the potential exposure area dataset were greater than that in the background dataset; essentially a similar comparison of the upper ends for the two datasets to that in the Quantile test. The R scripts for the Quantile Test and Test of Proportions are provided in Appendix BKG.

In some cases, the maximum value was above the BTV. Constituent concentrations within the potential exposure areas were determined to be within or above background using comparison of both statistical tests – comparison of central tendency and comparison of the highest quantiles. If the soil concentrations detected in the potential exposure area did not exceed background by either of the two tests, the concentrations were deduced to be consistent with the background levels. Exceeding background by any one of these tests resulted in a conclusion that soil concentrations detected in the potential exposure area are above background levels and the constituent was conservatively included in the HHERA.

All of these evaluations, in addition to FOD, were considered in reaching a conclusion as to whether it is likely that the constituent detected at a potential exposure area is above background levels. Results of these comparisons are presented in Table 3-6a through 3-6n for each potential exposure area. The ProUCL and R-stat outputs are presented in Appendix BKG. In general, the human health and ecological risk assessments were based on a conservative approach and included constituents as COPCs and/or COPECs instead of excluding them.

3.4.1.1.2 Evaluation of Essential Nutrients

Consistent with USEPA guidance (1989), chemicals "...that are (1) essential human nutrients; (2) present at low concentrations (i.e., only slightly above naturally occurring levels); and (3) toxic only at very high doses (i.e., much higher than those that could be associated with contact at the site) need not be considered further in the quantitative risk assessment. Examples of such chemicals are calcium, magnesium, potassium, iron, and sodium” (USEPA 1989).

Essential nutrients are commonly excluded from quantitative risk assessments (USEPA 1989). However, as requested by DOI, the relationship between the essential dose of these nutrients for different receptors and the “toxic dose” of the nutrient are to be evaluated based on toxicological information regarding essential nutrient dose and levels that may pose toxic effects for receptors of concern at the site. As stated in the RAWP (Arcadis 2008a), such toxicological information is to be provided by DOI. Using the information provided by DOI, essential nutrients are to be evaluated in the COPC/COPEC selection process accordingly. If these essential nutrients are detected above background but at levels not considered to be toxic (when the dietary dose and exposure dose are considered in combination), they are to be eliminated from the list of COPCs/ COPECs and will not be evaluated further in the risk assessments. If essential nutrients are detected above background and at levels considered to be toxic, they will be selected as COPCs/ COPECs and will be evaluated further in the risk assessments.

No additional toxicological information was provided by DOI. Therefore, essential nutrients detected above background levels, but where toxicity values were not available, were not selected as COPCs/ COPECs, including calcium, magnesium and sodium. Concentrations of potassium and iron were determined to be within background levels.

3.4.1.2 Soil Gas

Soil gas data was only collected in the inside TCS area and evaluated in the HHRA in Appendix ICS for the ICS potential exposure area. All constituents detected in soil gas are included in the quantitative HHRA for the ICS potential exposure area. The detected constituents in soil gas are summarized in Appendix ICS.

3.4.2 COPCs and COPECs Identified for the HHERA

Soil COPCsand COPECs identified for the HHERA are summarized in Tables 3-7 for each potential exposure area. Summary statistics and the rationale for whether a constituent is identified as a COPC and/or COPEC within a potential exposure area are detailed in the exposure area-specific appendices.

4 ESTIMATION OF EXPOSURE POINT CONCENTRATIONS

An EPC is the representative concentration of a constituent in an environmental medium that is potentially contacted by a potential receptor (USEPA 2002b). USEPA (1989) defines the EPC as “the arithmetic average of the concentration that is contacted over the exposure period” DTSC (1996b) and USEPA (1989, 1992) recommend using the 95% upper confidence limit (UCL) on the mean (95UCL) as an estimate for the EPC so that the estimate of the average (or mean) is conservative (i.e., unlikely to be underestimated). In calculating the 95UCL, the underlying statistical theory assumes that each observation in the dataset used to calculate the EPC is a random realization of all possible observations from the underlying distribution of chemicals in the subject area of interest. With a sufficient number of random observations, the dataset and its statistics may be used to accurately represent the population. Sampling programs, however, are often designed to evaluate the nature and extent of contamination, resulting in a biased sampling design focused on areas with known or suspected releases. Thus, they often do not provide an adequate representation of the distribution of possible concentrations across the depths and areal extent of exposure areas. To provide a basis for an accurate estimate of the 95UCL, a conservative upper-bound estimate of the mean concentration is calculated across all possible samples (i.e., the population of sample concentrations) in the potential exposure area.

While developing the RAWP (Arcadis 2008a) and in subsequent discussions with the stakeholders, several issues were identified associated with the nature of the available datasets and the proposed methods to calculate EPCs. The stakeholders expressed concern about the representativeness of the data given potential biases in the available data (e.g., non-uniform representation of depth intervals), and oversampling in some areas of interest. These sampling issues, the subsequent treatments of the data, and the statistical methods employed in the calculation of EPCs to address these issues are discussed in this section.

4.1 Overview of Statistical Methods

In the HHERA, three types of EPCs were calculated based on the depth-weighted soil datasets: maximum, depth-weighted 95UCL, and depth- and area-weighted 95UCL (referred to as area-weighted EPCs for simplicity). USEPA’s ProUCL v. 5.1 software was the basis for, and primary analytical tool used for, the statistical analyses conducted for soil. For a given dataset, ProUCL was used to examine the data distribution to determine the underlying statistical distribution (via goodness-of-fit tests); based on its expert decision process, ProUCL recommends the most appropriate statistic to represent the 95UCL (e.g., based on a normal, lognormal, or gamma distribution or nonparametrically). For area-weighted EPCs, one of the methods in ProUCL, the BCa bootstrap, was applied to the data using different software and data handling to allow for incorporation of area-weighting factors.

An additional criterion of sample size was applied before calculating either depth-weighted or depth- and area-weighted 95UCL. Based on recommendations from ProUCL guidance (USEPA 2015a) and best professional judgement, two sample size criteria were applied to determine whether a reliable 95UCL EPC calculation can be made for a dataset: if the dataset had fewer than four detected values (i.e., concentrations reported above the detection limit) or fewer than eight total observations, the EPC defaulted to the maximum depth-weighted concentration in that dataset. Essentially, the EPC for each dataset is either a 95UCL (UCL \method recommended by ProUCL for depth-weighted EPCs, BCa Bootstrap UCL for area-weighted EPCs) or the maximum depth-weighted concentration.

4.2 Calculation of EPCs

When sufficient data were available, depth-weighted and area-weighted EPCs were statistically estimated. Before calculating these EPCs, the soil datasets were depth-weighted to account for unequal sampling at each location. The methodology used to determine weighting factors and calculate EPCs is discussed in this section.

4.2.1 Depth-weighting Approach

Before calculating soil EPCs, samples from each unique location in the HHERA datasets (as described in Section 3.3) were combined into a single depth-weighted value. The rationale for depth-weighting and methodology used to implement this approach were presented in the RAWP Addendum 2 (Arcadis 2015) and are summarized in this section.

At facilities where extensive sampling programs have been conducted for a variety of purposes, such as at the Topock site, it is not uncommon for the dataset to contain unequal or unbalanced representations of different locations (i.e., samples collected from the same location over multiple core depths and segment thicknesses). The core depths and segment thicknesses vary by sample location. To develop an estimate of the mean concentration of a constituent in soil that is representative of a potential receptor's exposure, some consideration is required in the treatment of unequal datasets.

USEPA (1996a, b) guidance recommends depth-weighting to account for uneven sampling. Specifically, the guidance recommends that the average concentration at a sample location in the representative exposure interval accounts for the different lengths of the sample core segments. This risk assessment uses this approach for calculating the depth-weighted average concentration at each sampling location, as specified in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015). The guidance recommends that if samples are collected at equal depth intervals, the arithmetic mean concentration from the surface to the maximum sampled core depth can be used to estimate the average concentration for that location. However, when samples have unequal depth-segment thicknesses (e.g., some are collected over a span of 6 inches while others are collected over a span of 2 feet), the average calculation must account for the different segment lengths.

At this site, soil samples have been collected for multiple objectives over a period of several decades, resulting in unequal sampling depths and segment thicknesses. For most potential exposure areas, soil samples collected from each location have variable depth profiles (i.e., co-located samples). Despite the variability in segment thicknesses, most of the co-located soil samples were collected within the exposure depth intervals defined for the risk assessment, which allows for a straightforward depth-weighting process to be implemented.

Historically, contaminants in surface soil in SWMU 1 may have been eroded and entrained in stormwater/surface water runoff during high flow events and may have been subsequently re-deposited downstream in BCW. Based on a site reconnaissance conducted following a 2006 storm event in SWMU 1, data from surface and near-surface soil sample locations collected prior to the 2006 storm event may no longer be representative of site conditions. However, soil samples collected before 2006 were included in the HHERA datasets for EPC calculations and the depths for these samples were not adjusted to account for the 2006 storm event because no information is available to accurately make this adjustment.

The following simple decision tree was used to calculate the average concentration for co-located samples in a manner which reflects USEPA (1996a, b) recommendations:

- For a given relevant exposure depth for the risk assessment, if only a single sample is available at a given location, that value was used to represent the concentration for the entire exposure depth.
- For locations with samples from multiple depths, the samples were weighted to account for the different lengths of the segments in the manner described in USEPA (1996a, b).
- Furthermore, a given segment length is represented by the interval from an individual sample within that segment down to the top of the next available sample.

This approach was described in the RAWP Addendum 2 (Arcadis 2015) to ensure that depth-weighting resulted in conservative EPC estimates based on the assumption that site-related soil constituent concentrations are highest in surface soil. Each sample's weight is the proportional contribution of its length to the overall exposure depth. The depth-weighting approach is illustrated in the following examples.

A variety of combinations of samples at different depths for an exposure interval of 0 to 10 feet bgs are shown on Figure 4-1, wherein the actual segment intervals recorded for each sample and their proposed segment interval assignments for depth weighting are shown. The examples are taken from actual samples in the dataset and display variability in both the maximum soil sample depths and segment thicknesses. The color-coding indicates how samples were included (in other words, how they were weighted in calculating the average for that location).

Location 19 represents a relatively complex situation. Samples of variable segment thickness were collected from 0 to 10 feet bgs. The depth-weighted concentration for that location would be calculated from the available samples as follows:

- 0 to 0.5 foot bgs sample: The uppermost sample from this location is reported as 0 to 0.5 foot bgs. This sample represents the depth segment from the start of the sample to the start of the next sample depth at 2 feet bgs (2 feet). This segment would, therefore, contribute 20% (= 2 feet / 10 feet) toward the mean concentration and receive a weighting factor = 0.2.
- 2 to 3 feet bgs sample: The next sample from this location was reported as 2 to 3 feet bgs. It represents soil depths from the start of the sample at 2 feet bgs to the start of the next sample at 5 feet bgs, or 2 to 5 feet bgs (3 feet), with a weighting factor = 0.3.
- 5 to 6 feet bgs sample: The third deepest sample from this location was reported as 5 to 6 feet bgs. It represents soil depths from the start of the sample at 5 feet bgs to the start of the next sample at 9 feet bgs, or 5 to 9 feet bgs (4 feet), with a weighting factor = 0.4.
- 9 to 10 feet bgs sample: The deepest sample reported from this location was reported at 9 to 10 feet. It represents soil depths from the start of the sample at 9 feet bgs to the bottom of the exposure interval and of the sample at 10 feet bgs, or 9 to 10 feet bgs, with a weighting factor = 0.1.

The depth-weighted concentration for each location was then calculated by multiplying the concentration for each soil sample by its segment weighting factor and summing these products. Using the same methodology for location 6 (Figure 4-1), where there is only one sample, the concentration for the 0- to 10-foot bgs interval was represented by the single sample value. In cases where there is no sample start depth of 0, the upper most sample was used to represent the interval above it, as shown for Location 10 (where the uppermost sample was a single depth or “grab” sample collected at 0.5 foot bgs). In cases where a grab sample was at the end of the exposure interval (e.g., 10 to 10 feet), the sample was used to represent the deepest 0.5 foot of the exposure interval, as shown for Location 17.

In the depth-weighting procedure, ND values were replaced with ½ RLs for all results except those that were calculated total values. For results that were calculated total values (i.e., result values for B(a)PEQ, dioxin TEQ, total PCBs, and total high molecular weight [HMW] and [low molecular weight] LMW PAHs), the full value of any ND calculated total was used because the calculated total result value already includes ½ RLs or zero value for individual dioxin/furan, aroclor, and PAH ND results. [Note: LMW PAHs are PAHs with less than or equal to three benzene rings; parent LMW PAHs include naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, and phenanthrene. HMW PAHs are defined as PAHs with greater than three benzene rings; parent HMW PAHs include pyrene, fluoranthene, benz(a)anthracene, chrysene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene (Arcadis 2008b).] The approach for the calculations of B(a)PEQ, dioxin TEQ for potential human receptors, and total PCBs for the HHRA are described in Sections 5.4.4 through 5.4.6. The approach for the calculations of dioxin TEQ for avian and mammal receptors and total HMW and LMW PAHs are described in Section 6.5.

4.2.2 Soil EPCs

For soil datasets, maximum, depth-weighted, and area-weighted EPCs were calculated, as described in this section. The maximum EPC was selected to represent the 95UCL EPC when insufficient data exist to reliably calculate a 95UCL. The ProUCL input datasets and 95UCL ProUCL output results for depth-weighted EPCs are presented in Attachment A2 of each exposure area-specific appendix; equivalent input and output data for area-weighted EPCs are presented in Attachment A3 of each exposure area-specific appendix.

4.2.2.1 Depth-Weighted Soil EPCs (Maximum and 95UCL)

The maximum depth-weighed concentration for each dataset was selected as the EPC in the maximum EPC scenario (conducted for the ERA only).

For the depth-weighted 95UCL scenario, 95UCL EPCs were calculated from the soil datasets using ProUCL version 5.1 and the recommended UCL method in the ProUCL output was selected as the depth-weighted 95UCL EPC. When ProUCL recommended two or more 95UCL estimates, the relative percent difference (RPD) was used to compare the 95UCL values: if the RPD is less than 5%, the higher UCL was conservatively selected; if the RPD is greater than or equal to 5%, the estimate that, based on the rationales presented in Table 4-1, best represents the dataset was selected as the depth-weighted 95UCL EPC.

4.2.2.2 Area-Weighted Soil EPCs

Sampling programs often collect more samples in known or suspected of higher concentration or “hot spots.” The consequence of this over-representation of the highest concentrations in the distribution of all possible values (concentrations) is that the associated EPC is potentially biased high and, thus, over-estimates potential exposure and thus risk. More sophisticated methods can correct for sampling bias and provide a more accurate estimate of the EPC. Spatially-explicit EPCs are widely used in risk assessment to account for biased sampling design, as noted by USEPA (2001) and Thayer et al. (2003). DTSC guidance (1996b) and the Interstate Technology and Regulatory Council (ITRC) guidance on decision making for contaminated sites (ITRC 2015) also recommend using spatially-weighted (i.e., area-weighted) averages. Area-weighting techniques control for the effects of oversampling in areas of high concentration, such as is typical in site investigations designed to determine the extent of potential contamination.

Thiessen polygons are the basis for a standard technique to perform an objective area-weighting of sample values, where each sample is associated with a unique location in the field of interest. The appropriateness of its application in this risk assessment is discussed in the RAWP Addendum 2 (Arcadis 2015). In two dimensions, Thiessen polygons are constructed from straight lines, drawn equidistant between adjacent sample locations, such that every point within a given polygon is closer to the sample location contained within that polygon than any other sample location. The area associated with each Thiessen polygon was used to calculate the proportional weight for each sample location in calculating the statistics of a dataset. The potential exposure area boundaries were used to define the outer polygon boundary for sample locations along the boundary. This approach is necessary as the sample locations on the outer edge of a potential exposure area have no adjacent sample locations, beyond the potential exposure area, with which an equidistant line may be drawn to “close” the Thiessen polygon. The Thiessen polygon maps (figures in Attachment A3 of each exposure area-specific appendix) illustrate this situation and how the potential exposure area boundary “closes” certain Thiessen polygons.

With the depth-weighted concentration and the associated area represented by the Thiessen polygon for each sample, a bootstrap technique was used to estimate the 95UCL of the mean of area-weighted sample values for the EPC. The method used here, the bias-corrected, accelerated (BCa) bootstrap, is one of the nonparametric statistics provided in ProUCL for the calculation of the 95UCL and it is identified in the literature – as well as in ProUCL guidance – as a robust and conservative bootstrap method for confidence interval estimation when the underlying distribution is skewed, as is frequently the case with chemical concentrations measured in samples of physical media.

Area-weighting is necessary to control the effect of potential hot spots and biased sampling on the EPC calculations, but ProUCL cannot accommodate weighting factors such as these, based on the Thiessen polygons, into its BCa bootstrap calculation and so an R subroutine for the BCa bootstrap analyses (Ripley 2017) was used. In response to comments from DTSC (2017a), to demonstrate the equivalence of the BCa bootstrap calculations used in this risk assessment to those of ProUCL, the following example outputs are provided:

- Calculations of the 95UCL using the BCa bootstrap – without area-weighting – are provided from both ProUCL and the R subroutine to demonstrate the equivalence of the bootstrap calculations

- An example BCa bootstrap output (i.e., the file of 10,000 bootstrap values that are not typically retained by ProUCL or any other software) is provided in a spreadsheet in Appendix BCa along with the subsequent BCa calculation, thereby allowing the reader to compare the form of the BCa calculation directly to that in the formulas provided in ProUCL technical guidance.

The 95UCL calculations for the example BCa bootstrap, with and without area-weighting, are provided in Table 4-2; the 10,000 bootstrap values and a portable document format (pdf) file containing the formula are provided in Appendix BCa.

In response to comments from DTSC (2017a), maps are provided for each area-weighted 95UCL calculation (i.e., for each COPC/COPEC, depth interval, and potential exposure area used to calculate an area-weighted 95UCL) as a visual representation of how the spatial distribution of samples and their concentrations might impact the calculation of a given EPC. The maps display the Thiessen polygons used in the area weighting and the depth-weighted sample concentrations are represented by colors reflecting ranges of concentration based on Jenks natural breaks. The RL is used to represent the concentration for ND samples, and ND concentrations are distinguished by hatching on the figures. The Jenks natural breaks classification method is an iterative data clustering technique for creating legend categories in mapping (Jenks 1967). For a given number of classes (i.e., ranges of concentration), the method selects endpoints for the classes to minimize the variability within classes, while maximizing the differences between classes. This method creates legend breaks in a classification that are data-driven and tend to distribute data among the classes in a way that provides categories with concentrations most "like" each other. The Jenks method provides breaks in the data that allow for useful visualization of the data distribution in each dataset.

4.2.3 Soil Gas EPCs

For a given chemical and potential exposure scenario using soil gas data, individual observations were treated as separate estimates of exposure; no 95UCL calculations were made for soil gas. Soil gas data are presented in Attachment A1 of Appendix ICS.

5 HUMAN HEALTH RISK ASSESSMENT FOR SOIL

This section describes the HHRA for the site and includes the purpose and objectives, applicable guidance, exposure and toxicity assessments, and the approach for and summary of the risk characterization for potential human receptors.

5.1 Purpose and Objectives

The purpose of the HHRA for soil was to evaluate the likelihood that constituents detected in soil at the various potential exposure areas of the site could adversely impact human health under the assumed set of current and reasonable future land-use scenarios. The results of the risk assessment provide key information that assists the risk managers in making health-protective site management/remedial decisions. Applicable guidance, exposure and toxicity assessments, and risk characterization for potential human receptors are summarized in the following sections for the HHRA.

5.2 Applicable Guidance

The methodology used in this HHRA is based on, but not limited to, the following USEPA and DTSC guidance documents:

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) (USEPA 1989)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors (USEPA 1991a)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B: Development of Risk-Based Preliminary Remediation Goals) (USEPA 1991b)
- Region 9 Preliminary Remediation Goal (PRG) Table (USEPA 2004a) and the updated RSLs (USEPA 2018a)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA 2004b)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009)
- ProUCL Version 5.1 Technical Guide (USEPA 2015a)
- Preliminary Endangerment Assessment Manual (DTSC 2015b)
- Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. Human and Ecological Risk Office (HERO) HHRA Note Number: 1 (DTSC 2014c)
- DTSC-Modified Screening Levels (DTSC-SLs), HERO HHRA Note Number: 3 (DTSC 2018b)

- Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (DTSC 2011c)
- Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.7-04 Land Use in the CERCLA Remedy Selection Process (USEPA 1995a)
- OSWER Directive 9355.0-30 Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (USEPA 1991c)
- NCP (40 CFR Part 300))
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (RI/FS guidance, EPA/540/G-89/004) (USEPA 1988).

5.3 Exposure Assessment

Exposure assessment is the process of describing, measuring, or estimating the intensity, frequency, and duration of potential human exposure to COPCs in environmental media (e.g., soil, soil gas, and air). This section discusses the mechanisms by which people (receptors) might come in contact with the COPCs present in soil and subsurface soil gas at the site. During the exposure assessment, potentially exposed receptors and potentially complete exposure pathways are identified, and pathway-specific exposures are quantified using EPCs and intake assumptions based on current and reasonably anticipated future land uses.

An exposure assessment is best conducted within the context of a CSM, which shows the relationships between a chemical source (discussed previously in Section 2.5), potential exposure pathway, and potential receptor. Figures 2-2 through 2-6 present the CSMs for the site for the HHRA, illustrating the source-pathway-receptor relationships which provide the basis for the quantitative estimation of the exposure assessment. Only those potentially complete source-pathway-receptor relationships are quantitatively evaluated in the HHRA. The CSM figures are as follows:

- Figure 2-2 presents a CSM for the BCW (SWMU 1 and TCS-4, AOC1, and AOC28d).
- Figure 2-3 presents a CSM for the hypothetical future resident on USBLM land NORR (excluding FMIT land).
- Figure 2-4 presents a CSM for all other AOCs (other than BCW) located outside the TCS.
- Figure 2-5 presents a CSM for all AOCs (including BCW) located outside the TCS.
- Figure 2-6 presents a CSM for areas inside the TCS.

These CSMs were originally prepared in the RAWP (Arcadis 2008a) and were updated and refined in the RAWP Addendum 2 (Arcadis 2015).

5.3.1 Potentially Exposed Populations and Complete Exposure Pathways

The intent of the exposure assessment is to identify plausible human receptors that may be potentially exposed to site-related constituents in contaminated media under current and reasonably anticipated future site-use scenarios, and to identify the direct and indirect pathways by which they could potentially be exposed to site-related constituents. The appropriateness of including any given receptor scenario is a site-specific determination and depends on the potentially contaminated media, the extent of contamination, and the plausibility that human receptors would be exposed.

Potentially exposed populations were selected based on the current and reasonably anticipated potential future land uses described in Sections 2.6. The future land use is assumed, in this risk assessment, to be the same as the current land uses. One exception is the inclusion of a hypothetical unrestricted future residential user on USBLM land, NORR (excluding the FMIT land) as shown on Figure 3-3. Current land use does not include residential use for any part of the site, nor is it likely to in the future. See Section 5.3.1.4 for additional information for this receptor.

Therefore, with the exception of the hypothetical future residential receptor on the USBLM land, the risk assessment of the future populations addresses a reasonably representative upper bound for potential exposures for current and likely future receptor populations.

The following sections describe the receptors that are evaluated in the HHRA and the potentially complete pathways through which exposure could theoretically occur, as shown on the CSMs (Figures 2-2 through 2-6). Exposure depths applicable to each potential receptor are discussed in this section and shown on Figure 5-1.

5.3.1.1 Maintenance Workers

As stated in the RAWP (Arcadis 2008a), maintenance workers are evaluated as a potential receptor involved in routine maintenance and/or repair of the TCS equipment. As described in the RAWP, maintenance activities occur both inside and outside the TCS. This scenario captures the upper bound potential for intermittent but repeated short-term, as well as long-term, exposure to constituents in surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs) subsurface 1 soil (0 to 6 feet bgs) and subsurface 2 soil (0 to 10 feet) for the maintenance worker conducting activities both inside and outside the fenceline.

Two types of potential maintenance worker exposure scenarios were derived for the evaluation of maintenance workers at the site:

- Short-term workers, primarily contractors, who are assumed to only be present at the site for 1 year and do not come back, repeatedly, year after year.
- Long-term workers, primarily PG&E employees, who may be present during various types of activities for a certain period of hours and days per year for a 30-year period, as agreed to in the approved RAWP Addendum 2 (Arcadis 2015) for site-specific maintenance worker activity patterns.

Current maintenance worker activity patterns for working both inside and outside the TCS were provided by PG&E and used to develop the exposure assumptions used in estimating potential future exposures for the maintenance worker populations.

This baseline risk assessment assumes that potential contact with soil is not limited by the presence of engineering or institutional controls in the future. However, much of the area inside the TCS is paved and will remain as such. Consequently, potential exposure for current commercial (see Section 5.3.1.5) and both types of maintenance workers inside the TCS would likely be less than the baseline scenario assumption that there is no soil cover for future contact with soil ICS. Soil outside the TCS fenceline is unpaved except for roads and some minor structures. Consequently, the maintenance workers performing work in areas outside the TCS fenceline have unrestricted access to soil consistent with the baseline risk evaluation assumptions.

Substantial pipelines are present on PG&E property, along I-40, and along the railroad that periodically require maintenance. Exposure to soil may result from excavation and grading activities associated with utility work or equipment maintenance/repair along these pipelines. This work may require intrusive activity and direct contact with shallow and subsurface soil. The potential soil exposure pathways include ingestion and dermal contact with soil, as well as inhalation of particulates from ambient air. Another potential exposure pathway is inhalation of VOCs that may volatilize from the soil. Exposure of a maintenance worker to vapors in outdoor air is evaluated although the data indicate only a very minimal presence of VOCs in soil and soil vapor.

Note that none of the maintenance worker scenarios described previously refer to workers involved in site investigation activities (e.g., soil and groundwater sampling), nor workers who will be involved in the implementation of the remedy for either soil or groundwater. Workers (including both PG&E employees and contract employees) involved in either sampling or remedy implementation are required to be appropriately trained, in accordance with the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, Title 29 CFR, Part 1910.120.

Consistent with the HAZWOPER standard, all workers involved in either sampling or remedy implementation will be conducting work in accordance with a site-specific health and safety plan that considers and addresses potential exposures to impacted soil. The objective of the HAZWOPER standard is to protect people working at hazardous waste sites and to train them to handle hazardous substances safely and effectively. As one example, HAZWOPER requires the use of appropriate personal protective equipment (PPE) to minimize the potential for direct contact with substances in either soil or groundwater. As workers who may be involved in either sampling or remedy implementation at the site are required by federal law to be HAZWOPER trained, they are not included in the quantitative human health risk assessment.

5.3.1.2 Recreational Users

The lands managed by the federal agencies near the site are largely undeveloped, but there are several recreational opportunities available. DOI (2014b) has provided information to PG&E about the types of recreational activities that could occur at the site and the corresponding potential exposure scenarios and exposure assumptions that should be incorporated into the HHRA. The recreational user is evaluated for areas outside the compressor station including BCW and other AOCs for potential future land use.

As recommended by DOI, it is assumed that the recreational activities could take place at any location on federal land. In reality, specific locations may be preferred for certain activities, while other locations may be less attractive or may have limited recreational options (e.g., HNWR). As stated by DOI, the most probable recreational land use activities on federal land and the associated potential receptors are: camper, hiker, hunter, and OHV rider (OHVs are also referred to as ATVs). These potential recreational users are evaluated in the HHRA. This description of the recreational user scenarios is consistent with DOI memorandum (2014b), the RAWP Addendum 2 (Arcadis 2015), and OSWER Directive No. 9355.7-04, Land Use in the CERCLA Remedy Selection Process (USEPA 1995a).

Adults and youth (identified as “child” receptors in the HHRA) recreational users may access areas of the site for sporadic and short periods of time. The potential adult and/or child receptors are evaluated for exposure to surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) under all recreational site-use scenarios. It is assumed that the recreational user would contact only surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) and would not conduct intrusive activity at depths below 3 feet bgs. Potential soil exposure pathways for these receptors include incidental ingestion, dermal contact, and inhalation of dust in ambient air. Another potential exposure pathway is inhalation of VOCs that may volatilize from the soil. Exposure of recreational receptors to vapors in outdoor air was evaluated in the HHRA, although the data indicate only a very minimal presence of VOCs in soil and soil vapor.

5.3.1.3 Tribal Users

The FMIT requested that tribal users be included in the HHRA for soil. As such, tribal users were evaluated for areas outside the TCS including BCW and other investigation areas for current and potential future land use. In their exposure scenario memorandum (FMIT 2012), during the September 2013 RA Workshop, and in the follow-up letter from FMIT (2013), the Tribes indicated that the tribal use of the land in the area of the site is limited to the following:

- Tribal Group Activities - Several times during the year, tribal members may meet at the site for group prayer and reflection.
- Tribal Education Activities - As part of the education of tribal students and young people, school classes or other youth classes may come to the area to learn about its importance and spiritual significance. These visits may last for up to 2 hours and could occur several times during an individual’s time as a student.
- Tribal Member Individual Visits - Individual tribal members may go to various specific locations (e.g., the Topock Maze) within the Mojave Valley on a regular but infrequent basis for quiet time and reflection. These activities are part of the practice of their religion and culture, to pay homage to the area, and to honor their ancestors.

None of these activities include intrusive soil activities or direct contact with soil. Direct exposures (ingestion and dermal contact) to surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) for the tribal user are considered incomplete and thus were not evaluated in the HHRA. As agreed in the approved RAWP Addendum 2 (Arcadis 2015), potential exposure for a tribal user is limited to indirect exposures resulting from the inhalation of particulates from surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs), and VOCs present in subsurface 2 soil (0 to 10 feet bgs).

5.3.1.4 Commercial Workers

Onsite commercial workers may be incidentally exposed to soil as they perform their duties at the compressor station, such as office work and equipment maintenance and monitoring. The commercial worker was evaluated only for the ICS potential exposure area. Although commercial workers are not expected to conduct intrusive work, they may experience incidental soil contact because it was assumed that site soil is not paved nor vegetated. This scenario captures the upper-bound potential exposure for long-term routine contact with ICS potential exposure area shallow soil (0 to 0.5 foot) and surface soil (0 to 3 feet bgs).

Potential pathways for commercial workers to become exposed to soil include incidental ingestion, dermal contact, and inhalation of dust in ambient air. Another potential exposure pathway is inhalation of VOCs that may volatilize from the soil and be present either in outdoor/indoor air. Potential exposure of commercial workers to vapors in outdoor and/or indoor air while inside the TCS fenceline was evaluated using ICS potential exposure area soil and soil gas data.

5.3.1.5 Hypothetical Future Residential Users

The areas outside the compressor station are expected to remain under the control of the current landowners and lease holders, in particular, BNSF for the railroad, Caltrans for the freeway operations, and USBLM and the USFWS for wildlife management and recreational purposes. Nonetheless, the USBLM requested an evaluation of hypothetical future residential users on their property (DOI 2007), even though unrestricted residential use is highly unlikely (DOI 2014b). This potential receptor and exposure scenario are provided at the request of DOI and for informational purposes.

The BCW potential exposure area is partially located on USBLM property and excludes the land north of the railroad that is owned by the FMIT (see Figure 3-3). Potential exposure for the hypothetical future residential user on USBLM land was evaluated using the subset of data from BCW located north of the railroad on USBLM property.

It was assumed that the hypothetical future residential user would contact surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs), and subsurface 2 soil (0 to 10 feet bgs), The hypothetical future resident may be theoretically exposed to soil via inhalation of particulates entrained in ambient air, incidental ingestion of soil, and dermal contact with soil. During RFI/RI sampling, soil gas data to evaluate potential inhalation exposure to VOCs in indoor air from vapor intrusion was not identified as a data gap for the areas outside the TCS. Although soil gas sampling was not conducted outside the TCS fenceline, soil samples were analyzed for VOCs. Results show minimal, infrequent VOC detections in the OCS area soil samples. Therefore, the vapor intrusion pathway was considered potentially complete but insignificant and was not quantitatively evaluated for the hypothetical future resident. However, theoretical inhalation exposures to VOCs in outdoor air were quantitatively evaluated for the hypothetical future residential user.

The exposure scenario evaluated for a hypothetical future residential user was requested by the DOI for informational purposes and is not based on current or likely potential future site use. Under the direction of the DOI, the hypothetical future resident is a rural resident who obtains a significant portion of his/her diet from onsite produced food including vegetables, fruits, and poultry, and that chemicals in the soil and groundwater could partition into those food items. Therefore, the HHRA included those pathways involving the transfer of chemicals from soil into these food items and the theoretical potential for exposure to constituents from soil via these exposure media (Figure 2-3). The potential for transfer of chemicals in groundwater into either produce or poultry were evaluated in the GWRA (Arcadis 2009c) and determined not to be pathways of significance.

5.3.2 Potential Exposure Areas

While Section 2.6 describes the land use for the site and surrounding areas, Figure 5-2 presents a color-coded depiction of the anticipated future land uses for various areas of the site. Specifically, this figure uses three color-coded groupings for land-use patterns associated with the potential exposure areas. AOCs are shown for identification purposes because these are where the sampling points are located within the potential exposure areas. The potential exposure areas and associated receptor populations are grouped as follows:

- **BCW** – BCW is a drainage feature that includes the former percolation bed (SWMU 1) and the area around the former percolation bed (AOC1) that extends past the SWMU1/AOC1 areas to the Colorado River. For human receptors, all AOCs that are outside the TCS are assumed to be equally accessible for future human use. However, BCW is considered a unique potential exposure area separated out from the other AOCs and locations outside the compressor station. BCW is known to have received direct releases of wastewater, is a known source of the groundwater plume, and is shown to have some of the highest concentrations of site related compounds in soil. Evaluation of this potential exposure area (i.e., the BCW potential exposure area) separately is intended to better inform risk management decisions for potential focused cleanup needs. The three receptor populations assumed to be exposed to the BCW potential exposure area include maintenance workers, recreational users, and tribal users.
- **OCS area excluding BCW**– All AOCs that are outside the TCS, excluding BCW, are considered as one potential exposure area (i.e., the OCSxBCW potential exposure area) and were evaluated as one potential exposure area in the HHRA, because all areas outside the TCS are equally accessible to humans. The receptor populations assumed to be exposed to the potential exposure areas outside the TCS, excluding BCW, are maintenance workers, recreational users, and tribal users.
- **OCS area including BCW** – As agreed to in the RAWP Addendum 2 (Arcadis 2015), this additional human potential exposure area, which includes the AOCs that are outside the TCS and BCW (i.e., the OCS potential exposure area), was evaluated in the HHRA. As discussed in the RAWP Addendum 2 (Arcadis 2015), this potential exposure area provides additional perspective on the influence of BCW to an individual's overall estimated exposure. The three receptors assumed to be exposed to this additional potential exposure area are maintenance workers, recreational users, and tribal users.
- **ICS area** – For the HHRA, all SWMUs and AOCs that are inside the TCS fenceline are considered one potential exposure area (i.e., the ICS potential exposure area). Workers who perform work inside the TCS have full access to and work in all areas of the station; there are no specific exposure patterns associated with one particular group of workers being predominantly exposed to one specific area of the TCS. Therefore, the entire area inside the TCS fenceline was considered one representative potential exposure area in the HHRA. The two receptors assumed to be exposed to the potential exposure area inside the TCS fenceline include commercial workers and maintenance workers.

The four areas described previously represent the upper-bound potential exposure areas for the associated receptors. As noted in Section 3.3.1, for OCS, OCSxBCW, and ICS, these exposure areas are based on combined individual investigation areas, as shown on Figure 3-4a. Note that unsampled areas outside the investigation areas were not included in the aerial extent of the combined exposure areas. For the purposes of risk management, these areas are considered relevant to typical behavior patterns anticipated for those potential receptors and their activities.

In addition, at the request of DOI, even though future unrestricted use is unlikely (DOI 2014b), risk and hazards were estimated for a hypothetical future resident potentially exposed to COPCs in soil and home-produced food on DOI property NORR within BCW, defined as the NORR potential exposure area. Risks/hazards estimated for hypothetical residents at the NORR potential exposure area are based on assumptions that they are a rural resident who obtains a significant portion of his/her diet from onsite produced food including vegetables, fruits, and poultry. Although these assumptions are not realistic for potential future land use in this area or anywhere at the site, this hypothetical exposure scenario is evaluated at the request of DOI. The estimated risks and hazards for the hypothetical future resident presented for the NORR potential exposure area are at the request of DOI and are provided for informational purposes only.

In addition, DTSC requested that AOC-specific risk and hazard estimates be calculated for each individual AOC, for SWMU1/TSC-4 (referred to as the SWMU 1 potential exposure area), and for BCW excluding SWMU1 and TSC-4 (i.e., the BCWxSWMU1 potential exposure area) (DTSC 2017a). Although these additional risk evaluations do not represent reasonable current or future long-term exposure scenarios, and thus should not be the primary basis for risk management decisions, the information is presented in this HHERA Report at the agency's direction. These exposure area-specific risk evaluations are provided in Appendices BCW through ICS.

As agreed in the RAWP Addendum 2 (Arcadis 2015), part of the evaluation of the BCW and AOC10 potential exposure areas includes a scouring evaluation. Both of these wash features at the site channel stormwater runoff flow during heavy storms. It is possible that surface soil may become entrained in the runoff and transported away, resulting in concentrations of chemicals that were previously in the subsurface to the surface. Two scouring scenarios are evaluated for the BCW and AOC10 potential exposure areas; one assumes the top 2 feet of soil is removed due to scouring, and the other assumes the top 5 feet of soil is removed due to scouring. Then risks and hazards are estimated for the potential receptors and exposure pathways for the BCW and AOC10 potential exposure areas, assuming the surface has been shifted to the 2-foot or 5-foot depth. See additional details regarding estimation of EPCs in Section 5.2.3.

5.3.3 Exposure Point Concentrations

The different potential exposure areas and soil depth intervals used to estimate EPCs and evaluate risks for the various potential human receptors are discussed in this section. During the HHRA, EPCs were estimated for each of the depth intervals and potential exposure areas associated with each potential human receptor. Exposure depth intervals and areas are discussed for the following populations:

- Maintenance workers, recreational users, and tribal users engaged in activities outside the TCS
- Hypothetical future residential users on USBLM property, NORR
- Commercial and maintenance workers who perform work inside the TCS.

Figure 5-1 shows the areas of the site associated with the various land uses and human receptors. The potential exposure areas were identified, as described in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015), according to the reasonably anticipated future land-use scenarios for the areas, with consideration given to current uses and likely sources of site-related constituents. Each potential exposure area may include lands belonging to various owners. In addition, as requested by DOI and discussed previously, although future residential land use is a highly unlikely scenario, a future hypothetical residential land-use scenario was evaluated for informational purposes for USBLM property, located NORR, (see Figure 3-3). Soil data collected from the potential exposure areas described previously in Section 2.2 are evaluated by depth, based on the CSMs for the Soil HHRA (Section 2.5 and 5.3). All potential receptor populations were evaluated with respect to direct and /or indirect contact with surface soil as described previously in Section 5.3.1. To ensure that the implications of averaging concentrations over one depth zone versus another are clearly understood, the HHRA evaluated representative EPCs for soil within the following depth categories:

- Surface soil (0 to 0.5 foot bgs)
- Shallow soil (0 to 3 feet bgs)
- Subsurface 1 soil (0 to 6 feet bgs)
- Subsurface 2 soil (0 to 10 feet bgs).

For the BCW and AOC10 potential exposure areas, a 2-foot and 5-foot scouring scenario is assumed. These scouring scenarios, as previously described in Section 5.2.2, are included to account for the fact that heavy rainfall events can lead to erosion and deposition of surface soil.

Under a 2-foot scouring scenario, the soil HHRA evaluates representative EPCs for soil within the following depth categories:

- Surface soil (data collected at 2 to 3 feet bgs)
- Shallow soil (data collected at 2 to 6 feet bgs)
- Subsurface 1 soil (data collected at 2 to 10 feet bgs)
- Subsurface 2 soil (data collected at 2 to 12 feet bgs).

Under a 5-foot scouring scenario, the soil HHRA evaluates representative EPCs for soil within the following depth categories:

- Surface soil (data collected at 5 to 6 feet bgs)
- Subsurface 1 soil (data collected at 5 to 10 feet bgs)
- Subsurface 2 soil (data collected at 5 to 15 feet bgs).

5.3.3.1 EPC Datasets for Maintenance Workers Inside and Outside TCS

Based on the presence of subsurface pipelines and roads located throughout the site, subsurface maintenance activities could be conducted anywhere on the site. To address potentially complete exposure pathways shown on the CSMs (Figure 2-2 and Figures 2-4 through 2-6), four primary potential exposure areas were evaluated for the maintenance worker, as set forth in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015). The EPC datasets used for maintenance workers are as follows:

- The first EPC dataset includes soil data from the BCW potential exposure area.
- The second EPC dataset includes soil data from the OCSxBCW potential exposure area.

- The third EPC dataset includes soil data from the OCS potential exposure area.
- The fourth EPC dataset includes soil data from the ICS potential exposure area.

As described previously, because TCS activities are not localized, and there are subsurface features in a variety of areas, the area inside the TCS was evaluated as one potential exposure area.

Additionally, as directed by DTSC (2017a), potential exposures to maintenance workers conducting work outside the TCS were also calculated for each individual AOCpotential exposure area, the SWMU1, and the BCWxSMWU1 potential exposure areas.

As defined in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015), the risk assessment for maintenance workers evaluated representative potential EPC for soil within the following depth categories: surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs), and subsurface 2 soil (0 to 10 feet bgs). Potential receptors are not likely to contact soil at depth without having to penetrate the soil above that depth. For example, the maintenance worker would not contact soil in the interval from 6 to 10 feet bgs without having to go through the material in the 0 to 6 feet above it. However, depending on their activities, they might only go as far as the 3 or 6 feet depth and not all the way to 10 feet. The EPCs for COPCs in surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs), and subsurface 2 soil (0 to 10 feet bgs) are presented in Table 3.1 in the exposure area-specific appendices.

5.3.3.2 EPC Datasets for Recreational Users Outside TCS

The TCS is owned by PG&E, fenced, and planned for continued use as an industrial site for the foreseeable future. The area inside the TCS fenceline is not accessible to recreational users. However, all areas outside the TCS fenceline are open and accessible to recreational users, who may use the area for a variety of recreational activities, such as camping, hiking, hunting, and riding an ATV. The risks for soil contact for the potential recreational user are estimated using data from OCS potential exposure areas to address complete exposure pathways shown on the CSMs (Figures 2-2, 2-4, and 2-5).

To address potentially complete exposure pathways shown on the CSMs, three primary potential exposure areas were evaluated for the recreational user scenarios evaluated in the HHRA, as set forth in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015). The EPC datasets used for potential recreational users located OCS include the following:

- The first EPC dataset includes soil data from BCW.
- The second EPC dataset includes soil data for all OCS areas, excluding BCW.
- The third EPC dataset includes soil data for all OCS areas, including BCW.

Additionally, as directed by DTSC (2017a), potential exposures to recreational users are to be calculated for each individual AOC, SWMU1, and BCWxSWMU1 potential exposure areas.

For direct contact soil pathways (i.e., soil ingestion, dermal contact, and inhalation of particulates), sample data within the top 3 feet of soil is assumed to be available for contact for the potential recreational receptor. To understand the potential implications of averaging concentrations over one depth zone versus another, the risk assessment evaluated representative EPCs for soil within the following depth categories: surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) as shown on

Figure 5-1. As stated previously for the maintenance worker, potential receptors are not likely to contact soil at depth without having to penetrate the soil above that depth. For example, the potential recreational user would not contact soil in the interval from 0.5 to 3 feet bgs without having to go through the material in the 0- to 0.5-foot interval above it. However, depending on their activities, they might only go as far as 0.5 foot and not all the way to 3 feet.

The EPCs for COPCs in surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) are presented in Table 3.1 in the exposure area-specific appendices.

5.3.3.3 EPC Datasets for Tribal Users Outside TCS

As previously stated, the TCS is owned by PG&E, fenced, and planned for continued use as an industrial site for the foreseeable future. The ICS area is not accessible to tribal users. However, all OCS areas are open and accessible to tribal users.

The risks for soil contact for tribal users are estimated using data relevant for areas of interest for the tribal user. As described in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015), three EPC datasets were used to address potentially complete exposure pathways shown on the CSMs on Figures 2-2, 2-4, and 2-5 for the tribal user, as follows:

- The first EPC dataset is for indirect contact with soil in the BCW potential exposure area via the inhalation of particulates.
- The second EPC dataset is for indirect contact with soil in the OCSxBCW potential exposure area via the inhalation of particulates.
- The third EPC dataset is for indirect contact with soil for OCS potential exposure area via the inhalation of particulates.

Additionally, as directed by DTSC (2017a) potential exposures to the tribal users are to be calculated for each individual AOC, SWMU1, and BCWxSWMU1 potential exposure areas.

For indirect soil contact pathways (i.e., inhalation of particulates), sample data within the top 3 feet of soil is assumed to represent the soil that could become airborne and to which the tribal user could potentially be exposed via the inhalation pathway. The EPCs for COPCs in surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) are presented in Table 3.1 in the exposure area-specific appendices.

5.3.3.4 EPC Datasets for Hypothetical Future Unrestricted Use – USBLM Land

As a land owner, the USBLM has specifically requested that the potential exposure scenarios for future use of USBLM land include a future, unrestricted land-use scenario. Residential land use is not a current condition for any portion of the site, and it is highly unlikely to be in the future.

Per risk assessment guidance, a typical exposure area for a residential lot is approximately 1/8 of an acre (USEPA 1989). The USBLM has requested a residential evaluation assuming a rural resident who obtains a significant portion of his/her diet from onsite produced food including fruits, vegetables, and poultry. Such activities would likely require parcels larger than 1/8 of an acre. Additionally, under this hypothetical future residential use scenario, soil across larger areas could be mixed during any theoretical future redevelopment for rural residential and home garden use. For these reasons, the typical exposure area of 1/8 acre is not applicable to this evaluation; however, the hypothetical future residential exposure area for this evaluation would still likely be smaller than the entire NORR (on USBLM land) exposure area of 6.6 acres. As discussed in the RAWP (Arcadis 2008a), the approach for evaluating the USBLM land is based on the overall distribution of the impacts and the spatial distribution of the impacts. Impacts are relatively evenly and randomly distributed across the sampled area of the USBLM land, so the average concentration across the entire area likely represents a reasonable representation of any smaller subarea of the USBLM land that may theoretically be developed under the hypothetical future residential scenario evaluated here.

Surface soil samples (0 to 0.5 foot bgs) as well as a depth-weighted average concentration of samples down to 10 feet bgs are evaluated for direct contact EPCs. The risk assessment for the hypothetical future residential user evaluates representative EPC for soil within the following depth categories: surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs), and subsurface 2 soil (0 to 10 feet bgs). For the homegrown produce and poultry potential exposure pathways, poultry, vegetables and fruits are assumed to contact soil down to a depth of 3 feet.

The EPCs for COPCs in surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), subsurface 1 soil (0 to 6 feet bgs), and subsurface 2 soil (0 to 10 feet bgs) are presented in Table NORR-3.1 in Appendix NORR.

5.3.3.5 EPC Datasets for Commercial Workers Inside the TCS

Commercial workers inside the TCS have full access to and work in all areas of the station. According to PG&E, no specific exposure patterns can be associated with one particular group of workers being predominantly exposed to one specific area inside the TCS. Therefore, the entire ICS potential exposure area is considered one representative exposure area for workers inside the TCS. Accordingly, there is only one EPC dataset for this potential receptor.

The risk assessment for the commercial worker evaluates representative potential EPC for soil within surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs). The EPCs for COPCs in surface soil (0 to 0.5 foot bgs) and shallow soil (0 to 3 feet bgs) are presented in Table ICS-3.1 in Appendix ICS.

5.3.3.6 EPCs for Air

Concentrations of constituents in air were estimated as dust and VOCs in ambient air (if data indicate the presence of VOCs). The methodologies employed to model the transport of chemicals from soil and/or soil gas to ambient air are described in this section.

5.3.3.6.1 Dusts

The estimation of EPCs for compounds present in the particulate form (i.e., adsorbed onto soil particulates) requires the determination of the quantitative relationship between constituent concentrations in the soil (in milligram per kilogram [mg/kg]) and the concentration of respirable particulates (particulate matter of 10 micrometers or less in diameter) in the air due to fugitive dust emissions. Particulate emissions are due to wind erosion and, therefore, depend on the erodibility of the surface material. This HHRA used the particulate emission factor (PEF) as recommended by DOI for recreational users and by DTSC for workers and residents, as detailed in RAWP Addendum 2 (Arcadis 2015).

Predicted air concentrations of constituents in the particulate phase were estimated by dividing the concentration of each constituent in the soil (in units of mg/kg) by the PEF; in units of cubic meters of air per kilogram of dust [m^3/kg]). For maintenance workers who could be exposed to higher levels of dust during the limited subsurface digging/repair activities than dust levels simply from wind-blown erosion, it was assumed that the average 8-hour respirable dust level to which the worker could be exposed is equal to the respirable dust level of 1 milligram per cubic meter (mg/m^3), as recommended by DTSC (2014c).

A primary potential exposure concern associated with recreational users riding OHVs in the area is the generation and subsequent inhalation of airborne particulate matter. With their large wheels, OHVs such as ATVs can release relatively large amounts of surface soil into the ambient air when they are ridden. For the OHV rider population, it was necessary to identify an appropriate PEF that provides an estimate of the airborne level of respirable dust resulting from riding OHVs. USEPA (1991a) has developed a generic PEF for evaluating windblown fugitive dust from surface contamination sites, but that scenario does not agitate the soil as aggressively as the tires of an OHV.

Therefore, DOI reviewed available and relevant studies to recommend a PEF that should be used at the site to represent inhalation exposures for the OHV rider. Based on the studies reviewed, DOI (2014b) recommended the PEF derived for the Standard Mine Site in Colorado for OHV riding because that PEF was based on actual measurements collected during OHV riding. DOI considered the PEF from the Standard Mine Site, 8.47E+05 m^3/kg, to be the most accurate value for estimating airborne respirable dust levels from OHV riding at the TCS site. Accordingly, as presented in the RAWP Addendum 2 (Arcadis 2015), the DOI-recommended value was used as the PEF for estimating air EPCs and associated inhalation risks from OHV riding at the site.

Outdoor air potential exposure concentrations (ECs) in particulates for all population of concern are developed using the EPCs calculated for nonvolatile compounds in soil for each of the representative potential exposure areas and the applicable PEF.

5.3.3.6.2 EPCs for Inhalation of VOCs

The estimation of EPCs for VOCs present in soil requires the determination of the quantitative relationship between chemical concentrations in the soil (in mg/kg) and the concentration of VOCs in air due to VOC emissions from soil. Although only very minimal levels of select VOCs were detected in soil, the volatilization factor (VF) equation presented in the USEPA Soil Screening Guidance (1996a, b) is used to estimate <u>outdoor</u> ambient air exposures to VOCs for receptor populations of concern. Transport of volatile constituents from soil to outdoor air is modeled as two distinct processes: the volatilization of chemicals from soil to the ground surface, and the dispersion of the chemicals from the ground surface into the ambient air using the approach recommended in the USEPA Soil Screening Guidance (1996a, b). These two processes are accounted for in the calculation of VF is described in Appendix AM. The constituents in soil considered to be volatile are those that have a Henry's Law constant greater than 10^{-5} atmosphere-cubic meter per mole (atm-m^3/mol) or a vapor pressure in excess of 1 millimeter of mercury (mmHg) (DTSC 2015b, 2016). Physicochemical properties of the COPCs in soil and soil gas are presented in Table 5-4.

As previously described, a limited number of soil gas samples were collected from ICS areas, particularly in areas where there were physical limitations collecting soil samples. The transport of a volatile chemical from soil gas to indoor air is represented by the AF and calculated in accordance with DTSC guidance (2011c). The methodology used to calculate the AF is detailed in Appendix AM. Soil gas data and AFs are used to estimate potential indoor air exposures to VOCs for commercial workers working inside the TCS.

5.3.4 Exposure Assumptions

Constituent intake is the amount of the constituent entering the potential receptor's body. The risk assessment process follows regulatory guidance for both the calculation methods (e.g., equations used) and input terms used to estimate exposure. The calculation equations and input terms to be used in the soil HHRA are provided in the following guidance documents:

- Preliminary Endangerment Assessment Guidance Manual (DTSC 2015b)
- Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities (DTSC 2014c)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) (USEPA 1989)
- Exposure Factors Handbook, Volume I: General Factors (USEPA 1997b)
- Exposure Factors Handbook, Volume III: Activity Factors (USEPA 1997c)
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment) (USEPA 2004b).

The amount of constituent contacted depends upon activity patterns of the potential receptor and nature of the environmental media containing the COPC. Key components contributing to intake of site-related compounds include:

CR = contact rate, the amount of environmental medium contacted per unit time or event. There are different units depending on whether exposure occurs via ingestion, dermal contact, or inhalation (e.g., milligram per day [mg/day] for soil ingestion).

EF = exposure frequency, accounts for how often exposure occurs (days per year).

ED = exposure duration, describes how long exposure occurs (years).

BW = body weight, the average BW of the exposed individual receptor (kg).

AT = averaging time, period over which exposure is averaged (days). This term varies based on whether the compound being evaluated is a carcinogen or noncarcinogen.

The values available for each of the exposure factors can vary according to the type of receptor (e.g., recreational user vs. commercial worker) and also by age and sex for some components. For this HHRA, default agency-recommended exposure assumptions are used for both the hypothetical future unrestricted resident on USBLM land and the commercial worker inside the TCS. Site-specific exposure assumptions, as presented in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015), were used in the HHRA for soil direct and/or indirect contact for the maintenance worker, recreational users, and tribal user, as described in this section.

Specific exposure parameters that are selected for each scenario along with the rationale for selection are described in the following sections for the potential receptors. Consistent with regulatory guidance, exposure assumptions are developed using reasonable maximum exposure (RME) assumptions. The intent of the RME approach is to estimate the highest exposure level that could be reasonably expected to occur, but not the worst possible case (USEPA 1989, 1991c). In keeping with USEPA guidance, variables chosen for a baseline RME scenario for intake or contact rate, exposure frequency, and exposure duration are generally upper bounds. All exposure scenarios include an evaluation of both cancer and noncancer (systemic) potential health impacts, depending on the toxicity characteristics for each compound and the relevance for the exposure pathway.

Exposure assumptions used during the HHRA are described in the following sections summarized in Table 5-1 for each potential receptor. These exposure assumptions were used in formulas for developing the chronic daily intakes (CDIs) and ECs for estimating health risks for maintenance workers, recreational users, tribal users, and the hypothetical future residential users presented in Tables 5-2, 5-3a, and 5-3b.

5.3.4.1 Maintenance Workers

The maintenance worker is a plausible receptor under current and future land-use assumptions inside and outside the compressor station. Maintenance projects requiring intrusive work may be performed on any part of the site where the installation or repair of underground pipelines or utilities may occur.

Based on information provided by PG&E, excavation work at TCS is generally conducted by three types of maintenance workers:

- Local PG&E employees who could work at TCS for approximately 30 years
- Periodic PG&E employees who could work at TCS for approximately 1 to 2 years
- Contractors who could work at TCS for less than 1 year.

These categories of maintenance workers can conduct several types of subsurface/intrusive work, both inside and outside the TCS. These include:

- Small-sized event:
  - Short duration, hand digging work
  - Occurs approximately 20 times per year, average of 4 hours per event
  - Mostly conducted by local PG&E employees (assumed to be exposed 4 hours per day for 20 days per year).
- Medium-sized event:
  - Larger excavation, combination of hand digging and some backhoe work
  - Occurs approximately five times per year, average of 15 hours per event
  - 50% hours conducted by local PG&E employees (assumed to be exposed 7.5 hours per day for 5 days per year), 25% hours conducted by periodic PG&E employees (assumed to be exposed 3.75

hours per day for 5 days per year), 25% hours conducted by contractors (assumed to be exposed 3.75 hours per day for 5 days per year). [Note: 7.5 hours is 50% of the average of 15 hours per event.]

- Large-sized event:
  - Likely involves mechanical soil removal by hydro vacuum, and possibly mechanical digging devices
  - Occurs approximately one to two times per year, average of 200 hours per event
  - 10% hours conducted by local PG&E employees (assumed to be exposed 8 hours per day for a maximum of 5 days per year), 10% hours conducted by periodic PG&E employees (assumed to be exposed 8 hours per day for a maximum of 5 days per year), 80% hours conducted by contractors (assumed to be exposed 8 hours per day for a maximum of 40 days per year). [Note: Assumptions derived based on 10% of the average 200 hours (or 20 hours) divided by 8 hours for the exposure time of one workday resulting in an exposure frequency of 2.5 days per year if work occurs one time a year and an exposure frequency of 5 days per year if work occurs two times a year.]
- Linear event:
  - Likely uses excavators, and mostly occurs outside the TCS
  - Occurs approximately one time per year, average of 200 hours per event
  - 10% hours conducted by periodic PG&E employees (assumed to be exposed 8 hours per day for 2.5 days per year), 90% hours conducted by contractors (assumed to be exposed 8 hours per day for 22.5 days per year).

Based on the exposure assumptions provided previously, two types of worker exposure scenarios were derived for the protection of maintenance workers at the site. The two types of worker exposure scenarios include short-term maintenance workers (primarily contractors and periodic PG&E employees), and long-term maintenance workers (primarily PG&E employees). A short-term worker (such as a contractor, as described previously, who is assumed to only be present at the site for 1 year and does not come back, repeatedly, year after year) may be present during the various types of events as described previously. The highest exposure for a short-term worker would most likely occur during a large-sized event, where the worker could potentially be exposed for 8 hours per day, for 40 days per year for a period of 1 year. Thus, these exposure parameters were assumed to represent a short-term worker scenario. The short-term maintenance worker exposure assumptions are summarized in Table 5-1.

A long-term maintenance worker present at the site for longer periods (such as a local PG&E employee) may be present during various types of activities as described previously. The highest exposure for a long-term worker would most likely occur during a small-sized event, where the worker could potentially be exposed for 4 hours per day, 20 days per year for a 30-year period. Thus, these exposure parameters were assumed to represent the upper bound but not worst-case exposure for a long-term maintenance worker scenario. The long-term maintenance worker exposure assumptions are summarized in Table 5-1.

5.3.4.2 Recreational Users

Potential recreational land use and associated potential exposure are expected to occur only at areas outside TCS. Potential direct contact pathways for exposure to soil for the recreational adult and child include incidental ingestion, dermal contact, and inhalation of dust. The exposure assumptions for this exposure scenario were developed using site-specific input from DOI.

DOI (2014b) has provided information to PG&E about the types of recreational activities that could occur at the site and the corresponding exposure scenarios and exposure assumptions that should be incorporated into the Soil HHRA. As recommended by DOI, it is assumed that each of the recreational activities could take place at any location on federal land. In reality, specific locations may be preferred for certain activities, while other locations may be less attractive or may have limited recreational options (e.g., HNWR). As stated by DOI, the most probable recreational land use activities on federal land include hiking, camping, hunting, and OHV riding.

As summarized by DOI, generic, or default, exposure factors are generally not available for recreational land use (except for some specific scenarios, such as fishing and fish ingestion rates). The USEPA Exposure Factors Handbook Update does not present exposure factors for any recreational scenarios other than fishermen (USEPA 2011). Rather, informed professional judgment is necessary to select factors that best represent the types of recreational activities that may be conducted at the site.

Recreational use of federal land at the site is expected to vary during the course of a year due to a variety of factors, including weather (especially hot, cold, or rainy periods), seasonality of hunting, and time of year. In general, recreational activities at the site are expected to be limited in frequency and duration during the hottest summer months. Hunting would only occur during those months that are legally permitted; the exposure potential could vary based on game species being hunted. The exposure frequency is expected to be limited to a few weeks for the species of interest (e.g., game birds).

The exposure parameters proposed by DOI for recreational visitors on federal land near the site are based on site-specific considerations and information provided from nearby sites and relevant sources. The frequency of exposure parameters selected have been informed by information presented in the California Natural Resources Agency's (CNRA) document "Complete Findings: Survey on Public Opinions and Attitudes on Outdoor Recreation in California, 2009" (CNRA 2009), particularly Table 25 (Recreation Activity Participation of Respondents During the Past 12 Months). The use rates provided by CNRA are mean values; for risk assessment purposes, an upper bound measure of exposure (e.g., 95UCL) is generally preferred. To protect human health, it is assumed herein that a participant's entire annual recreational activity is conducted at the site rather than spread out at various recreational locations across the state. A camper or hunter is assumed to visit the site 8 days per year while a hiker or OHV rider is assumed to visit the site 16 days per year. The camper, hunter, and hiker are each assumed to be at the site the entire 24-hour day while the OHV rider is assumed to be on site for 1.5 hours per day. An exposure duration of 30 years is consistent with those used in the Clear Creek Management Area HHRA (USEPA 2008) for similar activities. The recreational user exposure assumptions are summarized in Table 5-1.

5.3.4.3 Tribal Users

Tribal use and associated potential exposure is expected to occur at areas outside the TCS. The potential indirect pathway for exposure to soil for tribal use is the inhalation of dust arising from wind erosion. The exposure assumptions for this potential exposure scenario were developed using site-specific input from the Tribes. In the memorandum provided by the Tribes regarding potential tribal exposure at the site

(FMIT 2012), the tribal user is assumed to visit the site 12 days a year for 2 hours each visit over a 60-year period. The tribal user exposure assumptions are summarized in Table 5-1.

5.3.4.4 Hypothetical Future Unrestricted Users

Residents are not currently present outside the TCS nor is the TCS intended for residential use in the future. Furthermore, the areas outside the TCS are highly unlikely to be developed for residential land use in the future. However, because the USBLM has specifically requested an evaluation of potential hypothetical future residential use, that exposure scenario is evaluated for USBLM land only. This hypothetical future receptor is evaluated at the request of DOI and for informational purposes.

As requested, the future unrestricted land use scenario is evaluated for the hypothetical future rural resident who obtains a significant portion of his/her diet from onsite produced food including vegetables, fruits, and poultry. Chemicals in soil could partition into these foods, as described in the RAWP (Arcadis 2008a). In agreement with DOI for evaluation of the USBLM managed land, the uptake into homegrown produce/animal products is evaluated using the uptake model from the CalEPA Office of Environmental Health Hazard Assessment (OEHHA) Toxic Hot Spots Program (2012, 2015). This model assumes uptake of compounds into different plants via deposition onto surfaces, and uptake from roots. Then, the model assumes uptake into meat, eggs, and dairy products, and uses the National Health and Nutrition Examination Survey data from 1999 to 2004 to generate per capita consumption distributions for produce (exposed, leafy, protected, and root categories), meat (beef, chicken, and pork), dairy products, and eggs. The specific uptake and exposure parameters recommended by OEHHA in the Toxic Hot Spots Model (2012, 2015) are presented in Attachment C in Appendix NORR. The transfer of chemicals in groundwater into either produce or poultry was evaluated in the GWRA (Arcadis 2009c) and determined to not to be pathways of significance.

The hypothetical future residential receptor uses standard default assumptions developed by USEPA and adopted by CalEPA to evaluate other potentially complete exposure pathways for this receptor, as shown in Table 5-1 (USEPA 2002c, OEHHA 2012, DTSC 2014c).

5.3.4.5 Commercial Workers

As discussed with stakeholders and as described in RAWP Addendum 2 (Arcadis 2015), the approach to estimating risk and hazard for commercial workers inside the fenceline is a screening evaluation. The available soil data from within TCS is screened by comparing the data to standard default soil screening levels for commercial/Industrial workers (i.e., USEPA commercial RSLs). The soil screening values (i.e., RSLs) are developed using standard default assumptions developed by USEPA (2002c, 2011) and are, therefore, appropriate for this screening analysis. As such, exposure parameters are not required to estimate exposure doses for this receptor.

5.4 Toxicity Assessment

The HHRA included a toxicity assessment, which characterized the relationship between the magnitude of exposure to a constituent and the potential for adverse health effects. The toxicity assessment identified agency-promulgated or derived toxicity values that were used to estimate the likelihood of adverse health effects occurring in humans at different exposure levels. The approach for the toxicity assessment was provided in the RAWP (Arcadis 2008a) and RAWP Addendum 2 (Arcadis 2015). Consistent with regulatory risk assessment policy, adverse health effects resulting from potential chemical exposures were evaluated in two categories: carcinogenic effects and noncarcinogenic effects. The hierarchy of sources for the toxicity criteria used in the risk assessment generally corresponds to the state's guidance (DTSC 2015b) and is discussed in more detail in this section.

5.4.1 Toxicity Assessment for Carcinogenic Effects

Current HHRA practice for carcinogens is based on the assumption that, for most substances, there is no threshold dose below which carcinogenic effects do not occur. This current "no-threshold" assumption for carcinogenic effects is based on the assumption that the carcinogenic processes are the same at high and low doses. This approach has generally been adopted by regulatory agencies as a conservative practice to protect public health, and the "no-threshold" assumption has been used in the agency-derived cancer slope factors (CSFs) and unit risk factors (URFs) used in this HHRA. Although the magnitude of the risk declines with decreasing exposure, the risk is assumed to be zero only at zero exposure.

The toxicity values used to quantify the response potency of a potential carcinogen are the following:

- The CSF, used to assess the oral and dermal routes of exposure, represents the incremental lifetime cancer risk (ILCR) due to a continuous, constant lifetime exposure to a specified level of a carcinogen generally reported as ILCR per milligram of constituent per kilogram body weight per day ($[\text{mg/kg-bw/day}]^{-1}$).
- The URF, used to assess the inhalation route of exposure, represents the ILCR due to a continuous, constant lifetime exposure to a specified level of a carcinogen in the air, generally reported as ILCR per microgram of chemical per cubic meter of air ($[\mu g/m^3]^{-1}$); URFs are reported as ILCR per milligram of chemical per cubic meter of air ($[mg/m^3]^{-1}$) in Table 5-5 for risk calculation purposes.

The CalEPA and USEPA have published a list of CSFs and URFs recommended for use in risk assessments. Consistent with DTSC's approach to evaluating potential vapor intrusion health risks (DTSC 2014d) and calculating risk-based screening levels (DTSC 2018b), in general, toxicity values for carcinogenic effects used in this HHRA were selected as the more conservative values obtained from the OEHHA Toxicity Criteria Database (OEHHA 2018) or the USEPA Integrated Risk Information System (IRIS) online database (USEPA 2018b). In the absence of carcinogenic toxicity criteria from these sources, the National Center of Environmental Assessment (NCEA)/Superfund Health Risk Technical Support Center (STSC) (Office of Superfund Remediation and Technology Innovation [OSRTI] 2018) was used as an additional resource, as recommended by the USEPA (2003a). The NCEA/STSC was used to identify a URF for cobalt and CSF for butylbenzyl phthalate and 1-methylnaphthalene (OSRTI 2018).

URFs were derived for 1-methylnaphthalene through route-extrapolation as recommended by DTSC (2014d, 2018b) to enable an evaluation of the potential inhalation excess lifetime cancer risk associated with this volatile COPC (Table 5-5). If CSFs or URFs have not been promulgated by either OEHHA or USEPA, the constituent was not evaluated as a carcinogen.

Neither URFs nor CSFs were available for a few COPCs belonging to carcinogenic classes of compounds. In these cases, surrogate chemicals were chosen based on structural similarity to avoid underestimating potential carcinogenic hazards:

- Alpha-chlordane and gamma-chlordane were represented by technical chlordane.
- Dioxin toxic t equivalents for the evaluation of human health (TEQ human) was represented by 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

Table 5-5 presents the CSFs and URFs used in this HHRA for the COPCs in soil and soil gas. As indicated, COPCs that are currently regulated as carcinogens include arsenic, beryllium (via inhalation only), cadmium (via inhalation only), hexavalent chromium, cobalt (via inhalation only), nickel (via inhalation only), benzene, carbon tetrachloride, chloroform, ethyl benzene, methylene chloride, tetrachloroethene, trichloroethene, bis (2-ethylhexyl) phthalate, di-n-butyl phthalate, 1-methyl naphthalene, naphthalene, carcinogenic polyaromatic hydrocarbons (cPAHs) as BaPEQ, 4,4-dichlorodiphenyldichloroethylene (DDE), 4,4- dichlorodiphenyltrichloroethane (DDT), alpha-chlordane, gamma-chlordane, dieldrin, total PCBs, and TEQ human.

Age-Dependent Adjustments for Mutagens

A few of the COPCs at the site that are currently regulated as carcinogens (B(a)PEQ, hexavalent chromium, trichlororethene, and vinyl chloride), operate by a mutagenic mode of action, meaning these COPCs may cause irreversible changes to DNA, and therefore may exhibit a greater effect in early-life versus later-life exposure (USEPA 2018a). To account for these life-stage differences in receptor populations that include children (recreational users [camper, hiker, and OHV rider], residents), separate equations were used to calculate ILCRs for mutagens that include age-dependent adjustment factors (ADAFs) (USEPA 2005, 2018a). Specifically, for the recreational user (camper, hiker) and hypothetical future resident receptor populations evaluated in this HHRA, ADAFs of 10, 3, and 1 were used for mutagens for exposure from 0 to 2 years of age, 2 to 16 years of age, and 16 to 26 years of age, respectively (Table 5-3b). For the recreational user (OHV rider) receptor populations evaluated in this HHRA, ADAFs of 3, and 1 were used for mutagens for exposure from 6 to 16 years of age and 16 to 32 years of age, respectively (Table 5-3b).

While trichloroethene (detected in soil gas only) is a mutagen, the URF, as recommended by USEPA (2018a), incorporates an ADAF thus inhalation exposure is evaluated using the URF presented in Table 5-5 and the equation presented in Table 5-3b. hexavalent chromium, methylene chloride, and B(a)PEq are evaluated using the carcinogenic toxicity values presented in Table 5-5 and the equations presented in Table 5-3b.

5.4.2 Toxicity Assessment for Noncarcinogenic Effects

The toxicity assessment for noncarcinogenic effects requires the derivation of an exposure level below which no adverse health effects in humans are expected to occur. USEPA refers to these levels as reference doses (RfDs) for oral and dermal exposures and reference concentrations (RfCs) for inhalation exposures (USEPA 1989). In the case of the CalEPA, noncarcinogenic oral and inhalation criteria, as derived by OEHHA, are referred to as Reference Exposure Levels (RELs). The noncancer RfD/REL represents a dose, given in mg/kg-bw/day, that would not be expected to cause adverse noncancer health effects in potentially exposed populations and is often referred to as the "acceptable dose." The noncancer RfC/REL represents the airborne concentration (in units of micrograms per cubic meter [$\mu g/m^3$]; however, reported as mg/m^3 in Table 5-5 for risk calculation purposes) that would not be expected to cause adverse noncancer health effects in populations exposed through the inhalation pathway.

Consistent with DTSC's approach to evaluating potential vapor intrusion health hazards (DTSC 2014d) and calculating risk-based remediation goals (DTSC 2018b), in general, the more conservative RfD/REL and RfC/REL obtained from either the OEHHA Toxicity Criteria Database (2018) or the USEPA sources listed in this section were used in this HHRA.

As recommended by USEPA (2003a), the hierarchy of USEPA toxicity values for noncarcinogenic effects for the oral and inhalation exposures (i.e., RfDs and RfCs, respectively) used in this HHRA is as follows:

1. USEPA-recommended RfDs and RfCs as maintained on the IRIS online database (USEPA 2018b)
2. NCEA/STSC-recommended provisional peer-reviewed toxicity values (PPRTVs) (OSRTI 2018)
3. USEPA toxicity values as recommended or provided for specific chemicals in the USEPA RSLs Table (2018a) (e.g., Agency for Toxic Substances Disease Registry [ATSDR] Minimal Risk Levels [MRLs] [2018] or Health Effects Assessment Summary Tables [HEAST] toxicity values [USEPA 1997d]).

To evaluate noncancer hazards associated with potential exposures to TPH as diesel and TPH as motor oil, reported in soil at the site, RfDs and RfCs developed by the California Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) were used (2016), consistent with DTSC (2015b) recommendations. [Note: The SFRWQCB's development of RfDs and RfCs is based on a weighted approach for TPH fractions. Each TPH fraction is weighted based on its relative proportion in the particular fuel mixture (e.g., diesel, motor oil). For the RfDs, the fraction weighting is based on weight percent composition in the fuel mixture. For the RfCs, the fraction weighting is based on percent vapor composition above the fuel for TPH as diesel, as TPH as motor oil is considered to be nonvolatile. A route-to-route extrapolation based on the RfD was conducted to evaluate the particulate inhalation pathway for TPH as motor oil.]

All noncarcinogenic toxicity values used in this HHRA for the COPCs in soil and soil gas are presented in Table 5-5.

Consistent with DTSC (2018b) recommendations, route-to-route extrapolation was used to calculate RfCs from RfDs when RfCs were not available. Similarly, when RfDs were not available for COPCs, RfDs were calculated from RfCs. However, neither RfCs nor RfDs were available for some COPCs. In such cases, surrogate chemicals were chosen based on structural similarity to avoid underestimating potential noncarcinogenic hazards:

- Total chromium was represented by chromium-3.
- Phosphate was represented by aluminum metaphosphate.
- Acenaphthylene was represented by acenaphthene.
- Potential noncarcinogenic effects of the cPAHs, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were represented by pyrene.
- Dibenz(a,h)anthracene was represented by benzo(a)pyrene.
- Benzo(g,h,i)perylene was represented by pyrene.
- Phenanthrene was represented by anthracene.
- Alpha- and gamma-chlordane were represented by technical chlordane.

- Total PCBs were represented by PCB 1254.
- TEQ human was represented by 2,3,7,8-TCDD.

5.4.3 Toxicity Assessment for Lead

The traditional RfD approach to the evaluation of chemicals was not applied to lead because most human health effects data are based on blood lead concentrations, rather than external dose (DTSC 2011d). Blood lead concentration is an integrated measure of internal dose, reflecting total exposure from site-related and background sources. A clear NOEL has not been established for such lead-related health effects endpoints such as birth weight, gestation period, heme synthesis and neurobehavioral development in children and fetuses, and blood pressure in middle-aged men. OEHHA has developed a 1 microgram per deciliter (µg/dL) benchmark for source-specific incremental change in blood lead levels for the protection of school children and fetuses (OEHHA 2007).

DTSC developed a methodology for evaluating exposure and the potential for adverse health effects resulting from exposure to lead in the environment (DTSC 2011d). The methodology presents an algorithm for estimating blood lead concentrations in children and adults based on a multi-pathway analysis. The agency has provided a spreadsheet (LeadSpread) based on its guidance for evaluating lead toxicity (DTSC 2011d, e).

The USEPA developed a methodology for evaluating exposure and the potential for adverse health effects resulting from nonresidential exposure to lead in the environment, in Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil (TRW ALM; USEPA 2003b). The methodology results in a blood lead concentration of concern for the protection of fetal health (in women of child-bearing age) and presents an algorithm for predicting quasi-steady state blood lead concentrations among adults who have relatively steady patterns of site exposure. DTSC's LeadSpread spreadsheet contains a modified version of the USEPA ALM which incorporates DTSC recommendations for evaluating potential nonresidential adult (i.e., maintenance workers and hunter) exposures to lead via the soil ingestion pathway only. The soil ingestion pathway is considered incomplete for the tribal user blood lead, so blood lead levels for the fetus of the tribal user were not calculated in this HHRA. Using the USEPA ALM (USEPA 2003b), OEHHA developed a health-based screening level for lead in commercial/industrial soil, 320 mg/kg, by querying the ALM for the soil concentration that would give rise to the 90th percentile estimate of change in blood lead of 1 µg/dL in a fetus of an adult worker assumed to be regularly exposed to lead in soil via incidental soil ingestion (including soil-derived indoor dust) (OEHHA 2009). In this HHRA, the commercial health-based screening level, 320 mg/kg (referred to by the DTSC as the commercial/industrial DTSC-SL [DTSC 2018b]) is used as a screening value for lead for commercial workers.

Per DTSC's current recommendation, the DTSC LeadSpread worksheets were used to evaluate potential exposure to lead in soil for the unrestricted hypothetical future residential land user on the USBLM property, north of the railroad, as well as recreational land-users. Impacts were evaluated based on the benchmark change in blood level concentration of 1 µg/dL for the child (based on blood lead concentration at the 90th percentile, estimated using LeadSpread) and for the fetus of an adult worker/hunter (based on blood lead concentration at the 90th percentile, estimated using ALM) for maintenance workers and hunters.

5.4.4 Toxicity Equivalency Factors for Polycyclic Aromatic Hydrocarbons

For human health, PAHs are evaluated for both carcinogenic and noncarcinogenic toxicity endpoints. The compounds with noncancer toxicity values will be addressed in the HHRA as individual compounds. The PAHs designated by the state of California as carcinogenic (cPAH) were addressed in terms of a benzo(a)pyrene equivalent value, or B(a)PEQ, for each sample. Carcinogenic toxicity values have not been established for each individual cPAH; rather, the carcinogenic potential of each cPAH was determined based upon its toxicity compared to benzo(a)pyrene. As a result, OEHHA has assigned a benzo(a)pyrene toxicity equivalency factor (TEF) for each cPAH, which when multiplied by the site concentration, converts the cPAH concentration into a concentration of BaPEq (DTSC 2015b). For this site, the concentrations of all cPAHs were converted into B(a)PEQ, which were summed for the sample to produce a total B(a)PEQ concentration for that sample. The total B(a)PEQ concentration was included in the final dataset. The B(a)PEQ included all seven cPAH constituents using half the RL for those constituents not reported above the RL.

The TEFs used in this HHRA are summarized in the table titled TEFs Used in the HHERA.

Toxicity Equivalency Factors Used in the HHERA

cPAH	OEHHA TEF
Benzo(a)pyrene	1.0 (index compound)
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Dibenz(a,h)anthracene	1
Chrysene	0.001
Indeno(1,2,3-cd)pyrene	0.1

Source: DTSC 2015b

5.4.5 Toxicity Factors for Dioxins and Furans

The carcinogenic toxicity of dioxins/furans is well established, especially for the most potent congener in the group, TCDD. OEHHA has published carcinogenic toxicity values (an oral CSF of 130,000 [mg/kg-day]$^{-1}$ and inhalation URF of 38 [μg/m^3]$^{-1}$) and noncarcinogenic toxicity values (an oral REL of 1×10^{-8} mg/kg-day and inhalation REL of 4×10^{-8} mg/m^3 for liver, reproductive system, development, endocrine system, respiratory system, and hematopoietic system toxicity) for assessing the toxicity of dioxins (OEHHA 2018). Based on these toxicity values, the DTSC has developed risk-based remediation goals for dioxins in soil that also account for the (minimal) contribution of soil and dust to dioxin human body burden, as demonstrated in dioxin exposure studies conducted at the University of Michigan (e.g., the DTSC remedial goal of 50 picograms per gram (pg/g) total TCDD TEQ for residential land use based on a target cancer risk of 1 in 1 million multiplied by a factor of 10 to account for the bioavailability of TCDD TEQ) (DTSC 2017b). USEPA has yet to complete its cancer reassessment of TCDD, but recently developed an oral RfD for the reproductive system toxicity of TCDD of 7×10^{-10} mg/kg-day (USEPA 2018b).

Although the toxicity of TCDD is best understood among the individual congeners of the group, other "TCDD-like" compounds within the group are understood to act through the same mechanism of action, a mechanism that depends on chemical structure, specifically the placement of chlorine atoms around the congener molecules. TCDD contains chlorines in the 2, 3, 7, and 8 positions. The other congeners that contain chlorines in at least the 2, 3, 7, and 8 positions, versus hydrogen molecules attached to any number of these positions, are understood to have TCDD-like toxicity. Of the 75 polychlorinated dibenzodioxin (PCDD) congeners and the 135 polychlorinated dibenzofuran (PCDF) congeners in the dioxin group, seven of the PCDD congeners and 10 of the PCDF congeners have chlorine substitutions in these positions (USEPA 1994, 2004c). TEF for human receptors have been developed to express the relative toxicity of individual dioxin-like compounds (DLCs) to that of TCDD. TCDD has a TEF defined as one, and TCDD-like PCDD and PCDF congeners have TEF values equal to one or less. Individual congeners may be assigned different TEFs in the ERA, due to differences in toxicity to different species.

TCDD TEQ is used to assess the risk of exposure to a mixture of TCDD-like compounds. TCDD TEQ is defined as the product of the concentration, Ci, of an individual "dioxin-like compound" in a complex environmental mixture and the corresponding TCDD TEF for that compound. The total TCDD TEQ is the sum of the TCDD TEQs for each of the congeners in a given mixture. The following equation summarizes this approach:

$$\text{Total TCDD TEQ} = \sum_{i=1}^{n}\left(C_i \times TEF_i\right) \qquad \text{Equation 5-1}$$

This approach was applied in the HHRA to estimate total TCDD TEQ concentrations for samples analyzed for TCDD and TCDD-like compounds. For the purposes of this report, total TCDD TEQ concentrations estimated specifically for potential human exposures in the HHRA are also referred to as TEQ human when necessary to differentiate these results from TCDD TEQ concentrations estimated for ecological receptors in the ERA. TCDD TEQ concentrations were estimated from the set of TEFs recommended in DTSC guidance (2017b) to evaluate potential human receptor exposure scenarios in the HHRA. These TEFs are based on the weighting system proposed by the World Health Organization (WHO) in 2005 (Van den Berg et al. 2006). Values equal to one-half of RLs were used for ND individual congeners in the TCDD TEQ concentration estimations for the HHRA.

WHO 2005 TEFs Used in the HHRA - Chlorinated dibenzo-p-dioxins

Compound	WHO 2005 TEF
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1

Compound	WHO 2005 TEF
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0003

Notes:

HpCDD = heptachlorodibenzo-p-dioxin
HxCDD = hexachlorodibenzo-p-dioxin
OCDD = cctachlorodibenzo-p-dioxin
PeCDD = pentachlorodibenzo-p-dioxin
Source: DTSC 2017b

WHO 2005 TEFs Used in the HHRA - Chlorinated dibenzofurans

Compound	WHO 2005 TEF
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0003

Notes:

HpCDF = heptachlorodibenzofuran
HxCDF = hexachlorodibenzofuran
OCDF = octachlorodibenzofuran
PeCDF = pentachlorodibenzofuran
TCDF = tetrachlorodibenzofuran
Source: DTSC 2017b

5.4.6 Toxicity Factors for Polychlorinated Biphenyls

PCB compounds are known carcinogens. Aroclors, which are a mixture of individual PCB congeners, were detected at the site. Currently, toxicity data for carcinogenic and noncarcinogenic endpoints are available for Aroclors rather than for individual PCB congeners. The sum of individual concentrations of Aroclors detected within an investigation area using 1/2 RL for NDs was reported as total PCBs and this value is used to assess the risks/hazards associated with exposure to PCBs.

OEHHA (2018) has published carcinogenic toxicity values for Aroclor-1016 (an oral CSF of 0.07 [mg/kg-day]$^{-1}$ and inhalation URF of 0.02 [μg/m^3]$^{-1}$) and other Aroclors (Aroclor-1221, 1232, 1242, 1248, 1254,1260,1262, 1268 (an oral CSF of 2 $[mg/kg\text{-}day]^{-1}$ and inhalation URF of 0.57 $[\mu g/m^3]^{-1}$). USEPA (2018b) has established noncarcinogenic toxicity values (an RfD of 20 in 1 million mg/kg-day and RfC of 80 in 1 million mg/kg-day) for assessing the toxicity of Aroclor-1254. Conservatively, the toxicity criteria established for Aroclor-1254, was used to evaluate the health risks associated with exposure to total PCBs.

5.4.7 Toxicity Assessment for Other Constituents

As per agency request, essential nutrients (calcium, iron, magnesium, manganese, sodium, and potassium) were evaluated for inclusion as COPCs in the HHRA. Human health toxicity values are available for iron and manganese, thus only these two essential nutrients were included as COPCs in the HHRA, where concentrations were found to exceed background levels (see Section 3.4.1.1).

Similarly, no human health toxicity values are available for chloride and sulfate, so these two constituents were excluded from the HHRA. These constituents did not have a BTV as they were not analyzed for in the background dataset.

5.5 Risk Characterization

This section of the HHRA presents the quantitative characterization of risks posed by the COPCs identified in soil and soil gas, and a discussion of uncertainties associated with the projected estimated risks. The methodology specific to the evaluation of hypothetical future residential exposure to COPCs through ingestion of home-produced food is described in Attachment C of Appendix NORR. This section is divided into three parts:

- The first part discusses the methodology used in calculating potential cancer risks and noncancer hazards to potentially exposed maintenance workers, recreational users, tribal users, and future hypothetical residential populations outside the TCS posed by the presence of COPCs in soil.
- The second part discusses the methodology used in calculating potential cancer risks and noncancer hazards to potentially exposed commercial worker receptors posed by the presence of COPCs in soil and VOCs in soil gas inside the TCS soil.
- The third part presents the estimated cumulative potential ILCR and noncancer hazard posed by the presence of COPCs in soil and soil gas. The quantitative estimates of ILCR and noncancer hazard provide the basis for identifying the specific areas and compounds that contribute most significantly to estimated cancer risks and noncancer hazard, and that may warrant some form of mitigation to reduce risks to levels that would be fully protective of human health.

As stated in Section 5.3.3, for potential exposure to lead in soil, the risk characterization for the camper, hiker, and OHV rider and hypothetical future residential scenarios used the latest version of LeadSpread (DTSC 2011d, e), version 8, to evaluate blood lead levels in child receptors that would result from regular contact with lead in soil assuming exposure via incidental ingestion, dermal contact, and dust inhalation. For worker and hunter scenarios, the USEPA ALM (USEPA 2003b) was used to estimate quasi-steady state fetal blood lead concentrations in pregnant women resulting from relatively steady patterns of site exposure. The results of the lead risk assessment are presented in Section 5.4.3, along with quantitative estimates of ILCR and noncancer hazard.

5.5.1 Methodology for Estimating Cancer Risks and Noncancer Hazards for Maintenance Workers, Recreational Users and Tribal Users

Estimating ILCRs and noncancer HIs for exposures to constituents in soil and/or soil gas requires information regarding constituent concentrations in the soil and/or soil gas, the level of potential exposure to each constituent, and the relationship between exposure to the constituent and its toxicity. The methodology used to derive the ILCRs and noncancer HIs for the selected COPCs is based principally on guidance provided in the regulatory documents listed in this section.

- Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A) (USEPA 1989)
- Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part F: Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009)
- Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. HHRA Note Number: 1. September 30 (DTSC 2014c)
- Preliminary Endangerment Assessment Manual (DTSC 2015b).

The following sections present the equations used to derive the ILCRs and noncancer HIs for the COPCs in soil and soil gas.

5.5.1.1 Carcinogenic Health Effects

The following equations describe the established relationship between exposure, toxicity, and risk for carcinogenic health effects. For exposures occurring via incidental soil ingestion and dermal contact with soil, the relationship for carcinogenic effects is given by the following equation (USEPA 1989):

$$ILCR = CDI \times CSF \quad \text{Equation 5-2}$$

Where:

ILCR = Incremental lifetime excess cancer risk; the incremental probability of and individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)

CDI = Chronic daily intake of a constituent (mg constituent/kg body weight day)

CSF = Cancer slope factor; the toxicity value which indicates the upper limit on ILCR per unit of dose of constituent (mg constituent/kg body weight-day)$^{-1}$

For the inhalation pathway, the relationship for carcinogenic effects is given by the following equation (USEPA 2009):

$$ILCR = EC \times URF \quad \text{Equation 5-3}$$

Where:

ILCR = Incremental lifetime excess cancer risk; the incremental probability of and individual developing cancer as a result of exposure to a particular cumulative dose of a potential carcinogen (unitless)

EC = Exposure concentration of a constituent in air (mg constituent/m^3 air)

URF = Unit risk factor; the toxicity value which indicates the upper limit on ILCR per unit of concentration of constituent (mg constituent/m^3 air)$^{-1}$

The formulas for developing the CDIs and ECs for the worker scenarios are presented in Table 5-2. The formulas for developing the CDIs and ECs for the residential, recreational, and tribal user scenarios are presented in Tables 5-3a and 5-3b.

Estimated ILCRs associated with exposure to COPCs in soil for exposure scenarios evaluated in this HHRA are presented in the respective exposure area-specific appendices and summarized in Table 5-6.

Estimated ILCRs associated with exposure to COPCs in soil gas for exposure scenarios evaluated in this HHRA for the ICS potential exposure area are summarized in Table ICS-4-6 in Appendix ICS.

As a point of reference, note that the NCP (40 CFR 300) indicates that lifetime incremental cancer risks posed by a site are compared to a range of 1 in 1 million (1×10^{-6}) to 100 in 1 million (1×10^{-4}). As indicated in the NCP (40 CFR Part 300), cancer risks between 1 in 1 million to 100 in 1 million probability of occurrence (1 in 1 million to 100 in 1 million) fall within a risk management range. This is generally referred to as the acceptable risk range. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. CalEPA's point of departure for excess incremental lifetime cancer risk for all receptor groups (i.e., residential populations) is 1 in 1 million, and risk management decisions may raise this criterion depending on site-specific conditions.

5.5.1.2 Noncarcinogenic Health Effects

The following equations describe the established relationship between estimated intake, toxicity, and noncarcinogenic hazard. For exposures occurring via incidental soil ingestion and dermal contact with soil, the relationship for noncarcinogenic effects is given by the following equation (USEPA 1989):

$$HQ = CDI/RfD \quad \text{Equation 5-4}$$

$$HI = \sum HQ \quad \text{Equation 5-5}$$

Where:

HQ = Hazard quotient; an expression of the potential for a constituent to cause noncarcinogenic effects, which relates the allowable amount of a constituent (RfD) to the estimated site-specific intake (unitless)

HI = HI; the sum of the constituent-specific HQs, which represents the cumulative potential for predicted exposures to result in noncarcinogenic effects (unitless)

CDI = Chronic daily intake of a constituent (mg constituent/kg body weight day)

RfD = Reference dose; the toxicity value indicating the threshold amount of constituent contacted below which no adverse health effects are expected (mg constituent/kg body weight-day)

For noncarcinogenic effects, the relationship for the inhalation pathway is given by the following equation (USEPA 2009):

$$HQ = EC/RfC \quad \text{Equation 5-6}$$

$$HI = \sum HQ \quad \text{Equation 5-7}$$

Where:

HQ = Hazard quotient; an expression of the potential for a constituent to cause noncarcinogenic effects, which relates the allowable concentration of a constituent (RfC) to the estimated site-specific EC (unitless)

HI = Hazard index; the sum of the constituent-specific HQs, which represents the cumulative potential for predicted exposures to result in noncarcinogenic effects (unitless)

EC = Exposure concentration of a constituent in air (mg constituent/m^3 air)

RfC = Reference concentration; the toxicity value indicating the threshold concentration of constituent contacted below which no adverse health effects are expected (mg constituent/m^3 air)

The formulas for developing the CDIs and ECs for the worker scenarios are presented in Table 5-2. The formulas for developing the CDIs and ECs for the residential, recreational, and tribal user scenarios are presented in Tables 5-3a and 5-3b.

Estimated noncancer HIs associated with exposure to COPCs in soil for exposure scenarios evaluated in this HHRA are presented in the respective exposure area-specific appendices and summarized in Table 5-7.

Estimated noncancer HIs associated with exposure to COPCs in soil gas for exposure scenarios evaluated for the ICS potential exposure area are summarized in Table ICS-4-6 in Appendix ICS.

For noncancer health effects, an HQ of less than or equal to 1 implies that the predicted exposure for a given population and chemical is not expected to result in adverse noncancer health effects; an HI of less than or equal to 1 implies the same for multi-chemical exposures (USEPA 1989).

5.5.2 Methodology for Estimating Cancer Risks and Noncancer Hazards – Screening Level Human Health Risk Assessment for the Commercial Worker

This section presents the methodology used to calculate cancer risks and noncancer HIs for potential current and future commercial workers to COPCs in soil inside the TCS. As described in the RAWP Addendum 2 (Arcadis 2015), the TCS is an active facility, and many areas within the facility were not accessible for sampling. Full characterization will be possible after the facility has shut down, and demolition occurs. Due to the limited ability to conduct full characterization, a screening level approach was selected to assess potential risks to current commercial workers conducting activities inside TCS. Specifically, as detailed in the RAWP Addendum 2 (Arcadis 2015), for current and future commercial workers inside the TCS, potential cancer risk and noncancer hazard posed by the presence of COPCs in soil are estimated in accordance with the methodology outlined in DTSC HHRA Note Number 4, Screening Level Human Health Risk Assessments (DTSC 2016). Potential human health risks for current and future commercial workers were evaluated using risk-based screening levels (RBSLs) protective of the exposure pathways identified as potentially complete for these receptors. DTSC-SLs (DTSC 2018b) for commercial soil were used as the applicable cancer-based and noncancer-based RBSLs. RSLs developed by USEPA (2018a) were used if a DTSC-SL was not available for a COPC. RSLs are based on the same exposure assumptions as DTSC-SLs, but priority is given to federal toxicity criteria over CalEPA toxicity criteria for the derivation of the RSLs. In the absence of available DTSC-SLs and USEPA RSLs for TPH mixtures, ESLs developed for whole TPH products (gasoline-range organic [GRO], diesel-range organic [DRO], etc.) by the SFRWQCB (2016) were selected for use in the risk assessment. RBSLs are set corresponding to a target lifetime excess cancer risk of 1 in 1 million or a target noncancer HQ of 1 (DTSC 2018b, SFRWQCB 2016, USEPA 2018a).

Theoretical ILCRs and noncancer HQs for each COPC were quantified by calculating the ratio of each EPC over the respective cancer-based and noncancer-based RBSLs and multiplying each resulting ratio by the target cancer risk level or HQ used in the development of the RBSL (i.e., cancer risk of 1 in 1 million; HQ of 1) (DTSC 2016). Cumulative effects from potential exposure to the COPCs in soil were then estimated by summing the individual, constituent-specific ILCRs and noncancer HQs, with the objective of estimating risks associated with current and future commercial land uses at the site. The resulting estimated cumulative ILCRs and noncancer hazards are presented as follows and discussed in Section 5.3.

ILCRs and noncancer HIs for COPCs in soil estimated for the potential soil exposure pathways for the current and future commercial worker receptors at the inside TCS are presented in Attachment B of Appendix ICS and summarized in Tables 5-6 and 5-7, respectively.

5.5.3 Results of the Cancer Risk and Noncancer Hazard Assessment

The following section provides the incremental cancer risks and noncancer hazards, estimated using the methods described previously, for each of the potential HHRA exposure areas. A detailed description of the risks/hazards, including the tables that provide the breakdown of risk/hazard by individual chemical and potential exposure pathway, is provided in exposure area-specific appendices (Appendices BCW through ICS).

5.5.3.1 Bat Cave Wash

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the BCW potential exposure area using depth- and area-weighted EPCs under baseline (non-scouring), 2-foot scouring (where 2 feet of soil are transported away due to heavy storm runoff), and 5-foot scouring (where 5 feet of soil are transported away due to heavy storm runoff) scenarios were estimated. Assuming lifetime soil contact is limited to the BCW potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results under the baseline scenario are summarized in the table and discussed in this section.

Baseline Scenario

Baseline Scenario for Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the BCW Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**5×10^{-6}** (chromium-6 and dioxin TEQ)	**9×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**5×10^{-6}** (chromium-6 and dioxin TEQ)	**5×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**7×10^{-6}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**8×10^{-6}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	**3×10^{-6}** (chromium-6 and dioxin TEQ)	**7×10^{-6}** (dioxin TEQ)	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hiker	Shallow	**3×10^{-6}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**2×10^{-6}** (chromium-6 and dioxin TEQ)	**4×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**2×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Baseline Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short-Term Maintenance Worker, Long-Term Maintenance Worker, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** - Short-Term Maintenance Worker (all depths), Camper (surface and shallow), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million (5 x 10^{-6})** – Long-Term Maintenance Worker (surface and shallow), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the BCW potential exposure area for the baseline scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the long-term maintenance worker, hiker, and OHV rider were due to hexavalent chromium and dioxin TEQ. Therefore, risks and hazards for these three potential receptors were estimated using area-weighted EPCs. Note that elevated concentrations of hexavalent chromium and dioxin TEQ are localized in the SWMU 1 and TCS-4 areas (see Figure BCW-1.1a in Appendix BCW; for the location of these areas within BCW). As summarized in this section, ILCRs and HIs estimated for all potential receptors for all exposure depths in the BCWxSWMU1 potential exposure area soil are below or at *de minimis* levels.

The area-weighted estimated ILCR and HI results for the long-term maintenance worker, hiker, and OHV rider are provided in this section.

<u>**Baseline Area-Weighted**</u>

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Long-Term Maintenance Worker, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (surface) and Hiker (surface)

- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

2-Foot Scouring Scenario

During the HHRA, two potential scouring scenarios due to heavy storm runoff were evaluated for the BCW potential exposure area – 2-foot scouring and 5-foot scouring. This table provides the results from the 2-foot scouring scenario.

2-Foot Scouring Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the BCW Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area- Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**4×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**6×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**6×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**6×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area- Weighted	HI Depth-Weighted	HI Area-Weighted
Camper	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

2-Foot Scouring Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Camper (surface and shallow), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2)
- **ILCR greater than 10 in 1 million less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the BCW potential exposure area for the 2-foot scouring scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the long-term maintenance worker, hiker, and OHV rider were due to hexavalent chromium and dioxin TEQ. Therefore, risks and hazards for these three potential receptors were estimated using area-weighted EPCs. As noted previously, elevated concentrations of hexavalent chromium and dioxin TEQ are localized in the SWMU 1 and TCS-4 areas (see Figure BCW-1.1a in Appendix BCW; for the locations of these two areas within BCW).

The estimated potential area-weighted ILCR and HI results for the long-term maintenance worker, hiker, and OHV rider for the 2-foot scouring scenario are provided in this section:

2-Foot Scouring Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Long-Term Maintenance Worker, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – Hiker and OHV Rider.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (all soil depths)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

<u>**5-Foot Scouring Scenario**</u>

The table in this section provides the results from the 5-foot scouring scenario. Risk estimates are not provided for the subsurface 2 exposure depths because soil data are not available for the additional interval between 15 and 20 feet bgs that would be considered to be 10 to 15 feet bgs after 5 feet of scouring.

5-Foot Scouring Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the BCW Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**4 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**3 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**6 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Camper	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

5-Foot Scouring Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Camper (surface and shallow), Hiker (surface and shallow), Hunter (surface and shallow), OHV Rider (surface), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface and shallow) and OHV Rider (shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the BCW potential exposure area for the 5-foot scouring scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the long-term maintenance worker and OHV rider were due to hexavalent chromium and dioxin TEQ. Therefore, risks and hazards for these two potential receptors were estimated using area-weighted EPCs. As noted previously, elevated concentrations of hexavalent chromium and dioxin TEQ are localized in the SWMU 1 and TCS-4 areas (see Figure BCW-1.1a in Appendix BCW for the locations of these two areas within BCW).

The estimated potential area-weighted ILCR and HI results for the long-term maintenance worker and OHV rider for the 5-foot scouring scenario are provided in this section.

5-Foot Scouring Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Long-Term Maintenance Worker and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – All receptors evaluated including: Long-Term Maintenance Worker and OHV Rider.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – None
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** - None.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the BCW potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil using depth-and area-weighted EPCs for the short-term maintenance worker, hunter, and tribal user under the baseline and scouring exposure scenarios are below 1 in 1 million and 1, respectively. However, the estimated cumulative ILCRs for the long-term maintenance worker, camper, hiker, and OHV rider were above the point of departure for risk management decisions of 1 in 1 million (1×10^{6}), but below or at 10 in 1 million (1×10^{-5}), which is well within the risk management range of 1 in 1 million to 100 in 1 million.

For the baseline scenario, depending on the depth interval, the area-weighted approach resulted in risks or hazard estimates ranging from 1 to 3 times lower or 1.2 to 2.8 times higher than the depth-weighted estimates. However, use of the area-weighted approach does not change the overall conclusions of the HHRA for the BCW potential exposure area baseline scenario evaluation.

The 2-foot and 5-foot scouring estimated cumulative ILCRs for all receptors are similar or only slightly lower than the baseline cumulative ILCRs. For the 2-foot scouring scenario, depending on the depth interval, the area-weighted approach resulted in risks or hazard estimates ranging from 1.8 to 3.6 times lower than the depth-weighted estimates. Therefore, the area-weighted evaluation for the 2-foot scouring scenario brings all estimated ILCRs to below or slightly above (i.e., 2 in 1 million, or 2×10^{-6}) the point of departure of 1 in 1 million. In general, for the 5-foot scouring scenario, the area-weighted approach resulted in a reduction in the risk or hazard estimate ranging from 2 to 4 times lower than the depth-weighted estimates. The area-weighted evaluation for the 5-foot scouring scenario brings all estimated cumulative ILCR values to below the point of departure of 1 in 1 million. These results suggest that impacts due to the risk drivers hexavalent chromium and dioxin TEQ are at surface to depths not greater than 5 feet bgs for the BCW potential exposure area.

The depth-and area-weighted EPCs for lead in the BCW potential exposure area soil at all exposure depths under the baseline, 2-foot scouring, and 5-foot scouring scenarios are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.2 SWMU 1 and TCS-4

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the SWMU 1 and TCS-4 potential exposure area (i.e., referred to hereafter as SWMU 1 potential exposure area) using depth- and area-weighted EPCs under the baseline scenario were estimated. The SWMU 1 potential exposure area includes TCS-4. Assuming lifetime soil contact is limited to the SWMU 1 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the SWMU 1 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	**1×10^{-5}** (chromium-6 and dioxin TEQ)	**4×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**3×10^{-6}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	**2×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	**6×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**1×10^{-4}** (chromium-6 and dioxin TEQ)	**3×10^{-5}** (chromium-6 and dioxin TEQ)	**3** (dioxin TEQ)	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**3×10^{-5}** (chromium-6 and dioxin TEQ)	**2×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**5×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**4×10^{-5}** (dioxin TEQ)	**1×10^{-5}** (dioxin TEQ)	**4** (dioxin TEQ)	Less than or equal to 1
Camper	Shallow	**1×10^{-5}** (dioxin TEQ)	**8×10^{-6}** (dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**8×10^{-5}** (dioxin TEQ)	**2×10^{-5}** (dioxin TEQ)	**8** (dioxin TEQ)	**2** (dioxin TEQ)
Hiker	Shallow	**2×10^{-5}** (dioxin TEQ)	**2×10^{-5}** (dioxin TEQ)	**2** (dioxin TEQ)	**2** (dioxin TEQ)

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hunter	Surface	**1×10^{-5}** (dioxin TEQ)	**4×10^{-6}** (dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hunter	Shallow	**3×10^{-6}** (dioxin TEQ)	**3×10^{-6}** (dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Surface	**4×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	**2** (dioxin TEQ)	Less than or equal to 1
OHV Rider	Shallow	**1×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (surface, subsurface 1, and subsurface 2), Camper (shallow), Hunter (surface and shallow), OHV Rider (shallow), and Tribal User (surface and shallow)
- **ILCR less than or equal to 1 in 1 million all soil depths** – Tribal User.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Long-Term Maintenance Worker (surface), Hiker (shallow), and OHV Rider (surface)
- **HI greater than 3** – Camper (surface) and Hiker (surface)
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (shallow and subsurface 1) and Hunter (shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Short-Term Maintenance Worker (surface and subsurface 2), Camper (shallow), Hunter (surface), and OHV Rider (shallow)

- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface, shallow, subsurface 1, and subsurface 2), Camper (surface), Hiker (surface and shallow), and OHV Rider (surface).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None

Assuming lifetime soil contact is limited to the SWMU 1 potential exposure area, the depth-weighted estimated risks above *de minimis* levels for the short- and long-term maintenance workers, camper, hiker, hunter, and OHV rider were due to hexavalent chromium and/or dioxin TEQ. Therefore, potential risks and hazards for these receptors were estimated using area-weighted EPCs and are as follows:

Area-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Short- and Long-Term Maintenance Workers, Camper, Hunter, and OHV Rider
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (subsurface 2).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Hiker (surface and shallow)
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (surface, shallow, and subsurface 1) and Hunter (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2), Camper (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface and shallow) and Hiker (surface and shallow).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the SWMU 1 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the SWMU 1 potential exposure area using depth-weighted EPCs for the tribal user are below the *de minimis* levels of 1 in 1 million and 1, respectively. However, the estimated cumulative ILCRs using the depth-weighted EPCs for the short- and long-term maintenance workers, camper, hiker, hunter, and OHV rider are above the point of departure for risk management decisions of 1 in 1 million but are within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative HIs using the depth-weighted EPCs for the long-term maintenance worker (surface), camper (surface), hiker (surface and shallow), and OHV rider (surface) are above an HI of 1.

The estimated cumulative ILCRs using the area-weighted EPCs for the short- and long-term maintenance workers, camper, hiker, hunter, and OHV rider were 1.2 to 4.8 times lower than the estimated cumulative ILCRs using the depth-weighted EPCs. The estimated cumulative ILCRs using the area-weighted EPCs for the short-term maintenance worker, camper, hiker, hunter, and OHV rider are above the point of departure for risk management decisions of 1 in 1 million but are below 10 in 1 million, which is well within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative ILCRs using the area-weighted EPCs for the long-term maintenance worker are above 10 in 1 million (1×10^{-5}), but below 5 in 1 million (5×10^{-5}), which is still within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative HIs using the area-weighted EPCs for the all receptors with the exception of the hiker, are below an HI of 1.

The depth-and area-weighted EPCs for lead in the SWMU 1 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.3 Bat Cave Wash Excluding SWMU 1 and TCS-4

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the BCW excluding SWMU 1 and TCS-4 potential exposure area (i.e., hereafter referred to as the BCWxSWMU1 potential exposure area) using depth-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the BCWxSWMU1 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the BCWxSWMU1Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Long-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the BCWxSWMU1 potential area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil using depth-weighted EPCs for all receptors, that is the short- and long-term maintenance workers, recreational users, and tribal user, are at or below the *de minimis* levels of 1 in 1 million and 1, respectively. Furthermore, the depth-weighted EPCs for lead in surface shallow, subsurface 1, and subsurface 2 soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

Note that the risk evaluation of the BCWxSWMU1 potential exposure area was included in the HHERA at the DTSC's request to inform risk managers as to whether the risks/hazards estimated for COPCs in BCW soil were driven by COPC concentrations in SWMU1 and TCS-4 soils. Based on the results of the HHRA conducted for the BCWxSWMU1 potential exposure area, the majority of the estimated risks and hazards associated with COPCs in BCW soils are attributed to COPC concentrations in SWMU1 and TCS-4 soils. Specifically, as indicated previously, when soil data collected from the SWMU1 potential exposure area are removed from the BCW potential exposure area dataset, the estimated risks and hazards for all human populations evaluated in the HHRA are at or below *de minimis* levels.

5.5.3.4 AOC4

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC4 potential exposure area using depth- and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC4 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

<u>**Baseline Scenario**</u>

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC4 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**2 x 10^{-6}** (chromium-6, Co, PCBs, and dioxin TEQ)	**2 x 10^{-6}** (chromium-6, Co, PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2 x 10^{-6}** (chromium-6, Co, PCBs, and dioxin TEQ)	**2 x 10^{-6}** (chromium-6, Co, PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Notes:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.
Co = cobalt

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million for all soil depths** – Short-Term Maintenance Worker, Camper, Hiker, Hunter, OHV Rider, and Tribal User.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC4 potential exposure area, the depth-weighted estimated risks above *de minimis* levels for the long-term maintenance worker were due to hexavalent chromium, cobalt, PCBs, and dioxin TEQ. Therefore, potential risks and hazards for the long-term maintenance worker were evaluated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Long-Term Maintenance Worker
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC4 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC4 potential exposure area using depth-weighted EPCs for the short-term maintenance worker, camper, hiker, hunter, OHV rider, and tribal user are below 1 in 1 million and 1, respectively. However, the estimated cumulative ILCRs using the depth-weighted EPCs for the long-term maintenance worker were slightly above the point of departure for risk management decisions of 1 in 1 million but are below 5 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million The estimated cumulative ILCRs using the area-weighted EPCs for the long-term maintenance worker were approximately the same as the estimated cumulative ILCRs using the depth-weighted EPCs (i.e., slightly above the point of departure for risk management decisions of 1 in 1 million).

The estimated cumulative HIs using the depth- and area-weighted EPCs for the long-term maintenance worker, were below HI of 1. The depth-and area-weighted EPCs for lead in AOC4 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.5 AOC9

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC9 potential exposure area using depth- and area-weighted EPCs were estimated. Assuming lifetime soil contact is limited to the AOC9 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC9 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	**3×10^{-5}** (chromium-6)	**2×10^{-5}** (chromium-6)	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	**2×10^{-5}** (chromium-6)	**2×10^{-5}** (chromium-6)	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	**1×10^{-5}** (chromium-6)	**8×10^{-6}** (chromium-6)	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	**6×10^{-6}** (chromium-6)	**5×10^{-6}** (chromium-6)	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**2×10^{-4}** (As, chromium-6, and dioxin TEQ)	**2×10^{-4}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**1×10^{-4}** (As, chromium-6, and dioxin TEQ)	**1×10^{-4}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**7×10^{-5}** (As, chromium-6, and dioxin TEQ)	**6×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**5×10^{-5}** (As, chromium-6, and dioxin TEQ)	**4×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**3×10^{-5}** (As, chromium-6, and dioxin TEQ)	**3×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Not calculated
Camper	Shallow	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Not calculated
Hiker	Surface	**6×10^{-5}** (As, chromium-6, and dioxin TEQ)	**5×10^{-5}** (As, chromium-6, and dioxin TEQ)	2 (As and dioxin TEQ)	Less than or equal to 1
Hiker	Shallow	**4×10^{-5}** (As, chromium-6, and dioxin TEQ)	**4×10^{-5}** (As, chromium-6, and dioxin TEQ)	2 (As and dioxin TEQ)	Less than or equal to 1
Hunter	Surface	**4×10^{-6}** (As, chromium-6, and dioxin TEQ)	**3×10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hunter	Shallow	**3×10^{-6}** (As, chromium-6, and dioxin TEQ)	**2×10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Not calculated
OHV Rider	Surface	**1×10^{-4}** (As, chromium-6, and dioxin TEQ)	**1×10^{-4}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**8×10^{-5}** (As, chromium-6, and dioxin TEQ)	**7×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Notes:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.
As = arsenic

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Short-Term Maintenance Worker, Long-Term Maintenance Worker, Camper, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Hiker (surface and shallow)
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Hunter (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Short-Term Maintenance Worker (subsurface 2)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Short-Term Maintenance Worker (shallow, surface, and subsurface 1), Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2), Camper (surface and shallow), Hiker (surface and shallow), and OHV Rider (surface and shallow).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – Long-Term Maintenance Worker (surface).

Assuming lifetime soil contact is limited to the AOC9 potential exposure area, the depth-weighted estimated risks and hazards above *de minimis* levels for the short- and long-term maintenance workers, camper, hiker, hunter, and OHV rider were due to arsenic, hexavalent chromium, and/or dioxin TEQ. Therefore, potential risks and hazards for these six receptors were estimated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Hunter (surface and shallow) and Short-Term Maintenance Worker (subsurface 2)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Short-Term Maintenance Worker (subsurface 1)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Short-Term Maintenance Worker (surface and shallow), Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2), Camper (surface and shallow), Hiker (surface and shallow), and OHV Rider (surface and shallow).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – Long-Term Maintenance Worker (surface).

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC9 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC9 potential exposure area using depth-weighted EPCs for the tribal user are below 1 in 1 million and 1, respectively. Therefore, the tribal user was not carried forward in the area-weighted evaluation. The estimated cumulative ILCRs using the depth- and area-weighted EPCs for the short-term maintenance worker, camper, hiker, hunter, and OHV rider were above the point of departure for risk management decisions of 1 in 1 million but at or below 100 in 1 million, which is within the risk management range of 1 in 1 million to 100 in 1 million. The depth- and area-weighted estimated cumulative ILCRs for the long-term maintenance worker potentially exposed to surface soil at the AOC9 potential exposure area are above the risk management range, driven by hexavalent chromium and the inhalation of particulates. The concentrations of hexavalent chromium driving the EPCs are from three sampling locations – AOC10-20 (2,700 mg/kg), #10 (114 mg/kg), and AOC9-8 (48.6 mg/kg).

In general, the area-weighted approach resulted in a reduction in the risk or hazard estimates ranging from 1.1 to 1.3 times lower than the depth-weighted estimates. However, use of the area-weighted approach does not change the overall conclusions of the HHRA for the AOC9 potential exposure area evaluation.

The estimated cumulative HIs using the depth-weighted EPCs for the short- and long-term maintenance workers, camper, hunter, and OHV rider were below an HI of 1; the cumulative HI using depth-weighed EPCs estimated for the hiker was slightly above an HI of 1, primarily attributable to arsenic and dioxin TEQ. The majority of the estimated cumulative HI for arsenic for the hiker (0.82 of 1 or approximately 82%) is attributed to background concentrations of arsenic in soil. Considering the substantial contribution of background arsenic in soil to the estimated cumulative HI for the all receptors potentially exposed to the AOC9 potential exposure area soil, it is likely that incremental hazard for site related COPCs in soil are well below an HI of 1. The cumulative HIs estimated using the area-weighted EPCs for all receptors, that is the short- and long-term maintenance workers, camper, hiker, hunter, and OHV rider, were at or below an HI of 1. The depth-and area-weighted EPCs for lead in the AOC9 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.6 AOC10

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC10 potential exposure area using depth-and area-weighted EPCs under baseline, 2-foot scouring, and 5-foot scouring scenarios were estimated. Assuming lifetime soil contact is limited to the AOC10 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results under the baseline scenario are summarized in the table and discussed in this section.

<u>**Baseline Scenario**</u>

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC10 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**3 x 10^{-6}** (chromium-6)	**2 x 10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	**3 x 10^{-6}** (chromium-6)	**2 x 10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Subsurface 2	**2×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2×10^{-5}** (As, chromium-6 and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**4×10^{-6}** (As and dioxin TEQ)	**3×10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**4×10^{-6}** (As and chromium-6)	**3×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**8×10^{-6}** (As and dioxin TEQ)	**6×10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**9×10^{-6}** (As, chromium-6, and dioxin TEQ)	**7×10^{-6}** (As, chromium-6, and dioxin TEQ)	2 (As)	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**6×10^{-6}** (As, chromium-6, and dioxin TEQ)	**5×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**1×10^{-5}** (As and chromium-6)	**7×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Baseline Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (all depths), Camper (all depths), Hiker (surface), Hunter (all depths), OHV Rider (all depths), and Tribal User (all depths)
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (surface), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Hiker (shallow)
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2) and Camper (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (surface), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC10 potential exposure area for the baseline scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the short-term maintenance worker, long-term maintenance worker, camper, hiker, and OHV rider were due to arsenic, hexavalent chromium, and dioxin TEQ. Therefore, potential risks and hazards for these five receptors were estimated using area-weighted EPCs and are as follows:

Baseline Area-Weighted

Potential exposures that area below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, and, OHV Rider
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (surface).

Potential exposures above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None

- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2), Camper (surface and shallow), and OHV Rider (surface)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (surface), Hiker (surface and shallow), and OHV Rider (shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

<u>**2-Foot Scouring Scenario**</u>

Two potential scouring scenarios due to heavy storm runoff were evaluated for the AOC10 potential exposure area – 2-foot scouring and 5-foot scouring. The results from the 2-foot scouring scenario for the AOC10 potential exposure area are presented in the following table.

2-Foot Scouring Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC10 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	**3×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**3×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	**3×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	**3×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**3×10^{-5}** (As, chromium-6, and dioxin TEQ)	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**2×10^{-5}** (As, chromium-6, and dioxin TEQ)	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Camper	Surface	**5×10^{-6}** (As and chromium-6)	**3×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**5×10^{-6}** (As and chromium-6)	**3×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**1×10^{-5}** (As, chromium-6, and dioxin TEQ)	**7×10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**9×10^{-6}** (As, chromium-6, and dioxin TEQ)	**7×10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**1×10^{-5}** (As and chromium-6)	**8×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**1×10^{-5}** (As and chromium-6)	**8×10^{-6}** (As and chromium-6)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

2-Foot Scouring Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Hunter (surface and shallow) and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None

- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (all depths) and Camper (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Hiker (surface and shallow) and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (all depths).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC10 potential exposure area for the 2-foot scouring scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the short-term maintenance worker, long-term maintenance worker, camper, hiker, and OHV rider were due to arsenic, hexavalent chromium, and dioxin TEQ. Therefore, potential risks and hazards for these five receptors were estimated using area-weighted EPCs and are provided in this section.

<u>2-Foot Scouring Area-Weighted</u>

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (all soil depths), and Camper (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface and shallow).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

5-Foot Scouring Scenario

Two potential scouring scenarios due to heavy storm runoff were evaluated for the AOC10 potential exposure area – 2-foot scouring and 5-foot scouring. Below are the results from the 5-foot scouring scenario for the AOC10 potential exposure area. The risk estimates are not provided for the subsurface 2 exposure depths because soil data are not available for the additional interval between 15 and 20 feet bgs that would be considered to be 10 to 15 feet bgs after 5 feet of scouring.

5-Foot Scouring Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC10 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	**9 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	**7 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**8 x 10^{-6}** (As and dioxin TEQ)	**7 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**8 x 10^{-6}** (As and dioxin TEQ)	**7 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**3 x 10^{-6}** (As)	**3 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**3 x 10^{-6}** (As)	**3 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**6 x 10^{-6}** (As and dioxin TEQ)	**5 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**6 x 10^{-6}** (As and dioxin TEQ)	**5 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Surface	**4 x 10^{-6}** (As and dioxin TEQ)	**3 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
Hunter	Shallow	**4 x 10^{-6}** (As and dioxin TEQ)	**3 x 10^{-6}** (As)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

5-Foot Scouring Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Camper (surface and shallow) and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (all depths) and Hiker (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Under the 5-foot scouring scenario, the depth-weighted estimated risks and hazards above *de minimis* levels for the long-term maintenance worker, camper, hiker, and OHV rider were due to arsenic, hexavalent chromium, and dioxin TEQ. Therefore, potential risks and hazards for these four receptors were estimated using area-weighted EPCs and are provided in this section.

<u>**5-Foot Scouring Area-Weighted**</u>

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Long-Term Maintenance Worker, Camper, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Camper (surface and shallow), Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (all depths)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

<u>**OVERALL SUMMARY**</u>

Assuming lifetime soil contact is limited to the AOC10 potential exposure area, the depth- and area-weighted estimated cumulative ILCRs and HIs for the hunter and tribal users under the baseline, 2-foot scouring, and 5-foot scouring scenarios are below 1 in 1 million and 1, respectively. The depth- and area-weighted estimated cumulative HIs for the short- and long-term maintenance workers, camper, and OHV rider under the baseline and scouring exposure scenarios are at or below 1. The depth-weighted estimated HI for the hiker exposed to shallow soil under the baseline is slightly above an HI of 1. The majority of the estimated HI for the hiker (0.82 of 1 or approximately 82%) is attributed to background concentrations of arsenic in soil. In addition, the area-weighted estimated HI for the hiker exposed to shallow soil under the baseline scenario is equal to 1. Considering the substantial contribution of background arsenic in soil to the estimated cumulative HI for the all receptors potentially exposed to the AOC10 potential exposure area soil under the baseline scenario, it is likely that incremental hazard for site related COPCs in soil are well below an HI of 1. In general, the area-weighted approach resulted in a reduction in the risk or hazard estimates ranging from 1.2 to 2 times lower than the depth-weighted estimates.

The depth- and area-weighted estimated cumulative ILCRs for the short-term maintenance worker and camper under the baseline, 2-foot scouring, and 5-foot scouring scenarios were above the point of departure for risk management decisions of 1 in 1 million but at or below 5 in 1 million. The depth- and area-weighted estimated cumulative ILCRs for the hikers and OHV riders under the baseline, 2-foot scouring, and 5-foot scouring scenarios were above the point of departure for risk management decisions of 1 in 1 million but at or below 1×10^{-5}. The depth- and/or area-weighted estimated cumulative ILCRs for the long-term maintenance worker under the baseline, 2-foot scouring, and/or 5-foot scouring scenarios were above the point of departure for risk management decisions of 1 in 1 million and slightly above 10 in 1 million. The values are within the risk management range of 1 in 1 million to 100 in 1 million.

For the 2-foot and 5-foot scouring scenarios, the area-weighted approach resulted in a reduction in the risk or hazard estimate ranging from 1.3 to 2 times lower than the depth-weighted estimates. However, use of the area-weighted approach does not change the overall conclusions of the HHRA for the AOC10 potential exposure area 2-foot and 5-foot scouring scenario evaluations.

As summarized above, the depth-weighted 2-foot scouring ILCRs for all receptors are slightly higher in surface soil than depth-weighted baseline ILCRs in surface soil; the depth-weighed 2-foot scouring ILCRs for the shallow, subsurface 1 and subsurface 2 ILCRs are approximately the same as the baseline ILCRs for shallow, subsurface 1 and subsurface 2 soil. The depth-weighted 5-foot scouring ILCRs for all receptors are lower in all soil depth intervals than the depth-weighted baseline and 2-foot scouring ILCRs. These results suggest that the impacts for risk drivers arsenic, hexavalent chromium, and dioxin TEQ are primarily within the 2- to 5-foot bgs interval for the AOC10 potential exposure area.

The depth-and area-weighted EPCs for lead in AOC10 potential exposure area soil at all exposure depths under the baseline, 2-foot scouring, and 5-foot scouring scenarios are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.7 AOC11

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC11 potential exposure area using depth- and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC11 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC11 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	**7 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**9 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	**8 x 10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**3 x 10^{-6}** (As and dioxin TEQ)	**3 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**3 x 10^{-6}** (As and dioxin TEQ)	**3 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**6 x 10^{-6}** (As and dioxin TEQ)	**5 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**6 x 10^{-6}** (As and dioxin TEQ)	**5 x 10^{-6}** (As and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
OHV Rider	Surface	**3×10^{-6}** (As and dioxin TEQ)	**3×10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**3×10^{-6}** (As and dioxin TEQ)	**3×10^{-6}** (As, chromium-6, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, and OHV Rider
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all soil depths), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Camper (surface and shallow) and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (all depths) and Hiker (surface and shallow)
- **ILCR greater than 1×10^{-5} and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC11 potential exposure area, the depth-weighted estimated risks and hazards above *de minimis* levels for the long-term maintenance workers, camper, hiker, and OHV rider were due to arsenic, hexavalent chromium, and/or dioxin TEQ. Therefore, potential risks and hazards for these receptors were estimated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Long-Term Maintenance Worker, Camper, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Camper (surface and shallow), and Hiker (surface and shallow), and OHV Rider (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (all depths)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC11 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil using depth-weighted EPCs for the short-term maintenance worker, hunter, and tribal user are below 1 in 1 million and 1, respectively. The estimated cumulative ILCRs using the depth- and area-weighted EPCs for the campers and OHV riders were above the point of departure for risk management decisions of 1 in 1 million, but below 5 in 1 million. The estimated cumulative ILCRs using the depth- and/or area-weighted EPCs for the long-term maintenance worker and hiker were above 5 in 1 million, but below 10 in 1 million. These values are within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative HIs using the depth- and area-weighted EPCs for the long-term maintenance worker, camper, hiker, and OHV rider were at or below HI of 1.

As demonstrated by comparing the values, the area-weighted estimated cumulative ILCRs for the camper, hiker, and OHV rider are not materially different than the depth-weighted cumulative ILCRs for all exposure depths. Approximately 78 to 85% of the estimated ILCRs for arsenic are attributed to background concentrations of arsenic in soil. Considering the substantial contribution of background arsenic in soil to the estimated cumulative ILCRs for all the receptors potentially exposed to the AOC11 potential exposure area soil, it is likely that incremental risks for site-related COPCs in soil are at or only slightly above 1 in 1 million, but below 5 in 1 million, which is well within the risk management range of 1 in 1 million to 100 in 1 million.

The depth-and area-weighted EPCs for lead in the AOC11 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.8 AOC12

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC12 potential exposure area using depth- EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC12 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC12 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Less than or equal to 1
Camper	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Camper	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Hiker	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Hiker	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Hunter	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
OHV Rider	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Less than or equal to 1
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Less than or equal to 1

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User.

Assuming lifetime soil contact is limited to the AOC12 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC12 potential exposure area using depth-weighted EPCs for all potential receptors, that is, the short- and long-term maintenance workers, recreational users, and tribal users, are below the *de minimis* levels of 1 in 1 million and 1.

5.5.3.9 AOC14

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC14 potential exposure area using depth- and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC14 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC14 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (surface and subsurface 2), Camper (surface and shallow), Hiker (surface and shallow), Hunter (surface and shallow), OHV Rider (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (shallow and subsurface 1)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC14 potential exposure area, the depth-weighted estimated risks above *de minimis* levels for the long-term maintenance workers were due to hexavalent chromium and dioxin TEQ. Therefore, potential risks and hazards for the long-term maintenance worker were estimated using area-weighted EPCs and are as follows:

Area-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Long-Term Maintenance Worker

- **ILCR less than or equal to 1 in 1 million for all soil depths** – Long-Term Maintenance Worker.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – None
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC14 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC14 potential exposure area using depth-weighted EPCs for the short-term maintenance worker, camper, hiker, hunter, OHV rider, and tribal user are at or below 1 in 1 million and 1, respectively. However, the estimated cumulative ILCRs using the depth-weighted EPCs for the long-term maintenance workers were 2 times above the point of departure for risk management decisions of 1 in 1 million but below 5 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative ILCRs using the area-weighted EPCs for the long-term maintenance workers were 1.2 to 1.5 times lower than the estimated cumulative ILCRs using the depth-weighted EPCs and are at or below the point of departure for risk management decisions of 1 in 1 million. The estimated cumulative HIs using the depth- and area-weighted EPCs for the long-term maintenance workers, were below HI of 1.

The depth-and area-weighted EPCs for lead in AOC14 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.10 AOC27

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC27 potential exposure area using depth and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC27 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC27 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**3 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hiker	Surface	**2 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**2 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**2 x 10^{-6}** (chromium-6, B(a)PEQ, and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (subsurface 2), Camper (surface and shallow), Hunter (surface and shallow), OHV Rider (shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface, shallow, and subsurface 1), Hiker (surface and shallow), and OHV Rider (surface)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the AOC27 potential exposure area, the estimated risks and hazards above *de minimis* levels for the long-term Maintenance worker, hiker, and OHV rider were due to hexavalent chromium, B(a)PEQ, and dioxin TEQ. Therefore, potential risks and hazards for these three potential receptors were estimated using area-weighted EPCs and are as follows:

Area-Weighted

Potential exposures that are below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Long-Term Maintenance Worker, Hiker, and OHV Rider
- **ILCR less than or equal to to 1 in 1 million for all soil depths** – All potential receptors evaluated including: Long-Term Maintenance Worker, Hiker, and OHV Rider.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – None
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 1 in one million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

Assuming that lifetime soil contact is limited to the AOC27 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC27 potential exposure area using depth-weighted EPCs for the short-term maintenance worker, camper, hunter, and tribal user are below 1 in 1 million and 1, respectively. The estimated cumulative HI for long-term maintenance worker, hikers, and OHV riders are below an HI of 1. The depth-weighted estimated cumulative ILCRs for the long-term maintenance worker, hiker, and OHV rider were slightly above the point of departure for risk management decisions of 1 in 1 million but below 5 in 1 million, which is well within the risk management range of 1 in 1 million to 100 in 1 million. Therefore, these potential receptors were carried forward to the area-weighted evaluation. The area-weighted approach resulted in a reduction in the risk or hazard estimates ranging from 2.9 to 3.6 times lower than the depth- weighted estimates. This reduction in the cumulative ILCR estimates for the long-term maintenance worker, hiker, and OHV rider brings estimated ILCR values to the point of departure for risk management decisions of 1 in 1 million for the area-weighted evaluation.

The depth-and area-weighted EPCs for lead in the AOC27 potential exposure area soil at all exposure depths are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.11 AOC28

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC28 potential exposure area using depth-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC28 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC28 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million all soil depths** – All potential receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC28 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC28 potential exposure area using depth-weighted EPCs for all receptors, that is short- and long-term maintenance workers, recreational users, and tribal users, are below 1 in 1 million and 1, respectively.

5.5.3.12 AOC31

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the AOC31 potential exposure area using depth-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact is limited to the AOC31 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the AOC31 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Long-Term Maintenance Worker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Camper	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hiker	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
OHV Rider	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Depth-Weighted

Potential exposures at or below *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the AOC31 potential exposure area, the cumulative ILCRs and HIs associated with potential exposure to COPCs in soil using depth-weighted EPCs for all receptors, that is short- and long-term maintenance workers and the recreational and tribal users, are below 1 in 1 million and 1, respectively. Furthermore, the depth-weighted EPCs for lead in surface shallow, subsurface 1, and subsurface 2 soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

5.5.3.13 UA-2

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at UA-2 potential exposure area using depth-weighted EPCs were estimated. Assuming lifetime soil contact is limited to

UA-2 potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the UA-2 Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	HI Depth-Weighted
Short-Term Maintenance Worker	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**2 x 10^{-6}** (As)	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	**2 x 10^{-6}** (As)	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**1 x 10^{-5}** (As)	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2 x 10^{-5}** (As)	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**2 x 10^{-5}** (As)	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**1 x 10^{-5}** (As)	Less than or equal to 1
Camper	Surface	**5 x 10^{-6}** (As)	Less than or equal to 1
Camper	Shallow	**7 x 10^{-6}** (As)	**2** (As)
Hiker	Surface	**1 x 10^{-5}** (As)	**3** (As)
Hiker	Shallow	**1 x 10^{-5}** (As)	**4** (As)
Hunter	Surface	**2 x 10^{-6}** (As)	Less than or equal to 1
Hunter	Shallow	**2 x 10^{-6}** (As)	Less than or equal to 1
OHV Rider	Surface	**5 x 10^{-6}** (As)	Less than or equal to 1
OHV Rider	Shallow	**8 x 10^{-6}** (As)	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Less than or equal to 1
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Less than or equal to 1

Depth-Weighted

Potential exposures that are at or below *de minimis* levels include the following:

- **HI less than or equal to 1** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (all depths), Camper (surface), Hunter (surface and shallow), OHV Rider (surface and shallow), and Tribal User (surface and shallow)
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (surface and subsurface 2) and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Camper (shallow) and Hiker (surface)
- **HI greater than 3** – Hiker (shallow)
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (shallow and subsurface 1), Camper (surface), Hunter (surface and shallow), and OHV Rider (surface)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (shallow and subsurface 2), Camper (shallow), Hiker (surface and shallow), and OHV Rider (shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (shallow and subsurface 1).

Potential exposures that above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Due to the small dataset (i.e., sample size of two or five), a UCL was not calculated and the maximum depth-weighted concentrations were used as the EPCs. Consequently, area-weighted EPCs and associated risk and hazard estimates are not provided for UA-2 potential exposure area.

OVERALL SUMMARY

Assuming lifetime soil contact is limited to the UA-2 potential exposure area, the estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil for the tribal user are at or below 1 in 1 million and 1, respectively. [Note: Due to the small dataset (i.e., sample size of 2 or 5), a UCL was not calculated and the maximum depth-weighted concentrations were used as the EPCs.] The estimated cumulative ILCRs for the camper, hiker, and OHV rider were above the point of departure for risk management decisions of 1 in 1 million but below or at 10 in 1 million, which is well within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative ILCRs for the long-term maintenance worker were just above 10 in 1 million, but well within the risk management range of 1 in 1 million to 100 in 1 million. The estimated cumulative HIs associated with potential exposure to COPCs in soil at UA-2 for the short- and long-term maintenance workers, hunter, and OHV rider are at or below 1. The estimated cumulative HIs for the camper (shallow) and hiker (surface and shallow) are above 1.

The estimated cumulative ILCRs and HIs above 1 in 1 million and 1 were due to arsenic detected in UA-2 potential exposure area soil. As previously noted in Section 2.2.4, the arsenic concentrations detected at UA-2 potential exposure area may represent a different background population from the sample population used to establish background comparison concentrations. UA-2 is located on bedrock, whereas the majority of the samples comprising the background dataset were collected from alluvial material. The potential for the arsenic concentrations detected at this unit to represent background concentrations was evaluated statistically and visually via probability plot (included on Figure C9-4 in Appendix A, Subappendix C9 of the Final Soil RFI/RI Workplan [CH2M 2013]). The distribution of detected arsenic concentrations at UA 2 is consistent with a single population or background dataset. Therefore, considering the substantial contribution of background arsenic in soil to the estimated cumulative ILCRs and HIs for the all receptors potentially exposed to UA-2 potential exposure area soil, it is likely that incremental risks and HIs for site related COPCs in soil are below *de minimis* levels.

5.5.3.14 Outside the Compressor Station

Cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the OCS potential exposure area using depth- and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact occurs randomly over the entire OCS potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results, are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the OCS Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Alternate Depth-Weighted	Cumulative ILCR Area-Weighted	Cumulative ILCR Alternate Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	**3×10^{-6}** (chromium-6)	Less than or equal to 1×10^{-6}	**2×10^{-6}** (chromium-6)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**2×10^{-6}** (chromium-6)	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Surface	**2×10^{-5}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1

Potential Receptor	**Exposure Depth**	**Cumulative ILCR Depth-Weighted**	**Cumulative ILCR Alternate Depth-Weighted**	**Cumulative ILCR Area-Weighted**	**Cumulative ILCR Alternate Area-Weighted**	**HI Depth-Weighted**	**HI Area-Weighted**
Long-Term Maintenance Worker	Shallow	**2 x 10^{-5}** (chromium-6 and dioxin TEQ)	**4 x 10^{-6}** (chromium-6 and dioxin TEQ)	**9 x 10^{-6}** (chromium-6 and dioxin TEQ)	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**9 x 10^{-6}** (chromium-6 and dioxin TEQ)	**4 x 10^{-6}** (chromium-6 and dioxin TEQ)	**5 x 10^{-6}** (chromium-6 and dioxin TEQ)	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**7 x 10^{-6}** (chromium-6 and dioxin TEQ)	**4 x 10^{-6}** (chromium-6 and dioxin TEQ)	**4 x 10^{-6}** (chromium-6 and dioxin TEQ)	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**3 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**6 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	**5 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**5 x 10^{-6}** (chromium-6 and dioxin TEQ)	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	**3 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Not calculated	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Not calculated	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**1 x 10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	**7 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**8 x 10^{-6}** (chromium-6 and dioxin TEQ)	**2 x 10^{-6}** (chromium-6 and dioxin TEQ)	**5 x 10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1 x 10^{-6}	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Alternate Depth-Weighted	Cumulative ILCR Area-Weighted	Cumulative ILCR Alternate Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Tribal User	Surface	Less than or equal to 1 x 10^{-6}	Not calculated	Not calculated	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1 x 10^{-6}	Not calculated	Not calculated	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are at below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (subsurface 1 and subsurface 2), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (surface and shallow), Camper (surface and shallow), and Hiker (shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2), Hiker (surface), and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface and shallow).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact occurs randomly over the entire OCS potential exposure area, the depth-weighted estimated risks above *de minimis* levels for the short- and long-term maintenance worker, camper, hiker, and OHV rider were due to hexavalent chromium and/or dioxin TEQ. Therefore, potential risks and hazards for these five receptors were estimated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (surface), Long-Term Maintenance Worker (subsurface 1 and subsurface 2), Camper (surface and shallow), Hiker (surface and shallow), and OHV Rider (shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (surface and shallow) and OHV Rider (surface)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the OCS exposure area using depth-weighted EPCs for the hunter and tribal user are below 1 in 1 million and 1, respectively. The estimated cumulative HIs for all other potential receptors are below an HI of 1. However, the cumulative ILCRs estimated using the depth and area-weighted EPC for the short- and long-term maintenance workers, camper, hiker, and OHV rider were above the point of departure for risk management decisions of 1 in 1 million, but within the risk management range of 1 in 1 million to 100 in 1 million.

For the OCS potential exposure area, the depth- and area-weighted risk estimates are not substantially different, with area-weighted estimated cumulative ILCRs being approximately 1.3 to 1.8 times lower than depth-weighted estimates for the same receptor and exposure depth. As shown in the table previously provided, this difference reduced the risk category for the short-term maintenance worker (shallow) long-term maintenance worker (surface, shallow, subsurface 1, and subsurface 2), hiker (surface), and OHV rider (surface and shallow), but does not substantially change the overall outcome for the risk estimates for this exposure area. The hazards are not noticeably impacted since all the estimated cumulative HIs were less than 1 with both depth- and area-weighted evaluations. Furthermore, the depth- and area-weighted EPCs for lead in all soil at the OCS potential exposure area are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for child recreational users and the fetus of a short-term maintenance worker, long-term maintenance worker, or hunter.

Sensitivity Analysis and Alternate EPC/ILCR Evaluation for OCS Potential Exposure Area

As described in the RAWP (Arcadis 2008a), the human populations that could be present in the areas outside the TCS (i.e., maintenance workers, recreational users, and tribal users) would more likely be exposed randomly, over the course of a lifetime, to soil present in all potential exposure areas outside of TCS, rather than have a lifetime of contact limited to the area of a single exposure area. Therefore, the combination of all exposure areas outside the TCS, evaluated as the OCS potential exposure area, is the scenario in this HHRA considered to most appropriately represent both current and potential future exposures for maintenance workers, recreational users, and tribal users.

To more clearly understand the locations of the risk drivers, a sensitivity analysis was performed to provide the risk managers with perspective on the areas/locations for the COPCs that are driving risk estimates and contributing most significantly to estimates of excess risk (see Appendix OCS). Estimated HIs were not evaluated in the sensitivity analysis because all receptors had HIs below 1 for all exposure depths in the original depth- and area-weighted evaluations. The sensitivity analysis did not evaluate the hunter and tribal user because their estimated cumulative ILCRs for all exposure depths in the original depth- and area-weighted evaluation were below 1 in 1 million.

As shown on the table previously provided and documented in more detail in Appendix OCS, the risk drivers for the OCS potential exposure area are hexavalent chromium and dioxin TEQ. The highest concentrations of hexavalent chromium and dioxin TEQ are localized in the SWMU 1 and TCS-4 areas within BCW, and at location AOC10-20 in AOC9 (see Figure OCS-1.1a for locations within SWMU 1, locations around TCS-4, and location AOC10-20). For the OCS potential exposure area, alternate depth- and area-weighted EPCs for hexavalent chromium and dioxin TEQ were calculated. The alternate EPC calculations excluded analytical data for hexavalent chromium and dioxin TEQ from SMWU 1 and TCS-4 potential exposure area (as described in Appendix SWMU1) and from location AOC10-20 in AOC9. The alternate depth- and area-weighted EPCs for these two compounds were then used, along with the original depth- and area-weighted EPCs for all other COPCs evaluated, to estimate alternate cumulative risks for the short- and long-term maintenance workers, camper, hiker, and OHV rider.

Alternate Depth-Weighted

Using alternate depth-weighted EPCs for hexavalent chromium and dioxin TEQ as described for the sensitivity analysis, alternate depth-weighted cumulative ILCRs were estimated for the short- and long-term maintenance workers, camper, hiker, and OHV rider. The alternate depth-weighted estimated cumulative ILCRs for these receptors are shown on the table previously provided, and are described in this section:

Potential exposures that are below or at the *de minimis* level of 1 in 1 million include the following:

- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Camper (surface and shallow), Hiker (surface), and OHV Rider (surface).

Potential exposures that are above the *de minimis* levels of 1 in 1 million and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (all depths), Hiker (shallow), and OHV Rider (shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact occurs randomly over the entire OCS potential exposure area (with the removal of selected hexavalent chromium and dioxin TEQ data as described for the sensitivity analysis), the alternate depth-weighted estimated cumulative ILCRs for the short-term maintenance worker, camper, hiker (surface), and OHV rider (surface) were below 1 in 1 million. The alternate depth-weighted estimated cumulative ILCRs for the long-term maintenance worker, hiker (shallow) and OHV rider (shallow) were above 1 in 1 million, the point of departure for risk management decisions, and below 5 in 1 million. These values are well within the risk management range of 1 in 1 million to 100 in 1 million.

Alternate Area-Weighted

Using alternate area-weighted EPCs for hexavalent chromium and dioxin TEQ as described for the sensitivity analysis, alternate area-weighted cumulative ILCRs were estimated for the short- and long-term maintenance workers, camper, hiker, and OHV rider. The alternate area-weighted estimated cumulative ILCRs for these receptors are shown on the table previously provided, and are described in this section:

Potential exposures that are below or at the *de minimis* level of 1 in 1 million include the following:

- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (all depths), Long-Term Maintenance Worker (surface), Camper (surface and shallow), Hiker (surface and shallow), and OHV Rider (surface and shallow).

Potential exposures that are above the *de minimis* levels of 1 in 1 million and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – None
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the OCS potential exposure area (with the removal of selected hexavalent chromium and dioxin TEQ data as described for the sensitivity analysis), the alternate area-weighted estimated cumulative ILCRs for the long-term maintenance worker (shallow), short-term maintenance worker (all depths), camper (all depths), hiker (all depths), and OHV rider (all depths) were below 1 in 1 million. The alternate area-weighted estimated cumulative ILCRs for the long-term maintenance worker for shallow, subsurface 1, and subsurface 2 soil were slightly above 1 in 1 million (i.e., at 2 in 1 million). These values are well within the risk management range of 1 in 1 million to 100 in 1 million.

Sensitivity Analysis Summary

Assuming lifetime soil contact is limited to the OCS potential exposure area, the sensitivity analysis demonstrates that there are some specific locations in this exposure area that drive the excess estimates of human health risk due to the presence of hexavalent chromium and dioxin TEQ in soil. Removing the data representing those elevated concentration locations, and estimating the alternate ILCR values, shows for both the depth- and area-weighted evaluations that some type of targeted remedial actions is likely to reduce residual risks levels to at or just above 1 in 1 million, the point of departure for risk management decisions. The depth- and area-weighted risk estimates are not substantially different. As shown in the table previously provided, using the area-weighted EPCs reduced the risk category for the long-term maintenance worker (surface), hiker (shallow), and OHV rider (shallow) from just above 1 in 1 million to at or just below 1 in 1 million, but does not substantially change the overall outcome for the risk estimates for this exposure area. Additional details regarding specific locations contributing to excess risk are provided in Section 8.

5.5.3.15 Outside the Compressor Station Excluding Bat Cave Wash

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the OCS excluding BCW potential exposure area (i.e., referred to hereafter as the OCSxBCW potential exposure area) using depth- and area-weighted EPCs under the baseline scenario were estimated. Assuming lifetime soil contact occurs randomly over the entire OCSxBCW potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the OCSxBCW Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Short-Term Maintenance Worker	Surface	**4×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Shallow	**3×10^{-6}** (chromium-6)	**2×10^{-6}** (chromium-6)	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 1	**2×10^{-6}** (chromium-6)	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Less than or equal to 1×10^{-6}	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Long-Term Maintenance Worker	Surface	**3×10^{-5}** (chromium-6 and dioxin TEQ)	**2×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**2×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**1×10^{-5}** (chromium-6 and dioxin TEQ)	**8×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**9×10^{-6}** (chromium-6 and dioxin TEQ)	**6×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Surface	**4×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Camper	Shallow	**3×10^{-6}** (chromium-6 and dioxin TEQ)	**2×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Surface	**9×10^{-6}** (chromium-6 and dioxin TEQ)	**5×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hiker	Shallow	**6×10^{-6}** (chromium-6 and dioxin TEQ)	**3×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hunter	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Hunter	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
OHV Rider	Surface	**2×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
OHV Rider	Shallow	**1×10^{-5}** (chromium-6 and dioxin TEQ)	**6×10^{-6}** (chromium-6 and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Tribal User	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Tribal User	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, Hunter, OHV Rider, and Tribal User
- **ILCR less than or equal to 1 in 1 million** – Short-Term Maintenance Worker (subsurface 2), Hunter (surface and shallow), and Tribal User (surface and shallow).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (surface, shallow, and subsurface 1) and Camper (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2), Hiker (surface and shallow), and OHV Rider (shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface and shallow) and OHV Rider (surface).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

The depth-weighted estimated cumulative ILCRs and His for the hunter and tribal user were below 1 in 1 million and 1, respectively. Consequently, risks and hazards for these two receptors were not estimated using area-weighted EPCs. The depth-weighted estimated cumulative HI values were below 1 for all receptors and all exposure depths evaluated. The depth-weighted estimated risks above *de minimis* levels for the short- and long-term maintenance workers, camper, hiker, and OHV rider were due to hexavalent chromium and/or dioxin TEQ. Therefore, potential risks and hazards for these receptors were estimated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: Short- and Long-Term Maintenance Workers, Camper, Hiker, and OHV Rider
- **ILCR less than or equal to 1 in 1 million** - Short-Term Maintenance Worker (subsurface 1 and subsurface 2).

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Short-Term Maintenance Worker (surface and shallow), Camper (surface and shallow), and Hiker (surface and shallow)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Long-Term Maintenance Worker (shallow, subsurface 1, and subsurface 2) and OHV Rider (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Long-Term Maintenance Worker (surface).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

For the OCSxBCW potential exposure area, risk drivers for both depth- and area-weighted evaluations are hexavalent chromium and dioxin TEQ. Depth-weighted estimated risks and hazards for the hunter and tribal user were less than or equal to 1 in 1 million and less than or equal to 1, respectively, therefore these receptors were not carried forward for evaluation using area-weighted EPCs. The cumulative HIs estimated for all potential receptors evaluated are below an HI of 1.

Assuming lifetime soil contact is limited to the OCSxBCW potential exposure area, the following summarizes the area-weighted HHRA results for the OCSxBCW potential exposure area. The estimated cumulative ILCRs associated with potential exposure to COPCs in soil using area-weighted EPCs for the short-term maintenance worker, camper, and hiker were above the point of departure for risk management decisions of 1 in 1 million but at or below 5 in 1 million. For the long-term maintenance worker and OHV rider, the area-weighted estimated cumulative ILCRs are above the point of departure for risk management decisions of 1 in 1 million but at or below 10 in 1 million, with one exception. The area-weighted estimated cumulative ILCR for the long-term maintenance worker (surface) is slightly above 10 in 1 million (i.e., 20 in 1 million). These values are well within the risk management range of 1 in 1 million to 100 in 1 million.

Furthermore, the depth- and area-weighted EPCs for lead in all soils at the OCSxBCW potential exposure area are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL in the fetus of a short- or long-term maintenance worker, fetus of a hunter, or child recreational user.

For the OCSxBCW potential exposure area, the depth- and area-weighted risk estimates are not substantially different, with area-weighted estimated cumulative ILCRs being approximately 1.2 to 2 times lower than depth-weighted estimates for the same receptor and exposure depth. As shown in the table previously provided, this difference reduced the risk category for the long-term maintenance worker (shallow), hiker (surface and shallow), and OHV rider (surface), but does not substantially change the overall outcome for the risk estimates for this exposure area. The hazards are not noticeably impacted since all the estimated cumulative HIs were below 1 with both depth- and area-weighted evaluations.

Note that the HHRAs conducted for the OCS potential exposure area (results summarized in Section 5.5.3.15) and the OCSxBCW potential exposure area provide risk managers with perspective on how much of the risks/hazards estimated for the overall OCS potential exposure area are influenced by the elevated concentrations of hexavalent chromium and dioxin TEQ located within BCW. The estimated cumulative ILCRs are generally only 1 to 1.6 times lower for the OCSxBCW potential exposure area when compared to estimated cumulative ILCRs for the OCS potential exposure area.

As indicated in other appendices (Appendices OCS and Appendix BCWxSWMU1), the weight-of-evidence (WOE) supports that the majority of excess risk is attributed to elevated concentrations of hexavalent chromium and/or dioxins located within SWMU 1 and TCS-4 areas within BCW, and at location AOC10-20 in AOC9.

5.5.3.16 North of the Railroad

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the NORR potential exposure area using depth and area-weighted EPCs under the baseline scenario for the hypothetical future resident were estimated. Assuming lifetime soil contact at the NORR potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the NORR Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Hypothetical Future Resident Exposure to Soil	Surface	**2×10^{-5}** (chromium-6 and dioxin TEQ)	**1×10^{-5}** (chromium-6 and dioxin TEQ)	2 (Dioxin TEQ)	Less than or equal to 1
Hypothetical Future Resident Exposure to Soil	Shallow	**1×10^{-5}** (chromium-6, total PCBs, and dioxin TEQ)	**1×10^{-5}** (chromium-6, total PCBs, and dioxin TEQ)	2 (Dioxin TEQ)	Less than or equal to 1
Hypothetical Future Resident Exposure to Soil	Subsurface 1	**9×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**7×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hypothetical Future Resident Exposure to Soil	Subsurface 2	**7×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**6×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Hypothetical Future Resident Consumption of	Surface	**1×10^{-3}** (chromium-6, total PCBs, and dioxin TEQ)	**1×10^{-3}** (chromium-6, total PCBs, and dioxin TEQ)	6 (chromium-6, total PCBs, and TPHd)	6 (chromium-6, total PCBs, and TPHd)

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Home-Produced Food					
Hypothetical Future Resident Consumption of Home-Produced Food	Shallow	**1×10^{-3}** (chromium-6, total PCBs, and dioxin TEQ)	**9×10^{-4}** (chromium-6, total PCBs, and dioxin TEQ)	7 (chromium-6, total PCBs, and TPHd)	6 (chromium-6, total PCBs, and TPHd)

Note:
TPHd = total petroleum hydrocarbon as diesel

Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Hypothetical Future Resident Exposure to Soil (subsurface 1 and 2)
- **ILCR less than or equal to 1 in 1 million** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – Hypothetical Future Resident Exposure to Soil (surface and shallow)
- **HI greater than 3** – Hypothetical Future Resident Exposure to Home-Produced Food (surface and shallow)
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – None
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Hypothetical Future Resident Exposure to Soil (shallow, subsurface 1, and subsurface 2)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – Hypothetical Future Resident Exposure to Soil (surface).

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – Hypothetical Future Resident Exposure to Home-Produced Food (surface and shallow).

For the NORR potential exposure area, the depth-weighted estimated risks and hazards above *de minimis* levels for the hypothetical future resident potentially exposed to soil and home-produced food were due to hexavalent chromium, total PCBs, and/or dioxin TEQ. Accordingly, potential risks and hazards for these receptors were estimated using area-weighted EPCs and are provided in this section.

Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – Hypothetical Future Resident Exposure to Soil (surface, shallow, subsurface 1, and subsurface 2)
- **ILCR less than or equal to 1 in 1 million** – None.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – Hypothetical Future Resident Exposure to Home-Produced Food (surface and shallow)
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – None
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Hypothetical Future Resident Exposure to Soil (surface, shallow, subsurface 1, and subsurface 2)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – Hypothetical Future Resident Exposure to Home-Produced Food (surface and shallow).

OVERALL SUMMARY

For the NORR potential exposure area, risk drivers for both depth- and area-weighted evaluations are hexavalent chromium, total PCBs, and/or dioxin TEQ. All potential receptors and exposure depths had estimated risk and hazards above *de minimis* levels with one exception. Using both depth- and area-weighted EPCs, the estimated cumulative HIs were at or below 1 for the hypothetical future resident potentially contacting COPCs in subsurface 1 and subsurface 2 soil.

The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the NORR potential exposure area using area-weighted EPCs for the hypothetical future resident are above the point of departure for risk management decisions of 1 in 1 million and an HI of 1, respectively. However, the estimated cumulative ILCRs for this receptor at or below 10 in 1 million and within the risk management range of 1 in 1 million to 100 in 1 million.

Using depth- and area-weighted EPCs and food consumption and uptake modeling (as described in Appendix NORR), for the hypothetical future resident consuming home-produced food, the risk estimates are 1,000 in 1 million and HIs are 6 to 7. These values are above the risk management ranges of 1 in 1 million to 100 in 1 million and HI of 1, respectively. Note that cancer risk estimates above the risk management range were primarily attributed to exposure to hexavalent chromium in home-produced food and that the area of hexavalent chromium detected above background is limited with only four of 134 samples detected above the BTV.

Noncancer hazard estimates above 1 were primarily attributed to exposure to TPH as diesel, hexavalent chromium, and PCBs in home-produced food. Significant uncertainties associated with the estimation of hypothetical future resident exposure to TPH as diesel, hexavalent chromium, and PCBs in home-produced food may result in an overestimate of potential cancer risks and noncancer hazards calculated for these exposures. These uncertainties are described in detail in Section 4.6.3 of Appendix NORR and include the assumption of an infinite source of TPH as diesel and use of maximum depth-weighted concentrations to estimate exposure to PCBs and TPH as diesel. In addition, several conservative assumptions associated with food uptake modeling were used for hexavalent chromium and TPH as diesel. When the estimated outdoor vapor concentration of TPH as diesel is adjusted to account for a limited source depth, the depth- and area-weighted estimated HQs for the hypothetical future resident potentially exposed to TPH as diesel in NORR potential exposure area home-produced food is reduced from 5 to 0.2.

The depth- and area-weighted EPCs for lead in all soils at the NORR potential exposure area are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for a hypothetical future resident child receptor.

For the NORR potential exposure area, the depth- and area-weighted risk estimates are not substantially different, with area-weighted ILCRs being approximately 1.2 to 2 times lower than depth-weighted estimates for the same receptor and exposure depth. As shown in the table previously provided, this difference reduced the risk category for the hypothetical future resident potentially contacting soil from 2 in 1 million to 10 in 1 million and the HIs from 2 down to 1. However, the overall outcome for the risk estimates for the NORR potential exposure area does not substantially change.

Note that the risk/hazards presented for the hypothetical future resident living in the NORR potential exposure area are presented at the request of DOI and for informational purposes only. It is highly unlikely that the site will be used for residential purposes in the future.

5.5.3.17 Inside the Compressor Station

Cumulative ILCRs and HIs associated with potential exposure to COPCs in soil and soil gas at the ICS potential exposure area using depth- and area-weighted soil EPCs were estimated. Assuming lifetime soil contact occurs randomly over all AOCs within the ICS potential exposure area for the receptors evaluated, the estimated potential ILCR and HI results under the baseline scenario are summarized in the table and discussed in this section.

Baseline Scenario Estimated Cumulative Incremental Lifetime Cancer Risk and HI for the ICS Potential Exposure Area

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
Commercial Worker	Surface	**1×10^{-5}** (chromium-6, total PCBs, and dioxin TEQ)	**8×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Commercial Worker	Shallow	**9×10^{-6}** (chromium-6,	**7×10^{-6}** (chromium-6,	Less than or equal to 1	Less than or equal to 1

Potential Receptor	Exposure Depth	Cumulative ILCR Depth-Weighted	Cumulative ILCR Area-Weighted	HI Depth-Weighted	HI Area-Weighted
		total PCBs, and dioxin TEQ)	total PCBs, and dioxin TEQ)		
Commercial Worker	Soil Gas	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Surface	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Shallow	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 1	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Short-Term Maintenance Worker	Subsurface 2	Less than or equal to 1×10^{-6}	Not calculated	Less than or equal to 1	Not calculated
Long-Term Maintenance Worker	Surface	**7×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**3×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Shallow	**6×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**3×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 1	**4×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**2×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1
Long-Term Maintenance Worker	Subsurface 2	**3×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	**2×10^{-6}** (chromium-6, total PCBs, and dioxin TEQ)	Less than or equal to 1	Less than or equal to 1

Note:
Not calculated = Area-weighted estimate not calculated because depth-weighted estimates for the receptor was below *de minimis* levels.

Depth-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All receptors evaluated including: commercial Worker and Short- and Long-Term Maintenance Workers
- **HI less than or equal to 1 for soil gas –** Commercial Worker

- **ILCR less than or equal to 1 in 1 million for all soil depths** – Short-Term Maintenance Worker
- **ILCR less than or equal to 1 in 1 million for soil gas–** Commercial Worker.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None
- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (subsurface 1 and subsurface 2)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Commercial Worker (surface and shallow) and Long-Term Maintenance Worker (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

Assuming lifetime soil contact is limited to the ICS potential exposure area, the depth-weighted estimated risks above *de minimis* levels for the commercial and long-term maintenance worker were due to hexavalent chromium, total PCBs, and dioxin TEQ. Accordingly, potential risks and hazards for these receptors were estimated using area-weighted EPCs. Note that the elevated concentrations of hexavalent chromium (170 mg/kg at AOC15-OS2), total PCBs (13.8 mg/kg at AOC4-28), and dioxin TEQ (2,000 ng/kg at AOC13-33 and AOC5-4) appear to be limited to these locations within the ICS potential exposure area.

The area-weighted estimated ILCR and HI results for the commercial worker and long-term maintenance worker are provided in this section.

Area-Weighted

Potential exposures that are below or at *de minimis* levels include the following:

- **HI less than or equal to 1 for all soil depths** – All potential receptors evaluated including: Commercial Worker and Long-Term Maintenance Worker
- **HI less than or equal to 1 for soil gas –** Commercial Worker
- **ILCR less than or equal to 1 in 1 million for all soil depths** – None
- **ILCR less than or equal to 1 in 1 million for soil gas –** Commercial Worker.

Potential exposures that are above *de minimis* levels of HI greater than 1 and/or within the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **HI greater than 1 and less than or equal to 3** – None
- **HI greater than 3** – None

- **ILCR greater than 1 in 1 million and less than or equal to 5 in 1 million** – Long-Term Maintenance Worker (surface, shallow, subsurface 1, and subsurface 2)
- **ILCR greater than 5 in 1 million and less than or equal to 10 in 1 million** – Commercial Worker (surface and shallow)
- **ILCR greater than 10 in 1 million and less than or equal to 100 in 1 million** – None.

Potential exposures that are above the risk management range of 1 in 1 million to 100 in 1 million include the following:

- **ILCR greater than 100 in 1 million** – None.

OVERALL SUMMARY

The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil at the ICS potential exposure area using depth-and area-weighted EPCs for short-term maintenance worker under the baseline scenario are below 1 in 1 million and 1, respectively. The estimated cumulative HIs for all potential receptors and all soil depths are below an HI of 1. The estimated cumulative ILCRs for the commercial and long-term maintenance workers estimated using depth- and area-weighted EPCs were above the point of departure for risk management decisions of 1 in 1 million but at or below 10 in 1 million which is well within the risk management range of 1 in 1 million to 100 in 1 million. In general, depending on the depth interval, the area-weighted approach resulted in risks or hazard estimates ranging from 1.3 to 2.1 times lower than the depth-weighted estimates. As shown in the table previously provided, this difference reduced the risk category for the long-term maintenance worker (surface and shallow) but does not substantially change the overall outcome for the risk estimates for this exposure area. The hazards are not noticeably impacted because all the estimated cumulative HIs were less than 1 with both depth- and area-weighted evaluations.

The estimated cumulative ILCRs and HIs for commercial workers potentially exposed to COPCs in soil gas via the vapor intrusion pathway are well below the point of departure for risk management decisions of 1 in 1 million and an HI of 1, respectively. Furthermore, the depth- and area-weighted EPCs for lead in all soils at the ICS potential exposure area under the baseline scenario are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a commercial worker, short-term maintenance worker, or long-term maintenance worker.

Note much of the ICS potential exposure area is covered by buildings, pavement, and gravel, and the assumptions that workers are exposed to all soil in the ICS potential exposure area is overly conservative. Furthermore, work practices are currently in place that limit the amount of exposure to dusts and soil and provide an added level of protection to all workers, above and beyond what is necessary to ensure full protection of the health of all PG&E workers at the TCS. Therefore, the estimated ILCRs and HIs associated with current potential exposure to COPCs in soil at the ICS potential exposure area are overestimated and are likely well below 10 in 1 million and HI of 1, respectively. PG&E follows all relevant and appropriate worker health and safety protocols and is in compliance with worker health and safety measures set forth by the Occupational Safety and Health Administration, as required by state and federal law. The results of the ICS HHRA are intended to provide additional information useful in identifying chemical hazards and appropriate controls, where necessary.

5.6 Uncertainty Analysis

The HHERA includes several uncertainties that warrant discussion. The generic and site-specific uncertainties discussed in this section with respect to the HHRA also apply to the ERA where noted. Additional uncertainties applicable only to the ERA are discussed in Section 6.5. Uncertainties applicable only to certain potential exposure areas are discussed in detail in the relevant potential exposure area-specific HHERA Appendices.

Risks and/or hazards estimated for individual AOC/SWMU/UA potential exposure areas are not considered representative of the realistic or likely potential exposures for the human populations that could be present in the areas outside the TCS (such as maintenance workers, recreational users, and tribal users). As described in the RAWP documents (Arcadis 2008a, 2009a, 2015), these human populations would more likely be exposed randomly, over the course of a lifetime, to soil present in all individual AOC/SWMU/UA potential exposure areas located outside the TCS, rather than have a lifetime of contact limited to the area of a single potential exposure area. Therefore, estimated risk and/or hazards presented for individual AOC/SWMU/UA potential exposure areas are not believed to be representative of the potential health risks to humans potentially contacting the soil outside the TCS. Rather, the HHRA results presented in Appendix OCS for all AOC/SWMU/UA potential exposure areas located outside the TCS combined will help to inform risk management decisions for the site.

In addition, many of the assumptions used in this risk assessment, regarding the representativeness of the sampling data, human exposures, fate and transport modeling, and chemical toxicity are conservative, following agency guidance, and reflect a 90th or 95th percentile value, rather than a typical or average value. The use of several conservative exposure and toxicity assumptions can introduce considerable uncertainty into the risk assessment. By using conservative exposure assumptions or toxicity estimates, the assessment can develop a significant conservative bias that may result in the calculation of significantly higher cancer risks or noncancer hazards than are actually posed by the chemicals present in soil and soil gas. A discussion of the key uncertainties used in this evaluation is presented in this section.

5.6.1 Uncertainty in the Data

5.6.1.1 Data Quality

Data used in this HHERA were analyzed by approved USEPA methods, and appropriate quality assurance/quality control (QA/QC) procedures were followed. Errors in chemical analyses may result from several sources, including errors inherent in the sampling and analytical procedures. Analytical accuracy or sampling errors can result in the rejection of data, which decreases the available data for use in the HHERA, or in the qualification of data, which increases the uncertainty in the detected chemical concentrations. Data used in the HHERA were validated, and the overall quality of the data was assessed. Only those data classified as Category 1 were used in the HHERA. A few analytical results were excluded from the HHERAs because they were rejected during the data validation process. These cases are discussed specifically in each potential exposure area appendix and exclusion of these rejected data do not significantly impact the risk assessment datasets. Additionally, some sample results were qualified as estimated (J) due to a high relative percent difference reported in a laboratory duplicate analysis. However, the data validation results indicate that the data are suitable for their intended use.

5.6.1.2 Analytical Methods and Reporting Limits

The analytical methods and RLs for data used in the HHERA were evaluated in Section 3.2.3. As described in Section 3.4, certain COPCs/COPECs may be excluded from the risk assessment if they were detected at the site at concentrations consistent with background. COPCs/COPECs with a maximum detected concentration less than the applicable BTV were excluded from the risk assessment. Elevated RLs may lead to a non-conservative decision to exclude a constituent from the HHERA (i.e., not selected as a COPC/COPEC) if the maximum detected concentration is lower than the BTV, and the BTV is, in turn, lower than the maximum RL. If elevated RLs at the site are greater than the maximum detected concentration, uncertainty in the ability to assess whether COPCs/COPECs are present at concentrations equivalent to background increases with the number of ND sample results with RLs greater than the BTV. A detailed discussion of the potential implications of RLs that exceed the BTVs on the COPC/COPEC selection process is provided here.

Section 3.2.3.1.1 identifies and discusses the percentage of nondetect samples for each constituent in which the RL in ND samples exceeds the applicable BTV. For ICS, beryllium, cadmium, hexavalent chromium, molybdenum, and B(a)PEQ were the only COPCs/COPECs for which ND samples had RLs greater than background (Table 3-1). Of these COPCs/COPECs, the maximum RL was greater than the maximum detected concentration in the ICS exposure area only for beryllium, indicating that this COPC/COPEC may have been erroneously excluded from the HHERA for the ICS exposure area due to elevated RLs.

As indicated in Table 3-2, for the OCS potential exposure area, which represents the combined individual AOC/SWMU/UA potential exposure areas outside TCS, beryllium, cadmium, hexavalent chromium, copper, molybdenum, selenium, and B(a)PEQ were the only COPCs/COPECs for which at least one sample had a RL greater than the BTV. RLs were above the BTV in ND results in 99.8% (beryllium), 4% (cadmium), less than 1% (hexavalent chromium), less than 1% (copper), 16% (molybdenum), 2% (selenium), and 2% (B(a)PEQ) of the soil samples collected within exposure areas outside TCS. Based on the frequency of RLs above the BTV in ND results, beryllium is the only COPEC where significant uncertainty exists regarding the ability to assess whether these COPCs/COPECs are present at concentrations equivalent to background.

The BTV for beryllium (0.672 mg/kg) is equivalent to the maximum detected concentration in the background dataset that contains RLs for beryllium ranging from 1 to 5.4 mg/kg. RLs in the ICS potential exposure area dataset exceed the BTV by a factor of two or less (maximum RL = 1.4 mg/kg; BTV = 0.672 mg/kg) and are well within the range of RLs in the background dataset. RLs in the OCS potential exposure area dataset exceed the maximum BTV by up to 16 times (maximum RL = 11 mg/kg) and exceed the maximum RL in the background dataset by a factor of two or less (maximum RL = 11 mg/kg). The majority of the RLs for beryllium in the OCS exposure area dataset are within the range of those in background dataset with only three of 1181 results that exceed the maximum RL in the background dataset of 5.4 mg/kg. To more fully understand the extent to which the exclusion of beryllium from the HHERA may materially underestimate risk and/or hazard, it is necessary to understand whether the RLs are greater than risk-based screening levels. As shown in Table 3-3, the risk-based screening level for beryllium is 210 mg/kg, which is greater than the maximum RLs of 1.4 mg/kg and 11 mg/kg for the ICS and OCS exposure area datasets, respectively. In addition, beryllium is not known to be associated with historical site activities and beryllium was never detected in the OCS potential exposure area. For these reasons, although beryllium RLs frequently exceed the BTV, the overall effect on the HHERA is expected to be negligible.

Based the information presented above, RLs for the HHERA dataset did not result in material underestimation of exposure or risk for human health or ecological receptors.

Analytical methods for metals only included analysis for total metals except for hexavalent chromium. The toxicity of many metals depends strongly on the oxidation state, presence of methylation, and other site-specific factors (such as presence of iron sulfide, or co-occurring metals) that influence uptake and effects. Thus, measurement of total metal concentration may overestimate actual risk from some metals to specific receptors, because the form and toxicity of these metals at the site is not accounted for in the exposure estimations.

5.6.1.3 Calculated Total Concentrations for Soil

Exposure to dioxin/furan congeners, PCBs (as Aroclors), and PAHs was evaluated in the HHERAs using calculated total concentrations for these mixtures. There are uncertainties associated with these calculated total concentrations, as described in this section.

5.6.1.3.1 Dioxin TEQ

Uncertainty associated with calculated total dioxin concentrations are related to the treatment of ND congeners in the TEQ estimates.

Because several congeners routinely were not detected in soil samples, a potential area of uncertainty is the evaluation of ND values in calculating TEQ concentrations. In the HHERAs, ND congeners were evaluated at one-half of the RL. TEQs calculated assuming ND concentrations are equal to zero would result in lower TEQ concentrations and associated exposure and risk. When ND congeners are evaluated at zero in the TEQ calculation, the TEQ contribution of individual congeners with elevated RLs may be underestimated. When ND congeners are evaluated at one-half or the full RL, the TEQ contributions of individual congeners are unlikely to be underestimated but may be overestimated, especially for congeners with elevated RLs.

5.6.1.3.2 Total PCBs

As described in Section 5.4.6, the calculation of total PCBs was conducted based on the specific Aroclors detected in each exposure area. For example, if two Aroclors were detected in the exposure area, the total PCB concentration in each sample would be calculated as the sum of the detected concentrations and/or one-half of the RL for ND samples for those two Aroclors only. Measured Aroclors that were not detected in the exposure area were not included in the total PCB concentration for that exposure area. Use of one-half or the full RL for calculation of total PCBs based on all Aroclors including those not detected within a given exposure area would result in overestimation of the total PCB concentrations present in soil.

5.6.1.3.3 B(a)P Equivalent Concentrations

Similar to the uncertainty associated with calculated total dioxin concentrations, uncertainty is related to the treatment of ND cPAHs in the B(a)PEQ estimates in the HHRA.

Because several cPAHs routinely were not detected in soil samples, a potential area of uncertainty is the evaluation of ND values in calculating B(a)PEQ concentrations. In the HHRA, ND cPAHs were evaluated at ½ the RL. B(a)PEQ calculated assuming ND concentrations are equal to zero would result in lower B(a)PEQ concentrations and associated exposure and risk. When ND cPAHs are evaluated at zero in the B(a)PEQ calculation, the B(a)PEQ contribution of individual cPAHs with elevated RLs may be underestimated. When ND cPAHs are evaluated at ½ the RL, the B(a)PEQ contributions of individual cPAHs are unlikely to be underestimated but may be overestimated, especially for cPAHs with elevated RLs.

5.6.1.4 Soil Datasets

5.6.1.4.1 Biased Sampling Design

Soil data were collected according to approved sampling work plans (CH2M 2013) to define the nature and extent of site-related constituents within the TCS and in areas outside the TCS potentially impacted by historical site use, and to refine the understanding of fate and transport of COPCs/COPECs. As such, soil samples were collected in a biased manner around known sources of release. Human and ecological receptors potentially using the site are assumed to use all areas of the site as described in Sections 5.3.2 and 6.3.2, respectively. They would not be expected to preferentially use more contaminated areas (and ecological receptors may even avoid highly developed or disturbed areas related to current or historical site operations). Human and ecological receptors would also be expected to have equal access to and utilization of unsampled areas distant from the historical sources of release. These unsampled areas are expected to contain lower or undetectable concentrations of site-related COPCs/COPECs. Therefore, use of the site soil data can potentially overestimate receptor exposure to COPCs/COPECs. In the HHERAs, area-weighting was used to reduce the impact of biased sampling on the EPCs. Overestimation of exposure and associated risk is more likely for EPCs calculated without area-weighting (i.e., the depth-weighted EPCs) and especially when the EPC is based on the maximum depth-weighted concentration. The maximum depth-weighted concentration was frequently selected as the EPC for some COPCs/COPECs that were rarely detected in the soil datasets outside and inside the TCS, such as antimony, cadmium, silver, thallium, and/or PCBs. As the HHERA risk conclusions are based primarily on risks estimated calculated using area-weighted EPCs (except in cases when area-weighted EPCs were not warranted due to lack of risk using depth-weighted EPCs), the effect of biased sampling on the risk conclusions was minimized, to the extent feasible. The area-weighting, however, did not take into account the unsampled areas between the source areas, and thus, although the effect of biased sampling on the risk conclusions was minimized, the area-weighted EPCs for the combined exposure areas (e.g., OCS potential exposure area) still likely represent an overestimate of exposure and risk for the receptors potentially exposed to the combined exposure areas.

5.6.1.4.2 Data Grouping

A comprehensive list of the sample locations that were analyzed in more than one AOC-based exposure area are presented in Section 3.3. These locations are identified in the AOC-specific appendices as well. The number of sample locations evaluated in more than one potential exposure area is small relative to the risk assessment datasets and elevated COPC/COPEC concentrations are not present at these locations. As a result, the effect on the calculated EPCs and resulting risk estimates is expected to be negligible.

5.6.1.5 Background Datasets

As described in Section 2.2.4, soil samples were collected from areas representative of background conditions near TCS and analyzed for inorganic constituents, PAHs, and dioxin/furans (CH2M 2009c, 2017a). Sample locations for inorganics and PAHs are shown on Figure 1 from the Background Tech Memo (CH2M 2009c). Sample locations for dioxins/furans and PAHs are presented on Figure 1 from the soil background investigation (CH2M 2017a). As shown on the figures, the samples collected represent a range of geologic soil types that broadly represent soil at the site and AOCs outside the TCS. However, some soil sample locations represented in the risk assessment datasets are in locations that may represent soil types not included in the background dataset. For example, soils in the UA-2 exposure area are known to be representative of bedrock (Section 2.2.4), while background datasets were taken primarily from alluvial soil. Therefore, the background soil datasets may not be representative of UA-2 bedrock related soil in this area. Soils in some areas of the Tamarisk Thicket appear to be representative of Quaternary river gravels, which are not well represented in soil samples analysed for inorganics, PAHs, and dioxin/furans included in the background datasets. Additionally, soil types and associated background concentrations can be patchy at small spatial scales. While the soil background datasets and resulting BTVs are generally appropriate for identifying the range of background concentrations at the TCS, it is possible that some sample concentrations exceeding the BTVs and/or range of background concentrations may be representative of concentrations in a different background population (i.e., different soil type). Similarly, some concentrations below the BTVs and/or range of background may be representative of a different background population (i.e., different soil type). Overall, constituents determined to be above background levels using the agency-approved site background dataset, were conservatively included as COPCs/COPECs in the HHERA.

5.6.2 Uncertainties in the Selection of Chemicals of Potential Concern

Selecting the COPCs/COPECs to be included in the risk assessments is a sequential process where a compound detected in site media may be eliminated from further consideration based on either the concentration being consistent with ambient background conditions, or its status as an essential nutrient. Current DTSC guidance (1997) allows inorganic compounds to be eliminated from a risk assessment if it can be demonstrated that they do not exceed local background levels. Methods comparable to the DTSC guidance (1997, 2009d) are also commonly used in the risk assessment process to evaluate whether ubiquitous anthropogenic compounds such as dioxins/furans and PAHs are present at a site at levels that exceed background concentrations. As described in Section 3.4, soil datasets from each exposure area were compared to background datasets for inorganics, dioxins/furans, and PAHs. Background conditions were not evaluated for the inorganics phosphate and orthophosphate so these COPCs were included in the risk assessment in exposure areas where detected. For some exposure areas where a small number of soil samples were collected (e.g., AOC28 and AOC31), a statistical comparison to background soil datasets is not possible because of small sample size.

With the exception of chemicals determined to be consistent with ambient background conditions, all detected chemicals were included in the risk assessment regardless of detection frequency. This would result in inclusion of chemicals in the quantitative risk assessment that are limited to small areas of the site, and which may not be site-related. Inclusion of these infrequently detected chemicals could result in an overestimation of site-related risks from exposure to these COPCs.

5.6.3 Uncertainties in the Exposure Assessment

5.6.3.1 Potentially Exposed Populations in the HHRA

Hypothetical future residential use of the site is evaluated in the HHRA for the NORR potential exposure area, as directed by DOI/DTSC (2014), even though future unrestricted use is highly unlikely (DOI 2014b). Note that risks/hazards estimated for the hypothetical future resident are not considered representative of the realistic or likely potential exposures for the human populations that could be present in this area or anywhere at the site. Specifically, it is highly unlikely that the site will ever be used for residential purposes. All future residential assumptions, including the assumptions that the resident is a rural resident, meaning a receptor who obtains a significant portion of his/her diet from onsite produced food including vegetables, fruits, and poultry, are unrealistic and presented at the request of DOI. Therefore, as requested, although future residential land use is a highly unlikely scenario, a future hypothetical residential land-use scenario is evaluated for USBLM property as described in Section 5.3.1.4 (see Figure 3-1).

5.6.3.2 Exposure Assumptions and Pathways

In general, this HHRA has quantified all potentially complete exposure pathways through which individuals could become exposed to COPCs present in site soil and indoor/outdoor air. Accordingly, except for the hypothetical future resident, the exposure pathways quantified in this HHRA are believed to capture the range of theoretical potential current and reasonably foreseeable future exposures and thus provide a conservative estimate of long-term exposures that could occur at the site.

This baseline risk assessment assumes that contact with soil is not limited by the presence of engineering or institutional controls in the future. Because much of the ICS potential exposure area is paved, potential exposure for current commercial and maintenance workers who work inside the TCS would likely be less than the assumptions used in the HHRA for potential future contact with soil for the worker receptor populations evaluated in the ICS potential exposure area. Further, current maintenance worker activities outside the TCS are used to estimate anticipated potential future exposures for the population. In addition, the potential health risks estimated for recreational users and tribal users do not account for potential vegetative covering outside the TCS that would reduce exposure below that assumed in this analysis.

The specific exposure assumptions used for the short- and long-term maintenance worker, for potential exposure areas located both inside and outside the TCS are believed to significantly overestimate the amount of exposure that these populations could potentially incur. First, the HHRA assumes that the workers are breathing a significant quantity of dust for the entire time they are working (an assumption that the dust concentration is 1 mg/m^3). Further, as described in Section 7, worker activities both inside and outside the TCS are part of the active facility operations at the TCS. Current use of health and safety protocols, required by PG&E as part of routine work practices inside and outside the TCS, limit worker exposure to soil and dust. The exposure assumptions used for the workers do not account for the protective measures that are part of required work practices, and therefore the exposure assumptions and corresponding risks for the workers, for potential exposure areas located both inside and outside TCS are overestimated.

The specific exposure assumptions for the recreational user were provided by DOI and included in RAWP Addendum 2 (Arcadis 2015). As summarized by DOI, generic, or default, exposure factors are generally not available for recreational land use (except for some specific scenarios, such as fishing and fish ingestion rates). USEPA's 2011 Exposure Factors Handbook Update does not present exposure factors for any recreational scenarios other than fishermen (USEPA 2011). Rather, informed professional judgment is necessary to select factors that best represent the types of recreational activities that may be conducted at the site of interest.

Recreational use of federal land at the site is expected to vary during the course of a year due to a variety of factors, including weather (especially hot, cold, or rainy periods), seasonality of hunting, and time of year. In general, recreational activities at the site are expected to be limited in frequency and duration during the hottest summer months. Hunting would only occur during those months that are legally permitted; the exposure potential could vary based on game species being hunted. The exposure frequency (EF) is expected to be limited to a few weeks for the species of interest (e.g., game birds). The exposure parameters recommended by DOI and used in the HHRA for recreational users are based on site-specific considerations and information provided from nearby sites and relevant sources. The EF parameters have been informed by information presented in State of California's Natural Resources Agency's (CNRA) document "Complete Findings: Survey on Public Opinions and Attitudes on Outdoor Recreation in California" (CNRA 2009). The use rates provided by CNRA are mean values; for risk assessment purposes, an upper bound measure of exposure (e.g., the 95% upper confidence limit on the mean) is generally preferred. To be protective of human health, it is assumed herein that a participant's entire annual recreational activity is conducted at the Topock site rather than spread out at various recreational locations across the state. Exposure duration values (ED, in years) are consistent with those used in the Clear Creek Management Area HHRA (USEPA 2008a) for similar activities. The exposure time, frequency, and duration for the recreational user provided by DOI and used in the HHRA erred on the side of conservatism to be protective of human health and may not represent "reasonably anticipated use" of the site. Therefore, the health risks estimated for recreational users may be overestimated and lower than presented in the HHRA.

In addition, as recommended by DOI (Arcadis 2015), it is assumed that each of the recreational activities could take place at any location on federal land. In reality, specific locations may be preferred for certain activities, while other locations may be less attractive or may have limited recreational options. No physical barrier (such as fencing) is present that would stop an individual recreational user from accessing any and all areas of the AOCs outside the TCS. Therefore, potential receptor populations would more likely be exposed randomly, over the course of a lifetime, to soils present across the OCS potential exposure area, rather than have a lifetime of contact limited to a potential exposure area based on an individual AOC(as evaluated in the area-specific appendices at the request of DTSC).

In sum, the risk assessment meets the regulatory requirement to address an upper bound for potential exposures for current and reasonably foreseeable future receptor populations; the actual exposures to soil at the site that could be incurred by workers, recreators, and tribal use would probably be much lower than has been estimated in this HHRA.

5.6.3.3 Bioavailability of Constituents in Soil

Exposure estimates calculated herein assume that measured concentrations of COPCs/COPECs in soil are 100% bioavailable. For many COPCs/COPECs, this assumption overestimates exposure. The chemical extraction methods used to measure COPC/COPEC concentrations in soil result in complete or nearly complete extraction of bound and insoluble COPC/COPEC fractions in soil, whereas chemical extraction in the gut of ecological and human receptors can be far less efficient. Uncertainties associated with bioavailability of COPECs in soil for ecological receptors are discussed in detail in Section 6.5.3.1.

Studies support that certain organic compounds, particularly highly lipophilic compounds such as PAHs, tend to be tightly bound to soil (Kelsey et al. 1997). This phenomenon can substantially reduce the bioavailability of chemicals to people exposed to chemicals in soil. A reduction in the bioavailability of the chemicals adsorbed to soil would reduce the projected health risk associated with exposure to soil. Low bioavailability could substantially reduce estimated risks below levels calculated using the default assumption that all chemicals are 100% bioavailable.

5.6.3.4 Soil Exposure Point Concentrations

Field duplicate samples were collected from select soil sample locations throughout the site. The use of the maximum detected concentration as representative of a data pair (when data from field duplicate samples are available) is conservative and may result in overestimation of the EPC. This conservative approach is preferred in risk assessment to set an upper bound on the uncertainty in the sample concentration where there is variability in the analysis. Although the approach is conservative, it is not unreasonable and is consistent with United States Environmental Protection Agency (USEPA) recommendations as described in the RAWP Addendum 2 (Arcadis 2015). Therefore, as directed by DTSC and DOI, PG&E managed field duplicate data in accordance with the stated approach set forth in Section 3.2.8 of the RAWP (Arcadis 2008).

Field duplicates were collected at approximately 9% frequency. For the risk driver, chromium-6, there are 194 pairs of primary and duplicates results; chromium-6 was detected in 143 of these samples with 22 chromium-6 detections above 3 mg/kg, of which 20 chromium-6 detections are paired primary and duplicate results. The relative percent difference (RPD) for a limited number of chromium-6 pair results (i.e., 10 pair results) were above 20%. Given the limited number of chromium-6 pair results with RPD above 20%, and the low levels of chromium-6 detected in a majority of the pair results, the use of the maximum detected concentration as representative of a data pair would likely not result in a significant overestimation of the EPC for chromium-6. For TEQ, there are 44 pairs of primary and duplicates results; 16 TEQ total results were above 100 ng/kg, of which 14 TEQ total results are paired primary and duplicate results. Given the low levels of TEQ total results in a majority of the pair results, the use of the maximum detected concentration as representative of a data pair would likely not result in a significant overestimation of the EPC for TEQ total results.

Before calculating soil EPCs, samples from each unique location in the HHERA datasets (as described in Section 3.3) were combined into a single depth-weighted value. The rationale for depth-weighting and methodology used to implement this approach were presented in the RAWP Addendum 2 (Arcadis 2015) and are summarized in Section 4.2.1. Before calculating EPCs, the soil datasets were depth-weighted to account for unequal sampling at each location. In the depth-weighting procedure, ND values were replaced with ½ RLs. When ND results are evaluated at ½ the RL, the resulting EPCs are unlikely to be underestimated but may be overestimated, especially for COPCs with elevated RLs. Accordingly, for those constituents that are included in the quantitative risk assessment, it may be concluded that the impact of elevated RLs is to potentially increase the representative EPC; thereby, potentially overestimating the risk and noncancer hazard associated with the presence of the chemical. Uncertainty in the EPC calculation is higher for COPCs with a low FOD. As discussed in detail in Section 3.2.3.1.2, COPCs detected at the site with both a low FOD and elevated RLs include antimony, cadmium, mercury, and selenium. Sample data were evaluated to assess the potential significance of including results with elevated RLs in the risk assessment by comparing RLs for each ND soil sample to applicable risk-based screening levels (Table 3-4). The maximum RLs for these COPCs do not exceed the risk-based screening levels for human exposure, indicating that risks to potential human receptors can be adequately evaluated using the existing data that includes elevated RLs.

Similarly, there is uncertainty in the exposure estimates due to the use of ½-RL in the depth-weighted procedure. The magnitude of this uncertainty is relatively small, as most EPCs are the same or differ by a factor of two or less. For example, depth-weighted EPCs for the BCW exposure area (0 to 10 feet bgs interval; Appendix BCW Table BCW-3.1) were recalculated using the full RL in the depth-weighting procedure. For most COPCs, the same UCL method was recommended by ProUCL and the resulting EPCs (using full RL) were less than 20 percent greater than estimated using ½-RL in the depth-weighting procedure. For those COPCs with FOD at or near 100 percent, the resulting EPCs using full RLs are the same as using ½-RLs because there are few or no non-detect values in the dataset. Similarly, for those COPCs with fewer than 4 detected concentrations, the resulting EPCs using full RLs are the same as using ½-RLs because the EPC is based on the maximum detected concentration. The remaining COPCs with EPCs that differed by more than 20% included only antimony (73% or 1.73 times greater), mercury (82% or 1.82 times greater), bis (2-ethylhexyl) phthalate (61% or 1.61 times greater), two individual PAHs (anthracene [78% or 1.78 times greater] and naphthalene [90% or 1.9 times greater]), and TPHd (31% or 1.31 times greater). For these COPCs (except for mercury), use of the full RL in the depth-weighting procedure resulted in the selection of the same UCL method when ½-RL were used, and therefore the resulting difference in EPCs can be attributed to the use of the full RL value. For antimony, mercury, bis (2-ethylhexyl) phthalate, anthracene, naphthalene, and TPHd, which contribute less than 1% to the cumulative estimated ILCRs and HIs for all potential exposed human receptors evaluated in the HHRA, use of the full RL would not result in significant changes to the cumulative estimated ILCRs and HIs and, therefore, would not result in changes to the HHRA conclusions.

As noted in the preceding paragraph, use of the full RL in the depth-weighting procedure resulted in the selection of the same UCL method when ½-RL were used. However, in a small number of cases, a different UCL method was recommended by ProUCL when the full RL was used. For the example BCW 0-10 feet bgs dataset, this occurred for arsenic and mercury. For arsenic, use of the full RL results in an arsenic 95UCL of 3.63 mg/kg based on the ProUCL-recommended method (95% KM (BCA) UCL), whereas use of ½-RL yields a 95UCL of 4.04 mg/kg based on the ProUCL-recommended method (95% KM Chebyshev UCL). Arsenic was the only case in the example dataset for which the full RL produced a lower EPC than calculated using ½RL.

For shallower depth intervals (e.g., 0 to 3 feet bgs), the effect of using the full RL is similar to using ½-RLs in that it produces higher EPCs for those COPCs with relatively low FOD. For the 0 to 3 feet bgs BCW dataset, the only COPCs with EPCs that differed by more than 20% included mercury (84% or 1.84 times greater) and TPHd (59% or 1.59 times greater). EPCs for antimony and bis (2-ethylhexyl) phthalate are based on the maximum detected concentration due to fewer than 4 detected concentrations for this depth interval. For mercury, and TPHd, which contribute less than 1% to the cumulative estimated ILCRs and HIs for all potential exposed human receptors evaluated in the HHRA for the shallower depth intervals, use of the full RL would not result in significant changes to the cumulative estimated ILCRs and HIs and, therefore, would not result in changes to the HHRA conclusions.

Overall, the use of ½-RL in the depth-weighting procedure has a minimal effect on the potential health risk estimates and does not impact the health risk conclusions for human receptors potentially exposed to soil at the site.

The area-weighted EPCs were based on Thiessen polygons to assign a proportional contribution for each sample to the total area of the exposure unit and the bias-corrected, accelerated (BCa) bootstrap to estimate the 95UCL on the mean of those area weights and associated concentrations for the dataset. Thiessen polygons remove bias associated with oversampling in areas of higher concentration. It does not exploit autocorrelation that might be associated with the data but is an objective technique that makes no assumptions regarding the spatial arrangement and spatial correlation of the data, and as such, should not have inherent biases. The BCa bootstrap is a nonparametric method that has theoretical advantages over other bootstraps, in particular with regards to the accuracy of its confidence intervals (Efron and Tibshirani 1993). It is also a recommended method in ProUCL (USEPA 2015a). Use of the BCa bootstrap is expected to reduce uncertainty in the EPC estimates relative to many other UCL methods available.

For some datasets, the area-weighted EPC was greater than the depth-weighted EPC. ProUCL is routinely assumed to return correct calculations and recommendations for all datasets. For both depth- and area-weighted EPCs, the R bootstrap was proofed by numerical example against ProUCL and hand calculations. Therefore, a flaw in the area-weighted EPC calculations is not suspected. Rather, the cases where area-weighted EPCs were greater than the depth-weighted EPCs may have occurred because particular samples with higher concentration values were associated with larger area-weights (i.e., in areas that were more sparsely sampled). Furthermore, in most of the cases where the area-weighted EPC is greater, Land's H-statistic was recommended by ProUCL for estimating the 95UCL (used in the depth-weighted EPCs). As noted in the ProUCL Technical Guidance (USEPA 2015a), Land's H-statistic can be unreliable and, consequently, the (lower) depth-weighted EPC may be suspect.

For soil datasets that consisted of fewer than four detected values (i.e., concentrations reported above the detection limit) or fewer than eight total observations, the EPC defaulted to the maximum depth-weighted concentration in that dataset. The use of the maximum detected soil concentration as the EPC may not appropriately represent exposures and resulting risks and/or hazards. This approach to estimating EPCs does not materially impact the results of the HHRA because the BCW potential exposure area COPCs with low frequency of detection and/or fewer than eight observations are not risk drivers at the site.

In some cases, a sample location was included in the evaluation of more than one AOC-based exposure area. For example, AOC4-GB10, AOC4-GB11, AOC4-GB12 were evaluated as part of BCW and also as part of AOC 4. The number of sample locations evaluated in more than one potential exposure area is small relative to the risk assessment datasets and elevated COPC/COPEC concentrations are not present at these locations. As a result, the effect on the calculated EPCs and resulting risk estimates is expected to be negligible.

5.6.3.5 Fate and Transport Modeling (Soil to Outdoor Air)

The transport of volatile COPCs from soil to outdoor air is modeled as two distinct processes: the volatilization of chemicals from soil to the ground surface and the dispersion of the chemicals from the ground surface into the ambient air using the approach recommended in the USEPA Soil Screening Guidance (USEPA 1996a, b). These two processes are accounted for in the development of volatilization factors (VF) as described in Appendix AM.

The VF equations are sensitive to the soil property inputs. No site-specific soil property values were available to use in the VF equations to estimate potential outdoor vapor concentrations and corresponding risks. Instead, conservative DTSC default soil property values (DTSC 2018b) were used as soil input parameters. These conservative assumptions incorporated into the VF equations could result in an overestimate of ECs and actual long-term exposures to volatile COPCs that may occur at the site. The conservative default soil properties used as inputs to the equations are presented in Table AM-2 of Appendix AM.

The modeling is based on the assumption that the source of contamination is infinite. The actual source of contamination is likely finite and will deplete over time, as volatile chemicals migrate upward through the soil column. This depletion can be further accelerated by biodegradation. Thus, the actual long-term exposures to VOCs in outdoor air that may occur at the site are likely significantly lower than assumed in the calculation of current and future potential health risks, especially if biodegradation is occurring. As VOCs were so infrequently detected at the site, either inside or outside the TCS, the potential overestimate of VOC exposures does not materially impact the estimation of cancer risk or noncancer hazard.

For all COPCs, concentrations of COPCs in airborne particulates are estimated using DTSC and DOI-recommended particulate emission factors (PEFs), as discussed in 5.3.3.6.1. Maintenance workers are assumed to be exposed to higher levels of dust during the limited subsurface digging/repair activities than dust levels simply from wind-blown erosion for the entire workday. It is unlikely that the maintenance worker would be exposed to the average 8-hour respirable dust level equal to the respirable dust level of 1 mg/m^3, as recommended by DTSC (2014c) for the entire time a maintenance worker is involved in dust-moving activities. Thus, the actual long-term exposures to COPCs in airborne particulates that may occur at the site for the maintenance worker are likely significantly lower than assumed in the calculation of current and future potential health risks.

5.6.4 Uncertainties in the Toxicity Assessment

Uncertainty in the toxicity assessment arises for those chemicals which rely on animal studies as the basis for determining the appropriate toxicity value. All risk assessments assume that adverse effects observed in animal toxicity experiments would also be observed in humans (animal-to-human extrapolation), and that the toxic effect observed after exposure by one route would occur following exposure by a different route (route-to-route extrapolation).

To adjust for uncertainties that arise from the use of animal data, regulatory agencies often base the RfD for noncarcinogenic effects on the most sensitive animal species (i.e., the species that experiences adverse effects at the lowest dose) and adjust the dose via the use of safety or uncertainty factors. The adjustment compensates for the lack of knowledge regarding interspecies extrapolation and possibility that humans are more sensitive than the most sensitive experimental animal species tested. The use of uncertainty factors is considered to be health protective.

Second, when route-specific toxicity data are unavailable, data are often derived by route-to-route extrapolation, and equal absorption rates for both routes are assumed (i.e., oral to inhalation and inhalation to oral). This may or may not reflect the actual differences in toxicity that can be associated with the route of exposure but is considered to be a conservative and health-protective assumption. For dermal exposure to soil, chemical-specific absorption data generally are not available. Instead, dermal absorption rates, which are based on the default assumptions provided by the DTSC (2015b), are assumed.

5.6.5 Uncertainties in the Risk Characterization

One source of uncertainty that is unique to risk characterization is the assumption that the total risk associated with exposure to multiple chemicals is equal to the sum of the individual risks for each chemical (i.e., the risks are additive). Other possible interactions include synergism, where the total risk is higher than the sum of the individual risks, and antagonism, where the total risk is lower than the sum of the individual risks. Relatively little data are available regarding potential chemical interactions following environmental exposure to chemical mixtures. Some studies have been carried out in rodents given simultaneous doses of multiple chemicals. The results of these studies indicated that no interactive effects were observed for mixtures of chemicals affecting different target organs (i.e., each chemical acted independently), whereas antagonism was observed for mixtures of chemicals affecting the same target organ, but by different mechanisms (Presidential/Congressional Commission on Risk Assessment and Risk Management [Risk Commission] 1997).

While there are no data on chemical interactions in humans to chemical mixtures at the dose levels typically observed in environmental exposures, animal studies suggest that synergistic effects will not occur at levels of exposure below their individual effect levels (Seed et al. 1995). As exposure levels approach the individual effect levels, a variety of interactions may occur, including those that are additive, synergistic and antagonistic (Seed et al. 1995).

Current USEPA guidance for risk assessment of chemical mixtures (USEPA 1989) recommends assuming an additive effect following exposure to multiple chemicals. Subsequent recommendations by other parties, such as the National Research Council (1988) and the Risk Commission (1997) have also advocated a default assumption of additivity. As currently practiced, risk assessments of chemical mixtures generally sum cancer risks regardless of tumor type, and sum noncancer HIs regardless of toxic endpoint or mode of action. Given the available experimental data, this approach likely overestimates potential risks associated with simultaneous exposure to multiple chemicals.

6 ECOLOGICAL RISK ASSESSMENT FOR SOIL

This section describes the ERA for the site and includes the purpose and objectives, applicable guidance, the approach used to estimate risks to ecological receptors, and the ecological risk characterization.

DTSC (1996b) guidance recommends conducting a scoping assessment to evaluate the need for more refined ecological risk evaluations. The elements of a scoping assessment were completed in accordance with state guidance for ERAs (DTSC 1996b). Results of the scoping assessment were presented in the RAWP (Arcadis 2008a), the RAWP Addendum (Arcadis 2009a), the RAWP Addendum 2 (Arcadis 2015), and supporting technical memoranda (Arcadis BBL 2007a, b; Arcadis 2008b, 2009b). Elements of the completed scoping assessment included identification of preliminary COPECs, development of a preliminary CSM, identification of potential terrestrial ecological receptors, and a preliminary exposure pathway analysis for the upland/terrestrial areas. Based on the findings of the scoping assessment, a Phase I Predictive ERA was considered necessary for the site and is presented in the following sections of this document.

The Phase I Predictive ERA consists of:

- Problem formulation
- Exposure assessment
- Effects assessment
- Risk characterization
- Uncertainty analysis.

A preliminary problem formulation and assessment and measurement endpoints have already been developed and documented (Arcadis BBL 2007a). Elements of the exposure assessment, as well as the effects assessment, have already been completed and documented (CH2M 2007a, Arcadis BBL 2007b), and exposure, effects assumptions for preliminary COPECs, and risk characterization methodology were selected and described in detail in the approved RAWP (Arcadis 2008a, 2009a, 2015). These assumptions, input values, and risk characterization methodology are summarized in the following sections; more details are presented in the RAWP documents (Arcadis 2008a, 2009a, 2015). In cases where new or revised assumptions or methodology were included (e.g., derivation of avian toxicity reference values [TRVs] for hexavalent chromium), a greater level of detail is provided in the text.

ERAs were completed for 17 potential ecological exposure areas identified for the site (Section 3.3.3). Potential exposure areas evaluated for ecological communities and small home-range receptors are presented on Figure 3-3. Potential exposure areas evaluated for large home-range receptors are presented on Figure 3-4b. These areas include:

- Potential terrestrial exposure (soil) for plants, soil invertebrates, and small home-range wildlife receptors:
  - BCW
  - SWMU 1

  - BCW excluding SWMU1
  - AOC4
  - AOC9
  - AOC10
  - AOC11
  - AOC12
  - AOC14
  - AOC27
  - AOC28
  - AOC31
  - UA-2
  - Tamarisk Thicket.
- Potential terrestrial exposures (soil) for large home-range wildlife receptors:
  - OCS
  - BCW and AOC4
  - OCS excluding BCW and AOC4.

The overall goal of the ERA for soil is to identify potential adverse effects of COPECs in soil that could result in adverse effects to potential ecological receptors and to use the results of the ERA to provide a basis for developing site management options. The specific purpose and objectives of the ERA for soil are described in Section 6.1.

6.1 Purpose and Objectives

The purpose of the ERA is to predict the potential for adverse effects of COPECs to potential ecological receptors and the objectives are to:

- Inform the RCRA corrective action and CERCLA remedy process by providing risk managers with risk characterization results for COPECs detected during the RFI/RI and related investigations
- Provide transparent estimates of potential site-related risks to potential ecological receptors
- Provide spatial context for the risk estimates
- Convey the magnitude and direction of uncertainty associated with the risk estimates
- Provide information that can be used to develop protective concentrations of site-related constituents in soil for “risk drivers.”

The findings and conclusions of the ERA will be used in the risk management decisions for the site including the CMS/FS portion of the environmental program to develop and evaluate remedial alternatives protective of potential ecological receptors. Ultimately, the conclusions reached from conducting the ERA along with other site information will be used to establish an overall site risk management strategy. These objectives are consistent with the USEPA's defined functions of an ERA (USEPA 1997a).

6.2 Applicable Guidance

The ERA is consistent with the approved RAWP documents (Arcadis 2008a, 2009a, 2015) following several regulatory guidance including:

- Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Parts A and B (DTSC 1996b)
- HERD Ecological Risk Assessment Note (EcoNote) 1, Depth of Soil Samples for Exposure of Burrowing Animals (DTSC 1998)
- HERD EcoNote 2, Calculation of Range of Intakes for Vertebrate Receptors (DTSC 1999)
- HERD EcoNote 4, Use of Navy/USEPA Region 9 Biological Technical Assistance Group (BTAG) TRVs for Ecological Risk Assessment (DTSC 2000)
- HERD EcoNote 5, Revised USEPA Region 9 BTAG TRV for Lead: Justification and Rationale (DTSC 2002a)
- Currently Recommended USEPA Region 9 BTAG Mammalian and Avian TRVs (DTSC 2002b)
- Currently Recommended USEPA Region 9 BTAG Avian TRVs (DTSC 2009e)
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997a)
- Guidelines for Ecological Risk Assessment (USEPA 1998)
- Guidance for Developing Ecological Soil Screening Levels (EcoSSLs) (USEPA 2007a)
- ECO Update Bulletin Series (USEPA various dates)
- Generic Ecological Assessment Endpoints (GEAE) for Ecological Risk Assessment (USEPA 2003c).

6.3 Problem Formulation

The problem formulation includes identifying societal or regulatory goals and assessment endpoints, preparing a CSM, and developing an analysis plan using available and relevant site data. The problem formulation consists of the ecological setting (described in Section 2.4), the CSM (discussed in Sections 2.5 and 6.3.2 and depicted on Figure 2-7) and the selection of assessment and measurement endpoints (Section 6.3.3). The analysis plan relies on chemical and spatial data collected during the site investigations and is discussed in Section 6.4.

Constituent discharges to areas near the TCS (most notably, but not exclusively, wastewater containing hexavalent chromium) as well as dioxins/furans from historical industrial activities and other sources unrelated to TCS activities (i.e., unauthorized dumping and burning; regional wildfires; combustion of diesel and leaded gas; and exhaust from cars, trucks, and trains) (CH2M 2017a), could result in potential risk to ecological receptors; however, the potential risks are undefined. The complete and significant potential terrestrial exposure pathways identified in the preliminary CSM (Arcadis 2008a) included direct contact or incidental ingestion of surface soil, shallow soil, or subsurface soil, and uptake and subsequent ingestion of constituents in biota. The CSM was finalized after implementation of the Final Soil RFI/RI Work Plan (CH2M 2013) is discussed in Section 6.3.11.

The surface soil transport pathway analyses, as described in Section 2.5, concluded potentially complete but insignificant transport pathways for surface soil entrained in runoff to reach the sediment areas near the river downgradient of BCW and AOC10 and therefore, quantitative evaluation of these sediment areas was not required.

6.3.1 Conceptual Site Model

The CSM is the basis for the Phase I Predictive ERA and summarizes the results of the scoping assessment. The CSM is the framework for relating potential receptors to chemically affected media and evaluating the degree of completion of potential exposure pathways. CSM development is an iterative process, using information from each phase of investigation to further refine the CSM. The components of a CSM include potential sources, release mechanisms, and retention and transport media; these constitute the fate and transport portions of the CSM and apply to both the HHRA and ERA as described in Section 2.5. The CSM also includes potential exposure routes and receptors, which are discussed in Sections 6.4.1.1 and 6.4.1.2, respectively for the ERA.

Figure 2-7 presents the ecological CSM, and shows the relationship between the constituent sources, potential exposure pathways, and potential receptors at the site. Only the complete and significant potential source-pathway-receptor relationships are evaluated quantitatively in the ERA. The CSM was originally prepared in the RAWP (Arcadis 2008a) and was updated and refined in the RAWP Addendum 2 (Arcadis 2015).

In the technical memorandum that presents the preliminary CSM (Arcadis BBL 2007a), BCW was evaluated separately from the rest of the AOCs outside the compressor station. However, based on further understanding of the potential exposure areas and the ecological receptors that potentially occupy the site, for large home-range receptors, the BCW was combined with AOC4 and evaluated as one potential exposure area (BCW+AOC4) as described earlier in Section 3.3. BCW and AOC4 are near each other, are physically and topographically separated from the other AOCs, and populations of wildlife receptors foraging in the BCW and AOC4 are assumed to be different from the wildlife populations foraging in the rest of the AOCs outside the TCS (evaluated as the OCS and OCSxBCW+AOC4 exposure areas). For small home-range receptors, as requested by DTSC and DOI, smaller potential exposure areas based on individual AOCs/investigation areas outside the compressor station, as described previously, were evaluated. The area within the fenceline is considered the active industrial portion of the Topock site and is not considered a viable habitat at this time. No potential ecological exposures are anticipated inside the fenceline of the compressor station (Eichelberger 2006) and, therefore, an ERA was not conducted for the ICS potential exposure area. Similarly, an ERA was not conducted for the NORR potential exposure area, as ecological receptors do not distinguish between BLM land and FMIT land in the northern part of BCW.

As shown on Figure 2-7, the primary potential terrestrial exposure pathways for soil are direct contact or incidental ingestion of surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs), and uptake and subsequent ingestion of constituents in biota. [Note: Subsurface soil exposure intervals are defined as subsurface 1 soil (0 to 6 feet bgs) and subsurface 2 soil (0 to 10 feet bgs). Subsurface soil 2 is considered in the human health risk assessment only.] Potential receptors evaluated include plants, terrestrial invertebrates, birds, and mammals. Reptiles, while common in the Mojave Desert, were not evaluated quantitatively in the ERA because methods to evaluate exposure to these receptors are generally unavailable. Further, as USEPA noted in the EcoSSL guidance (USEPA 2007a), toxicity data for amphibians and reptiles are insufficient to support establishing risk-based thresholds. However, as a range of risks were evaluated for other potential ecological receptors, it was assumed that conservative assumptions used in the evaluation of risks for other species will be protective of these receptors and managing risks for other COPECs will likely manage risks for reptiles as well. Reptiles are addressed qualitatively in the uncertainty analysis.

The CSM for this ERA (Figure 2-7) was updated from the CSM presented in the RAWP documents (Figure 6-1 of RAWP; Arcadis 2008a, 2015) to illustrate that the transport pathway to the sediment areas along the Colorado River downgradient of BCW and AOC10 as potentially complete but insignificant. This transport pathway is evaluated in the surface soil transport pathway analyses for the BCW and AOC10 potential exposure areas (Section 2.5 and Appendix SSTPA).

6.3.1.1 Potential Exposure Pathways

A complete potential exposure pathway consists of the elements described above: sources and release mechanisms, retention and transport media, exposure points, and exposure routes (USEPA 1989). The site history, potential constituent sources, and transport mechanisms are described in Section 2.5. The potential ecological exposure pathways are illustrated on Figure 2-7 and are similar for all potential soil exposure areas evaluated in this ERA (presented in Section 3.3). Exposure pathways can be characterized as incomplete, complete, or potentially complete. If any of the elements listed above is missing, the pathway is considered incomplete. According to USEPA (1992, 1997a), only complete or potentially complete exposure pathways need to be evaluated quantitatively. Exposure for each complete or potentially complete pathway is considered significant or insignificant. An exposure pathway may be considered insignificant if: (1) the level of exposure to contaminants through this pathway is sufficiently low; (2) the frequency of exposure to contaminants through this pathway is low; or (3) the contribution of this pathway to the overall risk is insignificant as compared to other risk-driving pathways.

All complete exposure pathways were evaluated in this ERA. Of those, pathways considered complete and significant were quantitatively evaluated and pathways that are considered less significant were qualitatively evaluated.

The following potential exposure pathways were identified as complete and significant and thus were quantitatively evaluated for the following potential terrestrial ecological receptors: (1) direct contact/uptake by plants and soil invertebrates; (2) incidental ingestion of soil by wildlife (mammals and birds); and (3) ingestion of terrestrial biota tissue by wildlife. These potential exposure pathways are presented on Figure 2-7.

The exposure depths were selected consistent with guidance provided by DTSC (1998), based on review of the soil data presented in the RFI/RI Soil Investigation Work Plan Part A (CH2M 2006a), and in coordination with the regulatory agencies (Arcadis 2008a). The maximum detected concentrations of COPECs were found in the upper 6 feet of soil in the investigation areas, and elevated concentrations relative to background are also typically found in this depth interval. DTSC guidance indicates that characterization of soil to 6 feet bgs is sufficient for the majority of ecological receptors (DTSC 1998). The exposure depths identified in the RAWP (Arcadis 2008a) for the ERA included: surface soil (defined as 0 to 0.5 foot bgs), shallow soil (defined as 0 to 3 feet bgs), and subsurface soil (defined as 0 to 6 feet bgs). The soil depths relevant for each ecological receptor are presented on Figure 6-1. Potential exposures to most ecological receptors, including such as soil invertebrates, birds, and non-burrowing mammals generally occur at the surface (0 to 0.5 foot bgs). Plant roots were assumed to reach depths of 6 feet bgs, and burrowing mammals can burrow to depths of 6 feet bgs (DTSC 1998).

Terrestrial wildlife receptor exposure to site COPECs is primarily via ingestion of biota tissue (plants and prey items) and incidental soil ingestion during foraging activities. Ingestion of biota tissue generally occurs at the surface, and prey items (e.g., invertebrates/insects/small mammals) reside and take up constituents from surface soil. Therefore, surface soil was used in estimating uptake into invertebrate and small mammal biota tissue. For plant tissue consumed by herbivorous receptors, plant uptake from soil up to 6 feet bgs (i.e., the maximum of the 0- to 0.5-foot, 0- to 3-foot, and 0- to 6-foot bgs intervals) was evaluated, assuming some deep-rooted plant species are exposed to subsurface soil.

Incidental soil ingestion by wildlife is largely associated with foraging for prey items, although some soil ingestion may occur during grooming/preening that could include soil from deeper burrows. For the burrowing receptors likely to be onsite, a maximum depth of 6 feet bgs is considered sufficient to capture the range of burrow depths of the majority of small mammals present onsite.

Inhalation of VOCs in ambient and burrow air were considered potentially complete but insignificant exposure pathways. VOCs were infrequently detected outside the TCS and measured concentrations in soil, when detected, were low. Ecological receptors are not present inside the TCS fenceline (ICS potential exposure area) where soil gas data were collected. Inhalation of particulates (generated by wind dispersion), by ecological receptors is also a potentially complete but insignificant pathway, contributing less than 1% of the ingestion pathway dose (USEPA 2007a) and was not evaluated.

6.3.1.2 Representative Potential Receptors

Representative potential receptors were identified in the RAWP documents (Arcadis 2008a, 2009a, 2015) for the terrestrial areas outside the compressor station based on habitat characteristics and available literature as summarized in this section.

The upland/terrestrial animal and plant species, based on habitat type (i.e., Mojave Desert scrub) and the location of the site, and the species present or potentially present near the site are identified in Section 2.4. Because evaluating potential risk to each species is not feasible, general classes of ecological receptors (i.e., plants and soil invertebrates) or indicator species representing general functional groups that may be exposed to terrestrial habitat at the site are needed to represent potential ecological receptors for the site. Indicator receptors were selected from the list of species potentially present at the site. These receptors were selected to represent a cross-section of feeding guilds for each assessment endpoint so that sufficient rates of survival, growth, and reproduction for their representative populations could be evaluated.

The indicator receptors were also selected based on species characteristics (e.g., small body size, high food intake rates, small home range, and diet consisting of a single food item) likely to produce risk estimates that are protective of other members of the functional group, Additionally, the following criteria were considered in selecting potential indicator species for the site (USEPA 1997a):

- Species has been observed at the site
- Upper trophic-level predator
- Important prey species
- Important to structure or function of the ecosystem
- Potential for exposure to constituents
- Susceptible to bioaccumulation of constituents
- Toxicological literature available
- Likely to exhibit toxic effects
- Species of special conservation concern or similar species.

The indicator receptors chosen are those identified in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015) and include the following:

- Terrestrial plants
- Soil invertebrates
- Granivorous bird: Gambel’s quail (*Callipepla gambelii*)
- Insectivorous bird: cactus wren (*Campylorhynchus brunneicapillus*)
- Carnivorous bird: red-tailed hawk (*Buteo jamaicensis*)
- Insectivorous mammal: desert shrew (*Notiosorex crawfordi*)
- Carnivorous mammal: desert kit fox (*Vulpes macrotis*)
- Granivorous mammal: Merriam’s kangaroo rat (*Dipodomys merriami*)
- Herbivorous mammal: Nelson’s desert bighorn sheep (*Ovis canadensis nelsoni*).

Each of the selected indicator species was identified by the biological assessment (see Section 2.4) as being potentially present at or near the site and within the Action Area. The receptors were selected to represent avian and mammalian populations that potentially reside or forage in the upland/terrestrial areas near the TCS.

As discussed in the PBA (CH2M 2007b, 2014a) and in the reinitiation requests for the PBAs (USFWS 2018a, b), and other reports (DTSC 2018a, CH2M 2015b), several special-status species were observed onsite including California fully protected species: the ring-tailed cat. The Tamarisk Thicket potential exposure area, located on the northern end of BCW, is considered potential habitat for the southwestern willow flycatcher (although last observed in 2009 and the single detection is considered transient and not resident [GANDA 2017]). No federal- or state-listed T&E plants or candidates for listing were found at the Topock site. Although there is potential habitat for other special-status species near the site, none have been observed at the site based on the multi-year protocol level surveys conducted to date (CH2M

2017a, DTSC 2018a). Special-status species were only qualitatively evaluated. Because conservative assumptions are used in the risk characterization of indicator receptors, the risk conclusions are believed to be protective of special-status species as well.

Additional details regarding the selection and characteristics of indicator receptors evaluated in the ERA are presented in the RAWP documents (Arcadis 2008a, 2009a, 2015).

6.3.2 Assessment and Measurement Endpoints

An assessment endpoint is an explicit expression of the environmental value (species, ecological resource, or habitat type) that is to be protected (USEPA 1997a). Assessment endpoints relate to statutory mandates (protection of the environment) but must be specific enough to guide the development of the risk assessment study design at a particular site (USEPA 1997a, 1998). Selecting appropriate assessment endpoints is an important step in developing an ERA that is useful to risk managers in the decision-making process (USEPA 2003c). Useful assessment endpoints define both the valued ecological resource (i.e., ecological entity) and a characteristic of the resource to protect (i.e., attributes) (USEPA 1997a, 1998, 2003c). Assessment and measurement endpoints for each indicator receptor, as selected in the RAWP documents (Arcadis 2008a, 2009a, 2015), are presented in Table 6-1. Assessment endpoints for ERAs were selected based on the ecosystems, communities, and species potentially present at the site and depend on:

- Constituents present and their concentrations
- Mechanisms of toxicity of the constituents to different groups of organisms
- Ecologically relevant receptor groups that are potentially sensitive or highly exposed to the constituents
- Potentially complete exposure pathways.

In accordance with the USEPA (1997a) guidance, the following assessment endpoints were developed to identify the ecological values at the project site:

- Sufficient rates of survival, growth, and reproduction to sustain terrestrial plant populations
- Sufficient rates of survival, growth, and reproduction to sustain soil invertebrate populations
- Sufficient rates of survival, growth, and reproduction to sustain avian populations
- Sufficient rates of survival, growth, and reproduction to sustain mammalian populations.

In addition to the above assessment endpoints, sufficient rates of survival, growth, and reproduction to sustain reptile populations were identified as an important environmental value. However, as noted above, reptiles were not quantitatively evaluated in the ERA due to a lack of available exposure and toxicity data for these receptors.

Generally, assessment endpoints cannot be directly measured; rather, a measurement endpoint related to the assessment endpoint is evaluated. Measurement endpoints are measurable ecological characteristics that are related to the valued characteristic chosen as the assessment endpoint (USEPA 1997a). The selected measurement endpoints for each assessment endpoint are provided in Table 6-1. Measurement endpoints to evaluate protection of ecological communities (i.e., terrestrial plants and soil invertebrates) are a comparison of constituent concentrations in soil to risk-based screening values. Measurement endpoints to evaluate protection of terrestrial avian and mammalian wildlife receptors are a comparison of estimated exposure doses with dietary dose-based no-effects and low-effects based TRVs.

Measurement endpoints such as estimates of HQs only account for a single line of evidence (LOE). A WOE approach using multiple LOEs provide a more robust approach for interpreting the risk results and evaluating assessment endpoints. LOEs could include but are not limited to the following: supporting statistical and site use information (e.g., frequency of detection [FOD]), basis of the exposure concentrations (maximum vs 95UCL), confidence in the toxicity values, the direction of uncertainty in the risk estimates, consideration of special-status species at the site, and spatial extent of elevated concentrations.

6.3.3 Constituents of Potential Ecological Concern

COPECs for each exposure area were selected in accordance with the RAWP (Arcadis 2008a) and as described in Section 3.4. The final COPEC selection process was conducted in a step-wise fashion for each potential exposure area, generally consisting of elimination of background-related constituents and elimination of essential nutrients (Section 3.4).

Soil data encompassing all relevant exposure depths for the HHERA (i.e., 0 to 10 feet bgs for the baseline scenario and 0 to 15 feet bgs for the scouring scenarios, as applicable) were used to select COPECs for each potential exposure area. COPECs for each potential exposure area are summarized in Table 3-7; detailed COPEC selection tables are presented in Section 2 of each exposure area-specific appendix.

6.4 Exposure Assessment

The exposure assessment describes the potential or actual contact of receptors with chemicals in site media. The objective of the exposure assessment is to estimate exposure concentrations or doses based on receptor contact with COPECs in the potential exposure area for the complete and significant exposure pathways described in the CSM. Thus, the exposure analysis identifies the assumptions necessary to estimate direct exposure EPCs (i.e., soil concentrations) and EPCs used as the basis for estimating bioaccumulation and subsequent exposure of upper trophic-level receptors (i.e., soil and biota tissue EPCs). These assumptions are described in the following sections.

6.4.1 Exposure Point Concentrations

As described above in Section 4, the EPC is the representative concentration of a constituent in an environmental medium that is potentially contacted by the receptor (USEPA 1997a), and USEPA (1989) defines the EPC as “the arithmetic average of the concentration that is contacted over the exposure period.” The EPC is constituent-specific and is estimated for each individual potential exposure area within the site. The potential exposure areas for ecological communities, small home-range receptors, and large home-range receptors are discussed in Section 3.3. For soil, EPCs were calculated based on depth-weighted data. In most cases, area-weighted data were also used to develop EPCs. The soil EPC calculation methodology is described in detail in Section 4.3. Summary statistics for the depth-weighted datasets used in the ERA and the resulting depth-weighted and area-weighted EPCs are presented in Section 3 of each exposure area-specific appendix.

For LMW PAHs, HMW PAHs, PCBs, and dioxins/furans, concentrations were calculated as totals as described in Section 4.2.1. For dioxin/furans, TEQ concentrations were calculated separately for mammals and birds using the mammalian or avian toxicity equivalency factors (TEFs) from Van den Berg et al. (1998, 2006). TEFs for mammals and birds are discussed in Section 6.5.3.

Biota tissue EPCs were calculated from soil EPCs using soil-to-biota uptake relationships for plants, invertebrates, and small mammals, as described in Section 6.4.3.2. The depth intervals selected to represent exposure to soil and calculate biota tissue EPCs for the risk calculations for each indicator receptor are presented in Section 6.4.2.

6.4.2 Exposure Depths

As described above in the CSM (Section 6.3.1), potential receptor exposure to soil varies by functional group (e.g., habitat requirements, feeding strategies, etc.). To understand the potential implications of depth-weighting soil concentrations over one depth interval versus another, the ERAs evaluated up to three relevant exposure depths for direct contact/incidental ingestion and biota uptake of soil for each receptor in the baseline (no scouring) scenario. In coordination with the regulatory agencies, these exposure depths were selected in the RAWP documents (Arcadis 2008a, 2009a, 2015) and are outlined in this section.

Direct Contact / Incidental Ingestion

- Plants – soil uptake based on the highest EPCs from surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs)
- Soil invertebrates – soil uptake based on surface soil EPCs (0 to 0.5 foot bgs)
- Granivorous, insectivorous, carnivorous birds, and invertivorous small mammals (non-burrowing) – soil EPCs from surface soil (0 to 0.5 foot bgs) for incidental ingestion
- Granivorous and carnivorous mammals (burrowing) – soil EPCs based on the highest EPCs from surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs) for incidental ingestion
- Herbivorous mammals (Nelson's desert bighorn sheep) – although not a burrowing receptor, soil EPCs based on the highest EPCs from surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs) for incidental ingestion were conservatively selected for this special-status receptor.

Biota Uptake

- Plant tissue as food – soil uptake based on the highest EPCs from surface soil (0 to 0.5 foot bgs), shallow soil (0 to 3 feet bgs), and subsurface 1 soil (0 to 6 feet bgs)
- Soil invertebrates tissue as prey – soil uptake based on surface soil (0 to 0.5 foot bgs) EPCs
- Small mammal tissue as prey – soil uptake based on surface soil (0 to 0.5 foot bgs) EPCs.

Figure 6-1 presents a schematic of depth intervals evaluated for each indicator receptor, and Table 6-2 provides selection of the appropriate exposure depth intervals, and selection of the appropriate EPCs.

The exposure depths previously provided presented previously are relevant from the ground surface (i.e., baseline scenario). In addition to the baseline scenario described previously, two scouring scenarios were evaluated to address potential for extensive soil loss via scouring due to surface runoff during high flow events. A 2-foot scouring scenario and a 5-foot scouring scenario were evaluated for the BCW and AOC 10 potential exposure areas, as described in Section 3.3. In the two scouring scenarios, the exposure depths for surface, shallow, and subsurface 1 soil described previously for the baseline (no scouring) scenario are modified, as shown in this table.

Exposure Depths for Baseline, 2-Foot Scouring, and 5-Foot Scouring Scenarios

Baseline Scenario	2-Foot Scouring	5-Foot Scouring
Surface soil (0 to 0.5 foot bgs)	Surface soil (2 to 3 feet bgs)	Surface soil (5 to 6 feet bgs)
Shallow soil (0 to 3 feet bgs)	Shallow soil (2 to 6 feet bgs)	Shallow soil (5 to 10 feet bgs)
Subsurface 1 soil (0 to 6 feet bgs)	Subsurface 1 soil (2 to 10 feet bgs)	Subsurface 1 soil (5 to 15 feet bgs)

Rationale for the selection of the exposure depth intervals for scouring scenarios is presented and discussed in detail in the RAWP Addendum (Arcadis 2009a).

6.4.3 Exposure Concentrations and Exposure Dose Models

For ecological communities (plants and soil invertebrates), although there is more than one potentially complete exposure pathway, route-specific doses are not quantified for these potential receptors. Potential exposures for these receptors are expressed as soil concentrations, for example, in units of milligrams or nanograms per kilogram.

For potential wildlife receptors (mammals and birds), route-specific and food-web or dietary exposure models were used to estimate doses in milligrams per kilogram body weight per day (mg/kg-bw/day). To calculate exposure doses for potential wildlife receptors, soil data and receptor-specific parameters were used in this dose equation:

$$ADDt = ADDf + ADDs \qquad \text{Equation 6-1}$$

Where:

ADDt = total average daily dose in milligrams per kilogram bw per day (mg/kg-bw/day)

ADDf = average daily dose resulting from food (mg/kg-bw/day)

ADDs = average daily dose resulting from soil (mg/kg-bw/day).

Consistent with DTSC guidance (DTSC 1996b), modelled exposure doses were estimated using both the maximum and 95UCL concentrations for each COPEC in soil. In most cases, an area-weighted 95UCL was also used to refine exposure doses. Risks estimated using maximum concentrations are considered overly conservative and generally used for screening level purposes. Use of maximum concentrations is not recommended for use in making risk management decisions, when the areas have been adequately characterized and data are available to estimated UCLs. Therefore, the risk results based on only on maximum depth-weighted EPCs are presented in each exposure area specific appendix but are not discussed in this ERA. The risk results discussed in the ERA are predominately based on the exposure doses calculated using an area-weighted 95UCL when data are sufficient for that calculation.

The ADDt presented in Equation 6-1 is estimated using the following equation and exposure parameters.

$$ADDt\ (mg/kg\text{-}day) = [(EPC_{soil} \times SIR) + (C_{plants} \times FIR \times F_{plants}) + (C_{ins/inv} \times FIR \times F_{ins/inv}) + (C_{mammals} \times FIR \times F_{mammals})] \times SUF \quad \text{Equation 6-2}$$

Where:

ADDt = total average daily dose per day (mg/kg-bw/day)

EPC_{soil} = exposure point concentration in soil in dry weight (mg/kg dw)

EPC_{plants} = exposure point concentration in plants in dry weight (mg/kg dw)

$EPC_{ins/inv}$ = exposure point concentration in insects/invertebrates in dry weight (mg/kg dw)

$EPC_{mammals}$ = exposure point concentration in mammals (mg/kg dw)

F_{plants} = fraction of plants in diet

$F_{ins/inv}$ = fraction of insects/invertebrates in diet

$F_{mammals}$ = fraction of mammals in diet

FIR = food ingestion rate (kg dw/kg-bw/day)

SIR = soil ingestion rate (kg dw/kg-bw/day)

SUF = site use factor (fraction).

6.4.3.1 Exposure Parameters for Indicator Receptors

For dietary dose modeling, species-specific values used for the potential terrestrial receptors were selected in the RAWP (Arcadis 2008a) and are presented in Table 6-3. For Nelson's desert bighorn sheep, exposure assumptions are presented in the RAWP Addendum 2 (Arcadis 2015). The rationale for and selection of indicator species exposure parameters is presented in this section and Table 6-3.

- Body Weight – Body weights for wildlife species were calculated for both juveniles and adults as specified by DTSC (1999). Body weights for male and female (combined) were used if available, consistent with the DTSC guidance (1999).
- Dietary Composition – The composition of the diet was based on information on the feeding habits for each of the species. The diet for each potential receptor was conservatively assumed to consist of 100% of a single food item.
- Ingestion Rate – Total FIRs for wildlife species were calculated as a function of body weight using allometric equations (Nagy 2001). Ingestion rates are presented in terms of kilograms per day (kg/day) as well as normalized for body weight (kg/kg bw/day).
- Home Range – Home range is defined as the geographic area encompassed by an animal's activities (except migration) over a specified time (USEPA 1993). For some species, foraging distances (i.e.,

distances that animals are willing to travel for potential food sources) and territory size are considered more meaningful than home ranges; although, some define foraging range under home range (USEPA 1993).

The SUF represents the area used by an individual relative to the size of the exposure area. If the home range of a receptor species is larger than the potential exposure area, the following equation was applied:

(Equation 6-3) SUF = exposure area acreage / home range of species

For terrestrial birds and mammal, risks were evaluated using two SUF scenarios: a generic SUF of 1 and a SUF based on a species- and site-specific home range (referred to as the site-specific SUF for simplicity) compared to the total area of each exposure area (Table 6-4).

6.4.3.2 Prey Uptake Assumptions (Bioaccumulation Factors)

Bioaccumulation in animal tissue or uptake into plants is the process where COPECs in the surrounding media are accumulated within the tissues of ecological receptors, especially to concentrations higher than in the surrounding media. Any COPEC that is excreted or metabolized at a slower rate than its uptake through absorption and ingestion will increase in tissues over time, resulting in bioaccumulation. Constituents with high octanol-water partitioning coefficient (log Kow) are more likely to bioaccumulate in tissues of prey (plants, invertebrates, and mammals) due to their lipophilic nature (USEPA 2000b). Constituents with low log Kow (less than 2), such as VOCs, are assumed to have negligible bioaccumulation potential (USEPA 2000b). Additionally, some metals that are not readily excreted are also known to bioaccumulate (e.g., lead). COPECs that bioaccumulate have the potential to be passed up the food chain.

Soil-to-biota uptake for plants, invertebrates, and mammals are developed as either regression equations or bioaccumulation factors (BAFs). Uptake regression equations express a significant and predictive relationship between COPEC concentrations in soil and biota tissues, and are typically expressed in a form similar to:

$$\ln(Cb) = M*\ln(Cs) + I \qquad \text{Equation 6-4}$$

Where:

Cb = constituent concentration in biota tissue (mg of constituent/kg of tissue)

M = slope of regression line

Cs = constituent concentration in soil (mg constituent/kg soil)

I = y-intercept of regression line (unitless).

When a significant and predictive uptake regression is unavailable, a simple uptake ratio can be used to estimate concentrations of constituents that can accumulate in tissues through any route of exposure (USEPA 2000b). A BAF is the ratio of biota constituent concentration to soil concentration and is expressed as follows:

$$BAF = Cb / Cs \qquad \text{Equation 6-5}$$

Where:

BAF = soil-to-biota bioaccumulation factor (kg soil/kg tissue)

Cb = constituent concentration in biota tissue (mg constituent/kg tissue)

Cs = constituent concentration in soil (mg constituent/kg soil).

Uptake regressions and BAFs were selected in the RAWP (Arcadis 2008a) and technical memoranda (Arcadis BBL 2007; Arcadis 2008b, 2009b) and were used to estimate concentrations of COPECs in biota and food item tissue (i.e., prey) from soil. Table 6-5a presents the uptake regressions/BAFs for soil COPECs including metals, PAHs, VOCs, SVOCs, dioxin TEQ, pesticides, and PCBs; uptake regressions/ BAFs were not available for TPHs. The selected uptake regressions/BAFs are from sources as cited in USEPA (2007a), unless otherwise noted. Constituents with low log Kow (less than 2) are assumed to have negligible bioaccumulation potential (USEPA 2000b); for VOCs, BAFs were assigned a value of zero. Higher-trophic level receptors (mammals and birds) tend to rapidly metabolize constituents like PAHs and therefore, the soil-to-mammal BAFs for PAHs were also assigned a value of zero, consistent with USEPA EcoSSL guidance (USEPA 2007a). All uptake regressions/BAFs are presented in Table 6-5a are on a dry-weight basis and are consistent with the RAWP and technical memoranda, unless otherwise noted in Tables 6-5a.

Note, the BAFs and uptake regressions presented in the RAWP documents (Arcadis 2008a, 2009a, 2015) were used in developing soil ECVs for use in the RFI/RI site characterization to determine nature and extent and therefore, were based on conservative and readily available literature/published values. These BAFs and uptake regressions are generally considered very conservative and therefore, tend to overestimate risk. The “selected” BAFs and uptake regressions (i.e., those present in the RAWP documents) were used in characterizing potential risk to wildlife (through their diet) at the site; however, the quality of the selected, BAFs and uptake regressions with respect to confidence in predicting risks are discussed as part of the risk characterization. Where risks are believed to be significantly overestimated because of these selected BAFs and uptake regressions, alternate and more robust values were developed and presented in this section (e.g., dioxin TEQ).

Although the selected BAFs and uptake regressions were used to estimate risk to potential ecological receptors at the site (i.e., forward risk calculations), the alternate and more robust values are recommended for consideration in risk-management decisions (e.g., when developing RBRGs), as discussed in this section for dioxin TEQ.

6.4.3.2.1 Alternate Dioxin TEQ BAFs

For dioxin TEQ, the BAFs selected in the RAWP (Arcadis 2008a) are based on uptake of a single congener: 2,3,7,8-TCDD. Although there are some published uptake factors (derived as the ratio of concentrations in earthworms to those in soil as for a BAF) for a few common dioxin congeners in the literature, notably 2,3,7,8-TCDD (Sample et al. 1998a), available uptake factors cannot be extrapolated across all dioxin and furan congeners to estimate invertebrate tissue concentrations for all of the individual congeners. This approach ignores differences in congener uptake due to differences in their structure and physico-chemical properties. Uptake data available in the literature for earthworms

(Fagervold et al. 2010) and published soil-to-invertebrate BAFs (USEPA 1999a) indicate that 2,3,7,8-TCDD has among the highest uptake rates for the 2,3,7,8-substituted congeners included in TEQ concentrations. As a result, uptake of dioxin TEQ is likely overestimated for some ecological receptors, especially for invertivorous wildlife receptors. This was demonstrated in the Tittabawassee River risk assessment when use of simplified uptake factors from the literature of 5 for 2,3,7,8-TCDD and 0.1 for 2,3,7,8-TCDF led to a 10-fold overprediction of dioxin and furan concentrations in soil invertebrates relative to measured values (Galbraith Environmental Sciences LLC [Galbraith] 2004; Kay et al. 2005). The uncertainty associated with the selected dioxin TEQ BAFs for the ERA is discussed in more detail in Section 6.7.4.

Because of the uncertainty associated with use of a single congener based BAF, dioxin TEQ uptake was also estimated using two congener-specific approaches: congener-specific BAFs for plants and soil invertebrates from USEPA (1999a) and congener-specific BAFs for soil invertebrates from Fagervold et al. (2010), as discussed in detail in the Section 6.7.4. The alternate congener-specific BAFs are presented in Table 6-5b. In summary, using the USEPA (1999a) BAFs, the congener-specific approach results in uptake by plants similar (within a factor of two) to uptake used in the ERA. However, uptake by invertebrates and subsequent ingestion by mammals and birds using the congener specific approach results in uptake ranging from approximately 10 to 18 times lower for mammals and two to seven times lower for birds compared to the uptake models used in the ERA for BCW (0 to 0.5 foot bgs). Congener specific soil BAFs from Fagervold et al. (2010) result in uptake by invertebrates approximately 165 times below that estimated in the ERA using the selected BAF. Uptake and risk calculations using the alternate BAFs were conducted for BCW and are presented in Section 6.7.4.

Data presented by Fagervold et al. (2010) for the Tittabawassee River site in Michigan were used to develop alternate congener-specific BAFs for uptake by earthworms. Details of the development of the alternate BAFs are presented in Section 6.7.4 and not repeated in this section. As mentioned in Section 6.4.3.2, selected BAFs and uptake models presented in the RAWP are generally conservative. Where risks are believed to be significantly overestimated because of these selected BAFs and uptake regressions, alternate and more robust values were developed (e.g., dioxin TEQ). Although the uptake regression identified in the RAWP for dioxin TEQ (based on 2,3,7,8-TCDD uptake) was used to estimate risk to potential ecological receptors at the site (i.e., forward risk calculations), the alternate and more robust BAFs approaches for dioxin TEQ based on congener-specific uptake were used to identify RBRGs in Section 8 and are recommended for consideration in risk management decisions.

6.5 Effects Assessment

For the ERA, screening levels for ecological communities and TRVs for wildlife were selected with review and/or input from the DTSC and USFWS and are presented in the RAWP documents (Arcadis 2008a, 2009a, 2015). Note, these screening values and TRVs were used in developing soil ECVs for use in the RFI/RI site characterization to determine nature and extent and therefore, were based on conservative and readily available literature/published values. These screening values and TRVs are generally considered very conservative and therefore, tend to overestimate risk. The “selected” screening values and TRVs (i.e., those present in the RAWP documents) are used in characterizing risk to potential ecological receptors at the site; however, the quality of the selected screening values and TRVs, with respect to confidence in predicting risks are discussed as part of the risk characterization. Where risks believed to be significantly overestimated because of these selected screening values and TRVs, alternate and more robust values were developed and presented in this section (e.g., dioxin TEQ). Although the selected screening values and TRVs were used to estimate risk to potential ecological receptors at the site, the alternate and more robust values are recommended for consideration in risk-management decisions.

Screening levels and TRVs updated with current values since the submission of the RAWP (Arcadis 2008a) are identified in Table 6-6 (soil screening levels) and Tables 6-7 through 6-10 (for TRVs) and discussed in this section.

6.5.1 Screening Levels

The screening values, or ecological benchmarks, for estimating risk to plants and soil invertebrates are presented in Table 6-6 for the soil COPECs identified outside the TCS. As shown in Table 6-6, COPECs not previously identified in the RAWP documents are shaded in green (mostly VOCs and some SVOCs) and screening levels that have been updated based on currently available literature are shaded in blue (total chromium, manganese, TCDD, and a few SVOCs). For total chromium, a soil screening level was developed for soil invertebrates based on available literature as discussed in this section.

Sources of soil screening values for plants and soil invertebrates are listed in order of preference:

- Guidance for Developing EcoSSLs (USEPA 2008)
- Oak Ridge National Laboratory (ORNL) documents (Efroymson et al. 1997a, b)
- Other published sources (USEPA 2003d, 2018c)
- Values derived from peer-reviewed literature.

Appropriate screening values are not available for TPHs and therefore, benzene, toluene, ethylbenzene, and xylenes (BTEX) and PAHs, if detected and above background, were used as indicator chemicals to characterize potential risks associated with TPH mixtures. Screening values are not available for some COPECs, as discussed in each exposure area-specific appendix and therefore, risks to potential ecological communities from these COPECs could not be estimated. Potential impact of the ERA due to lack of screening values are discussed in the Uncertainty Analysis (Section 6.5.5).

6.5.1.1 Soil Invertebrate Screening Level for Total Chromium

A recommended concentration-based screening value for soil invertebrates exposed to total chromium in soil was not available in the typical literature (listed previously). USEPA requires a minimum of three studies to develop an EcoSSL; however only two studies (Van Gestel et al. 1992, 1993) met USEPA guidelines for use in development of an EcoSSL for soil invertebrates. These studies were reviewed for development of a soil invertebrate screening level for use in this ERA, as summarized in this section.

Van Gestel et al. (1992, 1993) evaluated the exposure of adult earthworms (*Eisenia andrei*) to chromium-3 nitrate in an artificial soil substrate (10% sphagnum peat, 20% kaolin clay, ca. 69% fine sand). Earthworms were exposed for 1 week to untreated soil, three weeks to treated soil, followed by three weeks of recovery exposed to untreated soil. For chromium, six different ECs were used: 0, 10, 32, 100, 320, and 1,000 mg/kg dry soil. Growth, reproduction (i.e., cocoon production, fertility of cocoons, and number of juveniles produced per worm per week), and mortality were evaluated. The most sensitive endpoint was the number of juveniles produced per worm per week, which was significantly reduced at concentrations greater than 100 mg/kg chromium dry soil. Growth, cocoon production, and fertility of cocoons were significantly reduced at 1,000 mg/kg. However, during the 3-week recovery period, growth increased significantly and fertility was no longer affected. Mortality was not observed at any exposure level. Based on a no observed effect level of 32 mg/kg chromium and lowest observed adverse effect level of 100 mg/kg, USEPA (2008) provides a toxicity concentration of 57 mg/kg chromium, based on the geometric mean of the two concentrations, which was selected (Table 6-6) to evaluate potential toxicity to soil invertebrates potentially exposed to total chromium in soil.

6.5.2 Toxicity Reference Values

TRVs were used to assess potential risks to mammalian and avian wildlife in the ERA. A range of risks to wildlife were estimated using the NOAEL- and LOAEL-based TRVs presented in the RAWP (Arcadis 2008a) and supporting technical memoranda (Arcadis BBL 2007b; Arcadis 2008b, 2009b). These selected TRVs were primarily based on the TRVs used to develop USEPA's EcoSSLs (USEPA 2008); other sources included the Toxicological Benchmarks for Wildlife from ORNL (Sample et al. 1996) and the USEPA Region 6 ERA Guidance (USEPA 1999a). In addition, for estimating potential risk to wildlife, a second set of NOAEL- and LOAEL-TRVs based on the BTAG TRVs (DTSC 2002b, 2009e) were also used for COPECs, where available. [Note: Although these are referred to as LOAEL-based BTAG TRVs, they are based on a midpoint of a variety of adverse effects and are not necessarily lowest observed adverse effect levels. However, for simplicity, these BTAG TRVs are referred to as LOAEL-based TRVs.] The selected TRVs are presented in Table 6-7. As shown in Table 6-7, COPECs not previously identified in the RAWP documents (Arcadis 2008a, 2009a, 2015) are shaded in green (mostly VOCs and some SVOCs) and screening levels that have been updated based on currently available literature are shaded in blue (hexavalent chromium and thallium for birds only, cyanide, manganese, methy acetate TCDD, and a few SVOCs). The DTSC-recommended TRVs are presented in Table 6-8.

Following DTSC guidance (1996b, 2000), TRVs were adjusted when the differences in body weight between the site-specific wildlife receptor and the laboratory animals used in the studies to develop the TRVs were significant (i.e., greater than two orders of magnitude). Thus, literature-derived mammalian TRVs presented in Table 6-9 for potential terrestrial receptors were allometrically adjusted using the equation from Sample and Arenal (1999):

$$Aw = At * (BWt/BWw)^{1-b} \qquad \text{Equation 6-6}$$

Where:

Aw = TRV of wildlife species (mg/kg-bw/day)

At = TRV of test species (mg/kg-bw/day)

BWt = body weight of test species (kg)

BWw = body weight of wildlife species (kg)

b = allometric scaling factor (1.2 for birds, 0.94 for mammals).

Corresponding allometric conversions for DTSC-recommended TRVs are presented in Table 6-10 for potential terrestrial mammalian receptors. None of the avian TRVs required allometric conversions. Although no longer typically conducted, allometric conversions were used in line with the approved RAWP (Arcadis 2008a) and may increase uncertainty associated with the TRVs. However, no substantial changes to risk conclusions as a result of allometric conversions are expected (discussed further in Section 6.7.5.4).

TRVs are not available for some COPECs, as discussed in each exposure area-specific appendix and therefore, risks to wildlife from these COPECs could not be estimated. Potential impact to the ERA due to lack of TRVs is discussed in the Uncertainty Analysis (Section 6.7.5).

Additionally, avian TRVs for hexavalent chromium were developed following approval of the RAWP documents (Arcadis 2008a, 2009a, 2015) to assess potential risk associated with this important site-related COPEC. For mammals, hexavalent chromium, and total chromium TRVs from USEPA (2008) were presented in the approved RAWP (Arcadis 2008a). For birds, only total chromium TRVs are available; no published hexavalent chromium TRVs were located from the typical guidance documents used for ERA (Section 6.2). Available literature was reviewed to develop avian TRVs for hexavalent chromium, following appropriate guidance (USEPA 1999a, 2008), as described in this section.

6.5.2.1 Avian TRVs for Hexavalent Chromium

No avian TRVs were proposed in the RAWP documents (Arcadis 2008a, 2009a, 2015) to evaluate potential risk to birds from hexavalent chromium at the site, as available toxicity data for hexavalent chromium and birds are extremely limited. Avian TRVs are not available from published sources, including the EcoSSLs (USEPA 2008), BTAG TRVs (DTSC 2002a, b); ORNL Toxicological Benchmarks for Wildlife (Sample et al. 1996), and other published sources (e.g., USEPA Region 6 Ecological Risk Assessment guidance [USEPA 1999a]). However, several studies cited in the EcoSSL document for hexavalent chromium (USEPA 2008) meet the data quality standards specified for calculation of an EcoSSL. The USEPA did not derive an EcoSSL for hexavalent chromium because there were not enough study results to meet the minimum data requirements. Therefore, the acceptable EcoSSL studies were reviewed along with more recent studies published since the EcoSSLs were released (USEPA 2008). These data were used as the basis of avian TRVs, as described in this section.

A literature search for more recent data was conducted for studies published in 2004 or later. The literature search was conducted using all ProQuest Dialog databases in each subject area except those dedicated to patents. Final results were found on these databases: SciSearch, Inspec, ProQuest Newsstand Professional, ProQuest Dissertations and Theses Professional, PsycINFO and BIOSIS® Toxicology. All the records identified satisfied these four requirements:

- The phrases “hexavalent chromium” OR “chromium VI” in the title, abstract or subject heading field
- The terms “bird” OR “chicken” OR “quail” OR “avian” in the title OR abstract field
- The term “toxicity” in the title, abstract or subject heading field.

A total of 71 studies were retrieved. The abstracts were reviewed for relevance to developing avian hexavalent chromium TRVs. Six studies (Wan et al. 2017; Wang et al 2017; Hao et al. 2017; Islam and Bhowmik 2005; Mashkoor et al. 2016; Butkauskas and Sruoga 2004) were found to contain data relevant for TRV development, as described in this section. These data were combined with the EcoSSL dataset, and avian TRVs for hexavalent chromium were derived.

USEPA (2008) conducted an exhaustive review of available chromium toxicity data for birds as part of the development of the chromium EcoSSLs. For chromium-6, USEPA (2008) identified four studies with relevant chromium-6 toxicity data, and three did not meet the criteria for inclusion in the EcoSSL dataset. Because the minimum data requirements for calculation of an EcoSSL are three appropriate studies, no EcoSSL or avian TRV could be developed for chromium-6. In the one relevant study, Asmatullah et al. (1999) fed one-day old chicks of *Gallus domesticus* potassium dichromate in feed for 32 weeks. Although no effect was observed on fertility, chicken growth and hatchability of chicks were both reduced after 32 weeks exposure in both treatment groups (250 and 500 mg/kg in feed). Sublethal hepatotoxicity was also observed. Hexavalent chromium concentrations were not measured in the food, and feed type was not described in the study. A daily dose of 4.02 mg/kg-bw/day was estimated by USEPA (2008) for the 250 mg/kg concentration in food, which USEPA considered a chronic LOAEL for growth and reproduction endpoints.

Additional recent studies containing effects data were identified in the literature search. Islam and Bhowmik (2005) reported reduced growth, and pathological organ changes in 1-d old broiler chickens following exposure to 17.2 mg/kg-bw/day chromium oxide via drinking water. Mortality was not observed. The growth results were not tabulated or statistically evaluated and so cannot be used to derive a LOAEL. Mashkoor et al. (2016) report a 21% reduction in chick growth after 42-d exposure to potassium dichromate in the diet (270 mg/kg). A study-specific feed intake of 1.8 kg/kg bw/day was reported and was used to calculate an exposure dose of 486 mg/kg-bw/day for potassium dichromate, or 172 mg/kg-bw/day based on the molar mass of chromium.

The EcoSSL dataset, composed of the Asmatullah et al. (1999) study, did not contain NOAEL doses for birds. The literature search identified three additional recent studies containing no effects data. Butkauskas and Sruoga (2004) conducted a two-generation study with Japanese quail fed a diet containing 142 mg/kg potassium dichromate. Although hatching success was reduced by 14% in the parental generation, no adverse effects on fertility or hatching success were reported for birds in the F1 generation. Additionally, effects on 1-d old broiler chickens were investigated by Wan et al. (2017), Wang et al. (2017), and Hao et al. (2017) in 42-day exposures using potassium dichromate in drinking water. These studies used the same methodology to examine histopathological and biochemical changes in kidney, liver, and brain tissue, respectively. While the focus of these investigations was at the tissue and cellular level, the authors report that no chicks died during the 42-d tests. Minor changes in organ weights and pathological changes in organ histology were noted following exposure to 7.83 to 22.14 mg/kg-bw/day, and NOAELs for growth and reproductive effects at the individual level would not be expected at doses below those associated with minor changes in organ histology. It should be noted that co-exposure to selenium at low concentrations protected chicks from histological changes. This effect is consistent with data for other antioxidants, such as vitamin E and folic acid which reduce the effects of oxidative stress resulting from chromium exposure (El-Demerdash et al. 2006; Yousef et al. 2006; Mashkoor et al. 2016).

Based on the Asmatullah et al. (1999) study, hatchability appears to be among the most sensitive endpoints for assessing hexavalent chromium toxicity in birds. In more recently available data, hatching success or other indicators of reproductive success were measured only in the Butkauskas and Sruoga

(2004) study. Data from Butkauskas and Sruoga (2004) were used to derive a NOAEL dose of 2.5 mg/kg-bw/day, based on the NOAEL effect level of 142 mg/kg in feed associated with no observed effects on hatchability in the F1 generation, a Japanese quail body weight of 0.176 kg (USEPA 2007a), a FIR of 0.073 kg fresh matter intake per day calculated based on the allometric equation for all birds from Nagy (2001), and accounting for the 35.35% contribution of hexavalent chromium to the molar mass of potassium dichromate. The NOAEL-based dose of 2.5 mg/kg is below the two available LOAELs for effects on growth, reproduction, and survival (ranging from 4.02 to 172 mg/kg-bw/day) and was selected as the avian NOAEL-based TRV for hexavalent chromium. A LOAEL-based TRV of 25 mg/kg-bw/day was estimated by applying an uncertainty factor of 10 to the NOAEL-based TRV.

In summary, the selected avian NOAEL- and LOAEL-based TRVs for hexavalent chromium are 2.5 mg/kg-bw/day and 25 mg/kg-bw/day, respectively. Uncertainty associated with these TRVs is discussed in Section 6.7.5.

6.5.2.2 Dioxin TRVs

Toxicity of dioxins in mammals and birds is mediated through aryl hydrocarbon receptor (AHR). Exposure of mammals and birds to dioxins is associated with adverse effects on reproduction and development, and the sensitivity of mammals and birds to TCDD toxicity is highly variable. Acute toxicity studies with 2,3,7,8-TCDD have shown marked differences among species; up to a factor of 8,400 between the single oral LD50 dose for the guinea pig (the most sensitive mammal) and the hamster (Eisler 1985). The exposure levels at which adverse effects are observed span a large range across avian taxa, from low ng/kg to low micrograms per kilogram (µg/kg) in tissue. There are also clear differences among bird species in susceptibility to dioxin-like toxicity, which have been attributed to biochemical differences in AHRs among species (Karchner et al. 2006; Head et al. 2008). The range of sensitivity of various species to dioxins and furans results in significant uncertainty associated with the selected dioxin TEQ TRVs, as discussed in detail in Section 6.7.5.

For dioxin TEQ, the selected mammalian and avian TRVs for the ERA were based on TRVs presented in the RAWP documents and are based on the lowest available TRVs (NAOEL-based TRV and LOAEL-based TRV of 1 mg/kg-bw/day and 10 mg/kg-bw/day, respectively [Table 6-7]). Additional relevant toxicity data suggest that adverse effects would not be observed until higher doses. As a result, the risk estimates for dioxin TEQ are likely overestimated in the ERA.

Because of the uncertainty associated with use of highly conservative dioxin TRVs, alternate TRVs were calculated for this site. Details of the studies included as the basis for the alternate TRVs are discussed in Section 6.7.5. In summary, rat studies report NOAEL-based doses that are 7 to 70 times and LOAEL-based doses that are 1.6 to 22 times greater than the selected mammalian TRVs. Additionally, sensitive wildlife receptors, such as mink, have been shown to tolerate exposure doses 25 times greater than the NOAEL-based TRV from the RAWP and used in this ERA without adverse effect. Similarly, bird studies have shown a wide range of NOAEL- and LOAEL-based effects as well.

As mentioned in Section 6.5, selected screening values and TRVs presented in the RAWP are generally conservative. Where risks are believed to be significantly overestimated because of these selected screening values and TRVs, alternate and more robust values were developed (e.g., dioxin TEQ).

Following the approach used by USEPA in developing TRVs for the EcoSSLs (USEPA 2008), alternate dioxin TEQ TRVs were developed for mammals based the geometric mean of the reproduction and growth endpoints for the NOAEL and LOAEL effect levels, respectively. The alternate TRVs are presented in this section:

Alternate Mammal TRVs for Dioxin TEQ:

- NOAEL-based TRV = 4.9 ng/kg-bw/day
- LOAEL-based TRV = 30 ng/kg-bw/day.

Although the selected screening values and TRVs were used to estimate risk to potential ecological receptors at the site, the alternate and more robust values are recommended for developing RBRGs when considering risk-management decisions.

6.5.3 Dioxin TEFs

The toxicity of PCDD/PCDFs, collectively known as “dioxins”, is highly variable. Only 17 congeners are considered to be of interest for evaluating environmental exposure and risk. These are the PCDD/PCDF congeners that have chlorines attached in at least the 2, 3, 7, and 8 positions. The 2,3,7,8-substituted congeners are believed to exhibit similar toxicity and act through the same toxic mechanism.

The ability of the 2,3,7,8-substituted congeners to cause toxic effects is mediated by their ability to bind the AHR in vertebrates (ATSDR 1998; Safe 1986). Each congener has a different relative binding affinity, and thus a different relative toxicity. The most toxic congener to mammals is 2,3,7,8-TCDD. The other congeners are assigned a TEF, which is relative to 2,3,7,8-TCDD (thus, the TEF for 2,3,7,8-TCDD is equal to one.). The WHO provides published and peer-reviewed TEF values, shown in the table at the end of this section (Van den Berg et al. 1998, 2006). These TEFs are currently endorsed by the USEPA and most other regulatory agencies throughout the world. Individual congeners are assigned different TEFs for mammalian species and avian species, due to differences in toxicity to these species. Concentrations of the individual 2,3,7,8-substituted congeners in environmental samples are then multiplied by their respective TEF, resulting in a congener concentration normalized to the toxicity of 2,3,7,8-TCDD for each species (TEQ; see Section 4.2.1 for calculation of total TEQ). Because the congeners all share the same mode of toxicity, the TEF-adjusted concentrations are summed for all 17 congeners. The resulting value is a total dioxin TEQ concentration, given in terms of the toxicity of 2,3,7,8-TCDD. The total mammalian dioxin TEQ concentrations are used to assess exposure to mammalian wildlife at the site. The total avian dioxin TEQ concentrations are used to assess exposure to avian wildlife.

Mammal and Avian TEFs for Polychlorinated dibenzo-p-dioxins

Compound	Mammal TEF[a]	Avian TEF[b]
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	1	1
1,2,3,4,7,8-HxCDD	0.1	0.05
1,2,3,6,7,8-HxCDD	0.1	0.01
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.001
OCDD	0.0003	0.0001

References:
[a]Van den Berg et al. 2006
[b]Van den Berg et al. 1998

Mammal and Avian TEFs for Polychlorinated dibenzofurans

Compound	Mammal TEF[a]	Avian TEF[b]
2,3,7,8-TCDF	0.1	1
1,2,3,7,8-PeCDF	0.03	0.1
2,3,4,7,8-PeCDF	0.3	1
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.0003	0.0001

References:
[a]Van den Berg et al. 2006
[b]Van den Berg et al. 1998

6.6 Risk Characterization

The purpose of the ERA was to identify unacceptable risks to potential local terrestrial populations in areas outside the TCS. These objectives are consistent with DTSC and USEPA guidance for conducting an ERA (DTSC 1996b; USEPA 1999a), which focus on protecting local populations, communities, and habitats, as well as special-status species.

The risk characterization integrated the results of the exposure assessment and toxicity assessment, which are subject to uncertainties in both those efforts, as well as uncertainties in the problem formulation step. Risk characterization includes two major components: risk estimation and risk description. Risks (HQs) were estimated using HQs, following the approach described in the RAWP documents and summarized in this section. HQs only account for a single LOE. Following USEPA guidance (1998) guidance, risk estimates for each receptor and COPEC within a potential exposure area were interpreted based on a semi-quantitative WOE approach using multiple LOEs. The WOE assessment, including the HQs and supporting LOEs, was used to evaluate the assessment endpoints (Section 6.3.2), reduce uncertainty, and ultimately draw risk conclusions. These components comprise the risk description.

6.6.1 Approach

Risks to ecological receptors from COPECs in soil were estimated for all 17 potential ecological exposure areas by calculating HQs for each receptor and COPEC. COPECs were selected for each potential exposure area as discussed in Section 3.4. The ecological receptors evaluated included ecological communities (plants and invertebrates) and wildlife (mammals and birds) as discussed in Section 6.3.1.2. For plants and soil invertebrates, risks (HQs) were estimated by comparing the soil EPCs for each COPEC with respective screening levels and these HQs were compared to the target HQ of 1. For wildlife, HQs are an expression of the ratio of an exposure estimated dose (ADD_t) to an effects dose (i.e., TRV). ADD_t for indicator species presented in Section 6.4.3 were compared to the NOAEL-based (low) and LOAEL-based (high) TRVs presented in Section 6.5.2.

For wildlife, the exposure models estimate exposure to an individual and TRVs are derived from individual-level effects data. Therefore, HQs represent potential risk to individual receptors and populations must be extrapolated from these HQ values. The following standard HQ equation (USEPA 1997a) was used to estimate risks to wildlife:

$$HQ = \frac{Dose}{TRV} = \frac{(C_{soil} \times SIR) + (C_{biota} \times FIR) \times SUF}{TRV \times BW} = \frac{(C_{soil} \times SIR) + (C_{soil} \times BAF \times FIR) \times SUF}{TRV \times BW}$$

Equation 6-7

Where:

HQ = hazard quotient (unitless)

Dose = exposure dose (mg/kg-bw/day)

TRV = toxicity reference value (mg/kg-bw/day])

C_{soil} = concentration of constituent in soil (mg/kg soil)

SIR = soil ingestion rate (kg soil/day)

C_{biota} = concentration of constituent in biota or tissue (mg/kg tissue), represented by the EPC

FIR = food or biota ingestion rate (kg tissue/day)

SUF = site-use factor (unitless); an adjustment factor used when the foraging range of a potential receptor is larger than the potentially contaminated area; calculated by dividing the potentially contaminated area by the home or foraging range of the potential receptor

BW = body weight of receptor (kg bw)

BAF = bioaccumulation factor or regression for media-to-biota uptake (kg soil/kg tissue).

The exposure parameters used to calculate risks are discussed in Section 6.4 and the effects levels (screening levels and TRVs) are discussed in Section 6.5. As mentioned in Sections 6.4.3 and 6.5.2, selected BAFs/uptake regressions and selected screening values/TRVs as presented in the RAWP documents were used to estimate risk to potential ecological receptors at the site. However, where risks are believed to be significantly overestimated because of these selected values, alternate and more robust values were developed. For dioxins, alternate congener-specific BAFs are summarized in Section 6.4.3.2.1 (and presented in Table 6-5b; details are in Section 6.7.4) and alternate and more robust TRVs are summarized in Section 6.5.2.2 (details are in Section 6.7.5). These alternate and more robust values are recommended for consideration in risk-management decisions.

HQs based on LOAEL-based TRVs selected in the RAWP (Arcadis 2008a, 2009a, 2015) are referred to as "LOAEL-based HQs." HQs based on NOAEL-based TRVs selected in the RAWP are referred as "NOAEL-based HQs." Additionally, NOAEL- and LOAEL- based HQs were calculated using a second set of TRVs (i.e., NOAEL- and LOAEL-based BTAG TRVs), as previously described in Section 6.5.2. The BTAG NOAEL-based TRVs are considered very conservative, resulting in a wide range of risks to potential wildlife receptors. For the Topock site ERAs, the selected TRVs are considered more robust than the BTAG TRVs, as discussed in Section 6.7.5.3. Results associated with the selected TRVs, and the alternate and more robust TRVs in the case of dioxin TEQ, are recommended for developing RBRGs when considering risk management decisions at the site.

For each exposure area-specific ERA, potential risks to ecological receptors were estimated using depth-weighted EPCs for all COPECs identified for that potential exposure area. For wildlife, risks were also estimated using a generic SUF of 1 and also using site-specific SUFs. Following the RAWP, area-weighted EPCs were also calculated only if risks based on depth-weighted EPCs suggested potential risk to ecological receptors (i.e., HQ greater than 1 for any COPEC). Depth- and area-weighted EPCs are discussed in Section 4.2.

Per the RAWP (Arcadis 2008a) and DTSC guidance (DTSC 1996b), ecological risks (HQs) were also calculated using maximum depth-weighted concentrations and presented as Attachment D in each of the exposure area-specific appendices. Risks estimated using maximum depth-weighted concentrations are considered overly conservative and generally only used for screening level purposes. Use of maximum concentrations are not recommended for use in the risk management decisions at the site, where the area has been adequately characterized and data are available to estimated UCLs. Therefore, the risk results based on maximum depth-weighted concentrations are presented in Attachment D, but not discussed in the ERA.

The ERAs for each potential ecological exposure area are presented in detail in the exposure area-specific appendices, including risk calculations based on depth-weighted and area-weighted EPCs (when calculated) for all COPECs. Risk estimates (HQs) for all the COPECs and potential exposure areas calculated using depth-weighted EPCs and where applicable, area-weighted EPCs, are presented in in this section (reference to specific tables are included in the discussions in this section).

For the risk description part of the risk characterization process, a semi-quantitative WOE approach was used incorporating multiple LOEs. For interpreting the risk results and identifying potential adverse effects to ecological receptors, in addition to the HQ results, other LOEs included supporting statistical information (e.g., frequency of detection [FOD]), confidence in the screening values, the direction of uncertainty in the risk estimates, and spatial extent of elevated concentrations. Uncertainties specific to a potential exposure area are discussed in context with the risk characterization results in the exposure area-specific appendices. Generic uncertainties in the ERA are discussed in detail in Section 6.7.

For each potential exposure area, the results of individual LOE evaluations were evaluated collectively to derive an overall WOE conclusion for each receptor and COPEC. Key uncertainties were considered along with the strength, relevance, and other qualities of the LOE in reaching the WOE conclusions.

Potential risks to ecological communities (plants and invertebrates) were interpreted as follows:

- COPECs with HQs less than or equal to 1 pose *de minimis* risk (i.e., no unacceptable risk or negligible risk) risk to potential ecological communities.
- COPECs with HQs greater than 1 indicate unacceptable risk to plants and invertebrates is possible. However, exceedances of the screening levels (which are conservative and are generally uncertain) do not always clearly indicate that adverse effects to ecological communities are occurring. In such cases, the various LOEs included in the WOE approach were used to characterize potential risk to potential ecological communities. Observations made during the comprehensive botanical surveys completed in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) will be used as an LOE in interpreting potential risk to ecological communities.

There are ultimately three possible risk outcomes for plants and invertebrates based on HQs greater than 1 and the WOE: (1) unacceptable risk to ecological communities is possible (i.e., indicated by sufficient and strong supporting LOEs); (2) unacceptable risk to ecological communities is unlikely (i.e., indicated by sufficient and strong LOEs to support a conclusion of no unacceptable risk); or (3) unacceptable risk to ecological communities is uncertain (i.e., indicated by insufficient LOEs). Potential risks to wildlife (mammals and birds) were interpreted as follows.

Risk conclusions for wildlife used the following criteria:

- COPECs with NOAEL-based HQs less than or equal to 1 pose *de minimis* risk to individual and populations of potential wildlife receptors.
- COPECs with a NOAEL-based HQ greater than 1 but LOAEL-based HQ less than or equal to 1 pose no unacceptable risks to potential wildlife populations. However, as described in the RAWP (Arcadis 2008a), adverse effects to potential individual receptors are uncertain because the NOAEL-based TRVs are thresholds with an interval that is an artifact of the dosing study. The nature and magnitude of the effects, if any, that may occur at exposures between these values is unknown. In such cases, a WOE approach, including multiple LOEs, was used to reduce uncertainty and characterize potential risk to individual wildlife receptors.
- COPECs with LOAEL-based HQs greater than 1 indicate unacceptable risk is possible for populations of potential wildlife receptors. However, these LOAEL-based HQs are based on individual-level effects thresholds and only account for a single LOE. In such cases, a WOE approach, including an alternate target HQ of 10 for dioxin TEQ, was used to reduce uncertainty and characterize potential risk to wildlife populations as described in the preceding bullet. [Note: For dioxin TEQ, the selected BAFs and TRVs result in significant overestimation of risk for key wildlife receptors, primarily for invertivorous small mammals and insectivorous birds. Due to the compounded conservatism in the risk estimates for dioxin TEQ, HQs greater than 10 were considered to pose unacceptable risk. Alternate congener- specific BAFs and alternate TRVs demonstrating the magnitude of the risk overestimation are presented in Sections 6.4.3 and 6.5.2, respectively. These alternate BAFs and TRVs are based on current understanding of uptake and toxicity of TEQ mixtures and represent an additional LOE considered for dioxin TEQ. As a result, a target LOAEL-based HQ

of 10 for dioxin TEQ was used instead of a target LOAEL-based HQ of 1. Uncertainty in the risk estimates for dioxin TEQ is discussed in detail in Section 6.7.6.]

- The NOAEL-based HQs greater than 1 is considered a single LOE in assessing potential risk to special-status species, if present in a potential exposure area. Potential risks to T&E species were also included as an LOE in the risk characterization for a potential exposure area.

There are ultimately three possible risk outcomes for wildlife based on the HQs greater than 1 and WOE: (1) unacceptable risk to wildlife is possible (i.e., indicated by sufficient and strong supporting LOEs); (2) unacceptable risk to wildlife is unlikely (i.e., indicated by sufficient and strong LOEs supporting a conclusion of no unacceptable risk); or (3) unacceptable risk to wildlife is uncertain (i.e., indicated by insufficient LOEs).

Risks characterized for each potential exposure area are presented in detail in the exposure area-specific appendices and summarized in Section 6.6.2. For each area, COPECs with HQs greater than 1 using the depth-weighted EPCs were identified for further evaluation using refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs). Risk conclusions for ecological receptor populations exposed to COPECs in soil were characterized based on HQs calculated using refined exposure and effects assumptions associated with a higher level of confidence in predicting risks (area-weighted EPCs, site-specific SUF, and selected TRVs) and supporting LOEs. As mentioned previously, results associated with BTAG TRVs are presented and discussed in the potential exposure area ERA appendices; however, the selected TRVs and the alternate and more robust TRVs in the case of dioxin TEQ, are recommended for risk management decisions and risk results based only those results are summarized in this section.

At the conclusion of each potential exposure area ERA, risk drivers were identified for each potential exposure area based on those COPECs for which unacceptable community/population-level risk (i.e., HQs for plants and soil invertebrate communities and LOAEL-based HQs for wildlife populations) was predicted using refined exposure and effects assumptions and additional LOEs supporting the conclusion.

6.6.2 Results

Risks characterized for each potential exposure area are summarized in this section. Risk estimates are based on HQs calculated using refined exposure and effects assumptions associated with a higher level of confidence in predicting risks (area-weighted EPCs, site-specific SUF, and selected TRVs) and the supporting LOEs presented in Table 6-11 (see exposure area-specific appendices for details).

6.6.2.1 Bat Cave Wash

For the BCW potential exposure area, COPECs are listed in Table 3-7, and included nine metals (antimony, hexavalent chromium, total chromium, cobalt, copper, lead, mercury, thallium, and zinc), one VOC (methyl acetate), one SVOC (bis (2-ethylhexyl) phthalate), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs.

The BCW potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline (no scouring), 2-foot scouring, and 5-foot scouring scenarios using depth- and area-weighted EPCs.

Plant screening values are not available for dioxins, total chromium, and methyl acetate. Soil invertebrate screening values are not available for cobalt, thallium and methyl acetate. Avian TRVs are not available for antimony and methyl acetate. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs. Therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the BCW potential exposure area is presented in detail in Appendix BCW, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline and scouring scenarios. The HQs calculated for the BCW potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Tables 6-12 through 6-14 for the baseline, 2-foot scouring, and 5-foot scouring scenarios, respectively. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the BCW potential exposure area. The various LOEs considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix BCW.

6.6.2.1.1 Baseline Scenario

Table 6-12 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant communities – antimony, hexavalent chromium, and thallium
- Soil invertebrate communities – hexavalent chromium and total chromium
- Small mammals – none for granivorous small mammals; antimony, total chromium, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; total chromium, mercury, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-12.

Based on the ecological risk characterization for the BCW potential exposure area in the baseline scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions for the baseline scenario evaluation are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including BCW potential exposure area.
- Potential risks to plants are *de minimis* from exposure to cobalt, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results). The HQ for hexavalent chromium was reduced to 1 using an area-weighted EPC, indicating *de minimis* risk to plant communities from this COPEC as well.
- The HQs based on area-weighted EPCs for antimony and thallium remained the same as the depth-weighted HQs and are greater than 1. Unacceptable risks to plants are unlikely from potential exposure to antimony and thallium based on the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; (3) mean concentrations of these COPECs at the BCW potential exposure area result in HQs less than 1 for plants; and (4) low confidence in the plant screening values for these COPECs and their ability to predict risk.
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). More than 100 different vascular plant species have been observed within the survey area that includes the BCW potential exposure area; documented as Segments D and H in these survey reports (GANDA and CH2M 2013; CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions for the baseline scenario evaluation are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, TPHs (based on BTEX and PAH results), and 2,3,7,8-TCDD. Methyl acetate was not detected in surface soil, where exposure occurs for these potential receptors.
- The HQ for hexavalent chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. For hexavalent chromium, unacceptable risk to soil invertebrate communities is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) very conservative screening level (less than the BTV); (3) low confidence in the invertebrate screening value and its ability to predict risk; and (4) ECs are similar to background and thus, site and background HQs are the same (i.e., no incremental risk).
- The HQ for total chromium was reduced in this evaluation using an area-weighted EPC and is equal to 1. Unacceptable risks to soil invertebrates from potential exposure to total chromium is not expected.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) exposed to COPECs in soil are expected, except for dioxin TEQ for invertivorous small mammals. Conclusions for the baseline scenario evaluations are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the BCW potential exposure area; therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
    - The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of granivorous small mammals at the BCW potential exposure area.
    - Although the depth-weighted NOAEL-based HQ for dioxin TEQ is less than 1, the area-weighted NOAEL-based HQ is greater than 1. The impact of area-weighting on this COPEC is discussed in Section 5.6.3 and in Appendix BCW. For dioxin TEQ, unacceptable risk to individual receptors is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) limited spatial extent of elevated concentrations (including one anomalous concentration in SWMU 1/TCS-4 [Location SWMU1-25; 12,000 ng/kg]) in the BCW potential exposure area surface soil dataset; (3) conservative assumptions used in the risk estimates (e.g., conservative TRVs, dietary composition assumes 100% of a single item diet, bioaccumulation based on a single congener, etc. (see Section 6.7); and (4) T&E species with small home ranges have not been observed at the BCW potential exposure area.
- For the desert shrew (invertivorous small mammals):
    - The area-weighted NOAEL- and LOAEL-based HQs for antimony remained the same as the depth-weighted HQs and are greater than 1. Unacceptable risk to individual and populations of invertivorous small mammals from potential exposure to antimony is unlikely because of the following LOEs: (1) low magnitude of the HQs; (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; (4) the mean concentration at the BCW potential exposure area results in an HQ less than 1; and (5) conservative TRVs were used, which are overly conservative (orders of magnitude less than other available TRVs for antimony (see Section 6.7.5).
    - COPECs with HQs indicative of uncertain risks to individual receptors (i.e., where NOAEL-based HQs are greater than 1 but LOAEL-based HQs are less than 1) included only total chromium. The NOAEL-based HQ for total chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Although TRVs for total chromium are considered robust, unacceptable risk to individual receptors is unlikely for total chromium based on the following LO Es: (1) low magnitude of the NOAEL-based HQ; (2) conservative exposure assumptions used in the risk estimates (e.g., dietary composition assumes 100% of a single item diet and 100%

bioavailability); and (3) T&E species with small home ranges have not been observed at the BCW potential exposure area.

  - The NOAEL- and LOAEL-based HQs for total dioxin TEQ increased in magnitude in this evaluation using an area-weighted EPC and are still greater than 1. The impact of area-weighting on this COPEC is discussed in Section 5.6.3 and in Appendix BCW. There is some uncertainty associated with the dioxin TRVs (i.e., they are based on the lowest available NOAEL and LOAEL doses (see Section 6.7.5) and uptake factors for prey (conservative BAFs, dietary composition assumes 100% of a single item diet (Section 6.7.3), bioaccumulation based on a single congener potentially overestimating HQs by 10 times (see Sections 6.7.4 and 6.7.6), and spatial extent of elevated concentrations (i.e., 10 times the BTV) were limited primarily to SWMU 1. However, the magnitude of the HQs suggests that unacceptable risk is possible for individuals and populations of insectivorous small mammals, even if adjusted for compounding uncertainties associated with BAFs and TRVs (see Section 6.77.6).

Birds

Overall, no unacceptable risk to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil is expected. Conclusions for the baseline scenario evaluations are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4). A single observation of the federal listed southwestern willow flycatcher was made in the Tamarisk Thicket area (north end of BCW) in 2009 (CH2M 2014a); however, this species was considered transient and is not expected to nest or reside in the BCW potential exposure area. Therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the BCW potential exposure area.
- For the cactus wren (insectivorous bird):
  - The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds at the BCW potential exposure area, except for dioxin TEQ.
  - COPECs with HQs indicative of uncertain risks to individual receptors included mercury and total chromium. The NOAEL-based HQs for mercury and total chromium were reduced in this evaluation using area-weighted EPCs but are still greater than 1. Unacceptable risk to individual receptors is unlikely for mercury based on the following LOEs: (1) low FOD; (2) the mean concentration at the BCW potential exposure area results in a NOAEL-based HQ less than 1; (3) low confidence in the TRVs for mercury as they are unlikely to reflect the species of mercury present at the BCW potential exposure area; and (4) no observations of nesting T&E species with small home ranges at the BCW potential exposure area. Similarly, unacceptable risk to individual receptors is unlikely for total chromium based on the following LOEs: (1) low magnitude of the HQs; (2) conservative assumptions used in the risk estimates (e.g., dietary composition assumes 100% of a single item diet and 100% bioavailability); and (3) no observations of nesting T&E species with small home ranges at the BCW potential exposure area.

- The NOAEL- and LOAEL-based HQs for total dioxin TEQ increased in magnitude in this evaluation using an area-weighted EPC and are greater than 1. The impact of area-weighting on this COPEC is discussed in Section 5.6.3 and in Appendix BCW. Unacceptable risk to individual and populations of insectivorous birds is unlikely for dioxin TEQ based on the following LOEs: (1) the LOAEL-based HQ is less than 10 and likely to be reduced to 1 or less if adjusted for the compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 2 to 55 times (see Sections 6.7.4 and 6.7.6), and conservative TRVs (i.e., they are based on the lowest available NOAEL and LOAEL doses (see Section 6.7.5); (2) spatial extent of elevated concentrations were limited to SWMU 1, which are addressed separately for SWMU 1 potential exposure area; and (3) no observations of nesting T&E species with small home ranges at the BCW potential exposure area.

Potential Risk Drivers for BCW Exposure Area in the Baseline Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the BCW potential exposure area in the baseline scenario based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOEs supporting the conclusion of unacceptable risk. As noted previously in this section, unacceptable risk to ecological receptors at the BCW potential exposure area is associated primarily with concentrations of COPECs in soil present in the SWMU 1 potential exposure area.

Potential Receptors and Risk Drivers at BCW Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	**Dioxin TEQ**	None	None

6.6.2.1.2 Potential 2-Foot Scouring Scenario

Table 6-13 presents the HQs for all the COPECs for the potential 2-foot scouring scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Overall, the HQs for the potential 2-foot scouring scenario were similar to or lower than those presented previously for the baseline scenario, except for dioxin TEQ, for which HQs roughly doubled in this scenario. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant community – antimony, hexavalent chromium, and thallium
- Soil invertebrate community – hexavalent chromium, total chromium, and mercury

- Small mammals – none for granivorous small mammals; antimony, total chromium, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; total chromium, mercury, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site–specific SUFs and presented in Table 6-13; however, only the COPECs identified previously for further evaluation using area-weighted EPCs are discussed in this section for each potential receptor.

Based on the ecological risk characterization for the BCW potential exposure area in the 2-foot scouring scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. COPECs with HQs greater than 1 and risk conclusions for the 2-foot scouring scenario evaluation are the same as in the baseline scenario and are as follows:

- Potential risks to plants are *de minimis* from exposure to cobalt, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results). The HQ for hexavalent chromium was reduced to less than 1 using area-weighted EPCs, indicating *de minimis* risk to plant communities at BCW the potential exposure area for this COPEC, as well.
- Unacceptable risks to plants are unlikely from potential exposure to antimony and thallium based on the same WOE as the baseline scenario.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. COPECs with HQs greater than 1 are the same as in the baseline scenario except for mercury. Conclusions for the 2-foot scouring scenario evaluation are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, cobalt, copper, lead, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, TPHs (based on BTEX and PAH results), and 2,3,7,8-TCDD.
- Unacceptable risks to soil invertebrates are unlikely from potential exposure to mercury based on the following LOEs: (1) low confidence in the screening value its ability to predict risk; and (2) low FOD for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk.
- The HQ for hexavalent chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. For hexavalent chromium, unacceptable risk to soil invertebrate communities is considered unlikely based on the same WOE as the baseline scenario. HQ for total chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Unacceptable risks to soil invertebrates from potential exposure to total chromium is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) limited spatial extent of elevated concentrations; and (3) low confidence in the screening value, which likely overestimates risk to soil invertebrates.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected, except for dioxin TEQ for invertivorous small mammals. Conclusions for the 2-foot scouring scenario evaluations, are as follows:

- Potential risks to small mammals are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, mercury, thallium, and zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- For Merriam's kangaroo rat (granivorous small mammal), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous small mammals at the BCW potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - The area-weighted NOAEL- and LOAEL-based HQs for antimony remained the same as depth-weighted HQs and are greater than 1. Unacceptable risk to individual and populations of invertivorous small mammals from potential exposure to antimony is unlikely based on the same WOE as the baseline scenario.
  - COPECs with HQs indicative of uncertain risks to individual receptors (i.e., where NOAEL-based HQs are greater than 1 but LOAEL-based HQs are less than 1) included only total chromium. The NOAEL-based HQ value for total chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Potential risk to individual receptors is unlikely for total chromium based on the same WOE as the baseline scenario.
  - Although the NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced in this evaluation using an area-weighted EPC, they are still greater than 1. Unacceptable risks to individual and populations of invertivorous small mammals to dioxin TEQ at the BCW potential exposure area are possible based on the same WOE as the baseline scenario. The increased HQs for the 2-foot scouring scenario relative to the baseline HQs are related to soil concentrations at three locations (1,100 ng/kg at AOC1-T5D, 1,100 ng/kg at SWMU1-19, and 870 ng/kg at SWMU1-21) collected from 2 to 3 feet bgs that are not included in the surface soil dataset (0 to 0.5 foot bgs) for desert shrew in the baseline scenario.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions for the 2-foot scouring scenario evaluations are as follows:

- Potential risks to birds are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, thallium, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the BCW potential exposure area.
- For the cactus wren (insectivorous bird):

- The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds at the BCW potential exposure area.
- COPECs with HQs indicative of uncertain risks to individual receptors included mercury, total chromium, and dioxin TEQ. The NOAEL-based HQ values for mercury, total chromium, and dioxin TEQ were reduced in this evaluation using area-weighted EPCs but are still greater than 1. Potential risk to individual receptors is unlikely for mercury and total chromium based on the same WOE as the baseline scenario. For dioxin TEQ, unacceptable risk to individual receptors is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) conservative assumptions used in the risk estimates (e.g., conservative TRVs and BAFs, dietary composition assumes 100% of a single item diet, bioaccumulation based on a single congener, etc. (see Sections 6.7.3 through 6.7.5); and (3) T&E species with small home ranges are not resident at the BCW potential exposure area.

Potential Risk Drivers for BCW Exposure Area in the 2-Foot Scouring Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the BCW potential exposure area in the 2-foot scouring scenario based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOEs supporting the conclusion of unacceptable risk. As noted previously in this section, unacceptable risk at the BCW potential exposure area in the 2-foot scouring scenario is associated primarily with COPECs in soil present in the SWMU 1 potential exposure area.

Potential Receptors and Risk Drivers at BCW Exposure Area for the 2-Foot Scouring Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
2-Foot Scouring	None	None	None	**Dioxin TEQ**	None	None

6.6.2.1.3 Potential 5-Foot Scouring Scenario

Table 6-14 presents the HQs for all the COPECs for the potential 5-foot scouring scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Overall, the HQs for the 5-foot scouring scenario were similar to or lower than those presented previously for the baseline scenario. Dioxin TEQ is not a risk driver for the desert shrew. The total chromium HQ for invertebrates roughly doubled in this scenario. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant community – hexavalent chromium and thallium

- Soil invertebrate community – hexavalent chromium and total chromium
- Small mammals – none for granivorous small mammals; antimony, total chromium, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; total chromium, mercury, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site–specific SUFs and presented in Table 6-14; however, only the COPECs identified previously for further evaluation using area-weighted EPCs are discussed in this section for each potential receptor.

Based on the ecological risk characterization for the BCW potential exposure area in the 5-foot scouring scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions for the 5-foot scouring scenario evaluation are as follows:

- Potential risks to plants are *de minimis* from exposure to antimony, cobalt, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results). The HQ for hexavalent chromium was reduced to less than 1 using area-weighted EPCs, indicating *de minimis* risk to plant communities from this COPEC as well.
- Unacceptable risks to plants are unlikely from exposure to thallium based on the same WOE as the baseline scenario.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions for the in the 5-foot scouring scenario evaluation are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony cobalt, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, TPHs (based on BTEX and PAH results), and 2,3,7,8-TCDD.
- The HQ for hexavalent chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. For hexavalent chromium, unacceptable risk to soil invertebrate communities is considered unlikely based on the same WOE as the baseline scenario.
- The HQ for total chromium was reduced in this evaluation using area-weighted EPCs but is still greater than 1. Unacceptable risks to soil invertebrates from exposure to total chromium is unlikely based on the same WOE as the 2-foot scouring scenario. The increased HQs for the 5-foot scouring scenario relative to the baseline and 2-foot scouring scenario HQs are related to high concentrations measured in samples collected from three locations (4,400 mg/kg at Old Well-BCW-2 at 4 to 5 feet bgs, 3,300 mg/kg at TCS4-N at 5 to 6 feet bgs, and 3,200 mg/kg at SWMU1-1 from 5 to 6 feet bgs) that are not included in the surface soil dataset (0 to 0.5 foot bgs) for soil invertebrates in the baseline scenario.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected. Conclusions for the 5-foot scouring scenario evaluations, are as follows:

- Potential risks to small mammals are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, mercury, thallium, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- For Merriam's kangaroo rat (granivorous small mammal), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous small mammals at the BCW potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - COPECs with HQs indicative of uncertain risks to individual receptors included only antimony and total chromium. The HQs for antimony remained the same as the depth-weighted HQs. The NOAEL-based HQ value for total chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Potential risk to individual receptors is unlikely for antimony and total chromium based on the same WOE as the baseline scenario.
  - Although the NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced in this evaluation using an area-weighted EPCs, they are still greater than 1. Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet [see Section 6.7.3]), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times [see Section 6.7.4]), and conservative TRVs (based on the lowest available NOAEL and LOAEL doses [see Section 6.7.5]); and (2) T&E species with small home ranges have not been observed at the BCW potential exposure area.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions for the 5-foot scouring scenario evaluations are as follows:

- Potential risks to birds are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, thallium, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the BCW potential exposure area.
- For the cactus wren (insectivorous bird):

- The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds at the BCW potential exposure area.
- The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced to less than 1 from the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of insectivorous birds at the BCW potential exposure area.
- COPECs with HQs indicative of uncertain risks to individual receptors included mercury and total chromium. The NOAEL-based HQ for mercury remained the same as the depth-weighted HQ. The NOAEL-based HQ values for total chromium were reduced in this evaluation using area-weighted EPCs but is still greater than 1. Potential risk to individual receptors is unlikely for mercury and total chromium based on the same WOE as the baseline scenario.

Potential Risk Drivers for BCW Exposure Area in the 5-Foot Scouring Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the BCW exposure area in the 5-foot scouring scenario, as shown in the table in this section, based on unacceptable community/population-level risk (i.e., COPECs with HQs greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQ greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOEs supporting the conclusion of unacceptable risk. As noted previously in this section, unacceptable risk at the BCW potential exposure area in the 5-foot scouring scenario is primarily associated with COPECs in soil present in the SWMU 1 potential exposure area.

Potential Receptors and Risk Drivers at BCW Exposure Area for the 5-Foot Scouring Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
5-Foot Scouring	None	None	None	None	None	None

6.6.2.2 SWMU 1 and TCS-4

Because the SWMU 1 potential exposure area was evaluated specifically for comparison to the larger BCW potential exposure area, COPECs selected for the BCW potential exposure area were also selected as COPECs for the SWMU 1 potential exposure area, excluding any constituents that were never detected in the SWMU 1 potential exposure area. As listed in Table 3-7, COPECs included eight metals (antimony, hexavalent chromium, total chromium, cobalt, copper, lead, mercury, and zinc), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), and 2,3,7,8-TCDD (for potential ecological communities only), and TPHs. Note that some COPECs for the BCW potential exposure area (thallium, methyl acetate, and bis (2-ethylhexyl) phthalate) were not detected in any soil interval (i.e., 0 to 6 feet bgs) evaluated in the ERA at the SWMU 1 potential exposure area and are not included as COPECs for the SWMU 1 potential exposure area ERA.

The SWMU 1 potential exposure area was evaluated for potential risk plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated only for the baseline scenario (i.e., no scouring) using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD and total chromium; soil invertebrate screening values are not available for cobalt; and avian TRVs are not available for antimony. Therefore, potential risks to these receptors from potential exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (e.g., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the SWMU 1 potential exposure area is presented in detail in Appendix SWMU 1, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the SWMU 1 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-15. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the SWMU 1 potential exposure area. The various LOEs considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix SWMU1.

Table 6-15 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant community – antimony and hexavalent chromium
- Soil invertebrate community – hexavalent chromium, total chromium, and mercury
- Small mammals – total chromium and dioxin TEQ for granivorous small mammals; antimony, total chromium, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; total chromium and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site–specific SUFs and presented in Table 6-15; however, only the COPECs identified previously for further evaluation using area-weighted EPCs are discussed in this section for each potential receptor.

Based on the ecological risk characterization for the SWMU 1 potential exposure area using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants except for hexavalent chromium. Conclusions for the baseline scenario evaluation are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the SWMU 1 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to cobalt, copper, lead, mercury, zinc, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- Unacceptable risks to plants are unlikely from exposure to antimony. There is low confidence in the plant screening value and its ability to predict risk. Antimony was infrequently detected. For areas where a constituent is largely not detected, use of a maximum may not appropriately characterize site risk. The mean concentrations of antimony at the SWMU 1 potential exposure area result in HQ less than 1 for plants.
- The HQ for hexavalent chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Unacceptable risks to plants are possible from potential exposure to hexavalent chromium. Although there is low confidence in the plant screening level and its ability to predict risk to plants, hexavalent chromium was frequently detected at the SWMU 1 potential exposure area at concentrations exceeding background and the screening level. Six locations in surface soil and 11 locations in subsurface 1 soil have depth-weighted concentrations more than 10 times the BTV.

Soil Invertebrate Communities

Overall, no unacceptable risk to soil invertebrates is expected except for hexavalent chromium and total chromium. Conclusions for the in the baseline scenario evaluation, are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, copper, lead, mercury, zinc, PAHs, PCBs, TPHs (based on BTEX and PAH results), and 2,3,7,8-TCDD.
- The HQ for mercury remained the same as using the depth-weighted EPC. Unacceptable risk to soil invertebrates from exposure to mercury is unlikely because of the following LOEs: (1) low FOD; (2) for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQ; and (3) low confidence in the ability of the screening level to predict risk to soil invertebrate communities.
- HQ values for hexavalent chromium and total chromium were reduced in this evaluation using area-weighted EPCs but are still greater than 1. Unacceptable risks to soil invertebrates from exposure to hexavalent chromium and total chromium are possible. Although there is low confidence in the soil invertebrate screening values for these COPECs and the hexavalent chromium screening level is less than background, both of these COPECs were frequently detected at SWMU 1 at concentrations exceeding background in many locations of the exposure area and the HQs are relatively high in magnitude.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) exposed to COPECs in soil are expected, except for dioxin TEQ for granivorous small mammals and total chromium and dioxin TEQ for invertivorous small mammals. Conclusions for the baseline scenario evaluations, are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the SWMU 1 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.

- For Merriam's kangaroo rat (granivorous small mammal):
  - Potential risks are *de minimis* from exposure to antimony, hexavalent chromium, cobalt, copper, lead, mercury, zinc, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
  - The NOAEL-based HQ for total chromium was reduced to 1 using the area-weighted EPC, indicating *de minimis* risk to individuals and populations of granivorous small mammals.
  - COPECs with HQs indicative of uncertain risks to individual receptors included dioxin TEQ. The LOAEL-based HQ for dioxin TEQ was reduced to less than 1 using the area-weighted EPC, indicating *de minimis* risk to populations of granivorous small mammals. The area-weighted NOAEL-based HQ for dioxin TEQ was reduced using an area-weighted EPC; however, it is still great than 1. Unacceptable risk to individual receptors is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) limited spatial extent of elevated concentrations (five locations greater than 10 times the BTV, including one anomalous concentration in SWMU1/TCS-4 [Location SWMU1-25; 12,000 ng/kg]) in the soil dataset; (3) conservative assumptions used in the risk estimates (BAFs and TRVs; see Sections 6.7.4 and 6.7.5); and (4) T&E species with small home ranges have not been observed at the SWMU 1 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - Potential risks are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, mercury, zinc, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
  - The area-weighted NOAEL- and LOAEL-based HQs for antimony remained the same as depth-weighted HQs and are greater than 1. Unacceptable risk to individual and populations of invertivorous small mammals from exposure to antimony is unlikely because of the following LOEs: (1) low HQs; (2) low FOD; (3) use of the maximum depth-weighted concentration likely overestimates the HQs; (4) the mean concentration at the SWMU 1 potential exposure area results in an HQ less than 1; and (5) overly conservative TRVs were used, which are orders of magnitude less than other available TRVs for antimony (see Section 6.5.5).
  - Although the NOAEL- and LOAEL-based HQs were reduced for total chromium and dioxin TEQ from the depth-weighted evaluation, they are still greater than 1. Unacceptable risk to invertivorous small mammals is possible from exposure to total chromium based on the following LOEs: (1) elevated depth-weighted concentrations (more than 10 times the BTV) are present at 13 surface soil locations in SWMU1; and (2) total chromium TRVs are considered robust and there is confidence in the risk estimates. For dioxin TEQ, although there is some uncertainty associated with the dioxin TRVs (based on the lowest available NOAEL- and LOAEL-based doses; see Section 6.7.5) and BAFs (potentially overestimating HQs by about 10 times) for dietary items (Sections 6.7.3 and 6.7.4), the magnitude of the HQs suggests that unacceptable risk is possible for individuals and populations of insectivorous small mammals, even if adjusted for compounding uncertainties associated with BAFs and TRVs (see Section 6.7.6). However, the spatial extent of the elevated concentrations for dioxin TEQ is limited to five locations.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) exposed to COPECs in soil are expected except for dioxin TEQ for insectivorous birds. Conclusions for the baseline scenario evaluations are as follows:

- Potential risks to birds are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, mercury, zinc, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the SWMU 1 potential exposure area and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the SWMU 1 potential exposure area.
- For the cactus wren (insectivorous bird):
  - The LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds at SWMU 1 potential exposure area, except for dioxin TEQ.
  - COPECs with HQs indicative of uncertain risks to individual receptors included total chromium. The NOAEL-based HQ for total chromium was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Potential risk to individual receptors is unlikely for total chromium based on the following LOEs: (1) low magnitude of the HQs; (2) conservative assumptions used in the risk estimates; and (3) no observations of T&E species with small home ranges at the SWMU 1 potential exposure area.
  - The NOAEL- and LOAEL-based HQs were reduced for dioxin TEQ from the depth-weighted evaluation, but they are still greater than 1. Unacceptable risk to individual and populations of insectivorous birds is unlikely for dioxin TEQ based on the following LOEs: (1) LOAEL-based HQ is less than 10 and likely to be reduced to 1 or less if adjusted for the compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 2-55 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL- and LOAEL-based doses; see Section 6.7.5); (2) spatial extent of elevated concentrations were limited to five locations; and (3) no observations of nesting T&E species with small home ranges at the SWMU 1 potential exposure area.

Potential Risk Drivers for SWMU 1 Exposure Area in the Baseline Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the SWMU 1 exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQ greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at SWMU 1 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	**Chromium-6**	**Chromium-6, total chromium**	None	**Total chromium, dioxin TEQ**	None	None

6.6.2.3 Bat Cave Wash Excluding SWMU1 and TCS-4

Because the BCWxSWMU1 potential exposure area was evaluated specifically for comparison to the larger BCW potential exposure area, COPECs selected for the BCW potential exposure area were also selected as COPECs for the BCWxSWMU1 potential exposure area, excluding any constituents that were never detected in the BCWxSWMU1 potential exposure area. As listed in Table 3-7, COPECs included eight metals (hexavalent chromium, total chromium, cobalt, copper, lead, mercury, thallium, and zinc), one VOC (methyl acetate), one SVOC (bis (2-ethylhexyl) phthalate, LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs. Note that one COPEC for the BCW potential exposure area (antimony) was not detected in any soil interval (i.e., 0 to 6 feet bgs) evaluated in the ERA at the BCWxSWMU1 potential exposure area and is not included as a COPEC in the BCWxSWMU1 potential exposure area ERA.

Plant screening values are not available for dioxins, total chromium, and methyl acetate; soil invertebrate screening values are not available for cobalt, thallium, and methyl acetate; and avian TRVs are not available for methyl acetate. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs; therefore, indicator chemicals (e.g., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the BCWxSWMU1 potential exposure area is presented in detail in Appendix BCWxSWMU1, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the BCWxSWMU1 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Tables 6-16. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the BCWxSWMU1 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix BCWxSWMU1.

Table 6-16 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant community – thallium
- Soil invertebrate community – none
- Small mammals – none for granivorous small mammals; dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; mercury and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site –specific SUFs and presented in Table 6-16; however, only the COPECs identified previously for further evaluation using area-weighted EPCs are discussed in this section for each potential receptor.

Based on the ecological risk characterization for the BCWxSWMU1 potential exposure area in the baseline scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk is expected for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the BCWxSWMU1 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to hexavalent chromium, cobalt, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
- The HQ for thallium remained the same as the depth-weighted HQs and is greater than 1. Unacceptable risks to plants are unlikely from exposure to thallium based on the following LOEs: (1) low FOD; (2) for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQ; (3) low confidence in the plant screening value and its ability to predict risk; and (4) the mean concentration of thallium at the BCWxSWMU1 potential exposure area results in an HQ of 1 for plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to hexavalent chromium, total chromium, copper, lead, mercury, zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, TPHs (based on BTEX and PAH results), and 2,3,7,8-TCDD. Methyl acetate was not detected in surface soil, where exposure occurs for these receptors.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the BCWxSWMU1 potential exposure area and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of granivorous small mammals.
- For the desert shrew (invertivorous small mammals):
  - Potential risks are *de minimis* from exposure to hexavalent chromium, total chromium, cobalt, copper, lead, mercury, thallium, and zinc, bis (2-ethylhexyl) phthalate, PAHs, PCBs, and TPHs (based on BTEX and PAH results).
  - The NOAEL- and LOAEL-based HQs for total dioxin TEQ remained the same in this evaluation using an area-weighted EPC because area-weighting had little effect on the EPCs. The HQs are still greater than 1. Unacceptable risk to invertivorous small mammals from potential exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL and LOAEL doses; see Section 6.7.5); (2) spatial extent of elevated concentrations (greater than 10 times the BTV) were limited to eight locations, primarily around the SWMU 1 potential exposure area and near the confluence of AOC4 and BCW near the gabion locations; and (3) T&E species with small home ranges have not been observed in this area.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) exposed to COPECs in soil are expected for insectivorous birds. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4). A single observation of the federally listed southwestern willow flycatcher was made in the Tamarisk Thicket area (north end of BCW) in 2009 (CH2M 2014a; GANDA 2017); however, this species was considered transient and is not expected to nest or reside in BCW. Therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.

- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the BCWxSWMU1 potential exposure area.
- For the cactus wren (insectivorous bird):
  - The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds.
  - COPECs with HQs indicative of uncertain risks to individual receptors included mercury and dioxin TEQ. The NOAEL-based HQ for mercury is the same as the depth-weighted evaluation, and still greater than 1. Potential risk to individual receptors is unlikely for mercury based on the following LOEs: (1) low FOD; (2) for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQ; (3) low confidence in the TRVs for mercury as they are unlikely to reflect the species of mercury present at the BCWxSWMU1 potential exposure area and predict risk at the RL (a BTV is unavailable); and (4) no observations of nesting T&E species with small home ranges at the BCWxSWMU1 potential exposure area.
  - The NOAEL-based HQ for total dioxin TEQ remained the same in this evaluation using an area-weighted EPC because area-weighting had little effect on the EPCs. The NOAEL-based HQ is still greater than 1. Although there is some uncertainty associated with the dioxin TRVs and uptake factors for prey, unacceptable risks to individual receptors from dioxin TEQ at the BCWxSWMU1 potential exposure area is unlikely because of the following LOEs: (1) low HQs; (2) conservative assumptions used in the risk estimates (TRVs and BAF; see Section 6.7); (3) limited spatial extent of elevated concentrations; and (4) T&E species with small home ranges have not been observed at the BCWxSWMU1 potential exposure area.

Potential Risk Drivers for BCWxSWMU1 Exposure Area

As presented in Table 6-11, and summarized in the table in this section, no potential risk drivers were identified for the BCWxSWMU1 potential exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQ greater than 10 for dioxin TEQ) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk. This supports the conclusions for the BCW potential exposure area, that unacceptable risk at the BCW potential exposure area is primarily associated with COPECs in soil present in SWMU 1/TCS-4.

Potential Receptors and Risk Drivers at BCWxSWMU1 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.4 AOC4

For the AOC4 potential exposure area, COPECs are listed in Table 3-7 and included 11 metals (antimony, barium, hexavalent chromium, total chromium, cobalt, copper, lead, mercury, nickel, vanadium, and zinc), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), and 2,3,7,8-TCDD (for potential ecological communities only).

The AOC4 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs. Note that in parts of the AOC4 potential exposure area, extensive soil removal was performed as part of the 2009-2010 TCRA. The TCRA for AOC4, completed in 2010, is expected to be consistent with and contribute to any subsequent remedial action selected to respond to contaminated soils that are the subject of the ongoing RFI/RI. Soil samples remaining in place are available for the 0- to 3-foot bgs interval and were evaluated in this ERA; bedrock is present below 3 feet bgs in this area.

Plant screening values are not available for dioxins and total chromium; soil invertebrate screening values are not available for cobalt and vanadium; and avian TRVs are not available for antimony and barium. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the AOC4 potential exposure area is presented in detail in Appendix AOC4, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the AOC4 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-17. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC4 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC4.

Table 6-17 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant communities – vanadium and HMW PAHs
- Soil invertebrate Communities – none
- Small mammals – none for granivorous small mammals; antimony, nickel, HMW PAHs, PCBs, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; PCBs for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-17.

Based on the ecological risk characterization for the AOC4 potential exposure area using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the AOC4 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to antimony, hexavalent chromium, barium, copper, cobalt, lead, mercury, nickel, zinc, LMW PAHs, PCBs, and 2,3,7,8-TCDD. The HQ for HMW PAHs was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* risk to plant communities from this COPEC as well at the AOC4 potential exposure area.
- The HQ for vanadium did not change from the depth-weighting evaluation and is still greater than 1. Unacceptable risk to plants from exposure to vanadium is unlikely based on the following LOEs: (1) low confidence in the plant screening value and its ability to predict risk (based on a secondary report citing unspecified toxic effects in plants); (2) very conservative screening level for plants (more than 25 times less than the BTV); and (3) ECs similar to background.
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). More than 100 different vascular plant species have been observed within the survey area that includes the AOC4 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013; CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, barium, total chromium, cobalt, copper, lead, mercury, nickel, zinc, LMW PAHs, PCBs, and 2,3,7,8-TCDD (for ecological communities) in soil at the AOC4 potential exposure area.
- Although the depth-weighted HQ for hexavalent chromium is equal to 1, the area-weighted HQ is greater than 1. The impact of area-weighting on this COPEC is discussed in Section 5.6.3 and in Appendix AOC4. For hexavalent chromium, unacceptable risk to soil invertebrate communities is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) very conservative screening level (less than the BTV); (3) low confidence in the invertebrate screening value and its ability to predict risk; and (4) ECs are similar to background.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC4 potential exposure area; therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of granivorous small mammals at the AOC4 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - Potential risks to individuals and populations of invertivorous small mammals are *de minimis* for all COPECs (hexavalent chromium, cobalt, copper, lead, mercury, thallium, and zinc, bis(2-ethylhexyl) phthalate, LMW PAHs, PCBs, and TPH) except for antimony, nickel, and dioxin TEQ. The NOAEL-based HQs for HMW PAHs and PCBs were reduced to less than 1 using area-weighted EPCs, indicating *de minimis* risk to invertivorous small mammals from these COPECs as well at the AOC4 potential exposure area.
  - COPECs with HQs indicative of uncertain risks to individual receptors included antimony. The NOAEL-based HQ remained the same as the depth-weighted HQ and is greater than 1. Unacceptable risk to individual receptors is unlikely based on the following LOEs: (1) low FOD; (2) EPC based on the maximum depth-weighted EPC; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; (3) TRVs were considered overly conservative (orders of magnitude lower than other published values; see Section 6.7); and (4) T&E species with small home ranges have not been observed at the AOC4 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for nickel remained the same as the depth-weighted HQs and are greater than 1. Unacceptable risk to invertivorous small mammals from exposure to nickel is unlikely based on the following LOEs: (1) low magnitude of the HQs; (2) ECs are similar to background; (3) moderate confidence in the TRVs; and (4) T&E species with small home ranges have not been observed at the AOC4 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighted evaluation but are still greater than 1. Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL and LOAEL

doses; see Section 6.7.5); (2) elevated TEQ concentrations limited in spatial extent; and (3) T&E species with small home ranges have not been observed at the AOC4 potential exposure area. Note, a large part of the AOC4 potential exposure area has previously been remediated under the TCRA to address elevated dioxin TEQ concentrations in soil.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC4 potential exposure area; therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC4 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks to individual and populations of insectivorous birds are *de minimis* for all COPECs except for PCBs, same as in the depth-weighted evaluation.
  - COPECs with HQs indicative of uncertain risks to individual receptors included PCBs. The NOAEL-based HQ for PCBs was reduced in this evaluation using an area-weighted EPC but is still greater than 1. Unacceptable risk from PCBs to individual receptors is unlikely for PCBs based on the following LOEs: (1) low magnitude of the HQs; (2) conservative assumptions used in the risk estimates (e.g., TRVs based on test species sensitive to PCBs, dietary composition assumes 100% of a single item; see Section 6.7); and (3) T&E species with small home ranges have not been observed at the AOC4 potential exposure area.

Potential Risk Drivers for AOC4 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC4 potential exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at the AOC4 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.5 AOC9

For the AOC9 potential exposure area, COPECs are listed in Table 3-7 and included 10 metals (antimony, arsenic, hexavalent chromium, total chromium, copper, lead, mercury, nickel, thallium, and zinc), one SVOC (isophorone), LMW PAHs, HMW PAHs, one pesticide (4,4-DDE), PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs.

The AOC9 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD and total chromium; soil invertebrate screening values are not available isophorone; mammalian TRVs are not available for isophorone; and avian TRVs are not available for antimony or isophorone. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs; therefore, indicator chemicals (e.g., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the AOC9 potential exposure area is presented in detail in Appendix AOC9, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the AOC9 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-18. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC9 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC9.

Table 6-18 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant community – antimony, hexavalent chromium, copper, mercury, thallium, zinc, and HMW PAHs/TPHs
- Soil invertebrate community – hexavalent chromium, total chromium, copper, mercury, and zinc
- Small mammals – dioxin TEQ for granivorous small mammals; antimony, hexavalent chromium, total chromium, copper, nickel, HMW PAHs/TPHs, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; hexavalent chromium, total chromium, copper, mercury, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-18.

Based on the ecological risk characterization for the AOC9 potential exposure area, using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species, except for hexavalent chromium and copper. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the AOC9 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to arsenic, lead, nickel, PCBs, LMW PAHs, and 4,4-DDE at the AOC9 potential exposure area. The HQ for zinc was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* risk to plant communities from this COPEC as well.
- The HQs for antimony and thallium did not change from the depth-weighted evaluation and are greater than 1. Unacceptable risks to plants from exposure to antimony and thallium are unlikely based on the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted EPCs; for areas where a constituent is largely not detected, use of a maximum concentrations can potentially overestimate HQs; (3) the mean concentrations of these COPECs at the AOC9 potential exposure area results in HQs less than or equal to 1; (4) low confidence in screening values to predict risk; and (5) limited spatial extent of elevated concentrations (detected in one location only).
- The HQ for mercury remained the same as in the depth-weighted evaluation and is still greater than 1. Unacceptable risk to plants from exposure to mercury is unlikely based on the following LOEs: (1) low FOD; (2) elevated concentrations limited to a single location (35 mg/kg at AOC10-21); and (3) low confidence in the screening level to predict risk to plants.
- The HQ for hexavalent chromium remained the same as in the depth-weighted evaluation and is still greater than 1. Although there is low confidence in the screening value and its ability to predict risk to plants and elevated concentrations were limited primarily to a few locations along the perimeter fenceline, unacceptable risk from exposure to hexavalent chromium is possible based on the following LOEs: (1) frequently detected at the AOC9 potential exposure area at concentrations exceeding the BTV; and (2) high magnitude of the HQs. Elevated concentrations (greater than 10 times the BTV) are limited to a few locations along the perimeter of the TCS. For hexavalent chromium these are: AOC10-20 (2,700 mg/kg), #10 (114 mg/kg), and AOC9-8 (48.6 mg/kg).
- The HQ for copper was slightly reduced in the area-weighted evaluation but is still greater than 1. Although elevated concentrations were limited primarily to a few locations along the perimeter fenceline and the HQ is low in magnitude, unacceptable risk to plants from exposure to copper is possible based on the following LOEs: (1) frequently detected at the AOC9 potential exposure area at concentrations exceeding the BTV; and (2) confidence in the copper screening value to predict risk. Elevated concentrations (greater than 10 times the BTV) are limited to a few locations along the perimeter of the TCS. For copper, these are: AOC10-21 (3,100 mg/kg), AOC10a-1 (270 mg/kg), PA-19 (160 mg/kg), and AOC10-23 (140 mg/kg).
- For HMW PAHs, the HQ was reduced in the area-weighted evaluation but is still greater than 1. Unacceptable risk to plants from exposure to HMW PAH is considered unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) low confidence in the screening level to predict risk; and (3) limited spatial extent of elevated concentrations. Elevated concentrations (greater than 10 times the

BTV) are primarily located in the perimeter area locations (PA18 through PA-21 and AOC10a-1, ranging from 5.9 to 32.9 mg/kg). Risk conclusions for TPHs are the same as for HMW PAHs.

- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). More than 100 different vascular plant species have been observed within the survey area that includes the AOC9 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013; CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected except for hexavalent chromium, total chromium, and copper. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, arsenic, lead, nickel, PCBs, LMW PAH, HMW PAH, 4,4-DDE, and 2,3,7,8-TCDD at the AOC9 potential exposure area. Thallium was not detected in surface soil, where exposure occurs for this receptor. The HQ for zinc was reduced to 1 using an area-weighted EPC, indicating *de minimis* risk to soil invertebrate communities from this COPEC as well.
- The HQ for mercury remained the same as in the depth-weighted evaluation and is still greater than 1. Unacceptable risk to soil invertebrates from exposure to mercury is unlikely based on the following LOEs: (1) low FOD; (2) elevated concentrations limited to a single location (35 mg/kg at AOC10-21); and (3) low confidence in the screening level to predict risk to invertebrates.
- The HQ for copper was slightly reduced in the area-weighted evaluation but is still greater than 1. Although elevated concentrations were limited primarily to a few locations along the perimeter fenceline and the HQ is low in magnitude, unacceptable risk to soil invertebrates from potential exposure to copper is possible based on the following LOEs: (1) frequently detected at the AOC9 potential exposure area at concentrations exceeding background; and (2) confidence in the copper screening value to predict risk. Unacceptable risk to soil invertebrate communities is likely driven by elevated concentrations in a few locations along the perimeter of the TCS (listed previously for plants).
- The HQ for total chromium remained the same as in the depth-weighted evaluation and the HQ for hexavalent chromium was reduced; however, they are still greater than 1. Although confidence in the screening values for these COPECs is low, unacceptable risks to soil invertebrates from exposure to hexavalent chromium and total chromium are possible because of the following LOEs: (1) frequently detected above the BTV; and (2) high HQs due to the presence of elevated concentrations at a few locations near the perimeter of the TCS. For hexavalent chromium, these locations are listed previously for plants. For total chromium, high concentrations were primarily in two locations: AOC10-20 (2,800 mg/kg) and #10 (398 mg/kg).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected except for total chromium and dioxin TEQ for invertivorous small mammals. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC9 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs. For dioxin TEQ, the NOAEL-based HQ was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* risk to individual and populations of granivorous small mammals for all COPECs at the AOC9 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - Potential risks are *de minimis* from exposure to arsenic, lead, mercury, thallium, zinc, PCBs, LMW PAH, 4,4-DDE, and TPHs (based on BTEX and PAH results).
  - COPECs with HQs indicative of uncertain risks to individual receptors included hexavalent chromium, nickel, and HMW PAHs. Unacceptable risk to invertivorous small mammal populations from potential exposure to these COPECs are not expected because the LOAEL-based HQs are less than or equal to 1. For individual receptors, unacceptable risk is considered unlikely based on the following LOEs: (1) low HQs; (2) limited spatial extent of elevated concentrations; (3) conservative TRVs, especially for HMW PAHs (see Section 6.7.5); (4) conservative dietary assumptions (100% earthworms; see Section 6.7.3); (5) nickel concentrations similar to background; and (6) T&E species with small home ranges have not been observed at the AOC9 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for antimony remained the same as the depth-weighted evaluation, and still greater than 1. Unacceptable risk to invertivorous small mammals is unlikely from exposure to antimony based on the following LOEs: (1) low FOD; (2) EPC based on the maximum depth-weighted EPC; for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQ; (3) the mean concentration at the AOC 9 potential exposure area results in an HQ less than 1; (4) TRVs were considered overly conservative (orders of magnitude lower than other published values; see Section 6.7.5); and (5) T&E species with small home ranges have not been observed at the AOC9 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for total chromium and copper were reduced from the depth-weighted evaluation but are still greater than 1. Although the LOAEL-based HQs are low in magnitude and elevated concentrations are limited in spatial extent, unacceptable risk to invertivorous mammals from exposure to total chromium and copper is possible based primarily on moderate to high confidence in the TRVs to predict risk and anomalous concentrations at a few locations. The spatial extent of the elevated concentrations (greater than 10 times the BTV)

for these COPECs were limited a few locations. For copper, these are: AOC10-21 (3,100 mg/kg), AOC10a-1 (270 mg/kg), PA-19 (160 mg/kg), and AOC10-23 (140 mg/kg). For total chromium, these are: AOC10-20 (2,800 mg/kg) and #10 (398 mg/kg).

  - The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighted evaluation but are still greater than 1. Although there is some uncertainty associated with the dioxin TRVs (considered very conservative, based on the lowest available NOAEL- and LOAEL-based doses; see Section 6.7.5) and uptake factors for prey (conservative BAFs, dietary composition assumes 100% of a single item diet [Section 6.7.3], bioaccumulation based on a single congener potentially overestimating HQs by 10 times; see Section 6.7.4), and spatial extent of elevated concentrations were limited to a few locations: PA18 through PA-21 (ranging from 220 ng/kg to 1,600 ng/kg) and AOC10-23 (1,100 ng/kg). Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is possible based primarily on the high magnitude of the HQs (LOAEL-based HQ greater than 10), even if adjusted for compounding uncertainties associated with diet composition, BAFs, and TRVs (see Section 6.7.6).

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC9 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC9 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks are *de minimis* from exposure to arsenic, lead, nickel, zinc, PCBs, PAHs, 4,4-DDE, and TPHs (based on BTEX and PAH results).
  - COPECs with HQs indicative of uncertain risks to individual receptors included hexavalent chromium, total chromium, copper, mercury, and dioxin TEQ. Unacceptable risk to insectivorous bird populations from exposure to these COPECs is not expected because the LOAEL-based HQs are less than or equal to 1, same as the depth-weighted evaluation. For individual receptors, unacceptable risk from hexavalent chromium, total chromium, copper, mercury, and dioxin TEQ is considered unlikely based on the following LOEs: (1) low magnitude of the HQs; (2) limited spatial extent of elevated concentrations; (3) conservative assumptions incorporated in the ERA (see Section 6.7); and (4) T&E species with small home ranges have not been observed at the AOC9 potential exposure area. The spatial extent of the elevated concentrations for these COPECs were limited a few locations (listed previously for the desert shrew).

Potential Risk Drivers for AOC9 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the AOC9 potential exposure area, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC9 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	**Chromium-6, copper**	**Chromium-6, total chromium, copper**	None	**Total chromium, copper, dioxin TEQ**	None	None

6.6.2.6 AOC10

For the AOC10 potential exposure area, COPECs are listed in Tables 3-7, and included 10 metals (antimony, arsenic, hexavalent chromium, total chromium, copper, lead, manganese, mercury, thallium, and zinc), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs.

The AOC10 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline, 2-foot scouring, and 5-foot scouring scenarios using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD and total chromium; soil invertebrate screening values are not available for thallium; and avian TRVs are not available for antimony. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the AOC10 potential exposure area is presented in detail in Appendix AOC10, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline and scouring scenarios. The HQs calculated for the AOC10 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site–specific SUFs are presented in Tables 6-19 through 6-21. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC10 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC10.

6.6.2.6.1 Baseline Scenario

Table 6-19 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant communities – hexavalent chromium, manganese, and thallium
- Soil invertebrate communities – hexavalent chromium and total chromium
- Small mammals – total chromium for granivorous small mammals; total chromium and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; total chromium and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs, and are presented in Table 6-19.

Based on the ecological risk characterization for the AOC10 potential exposure area in the baseline scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risks to plant communities from exposure to COPECs are expected except for hexavalent chromium. Conclusions for the baseline scenario evaluation, are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the AOC10 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to antimony, arsenic, copper, lead, mercury, zinc, PAHs, total PCBs, and TPHs.
- The HQ for thallium did not change from the depth-weighting evaluation and is still greater than 1. Unacceptable risk to plants from exposure to thallium is unlikely based on the following LOEs: (1) low FOD; (2) EPC based on the maximum depth-weighted EPC; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; and (3) low confidence in the plant screening value and its ability to predict risk (based on a secondary report citing unspecified toxic effects in plants).
- The HQ for manganese was reduced from the depth-weighting evaluation but is still greater than 1. Unacceptable risk to plants from exposure to manganese is unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) detected at concentrations frequently less than the BTV; and (3) very conservative plant screening value (approximately two times lower than the BTV); (4) low confidence in the plant screening value and its ability to predict risk; and (5) HQ similar to the background HQ.
- The HQ for hexavalent chromium was reduced from the depth-weighting evaluation but is still greater than 1. Although there is low confidence in the plant screening level to predict toxicity to plant

communities, unacceptable risk to plants from exposure to hexavalent chromium is possible based primarily on the high magnitude of the HQ. Hexavalent chromium was frequently detected at the AOC 10 potential exposure area at concentrations exceeding background and the screening level. Four locations in surface soil (31.5 mg/kg at DTSC-AOC10d-1, 27.7 mg/kg at AOC10b-3, 13 mg/kg at AOC10-12, and 9.4 mg/kg at L-3-2) and 10 locations (concentrations range from 9.4 to 150 mg/kg) in subsurface 1 soil have depth-weighted concentrations more than 10 times the BTV.

- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). More than 100 different vascular plant species have been observed within the survey area that includes the AOC10 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013; CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates from potential exposure to COPECs are expected except for total chromium and hexavalent chromium. Conclusions for the baseline scenario evaluation, are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to arsenic, copper, lead, manganese, zinc, PAHs, total PCBs, 2,3,7,8-TCDD, and TPHs. Antimony, mercury, and thallium were not detected in surface soil, where exposure occurs for these receptors.
- The HQ for hexavalent chromium did not change and the HQ for total chromium was reduced from the depth-weighting evaluation, but they are still greater than 1. Although there is low confidence in the screening levels for these COPECs to predict toxicity to soil invertebrate communities, unacceptable risks to soil invertebrate communities from exposure to hexavalent chromium and total chromium are possible based primarily on the high magnitude of the HQs. Hexavalent and total chromium was frequently detected at the AOC10 potential exposure area at concentrations exceeding background and the screening levels. In surface soil, four locations have depth-weighted hexavalent chromium concentrations more than 10 times the BTV (31.5 mg/kg at DTSC-AOC10d-1, 27.7 mg/kg at AOC10b-3, 13 mg/kg at AOC10-12, and 9.4 mg/kg at L-3-2) and three locations have depth-weighted total chromium concentrations more than 10 times the BTV (652 mg/kg at DTSC-AOC10d-1, 820 mg/kg at AOC10b-3, and 460 mg/kg at AOC10-12).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected except for dioxin TEQ for invertivorous small mammals. Conclusions for the baseline scenario evaluations, are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC10 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - Potential risks to individuals and populations of granivorous small mammals are *de minimis* for all COPECs (antimony, arsenic, hexavalent chromium, total chromium, copper, lead, manganese, mercury, thallium, zinc, LMW PAHs, HMW PAHs, PCBs, dioxin TEQ, and TPHs), except for total chromium. The NOAEL-based HQs for total chromium was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* to granivorous small mammals from total chromium as well at the AOC10 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - Potential risks to individuals and populations of invertivorous small mammals are *de minimis* for all COPECs (arsenic, hexavalent chromium, total chromium, copper, lead, manganese, zinc, LMW PAHs, HMW PAHs, PCBs, and TPHs), except for total chromium and dioxin TEQ. Antimony, mercury, and thallium were not detected in surface soil, where exposure occurs for these receptors.
  - COPECs with HQs indicative of uncertain risks to individual receptors included total chromium. The NOAEL-based HQ for total chromium was reduced from the depth-weighting evaluation but is still greater than 1. Unacceptable risk to individual invertivorous small mammals is unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) EPCs likely overestimate risk; the AOC10 potential exposure area is composed of four subareas along the course of a steep ravine; the EPCs were based on exposure to these subareas only and did not account for the unimpacted areas in between the subareas, where receptors could be exposed, and therefore estimated HQs are likely are biased high; (3) the exposure parameters assumed for this receptor are conservative (e.g., 100% invertebrate diet, instead of a mixed diet and invertebrate BAFs based on earthworm uptake only, instead of mixed invertebrate species that are more likely encountered at the AOC10 potential exposure area; see Section 6.7.3); and (4) T&E species with small home ranges have not been observed at the AOC10 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighted evaluation but are still greater than 1. Although there is some uncertainty associated with the dioxin TRVs (considered very conservative, based on the lowest available NOAEL- and LOAEL-based doses; see Section 6.7.5) and uptake factors for prey (conservative BAFs, dietary composition assumes 100% of a single item diet [Section 6.7.3], bioaccumulation based on a single congener potentially overestimating HQs by 10 times; see Section 6.7.4), and spatial extent of elevated concentrations (greater than 10 times the BTV) were limited to two locations: AOC10-15 (290 ng/kg) and AOC10c-4 (360 ng/kg), unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is possible based primarily on the high magnitude of the HQs (LOAEL-based HQ greater than 10), even if adjusted for compounding uncertainties associated with diet composition, BAFs, and TRVs (see Section 6.7.6).

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions for the baseline scenario evaluations are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC10 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC10 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks to individual and populations of insectivorous birds are *de minimis* for all COPECs except for total chromium and dioxin TEQ, same as in the depth-weighted evaluation.
  - COPECs with HQs indicative of uncertain risks to individual receptors included total chromium, mercury, total PCBs, and dioxin TEQ. The NOAEL-based HQs for these COPECs were reduced in this evaluation using area-weighted EPCs but are still greater than 1. Unacceptable risk to individual receptors is unlikely for total chromium and dioxin TEQ based on the following LOEs: (1) low magnitude of the HQs; (2) conservative assumptions used in the risk estimates (e.g., dietary composition assumes 100% of a single item diet, bioaccumulation based on a single congener for dioxins, and very conservative TRVs and BAFs; see Section 6.7.6); and (3) T&E species with small home ranges have not been observed at the AOC10 potential exposure area.

Potential Risk Drivers for AOC10 Exposure Area in the Baseline Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the AOC10 potential exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQ greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk. As noted previously in this section, elevated concentrations of hexavalent chromium and dioxin TEQ are present in a few locations. These locations are primarily located within the drainage depressions (i.e., subareas AOC10b, c, and d) behind the berms at the AOC10 potential exposure area.

Potential Receptors and Risk Drivers at AOC10 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	**Chromium-6**	**Chromium-6, total chromium**	None	**Dioxin TEQ**	None	None

6.6.2.6.2 Potential 2-Foot Scouring Scenario

Table 6-20 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Overall, the HQs for the 2-foot scouring scenario were similar to or lower than those presented previously for the baseline scenario for many COPEC, except for hexavalent chromium and total chromium for which HQs increased in this scenario. Antimony, copper, mercury, and total PCBs also had HQs greater than 1 for at least one receptor in the 2-foot scouring scenario, whereas these COPECs had HQs less than 1 in the baseline scenario. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant communities – hexavalent chromium and thallium
- Soil invertebrate communities – hexavalent chromium, total chromium, and mercury
- Small mammals – none for granivorous small mammals; antimony, total chromium, PCBs, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; copper, total chromium, mercury, PCBs, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-20. COPECs for the 2-foot scouring scenario are the same as the baseline, except for manganese, as it was only detected in 0 to 2 feet bgs in the baseline scenario.

Based on the ecological risk characterization for the AOC10 potential exposure area in the 2-foot scouring scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risks to plant communities from potential exposure to COPECs are expected except for hexavalent chromium, same as in the baseline scenario. Conclusions for the 2-foot scouring scenario evaluation are as follows:

- Potential risks to plants are *de minimis* from exposure to antimony, arsenic, copper, lead, mercury, zinc, PAHs, total PCBs, and TPHs.

- The HQ for thallium did not change from the depth-weighting evaluation and is still greater than 1. Unacceptable risk to plants from exposure to thallium is unlikely based on the same WOE as the baseline scenario.
- The HQ for hexavalent chromium was reduced from the depth-weighting evaluation but is still greater than 1. Unacceptable risk to plants from exposure to hexavalent chromium is possible based on the same WOE as in the baseline scenario.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates from potential exposure to COPECs are expected except for hexavalent chromium and total chromium, same as in the baseline scenario. Conclusions for the 2-foot scouring scenario evaluation, are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to antimony, arsenic, copper, lead, zinc, PAHs, TPHs, total PCBs, and 2,3,7,8-TCDD.
- The HQs for hexavalent chromium and total chromium were reduced from the depth-weighting evaluation but are still greater than 1. Unacceptable risks to soil invertebrate communities from potential exposure to hexavalent chromium and total chromium are possible based the same WOE as in the baseline scenario. The increased HQs for the 2-foot scouring scenario relative to the baseline HQs are related to soil concentrations at five locations (4,000 mg/kg at MW-58BR_S, 3,360 mg/kg at L-2, 2,740 mg/kg at L-2-3, 1,610 mg/kg at L-2-2, and 1,500 mg/kg at AOC10c-5) that exceed the maximum concentration in the surface soil dataset (820 mg/kg) in the baseline scenario (0 to 0.5 foot bgs).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected except for total chromium and dioxin TEQ for invertivorous small mammals (for the baseline scenario, unacceptable risk was identified only for dioxin TEQ for invertivorous small mammals). Conclusions for the 2-foot scouring scenario evaluation are as follows:

- For Merriam’s kangaroo rat (granivorous small mammal):
    - Potential risks to individuals and populations of granivorous small mammals are *de minimis* for all COPECs (antimony, arsenic, hexavalent chromium, copper, lead, manganese, mercury, thallium, zinc, LMW PAHs, HMW PAHs, PCBs, dioxin TEQ, and TPHs), except for total chromium (in the depth-weighted scenario). The NOAEL-based HQ for total chromium was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* to granivorous small mammals from total chromium as well at the AOC10 potential exposure area.
- For the desert shrew (invertivorous small mammals):
    - Potential risks to individuals and populations of invertivorous small mammals are *de minimis* for all COPECs (arsenic, hexavalent chromium, total chromium, copper, lead, manganese, zinc, LMW PAHs, HMW PAHs, and TPHs), except for antimony, total chromium, PCBs, and dioxin TEQ.

- COPECs with HQs indicative of uncertain risks to individual receptors included antimony and PCBs. Unacceptable risk to populations of invertivorous small mammals is not expected based on LOAEL-based HQs less than 1. Unacceptable risk to individual invertivorous small mammals from potential exposure to antimony and PCBs is unlikely because of the following LOEs: (1) low magnitude of the HQs (for PCBs); (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; (4) conservative assumptions were used in the ERA; (5) conservative TRVs were used for antimony (antimony TRVs are orders of magnitude less than other available TRVs for antimony; see Section 6.5.5); and (6) no T&E species with small home ranges were observed at the AOC10 potential exposure area.
- The NOAEL- and LOAEL-based HQs for total chromium and dioxin TEQ were reduced from the depth-weighting evaluation but are still greater than 1. Unacceptable risk to individual and populations of invertivorous small mammals for total chromium and dioxin TEQ is possible based on the same WOE as discussed for the baseline scenario. Elevated concentration of dioxin TEQ are present at five locations: AOC10-15 (110 ng/kg); AOC10-24 (190 ng/kg); AOC10-26 (295 ng/kg); AOC10b-1 (200 ng/kg); and AOC10c-4 (66 ng/kg); elevated total chromium is present at seven locations: AOC10c-1 (490 mg/kg); AOC10c-3 (690 mg/kg); AOC10-c-5 (1,500 mg/kg); L-2 (3,360 mg/kg); L-2-2 (1,610 mg/kg); L-2-3 (2,740 mg/kg); and MW-58BR_S (4,000 mg/kg). As noted previously for soil invertebrates, the increased total chromium HQs for the 2-foot scouring scenario relative to the baseline HQs are related to soil concentrations at five locations (4,000 mg/kg at MW-58BR_S, 3,360 mg/kg at L-2, 2,740 mg/kg at L-2-3, 1,610 mg/kg at L-2-2, and 1,500 mg/kg at AOC10c-5) that exceed the maximum concentration in the surface soil dataset (820 mg/kg) in the baseline scenario (0 to 0.5 foot bgs).

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected, same as in the baseline scenario. Conclusions for the 2-foot scouring scenario evaluation are as follows:

- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC10 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks to individual and populations of insectivorous birds are *de minimis* for arsenic, hexavalent chromium, lead, thallium, zinc, PAHs, and TPHs. The NOAEL-based HQs for total chromium was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* to insectivorous small mammals from total chromium as well at the AOC10 potential exposure area.
  - COPECs with HQs indicative of uncertain risks to individual receptors included mercury, PCBs, and dioxin TEQ. The NOAEL-based HQs for these COPECs are the same as in the depth-weighted evaluation and are still greater than 1. Unacceptable risk to individual receptors is unlikely for these COPECs based on the same WOE as discussed in the baseline scenario.

Potential Risk Drivers for AOC10 Exposure Area in the 2-Foot Scouring Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the AOC10 potential exposure area in the 2-foot scouring scenario based on unacceptable community/ population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk. Same as in the baseline scenario, elevated concentrations of risk drivers are present in a few locations. These locations are primarily located within the drainage depressions (i.e., subareas AOC10b, c, and d) behind the berms at the AOC10 potential exposure area.

Potential Receptors and Risk Drivers at AOC10 Exposure Area for the 2-Foot Scouring Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
2-Foot Scouring	**Chromium-6**	**Chromium-6, total chromium**	None	**Dioxin TEQ, total chromium**	None	None

6.6.2.6.3 Potential 5-Foot Scouring Scenario

Table 6-21 presents the HQs for all the COPECs for the 5-foot scouring scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Overall, the HQs for the 5-foot scouring scenario were similar to or lower than those presented previously for the baseline scenario. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant communities – hexavalent chromium
- Soil invertebrate communities – hexavalent chromium
- Small mammals – none for granivorous small mammals; total chromium and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-21. COPECs for the 5-foot scouring scenario are the same as the baseline, except antimony, manganese, mercury, thallium, and 2,3,7,8-TCDD were not detected in the 5-foot scouring scenario dataset.

Based on the ecological risk characterization for the AOC10 potential exposure area in the 5-foot scouring scenario using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risks to plant communities from potential exposure to COPECs are expected (unacceptable risk for hexavalent chromium was identified in the baseline scenario). Conclusions for the 5-foot scouring scenario evaluation are as follows:

- Potential risks to plants are *de minimis* from exposure to arsenic, copper, lead, zinc, PAHs, total PCBs, and TPHs.
- The HQ for hexavalent chromium was reduced to 1 from the depth-weighting evaluation, indicating *de minimis* to plant communities from hexavalent chromium as well at the AOC10 potential exposure area.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates from exposure to COPECs are expected (unacceptable risk for hexavalent chromium and total chromium were identified in the baseline scenario). Conclusions for the 5-foot scouring scenario evaluation, are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to arsenic, total chromium, copper, lead, zinc, PAHs, total PCBs, and TPHs.
- The HQs for hexavalent chromium were reduced from the depth-weighting evaluation but are still greater than 1. Unacceptable risks to soil invertebrate communities from potential exposure to hexavalent chromium is unlikely based the following LOEs: (1) low magnitude of HQs (same/similar to background HQs; (2) low confidence in the screening levels to predict risk; (3) screening levels are conservative (less than the BTVs); and (4) no locations with elevated concentrations (greater than 10 times the BTV).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected except for dioxin TEQ for invertivorous small mammals, same as in the baseline scenario. Conclusions for the 5-foot scouring scenario evaluation are as follows:

- For Merriam’s kangaroo rat (granivorous small mammal):
  - Potential risks to individuals and populations of granivorous small mammals are *de minimis* for all COPECs, same as in the depth-weighting evaluation.
- For the desert shrew (invertivorous small mammals):
  - Potential risks to individuals and populations of invertivorous small mammals are *de minimis* for all COPECs except for total chromium and dioxin TEQ.
  - COPECs with HQs indicative of uncertain risks to individual receptors included total chromium. Unacceptable risk to individual invertivorous small mammals from potential exposure to total chromium is unlikely because of the following LOEs: (1) low magnitude of the HQs; (2) conservative assumptions used in the risk estimates (not accounting for unimpacted areas between the AOC10

subareas, assuming 100% of an invertebrate diet, etc.; see Section 6.7.3); and (3) T&E species with small home ranges have not been observed at the AOC10 potential exposure area.

- The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighting evaluation but are still greater than 1. Although there is some uncertainty associated with the dioxin TRVs and uptake factors for prey, unacceptable risk to individual and populations of invertivorous small mammals for dioxin TEQ is possible based the same WOE as the baseline scenario. Concentrations exceeding 10 times the BTV are limited to four locations (200 ng/kg at AOC10-11, 150 ng/kg at AOC10b-1,100 ng/kg at AOC10-26, and 77 ng/kg at AOC10-15).

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected, same as in the baseline scenario. Conclusions for the 5-foot scouring scenario evaluation, are as follows:

- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC10 potential exposure area.
- For the cactus wren (insectivorous bird):
    - Potential risks to individual and populations of insectivorous birds are *de minimis* for all COPECs except for dioxin TEQ.
    - COPECs with HQs indicative of uncertain risks to individual receptors included dioxin TEQ. The NOAEL-based HQ was reduced from the depth-weighting evaluation but is still greater than 1. Unacceptable risk to individual receptors is unlikely for dioxin TEQ based on the same WOE as the baseline scenario.

Potential Risk Drivers for AOC10 Exposure Area in the 5-Foot Scouring Scenario

As presented in Table 6-11 and summarized in the table in this section, potential risk drivers were identified for the AOC10 exposure area in the 5-foot scouring scenario based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk. Same as in the baseline scenario, elevated concentrations of risk drivers (only dioxin TEQ in this case) are present in a few locations. These locations are primarily located within the drainage depressions (i.e., subareas AOC10b, c, and d) behind the berms at the AOC10 potential exposure area.

Potential Receptors and Risk Drivers at AOC10 Exposure Area for the 5-Foot Scouring Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
5-Foot Scouring	None	None	None	**Dioxin TEQ**	None	None

6.6.2.7 AOC11

For the AOC11 potential exposure area, COPECs are listed in Table 3-7 and included seven metals (arsenic, hexavalent chromium, total chromium, copper, lead, mercury, and zinc), one VOC (methyl acetate), LMW PAHs, HMW PAHs, four pesticides (4,4-DDE, alpha chlordane, gamma-chlordane, and dieldrin), PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs.

The AOC11 potential exposure area was evaluated for potential risk plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs.

Plant screening values are not available for dioxins, total chromium, and methyl acetate; soil invertebrate screening values are not available for methyl acetate; and avian TRVs are not available for methyl acetate. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the AOC11 potential exposure area is presented in detail in Appendix AOC11, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. The HQs calculated for the AOC11 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-22. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC11 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC11.

Table 6-22 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant Community – hexavalent chromium and HMW PAHs/TPHs
- Soil Invertebrate Community – hexavalent chromium, mercury, zinc, and alpha- and gamma-chlordane

- Small Mammals – none for granivorous small mammals; HMW PAH and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; mercury, total PCBs, and dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site -specific SUFs and presented in Table 6-22.

Based on the ecological risk characterization for the AOC11 potential exposure area using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions for the baseline scenario evaluation are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including AOC 11.
- Potential risks to plants are *de minimis* from exposure to all COPECs except hexavalent chromium. The HQ for HMW PAHs was reduced to 1 in the area-weighted evaluation, indicating *de minimis* to plant communities from HMW PAHs (and TPHs) at the AOC11 potential exposure area.
- The HQ for hexavalent chromium remained the same as in the depth-weighting evaluation and still greater than 1. Unacceptable risk to plants from exposure to hexavalent chromium is unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) although frequently detected, concentrations were below the BTV in many of the locations; (3) low confidence in the plant screening value in predicting toxicity (screening level is less than the BTV); and (4) elevated concentrations (greater than 10 times the BTV) were limited to a single location (AOC11e-6).
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). Over a hundred different vascular plant species have been observed within the survey area that includes AOC11 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013, CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions for the baseline scenario evaluations are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to arsenic, total chromium, copper, lead, zinc, PAHs, TPHs, 4,4-DDE, dieldrin, PCBs, and 2,3,7,8-TCDD at the AOC11 potential exposure area. The HQ for zinc was reduced to less than 1 from the depth-weighting evaluation, indicating *de minimis* to soil invertebrate communities from zinc as well at the AOC11 potential exposure area.

- The HQs for mercury, alpha- and gamma-chlordanes remained the same as in the depth-weighted evaluation. Unacceptable risks to soil invertebrates from exposure to these COPECs are unlikely because of the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQs; (3) low magnitude of HQs; and (4) low confidence in the screening values to predict toxicity to soil invertebrate communities.
- The area-weighted HQs for hexavalent chromium increased from the depth-weighting evaluation and is greater than 1. The impact of area-weighting on this COPEC is discussed in Section 5.6.3 and in Appendix AOC11. Unacceptable risk to soil invertebrate communities is considered unlikely for hexavalent chromium based on the following LOEs: (1) low magnitude of the HQ; (2) very conservative screening level (less than the BTV); (3) and low confidence in the invertebrate screening value and its ability to predict risk.

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) exposed to COPECs in soil are expected. Conclusions for the baseline scenario evaluations, are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC11 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of granivorous small mammals at the AOC11 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - Potential risks are *de minimis* from exposure to all COPECs, except dioxin TEQ. The NOAEL-based HQ for HMW PAHs was reduced to 1 in the area-weighted evaluation, indicating *de minimis* risk to invertivorous small mammals from HMW PAHs (and TPHs) at the AOC11 potential exposure area.
  - The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighted evaluation but are still greater than 1. Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL and LOAEL doses; see Section 6.7.5); (2) spatial extent of elevated concentrations were limited to four

locations along the TCS fenceline (PA-10, PA-11, PA-12, and SD-11A); and (3) T&E species with small home ranges have not been observed in the AOC11 potential exposure area.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions for the baseline scenario evaluations are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC11 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC11 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks are *de minimis* from exposure to all the COPECs except for lead, mercury, and dioxin TEQ. The NOAEL-based HQ for PCBs was reduced to 1 from the depth-weighting evaluation, indicating *de minimis* risk to insectivorous birds from PCBs as well at the AOC11 potential exposure area.
  - The area-weighted NOAEL-based HQ for lead increased from the depth-weighting evaluation and is greater than 1 only in the area-weighted evaluation. The impact of area-weighting on this COPECs is discussed in Section 5.6.3 and in Appendix AOC11. The area-weighted NOAEL-based HQ for mercury remained the same as in the depth-weighted evaluation and is greater than 1. The area-weighted NOAEL-based HQ for dioxin TEQ was reduced from the depth-weighting evaluation and still greater than 1.
  - COPECs with HQs indicative of uncertain risks to individual receptors included lead, mercury, and dioxin TEQ. Unacceptable risk to individual receptors is unlikely for these COPECs based on the following LOEs: (1) low magnitude of the HQs; (2) low FOD for mercury; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risk; (3) conservative assumptions in the risk estimates (not accounting for site-specific bioavailability of lead, assuming 100% of invertebrate diet; see Section 6.7.3); (4) low confidence in the TRVs for mercury as they are unlikely to reflect the species of mercury present at the AOC11 potential exposure area; and (5) no observations of T&E species with small home ranges at the AOC11 potential exposure area.
  - No COPECs had LOAEL-based HQs greater than 1, indicating unacceptable risk to populations of insectivorous birds is not expected at the AOC11 potential exposure area.

Potential Risk Drivers for AOC11 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC11 potential exposure area, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC11 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.8 AOC12

For the AOC12 potential exposure area, COPECs are listed in Table 3-7 and included 1 metal (zinc), HMW PAHs, PCBs, and TPHs.

The AOC12 potential exposure area was evaluated for potential risks to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs only. Area-weighted EPCs were not evaluated for this exposure area based on the risk estimates using depth-weighted EPCs.

Appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The HQs calculated for the AOC12 potential exposure area, COPECs using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-23. The ERA for the AOC12 potential exposure area is presented in detail in Appendix AOC12, including risk calculations based on depth-weighted EPCs for all COPECs for the baseline scenario. The depth-weighted EPCs are based on the maximum depth-weighted concentration due to small samples sizes for this exposure area.

Conclusions for the baseline scenario evaluations, are as follows:

- Potential risks to all ecological receptors are expected to be *de minimis* from exposure to all the COPECs including TPHs (based on PAH results) in soil at the AOC12 potential exposure area. These COPECs were detected at concentrations less than available screening values for plants and soil invertebrates and all NOAEL-based HQs for small mammals and birds were equal to or less than 1 based on depth-weighted EPCs, site-specific SUFs, and selected TRVs. As such, area-weighted evaluations were not required for the AOC12 potential exposure area COPECs.
- No T&E plants or small home-range wildlife receptors have been observed in the AOC12 potential exposure area.

Potential Risk Drivers for AOC12 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC12 potential exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC12 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.9 AOC14

For the AOC14 potential exposure area, COPECs are listed in Table 3-7 and included six metals (antimony, hexavalent chromium, copper, lead, mercury, and thallium), two SVOCs (4-methylphenol and bis (2-ethylhexyl) phthalate), LMW PAHs, HMW PAHs, two pesticides (4,4-DDE and 4,4-DDT), PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs. Although butylbenzylphthalate is also listed as in Table 3-7 as a COPEC for the AOC14 potential exposure area, it was detected only in soil deeper than 6 feet bgs (not in the exposure depths relevant for potential ecological receptors).

The AOC14 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD, avian TRVs are not available for antimony and 4-methylphenol, and mammalian TRVs are not available for 4-methylphenol. Therefore, risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the AOC14 potential exposure area is presented in detail in Appendix AOC14, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the AOC14 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-24. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC14 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC14.

Table 6-24 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant Community – antimony, hexavalent chromium, copper, lead, mercury, thallium, and HMW PAHs/TPHs
- Soil Invertebrate Community – mercury and 4-methylphenol
- Small Mammals – antimony and mercury for granivorous small mammals; HMW PAHs/TPHs and dioxin TEQ for insectivorous small mammals
- Birds – none for granivorous birds; mercury for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site -specific SUFs and presented in Table 6-24.

Based on the ecological risk characterization for the AOC14 potential exposure area, using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the AOC14 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to 4-methylphenol and bis (2-ethylhexyl) phthalate), LMW PAHs, 4,4-DDE and 4,4-DDT, and PCBs at the AOC14 potential exposure area. The HQ for HMW PAHs was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* risk to plant communities from this COPEC as well at the AOC14 potential exposure area.
- The HQs for antimony, mercury, and thallium did not change from the depth-weighted evaluation. Unacceptable risks to plants from exposure to antimony and thallium are unlikely based on the following LOEs: (1) low magnitude of the HQs; (2) low FOD; (3) EPCs based on the maximum depth-weighted EPCs; for areas where a constituent is largely not detected, use of a maximum concentration may not appropriately characterize site risks; and (4) low confidence in screening values to predict risk. For mercury, although the HQs were high in magnitude, unacceptable risk to plants is unlikely based on the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted EPCs; (3) low confidence in screening values to predict risk; and (4) limited spatial extent of elevated concentrations (mercury BTV unavailable; greater than 10 times the RL) of mercury (102 mg/kg at AOC14-16W).
- The area-weighted HQ for hexavalent chromium increased to greater than 1 from the depth-weighted evaluation. The impact of area-weighting on these COPECs is discussed in Section 5.6.3 and in Appendix AOC14. Unacceptable risk to soil invertebrate communities is considered unlikely for hexavalent chromium based on the following LOEs: (1) low magnitude of the HQ; (2) very

conservative screening level (less than the BTV); and (3) low confidence in the invertebrate screening value and its ability to predict risk.

- The HQs for copper and lead were reduced from the depth-weighting evaluation but are still greater than 1. Although the screening levels are considered robust for prediction of toxicity to plants and these COPECs were frequently detected at the AOC14 potential exposure area, unacceptable risk to plant communities from exposure to copper and lead is unlikely based on the following LOEs: (1) detected concentrations infrequently exceeded the BTVs and screening levels; and (2) limited spatial extent of concentrations greater than 10 times the BTV; only AOC14-16W (438 mg/kg) and AOC14-19 (1,800 mg/kg) for copper, and AOC14-19 (1,600 mg/kg) for lead.
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). Over a hundred different vascular plant species have been observed within the survey area that includes AOC14 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013, CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to all COPECs except mercury and 4-methylphenol at the AOC14 potential exposure area. Antimony, thallium, and PCBs were not detected in surface soil, where exposure occurs for this receptor.
- The HQs for mercury and 4-methylphenol remained the same as in the depth-weighted evaluation. Unacceptable risks to soil invertebrates from exposure to these COPECs is unlikely based of the following LOEs: (1) low magnitude of the HQs; (2) low FOD; (3) EPCs based on the maximum depth-weighted EPCs; for areas where a constituent is largely not detected, use of a maximum concentrations may not appropriately characterize site risks; (4) low confidence in screening values to predict risk; and (5) limited spatial extent of detected concentrations (0.41 mg/kg at AOC14-16W for mercury, and 0.43 mg/kg at AOC14-2 for 4-methylphenol).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC14 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.

- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of granivorous small mammals, except for antimony and mercury.
  - COPECs indicative of uncertain risks to individual receptors included antimony and mercury. Unacceptable risk to granivorous small mammal populations from exposure to these COPECs is not expected based on LOAEL-based HQs less than 1. Unacceptable risk to individual granivorous small mammals from potential exposure to these COPECs is unlikely based on the following LOEs: (1) low magnitude of the HQs; (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentrations may not appropriately characterize site risks; (4) TRVs were considered overly conservative (for antimony, orders of magnitude lower than other published values; for mercury, based on methylmercury which is unlikely to be present in upland soil; see Section 6.7.5); and (5) T&E species with small home ranges have not been observed at the AOC14 potential exposure area.
- For the desert shrew (invertivorous small mammals):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of insectivorous small mammals, except for HMW PAHs and dioxin TEQ. The NOAEL-based HQ for HMW PAHs was reduced to less than 1 using an area-weighted EPC, indicating *de minimis* risk to individual receptors from this COPEC as well at the AOC14 potential exposure area.
  - COPECs indicative of uncertain risks to individual receptors included dioxin TEQ. The NAOEL-based HQ was reduced from the depth-weighted evaluation but is still greater than 1. Unacceptable risk to individual receptors for dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQ; (2) conservative assumptions used in the risk estimates (dietary composition assumes 100% of a single item diet, bioaccumulation based on a single congener, and very conservative TRVs and BAFs; see Section 6.7.6); (3) no locations with concentrations more than 10 times the BTV; and (4) T&E species with small home ranges have not been observed at the AOC14 potential exposure area.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC14 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC14 potential exposure area.

- For the cactus wren (insectivorous bird):
  - The NOAEL and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of insectivorous birds at the AOC14 potential exposure area, except for mercury.
  - COPECs indicative of uncertain risks to individual receptors included mercury. For mercury, the NOAEL-based HQs remained the same as the depth-weighting evaluation. LOAEL-based HQs for mercury are less than 1, same as the same as the depth-weighting evaluation. Unacceptable risk to insectivorous birds from exposure to mercury is unlikely based on the following LOEs: (1) low magnitude of the HQs; (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentrations may not appropriately characterize site risks; (4) low confidence in the TRVs for mercury as they are unlikely to reflect the species of mercury present at the AOC14 potential exposure area; and (5) no observations of nesting T&E species with small home ranges at the AOC14 potential exposure area.

Potential Risk Drivers for AOC14 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC14 potential exposure area for the baseline scenario, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOEs supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC14 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.10 AOC27

For the AOC27 potential exposure area, COPECs are listed in Table 3-7 and included seven metals (antimony, cadmium, hexavalent chromium, copper, lead, mercury, and zinc), two VOCs (bromomethane and chloromethane), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only) and TPHs.

The AOC27 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD; avian TRVs are not available for antimony; and plant screening values and wildlife TRVs are not available for bromomethane and chloromethane.

Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5

The ERA for the AOC27 potential exposure area is presented in detail in Appendix AOC27, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the AOC27 potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site–specific SUFs are presented in Table 6-25. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the AOC27 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix AOC27.

Table 6-25 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant Community – copper, lead, zinc, and HMW PAHs/TPHs
- Soil Invertebrate Community – hexavalent, copper, mercury, and zinc
- Small Mammals – none for granivorous small mammals; cadmium, copper, lead, HMW PAHs/TPHs, and dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous birds; cadmium, copper, and lead for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site -specific SUFs and presented in Table 6-25.

Based on the ecological risk characterization for the AOC27 potential exposure area using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the AOC27 potential exposure area.
- Potential risks to plants are *de minimis* from exposure to antimony, cadmium, hexavalent chromium, mercury, LMW PAHs, and PCBs at the AOC27 potential exposure area. The HQs for lead and zinc were reduced to less than 1 using area-weighted EPCs, indicating *de minimis* risk to plant communities from these COPECs as well at the AOC27 potential exposure area.
- The HQ for HMW PAHs was reduced from the depth-weighting evaluation but is still greater than 1. Unacceptable risk to plants from potential exposure to HMW PAHs is unlikely based on the following

LOEs: (1) low magnitude of the HQ; (2) low confidence in screening values to predict risk; and (3) limited spatial extent of elevated concentrations; the elevated concentrations of HMW PAHs driving risk are localized in surface and shallow soil in the eastern edge of the road from AOC27 to BCW where potential burn waste was identified. Depth-weighted concentrations more than 10 times the BTV are limited to four locations (31.5 mg/kg at AOC27-6, 4.04 mg/kg at AOC27-50, 3.78 mg/kg at AOC27-51, and 3.39 mg/kg at AOC27-7).

- The HQ for copper was reduced from the depth-weighting evaluation but is still greater than 1. Although copper was frequently detected at the AOC27 potential exposure area, unacceptable risk to plants from exposure to copper is unlikely based on the following LOEs: (1) magnitude of HQ is low; and (2) spatial extent of elevated concentrations (greater than 10 times the BTV) is limited to two locations (580 mg/kg at AOC27-7 and 500 mg/kg at AOC27-6).
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). Over a hundred different vascular plant species have been observed within the survey area that includes AOC27 potential exposure area; documented as Segment H in these survey reports (GANDA and CH2M 2013, CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from exposure to cadmium, lead, PAHs, PCBs and 2,3,7,8-TCDD at the AOC27 potential exposure area. Antimony, bromomethane, and chloromethane were not detected in surface soil, where exposure occurs for these potential receptors. The HQs for hexavalent chromium, copper, and mercury were reduced to less than 1 using area-weighted EPCs, indicating *de minimis* risk to soil invertebrate communities from these COPECs as well at the AOC27 potential exposure area.
- The HQ for zinc was reduced from the depth-weighting evaluation but is still greater than 1. Although zinc was frequently detected at the AOC27 potential exposure area, unacceptable risk to soil invertebrates from exposure to zinc is unlikely based on the following LOEs: (1) magnitude of HQ is low; and (2) spatial extent of elevated concentrations (greater than 10 times the BTV) is limited to two locations (1,200 mg/kg at AOC27-51 and 700 mg/kg at AOC27-6).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) potentially exposed to COPECs in soil are expected except for dioxin TEQ for invertivorous small mammals. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC27 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous small mammals.
- For the desert shrew (invertivorous small mammals):
  - Potential risk is *de minimis* from exposure to hexavalent chromium, mercury, LMW PAHs, and PCBs. Antimony, bromomethane, and chloromethane were not detected in surface soil, where exposure occurs for this receptor. The NOAEL- and LOAEL-based HQs for copper were reduced to 1 or less from the depth-weighting evaluation, indicating *de minimis* risk to invertivorous small mammals from this COPEC as well at the AOC27 potential exposure area.
  - COPECs indicative of uncertain risks to individual receptors included cadmium, lead, and HMW PAHs. For cadmium, the NOAEL- based HQ is greater than 1 and LOAEL-based HQ is less than 1, same as in the depth-weighted evaluation. The NOAEL-based HQs for lead and HMW PAHs were reduced from the depth-weighted evaluation but are still greater than 1; the LOAEL-based HQs remained less than 1 for lead and HMW PAHs.
  - Unacceptable risk to individual receptors is unlikely for cadmium based on the following LOEs: (1) low magnitude of the HQ; (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of maximum concentrations can potentially overestimate risks; and (4) T&E species with small home ranges have not been observed at the AOC27 potential exposure area.
  - Unacceptable risk to individual receptors is unlikely for lead based on the following LOEs: (1) low magnitude of the HQ; (2) conservative assumptions in the risk estimates (not accounting for site-specific bioavailability of lead, assuming 100% invertebrate diet; see Section 6.7.3); and (3) T&E species with small home ranges have not been observed at the AOC27 potential exposure area.
  - Unacceptable risk to individual receptors is unlikely for HMW PAHs based on the following LOEs: (1) low magnitude of the HQ; (2) likely associated with the burn waste activities in AOC27 (in the eastern edge of the road cut on the road from AOC27 to BCW); (3) NOAEL-based TRV is conservative compared to other studies (see Section 6.7); (4) conservative assumptions used in the ERA (e.g., 100% invertebrate diet, instead of a mixed diet and invertebrate BAFs based on earthworm uptake only, instead of mixed invertebrate species that are more likely encountered at the AOC27 potential exposure area); and (5) T&E species with small home ranges have not been observed at the AOC27 potential exposure area. Risk conclusions are the same for TPHs.
  - The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighting evaluation but are still greater than 1. Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding

uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL and LOAEL doses; see Section 6.7.5); (2) spatial extent of elevated concentrations were limited to two locations: AOC27-6 (120 ng/kg) at and AOC27-7 (110 ng/kg); and (3) T&E species with small home ranges have not been observed in the AOC27 potential exposure area.

Birds

Overall, no unacceptable risk to bird populations (granivorous and insectivorous) potentially exposed to COPECs in soil is expected. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed at the AOC27 potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds at the AOC27 potential exposure area.
- For the cactus wren (insectivorous bird):
  - Potential risks are *de minimis* from exposure to hexavalent chromium, PAHs, and TPHs (based on BTEX and PAH results). The NOAEL- and LOAEL-based HQs for zinc were reduced to less than 1 from the depth-weighting evaluation, indicating *de minimis* risk to invertivorous small mammals from this COPEC as well at the AOC27 potential exposure area.
  - COPECs indicative of uncertain risks to individual receptors included cadmium, copper, mercury, and dioxin TEQ. For cadmium and mercury, the NOAEL- based HQ is greater than 1 and LOAEL-based HQ is less than 1, same the depth-weighting evaluation. The NOAEL-based HQs for copper and dioxin TEQ were reduced from the depth-weighting evaluation but are still greater than 1; the LOAEL-based HQs remained less than 1 for copper and dioxin TEQ.
  - Unacceptable risk to individual receptors is unlikely for cadmium based on the following LOEs: (1) low magnitude of the HQ; (2) low FOD; (3) EPCs based on the maximum depth-weighted concentrations; for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate risks; and (4) T&E species with small home ranges have not been observed at the AOC27 potential exposure area.
  - Unacceptable risk to individual receptors is unlikely for copper, mercury, and dioxin TEQ based on the following LOEs: (1) low magnitude of the HQs; (2) conservative TRVs for dioxins and mercury; (3) conservative assumptions used in the risk estimates (dietary composition assumes 100% of a single item diet, bioaccumulation based on a single congener for dioxins, and very conservative TRVs and BAFs for dioxins; see Section 6.7.6); and (4) T&E species with small home ranges have not been observed at the AOC27 potential exposure area.

- The NOAEL- and LOAEL-HQs for lead were reduced from the depth-weighting evaluation but are still greater than 1. Unacceptable risk to insectivorous birds from exposure to lead is unlikely based on the following LOEs: (1) magnitude of HQ is low; (2) assumes lead in soil is 100% available for uptake by prey/absorption to target organ, which is rarely the case or lead, average is 60% (see Section 6.7.3); and (3) spatial extent of elevated concentrations is limited to two locations (630 mg/kg at AOC27-6 and 170 mg/kg at AOC27-7).

Potential Risk Drivers for AOC27 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC27 potential exposure area, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC27 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.11 AOC28

For the AOC28 potential exposure area, COPECs included only TPHs. Although molybdenum and zinc are also listed as in Table 3-7 as COPECs for the AOC28 potential exposure area, they were detected in soil deeper than 6 feet bgs (not in the exposure depths relevant for potential ecological receptors).

The AOC28 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Due to the small dataset size, the depth-weighted EPCs are based on maximum depth-weighted concentrations; area-weighted EPCs were not calculated.

Appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

Potential risks were estimated using depth-weighted EPCs for indicator chemicals. A summary of the risk results for TPHs are presented in Table 6-26. The ERA for the AOC28 potential exposure area is presented in detail in Appendix AOC28. The depth-weighted EPCs are based on the maximum depth-weighted concentration due to small samples sizes for this exposure area. Conclusions for the baseline scenario evaluations are as follows:

- Potential risks to all ecological receptors are expected to be *de minimis* from exposure to TPHs in soil at the AOC28 potential exposure area. BTEX were not detected in any samples (Attachment AOC28-

A) and LMW and HMW PAHs were not selected as COPECs, as concentrations are less than the BTVs.

- T&E Species – No T&E small home-range wildlife receptors have been observed in the AOC28 potential exposure area. Concentrations of COPECs at the AOC28 potential exposure area do not pose unacceptable risk to potential individual receptors.

Based on the results of the ERA, potential exposures to COPECs in soil at the AOC28 potential exposure area are not expected to pose unacceptable risk to ecological receptors.

Potential Risk Drivers for AOC28 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC28 exposure area, as COPECs were limited to TPHs and indicator compounds for TPHs were either not detected or below background levels. Therefore, potential HQs for TPHs are expected to be less than 1 for all receptors.

Potential Receptors and Risk Drivers at AOC28 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.12 AOC31

For the AOC31 potential exposure area, COPECs are listed in Table 3-7 and included three metals (copper, lead, and zinc), one VOC (chloroform, detected only in the 0- to 3-foot and 0- to 6-foot bgs intervals), LMW PAHs, HMW PAHs, PCBs, and TPHs.

The AOC31 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Due to the small dataset size, the depth-weighted EPCs are based on maximum depth-weighted concentrations; area-weighted EPCs were not calculated.

Plant screening values and avian TRVs are not available for chloroform. Therefore, potential risks to these receptors from exposure to this specific COPEC could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

Potential risks were estimated using depth-weighted EPCs and selected screening values and TRVs. The risk results are summarized in Table 6-27. The ERA for the AOC31 potential exposure area is presented in detail in Appendix AOC31. Conclusions for the baseline scenario evaluations are as follows:

- Plant Communities – *de minimis* risk to plant communities from exposure to all COPECs in soil

- Soil Invertebrates Communities – *de minimis* risk to soil invertebrate communities from exposure to all COPECs in soil
- Small Mammals – *de minimis* risk to individuals and populations of small mammals (granivorous and invertivorous) exposed to all COPECs in soil
- Birds – *de minimis* risk to individuals and populations of birds (granivorous and insectivorous) exposed to all COPECs in soil
- T&E Species – No state or federal T&E species have been observed in the AOC31 potential exposure area. Concentrations of COPECs at the AOC31 potential exposure area pose no unacceptable risk to potential individual receptors.

Based on the results of the ERA, potential exposures to COPECs in soil at the AOC31 potential exposure area are not expected to pose unacceptable risk to potential ecological receptors.

Potential Risk Drivers for AOC31 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the AOC31 potential exposure area, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds) predicted from HQs calculated using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOEs supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at AOC31 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.13 UA-2

For the UA-2 potential exposure area, COPECs are listed in Table 3-7 and included five metals (arsenic, barium, lead, manganese, and zinc), two SVOCs (4-methylphenol and bis (2-ethylhexyl) phthalate detected only in the 0- to 3-foot and 0- to 6-foot bgs intervals), and TPHs.

The UA-2 potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Due to the small dataset size, the depth-weighted EPCs are based on maximum depth-weighted concentrations; area-weighted EPCs were not calculated.

Avian TRVs are not available for barium and 4-methylphenol, and mammalian TRVs are not available for 4-methylphenol. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the UA-2 potential exposure area is presented in detail in Appendix UA2, including risk calculations based on depth-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the UA-2 potential exposure area COPECs using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-28. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., depth-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the UA-2 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix UA2.

Table 6-28 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant Community – manganese
- Soil Invertebrate Community – manganese
- Small Mammals – none for granivorous and invertivorous small mammals
- Birds – none for granivorous and insectivorous birds.

Evaluation of area-weighted EPCs was not warranted based on potential risks estimated using depth-weighted EPCs. Based on the ecological risk characterization for the UA-2 potential exposure area, using depth-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including the UA-2 potential exposure area.
- Potential risks to plants are *de minimis* for all the COPECs, including TPHs (based on BTEX and PAH data) at the UA-2 potential exposure area, except for manganese.
- Unacceptable risk to plant communities from exposure to manganese is unlikely based on the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted EPCs; for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQs; and (3) low confidence in the screening value to predict toxicity to plants (plant screening value less than the BTV).
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). Over a hundred different vascular plant species have been observed within the survey area that includes UA-2 potential exposure area; documented as Segment H in

these survey reports (GANDA and CH2M 2013, CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* for all the COPECs, including TPHs (based on BTEX and PAH data) at the UA-2 potential exposure area, except for manganese.
- Unacceptable risk to soil invertebrate communities from potential exposure to manganese is unlikely based on the same WOE as discussed previously for plants.

Small Mammal

Potential risk to small mammals (granivorous and invertivorous) is *de minimis* for all COPECs in soil at the UA-2 potential exposure area (i.e., the NOAEL- and LOAEL-based HQs are all less than 1).

Birds

Potential risk to birds (granivorous and insectivorous) is *de minimis* for all COPECs in soil at UA-2 (i.e., the NOAEL- and LOAEL-based HQs are all less than 1).

Potential Risk Drivers for UA-2 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the UA-2 potential exposure area, based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at UA-2 Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.14 Tamarisk Thicket

For the Tamarisk Thicket potential exposure area, COPECs are listed in Table 3-7 and included five metals (hexavalent chromium, total chromium, copper, lead, manganese, and zinc), PCBs, dioxin TEQ (for potential wildlife receptors only), 2,3,7,8-TCDD (for potential ecological communities only), and TPHs.

The Tamarisk Thicket potential exposure area was evaluated for potential risk to plants and soil invertebrates and small home-range wildlife receptors. Potential risks to these ecological receptors were calculated for the baseline scenario using depth- and area-weighted EPCs.

Plant screening values are not available for 2,3,7,8-TCDD and total chromium. Therefore, potential risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the Tamarisk Thicket potential exposure area is presented in detail in Appendix TT, including risk calculations based on depth-weighted and area-weighted EPCs for all COPECs for the baseline scenario. Scouring scenarios were not evaluated. The HQs calculated for the Tamarisk Thicket potential exposure area COPECs using depth-weighted and area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-29. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for Tamarisk Thicket potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix TT.

Table 6-29 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. The HQs based on depth-weighted EPCs were greater than 1 for the following COPECs:

- Plant Community – manganese
- Soil Invertebrate Community – none
- Small Mammals – none for granivorous small mammals; dioxin TEQ for invertivorous small mammals
- Birds – none for granivorous bird; dioxin TEQ for insectivorous birds.

HQs were also calculated for all the COPECs using area-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs and presented in Table 6-29.

Based on the ecological risk characterization for the Tamarisk Thicket potential exposure area using area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs, the following conclusions were made.

Plant Communities

Overall, no unacceptable risk was identified for plants, including special-status species. Conclusions are as follows:

- No federal- or state-listed T&E plants or candidates for listing were found at the site, including Tamarisk Thicket potential exposure area.
- Potential risks to plants are *de minimis* from exposure to all the COPECs, same as the depth-weighted evaluation (i.e., HQs are less than 1) except for manganese.
- The HQ for manganese did not change from the depth-weighted evaluation and is still greater than 1. Unacceptable risk to plant communities from exposure to manganese is unlikely based on the following LOEs: (1) low FOD; (2) EPCs based on the maximum depth-weighted EPCs; for areas where a constituent is largely not detected, use of a maximum concentration can potentially overestimate HQs; and (3) low confidence in the screening value to predict toxicity to plants (plant screening value less than the BTV).
- Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and in 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). Over a hundred different vascular plant species have been observed within the survey area that includes Tamarisk Thicket potential exposure area; documented as Segment D in these survey reports (GANDA and CH2M 2013, CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

Soil Invertebrate Communities

Overall, no unacceptable risks to soil invertebrates are expected. Conclusions are as follows:

- Potential risks to soil invertebrates are *de minimis* from all the COPECs, same as the depth-weighted evaluation (i.e., HQs are less than 1).).

Small Mammals

Overall, no unacceptable risks to populations of small mammals (granivorous and invertivorous) exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of mammals have been observed at or near the site (Tables 2-2 and 2-4); however, T&E species with small home ranges were not observed in the Tamarisk Thicket potential exposure area, and therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Merriam's kangaroo rat (granivorous small mammal):
  - The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of granivorous small mammals.
- For the desert shrew (invertivorous small mammals):

- The NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to individual and populations of invertivorous small mammals, except for dioxin TEQ.
- The NOAEL- and LOAEL-based HQs for dioxin TEQ were reduced from the depth-weighted evaluation but are still greater than 1. Unacceptable risk to invertivorous small mammals from exposure to dioxin TEQ is unlikely based on the following LOEs: (1) low magnitude of the HQs (LOAEL-based HQ is less than 10), and likely reduced to 1 or less if adjusted for compounding uncertainties associated with the conservative assumptions (see Section 6.7.6); these include diet (dietary composition assumes 100% of a single item diet; see Section 6.7.3), uptake into dietary items (bioaccumulation based on a single congener likely overestimates HQs by 10 times; see Section 6.7.4), and conservative TRVs (based on the lowest available NOAEL and LOAEL doses; see Section 6.7.5); (2) spatial extent of elevated concentrations (greater than 10 times the BTV) were limited to seven locations: AOC1-BCW6 (64 ng/kg), AOC1-BCW10 (110 ng/kg), AOC 1-BCW25 (58 ng/kg), AOC1-BCW26 (100 ng/kg), AOC1-BCW28 (180 ng/kg), AOC1-BCW29 (84 ng/kg), and AOC1-BCW29 (140 ng/kg); and (3) T&E species with small home ranges have not been observed in this area.

Birds

Overall, no unacceptable risks to bird populations (granivorous and insectivorous) exposed to COPECs in soil are expected. Conclusions are as follows:

- Several species of birds have been observed at or near the site (Tables 2-2 and 2-4). A single observation of the federally listed T&E species, the southwestern willow flycatcher, was made in the Tamarisk Thicket potential exposure area in 2009 (CH2M 2014a; GANDA 2017),; however, this species was considered transient and is not expected to nest or reside in this area (GANDA 2017). Therefore, protection at the individual level (i.e., NOAEL-based HQ less than or equal to 1) is not warranted.
- For Gambel's quail (granivorous bird), the NOAEL- and LOAEL-based HQs are less than 1 for all COPECs, same as in the depth-weighted evaluation, indicating *de minimis* risk to individuals and populations of granivorous birds in the Tamarisk Thicket potential exposure area.
- For the cactus wren (insectivorous bird):
    - The LOAEL-based HQs are less than 1 for all COPECs, same as the depth-weighted evaluation, indicating *de minimis* risk to populations of insectivorous birds.
    - COPECs with HQs indicative of uncertain risks to individual receptors included dioxin TEQ. The NOAEL- based HQ was reduced from the depth-weighted evaluation but is still greater than 1. Unacceptable risk to individual receptors is considered unlikely based on the following LOEs: (1) low HQ; (2) conservative assumptions used to estimate risks (BAF and TRVs; see Section 6.7); and (3) small home-range T&E wildlife are not resident in the Tamarisk Thicket potential exposure area.

Potential Risk Drivers for the Tamarisk Thicket Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the Tamarisk Thicket exposure area based on unacceptable community/population-level risk (i.e., HQ greater than 1 for plants and soil invertebrates and LOAEL-based HQs greater than 1 for mammals and birds [or LOAEL-based HQs greater than 10 for dioxin TEQ]) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, area-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at Tamarisk Thicket Exposure Area for the Baseline Scenario

Scenario	Plants	Soil Invertebrates	Granivorous Mammals (Merriam's Kangaroo Rat)	Invertivorous Mammals (Desert Shrew)	Granivorous Birds (Gambel's Quail)	Insectivorous Birds (Cactus Wren)
Baseline	None	None	None	None	None	None

6.6.2.15 Outside the Compressor Station

For the OCS potential exposure area, COPECs are listed in Table 3-7 and included nine inorganic compounds (antimony, hexavalent chromium, total chromium, cobalt, copper, cyanide, lead, mercury, thallium, vanadium, and zinc), four VOCs (bromomethane, chloromethane, chloroform, and methyl acetate), three SVOCs (4-methylphenol, bis (2-ethylhexyl) phthalate, and isophorone,), LMW PAHs, HMW PAHs, pesticides (4,4-DDT, 4,4-DDE, alpha-chlordane, dieldrin, and gamma-chlordane), PCBs, dioxin TEQ, and TPHs.

The OCS potential exposure area was evaluated for potential risk to large home-range wildlife receptors only. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Area-weighted EPCs were not evaluated based on the risk conclusions using depth-weighted EPCs.

Avian TRVs are not available for antimony, VOCs, and most SVOCs (except bis (2-ethylhexyl) phthalate) for birds; and mammalian TRVs are not available for bromomethane, chloromethane, 4-methylphenol and isophorone. Therefore, risks to these receptors from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the OCS potential exposure area is presented in detail in Appendix OCS, including risk calculations based on depth-weighted EPCs for all COPECs for the baseline scenario. Consistent with the approach for large home-range receptors presented in the RAWP (Arcadis 2008a, 2009a, 2015), scouring scenarios were not evaluated. The HQs calculated for the OCS potential exposure area COPECs using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-30. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., depth-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for OCS. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix OCS.

Table 6-30 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Conclusions are as follows:

- Red-tailed hawk – *de minimis* risk to the red-tailed hawk and other carnivorous birds from exposure to COPECs in soil
- Desert kit fox – *de minimis* risk to the desert kit fox and other carnivorous mammals from exposure to COPECs in soil
- Nelson's Desert Bighorn Sheep – *de minimis* risk to herbivorous mammals exposed to COPECs in soil.

One large home-range T&E species has been observed in BCW within the OCS potential exposure area, the ring-tailed cat (California fully protected species), primarily a carnivorous mammal. Bat surveys indicated presence of the cave myotis and pallid bat (state species of concern) at BCW (Harvey 2015). Concentrations of COPECs at the OCS potential exposure area are not expected to pose unacceptable risk to individual receptors based on NOAEL-based HQs less than 1 for indicator receptors. For ring-tail cat and bats, risks were evaluated qualitatively, as described in this section:

- For the ring-tailed cat, the desert kit fox is the most representative surrogate receptor based on body sizes, similar dietary preferences, and large home ranges. Unlike the fox, which lives and forages primarily in the open desert, on creosote bush flats, and amongst the sand dunes (National Park Service 2015), the ring-tailed cat prefers habitat associated with water (California Department of Fish and Wildlife [CDFW] 2005) and is unlikely to use upland areas in the OCS with great frequency. Risk estimates for the fox are adequate to evaluate potential risk to the ring-tailed cat. For this species, protection at the NOAEL is warranted. The NOAEL-based HQs greater than 1 estimated for the fox using a SUF of 1 are low in magnitude and would reduce to *de minimis* levels using a site-specific SUF for ring-tailed cat based on a home range of 109 to 1280 acres (CDFW 2005). Because the ring-tailed cat is likely to forage in the riparian area, the risk characterization for the Tamarisk Thicket is considered adequate for evaluating for potential risk to the ring-tail cat as well. However, a carnivorous mammal, representative of the ring-tailed cat was not evaluated for the Tamarisk Thicket. The desert shrew evaluated in the Tamarisk Thicket potential exposure area (Section 6.6.2.14), is considered an adequate surrogate because it is a sensitive receptor assumed to be more highly exposed to soil than the ring-tailed cats based on foraging habits. The NOAEL-based HQs for the shrew in the Tamarisk Thicket potential exposure area are less than 1 for all the COPECs except for dioxin TEQ. The NOAEL-based HQ for dioxin TEQ would be reduced to *de minimis* levels when using a site-specific SUF for ring-tailed cat based on a home range of 109 to 1280 acres (CDFG 2005) in addition to accounting for the compounded uncertainties related to dioxin uptake and TRVs.
- For bats, the desert shrew is the most representative surrogate receptor based on prey preferences (invertebrates); however, bats have significantly larger home ranges than shrews and less exposed to soils as they are aerial feeders. The NOAEL-based HQs for the shrew at BCW the potential exposure area (Section 6.6.2.1) are less than 1 for all COPECs except for antimony, total chromium, and dioxin

TEQ. The NOAEL-based HQs would be reduced to *de minimis* levels when using a site-specific SUF for bats (e.g., 42 acres for myotis [Henry et al. 2002] compared to the home range of 0.1 for the shrew) in addition to the LOE discussed for BCW, the potential exposure area, including compounded uncertainties related to dioxin uptake and TRVs.

Based on the results of the ERA, potential exposures to COPECs in soil at the OCS potential exposure area are not expected to pose unacceptable risk to ecological receptors including special-status species.

Potential Risk Drivers for the OCS Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no risk drivers were identified for the OCS potential exposure area based on unacceptable population-level risk (i.e., LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at OCS Exposure Area for the Baseline Scenario

Scenario	Carnivorous Birds (Red-Tailed Hawk)	Carnivorous Mammals (Desert Kit Fox)	Herbivorous Mammals (Nelson's Desert Bighorn Sheep)
Baseline	None	None	None

6.6.2.16 Bat Cave Wash and AOC4

For BCW+AOC4 potential exposure area, COPECs are listed in Table 3-7 and included 12 metals (antimony, barium, hexavalent chromium, total chromium, cobalt, copper, lead, mercury, nickel, thallium, vanadium, and zinc), one VOC (methyl acetate), one SVOC (bis [2-ethylhexyl] phthalate), LMW PAHs, HMW PAHs, PCBs, dioxin TEQ, and TPHs.

The BCW+AOC4 potential exposure area was evaluated for potential risk to large home-range wildlife receptors only. Potential risks to these ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Area-weighted EPCs were not evaluated based on the risk conclusions using depth-weighted EPCs.

Avian TRVs are not available for antimony, barium, and methyl acetate. Therefore, potential risks to birds from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the BCW+AOC4 potential exposure area is presented in detail in Appendix BCW+AOC4, including risk calculations based on depth-weighted EPCs for all COPECs for the baseline scenario. Consistent with the approach for large home-range receptors presented in the RAWP (Arcadis 2008a, 2009a2008, 2009, 2015), scouring scenarios were not evaluated. The HQs calculated for the BCW+AOC 4 potential exposure area COPECs using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-31. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., depth-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the BCW+AOC4 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix BCW+AOC4.

Table 6-31 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Conclusions are as follows:

- Red-tailed hawk – *de minimis* risk to the red-tailed hawk and other carnivorous birds from exposure to COPECs in soil
- Desert kit fox – *de minimis* risk to the desert kit fox and other carnivorous mammals from exposure to COPECs in soil
- Nelson's Desert Bighorn Sheep – *de minimis* risk to herbivorous mammals exposed to COPECs in soil.

One large home-range T&E species has been observed in BCW within the BCW+AOC4 potential exposure area, the ring-tail cat, primarily a carnivorous mammal. Concentrations of COPECs in the BCW+AOC4 potential exposure area are unlikely to pose unacceptable risk to individual receptors, based on the quantitative risk estimates for Nelson's desert bighorn sheep and qualitative evaluation for indicator species (see discussion for the OCS potential exposure area, Section 6.7.2.15).

Based on the results of the ERA, potential exposures to COPECs in soil in the BCW+AOC4 potential exposure area are not expected to pose unacceptable risk to ecological receptors.

Potential Risk Drivers for the BCW+AOC4 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the BCW+AOC4 potential exposure area based on unacceptable population-level risk (i.e., LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at BCW+AOC4 Exposure Area for the Baseline Scenario

Scenario	Carnivorous Birds (Red-Tailed Hawk)	Carnivorous Mammals (Desert Kit Fox)	Herbivorous Mammals (Nelson's Desert Bighorn Sheep)
Baseline	None	None	None

6.6.2.17 Outside the Compressor Station Excluding Bat Cave Wash and AOC4

For the OCS excluding BCW and AOC4 potential exposure area (i.e., referred to hereafter as the OCSxBCW+AOC4 potential exposure area), COPECs are listed in Table 3-7 and included eight metals (antimony, hexavalent chromium, total chromium, copper, lead, mercury, thallium, and zinc), four VOCs (bromomethane, chloromethane, chloroform, and methyl acetate), four SVOCs (4-methylphenol, bis (2-

ethylhexyl) phthalate, butylbenzylphthalate, and isophorone), LMW PAHs, HMW PAHs, five pesticides (4,4-DDT, 4,4-DDE, alpha-chlordane, dieldrin, and gamma-chlordane), PCBs, dioxin TEQ, and TPHs.

The OCSxBCW+AOC4 potential exposure area was evaluated for potential risk to large home-range wildlife receptors only. Potential risks to ecological receptors were calculated for the baseline scenario using depth-weighted EPCs. Area-weighted EPCs were not evaluated based on the risk conclusions using depth-weighted EPCs.

Avian TRVs are not available for antimony, barium, VOCs, and most SVOCs (except bis (2-ethylhexyl) phthalate); and mammalian TRVs are not available for bromomethane, chloromethane, 4-methylphenol and isophorone. Therefore, potential risks to birds from exposure to these specific COPECs could not be estimated. In addition, appropriate screening values and TRVs are not available for TPHs, and therefore, indicator chemicals (i.e., BTEX and PAHs – if detected and above background) were used to characterize TPH risks. The lack of screening values and TRVs and the impact to the ERA are discussed in Section 6.7.5.

The ERA for the OCSxBCW+AOC4 potential exposure area is presented in detail in Appendix OCSxBCW+AOC4, including risk calculations based on depth-weighted EPCs for all COPECs for the baseline scenario. Consistent with the approach for large home-range receptors presented in the RAWP (Arcadis 2008a, 2009a, 2015), scouring scenarios were not evaluated. The HQs calculated for the OCSxBCW+AOC4 potential exposure area COPECs using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs are presented in Table 6-32. For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., depth-weighted EPCs, site-specific SUF, and selected TRVs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for the OCSxBCW+AOC4 potential exposure area. The various LOE considered in the WOE assessment and risk conclusions are presented in Table 6-11 and summarized in this section; details are presented in Appendix OCSxBCW+AOC4.

Table 6-32 presents the HQs for all the COPECs for the baseline scenario calculated using depth-weighted EPCs, selected screening levels/selected TRVs, and site-specific SUFs. Conclusions are as follows:

- Red-tailed hawk – *de minimis* risk to the red-tailed hawk and other carnivorous birds from exposure to COPECs in soil
- Desert kit fox – *de minimis* risk to the desert kit fox and other carnivorous mammals from exposure to COPECs in soil
- Nelson's Desert Bighorn Sheep – *de minimis* risk to herbivorous mammals exposed to COPECs in soil.

Based on the results of the ERA, potential exposures to COPECs in soil in the OCS excluding BCW and AOC4 potential exposure area are not expected to pose unacceptable risk to ecological receptors.

Potential Risk Drivers for the OCSxBCW+AOC4 Exposure Area

As presented in Table 6-11 and summarized in the table in this section, no potential risk drivers were identified for the OCSxBCW+AOC4 exposure area based on unacceptable population-level risk (i.e., LOAEL-based HQs greater than 1 for mammals and birds) predicted using the most refined exposure and effects assumptions (i.e., site-specific SUF, depth-weighted EPCs, and selected TRVs) and additional LOE supporting the conclusion of unacceptable risk.

Potential Receptors and Risk Drivers at OCSxBCW+AOC4 Exposure Area for the Baseline Scenario

Scenario	Carnivorous Birds (Red-Tailed Hawk)	Carnivorous Mammals (Desert Kit Fox)	Herbivorous Mammals (Nelson's Desert Bighorn Sheep)
Baseline	None	None	None

6.7 Uncertainty Analysis

Understanding the underlying uncertainties inherent in the data and models used in the risk assessment is a critical aspect of a risk-based decision-making process. The uncertainty analysis presented in this section includes qualitative discussions and, in some cases, quantitative evaluations intended to convey the magnitude and direction of uncertainty in the risk estimates. Sources of uncertainty that influenced risk characterization included uncertainties in the analytical results, data evaluation, CSM, exposure assessment, effects assessment, and interpretation of the risk estimates. Many of these sources of uncertainty are generic in nature and inherent in the risk assessment process. Site-specific uncertainties are also discussed. In many cases, the generic and site-specific uncertainties discussed in Section 5.6 with respect to the HHRA also apply to the ERA and are not repeated here. Additional uncertainties applicable to the ERA are discussed in this section.

In general, conservative practices and assumptions were made to minimize underestimation of risk in the ERA, including:

- Estimates of COPEC concentrations in media were based on samples collected from known or suspected impacted locations within each exposure area and, thus, are likely to overestimate actual exposures to ecological receptors that might use the site.
- Wildlife representative receptor species were intentionally selected based on attributes (e.g., small foraging areas) that provide conservative estimates of exposure for other members of the feeding guild. Exposure parameters for the selected representative species from approved sources (e.g., USEPA Wildlife Exposure Factor Handbook [USEPA 1993]) were preferred sources of wildlife exposure information to reduce the uncertainty for the species living at this specific site.
- Estimates of exposure assume that wildlife do not avoid contaminated areas or foods, and do not actively avoid areas of the site in close proximity to industrial development and/or uses.
- Reproductive, developmental, and mortality effects, among the most sensitive of test endpoints for evaluating effects at the individual and population-level, were the preferred endpoints when identifying toxicity studies used in the selection of TRVs.
- The exposure assumptions and toxicity values used in the ERA were based on values selected in the various agency approved tech memos (Arcadis BBL 2007b; Arcadis 2008b, 2009b). These assumptions and toxicity values were used in developing soil ECVs for use in the RFI/RI site characterization to determine nature and extent and therefore, were based on conservative and

readily available literature/published values. These screening values and TRVs are generally considered very conservative and therefore, tend to overestimate risk as discussed in the risk characterization for ecological receptors. However, the quality of the exposure assumptions and toxicity values, with respect to confidence in predicting risks are believed to be significantly overestimated. This is especially the case for dioxin TEQ, one of the key risk drivers for small mammals. The uncertainties associated with the uptake of dioxins into prey tissue and the dioxin TRVs are discussed in Sections 6.7.4, and 6.7.5, respectively. Because of the uncertainties associated with the selected dioxin TEQ uptake regression and TRVs, alternate and more robust values were developed based on more current literature and approaches and presented in this section (and summarized earlier in Section 6.6). These alternate and more robust values are recommended for consideration in developing RBRGs for risk-management decisions.

Because of these approaches and other protective assumptions made throughout the ERAs, risk estimates are expected to be overestimated rather than underestimated.

Topics included in this analysis address uncertainties inherent in each phase of the ERAs. Specifically, uncertainties associated with the problem formulation, the data evaluation, the exposure assessment, the effects assessment, and risk characterization are described in detail in this section.

6.7.1 Uncertainty in the Problem Formulation

The primary uncertainties associated with the problem formulation included lack of site-specific information for the CSM as discussed in this section.

6.7.1.1 Omission of Potentially Complete but Insignificant Exposure Pathways

According to USEPA guidance (USEPA 1998), an exposure pathway must consist of four elements to be considered complete: (1) sources and release mechanisms; (2) retention and transport mechanisms; (3) exposure points; and (4) exposure routes. A pathway is considered incomplete if any of these elements is missing. Additionally, complete or potentially complete pathways may be considered insignificant due to the following: (1) low levels of contaminants; (2) low exposure frequency; or (3) because they are insignificant compared to other “risk driving” pathways. Complete or potentially complete pathways considered less significant may not warrant quantitative evaluation in an ERA as discussed in USEPA guidance (USEPA 1989, 1997a). Additionally, exposure and toxicity information necessary for quantitative evaluation of some pathways (e.g., dermal exposure) are limited or lacking. Therefore, these less significant or unquantifiable pathways should be qualitatively evaluated and identified as a source of uncertainty. Potential exposures due to dermal contact, inhalation of volatiles in burrow air and ambient air, and exposure to sediment were considered unquantifiable and/or insignificant for wildlife and were not quantitatively evaluated in this ERA.

Potential exposures via dermal contact were considered insignificant for wildlife receptors. For ecological communities, dermal contact was evaluated via direct contact with site media. For wildlife, dermal exposure through direct contact with site media can be considered a complete exposure pathway; however, this pathway was considered incidental due to low frequency and/or duration of exposure. Dermal exposure was also expected to minimally contribute to risk compared to oral routes of exposure (USEPA 2007a). Additionally, data necessary to estimate dermal exposure are generally not available for wildlife (USEPA 1993). Thus, dermal exposure to wildlife was not quantitatively evaluated in this ERA.

Inhalation of VOCs in ambient and burrow air were considered complete but insignificant exposure pathways because VOCs were infrequently detected outside the TCS, and detected concentrations were low. VOCs are expected to disperse rapidly in air following volatilization from soil or groundwater and are generally not highly toxic to birds or mammals (USEPA 2007a). Additionally, VOCs have log Kow values less than 2.0 and are unlikely to bioaccumulate in plant and animal tissues at significant levels (USEPA 2000b).

Consistent with USEPA guidance (1989, 2008), dermal exposure to soil, inhalation of VOCs in ambient air and burrow air are not expected to be significant routes of exposure and were not considered a major source of uncertainty for this ERA.

Exposure to sediment was considered a potentially complete but insignificant exposure pathway as well, based on the gradient analysis (Section 2.5) indicating that site-related constituents (i.e., hexavalent chromium, total chromium, and dioxins/furans) reach concentrations within the range of background in soil before reaching sediment in BCW or East Ravine. For BCW, the concentration trends for these constituents are clear, in that soil concentrations of hexavalent chromium, total chromium, and dioxins/furans are elevated in some upland soil near the TCS (specifically in SWMU1) but decrease to background levels well before reaching the Tamarisk Thicket. Fewer surface soil locations were sampled in East Ravine / AOC10, and therefore the conclusion of insignificant exposure has more uncertainty in this area. However, sediment concentrations of hexavalent chromium, total chromium, and dioxin TEQ are below background in the East Ravine sediment area, which support the conclusion that exposure to site-related constituents (and associated risk) would not be distinguishable from background levels and no unacceptable risk would be expected. The conclusion that exposure to sediment represents a potentially complete but insignificant exposure pathway does not represent a significant source of uncertainty in the ERA.

6.7.2 Uncertainty in the Data

The primary uncertainties associated with the data that apply to the HHRA and the ERA are discussed in Section 5. 6.1. Additional uncertainties specific to the ERA included calculated total concentrations of COPECs are discussed in this section.

6.7.2.1 calculated Total Concentrations for Soil

Exposure to dioxin/furan congeners, PCBs (as Aroclors), and HMW and LMW PAHs was evaluated in the ERAs using calculated total concentrations for these mixtures. The uncertainties associated with the calculated total concentrations of dioxin/furan congeners and HMW and LMW PAHs are described in this section. Uncertainties associated with using calculated total concentrations of PCBs also apply to the HHRA and are discussed in Section 5.6.1.

6.7.2.1.1 Dioxin TEQ

There are two main uncertainties for dioxin TEQ: (1) uncertainty related to the treatment of ND congeners in the TEQ estimates which is applicable to both the HHRA and ERA and previously discussed in Section 5.6.1.3.1; and (2) uncertainty regarding the applicability of TEFs to abiotic media which is applicable only to the ERA and discussed in this Section.

Dioxin TEQs calculated for soil using mammalian TEFs are based on prey tissue ingestion (i.e., primarily from oral uptake studies through dietary exposure). Direct calculation of dioxin TEQ concentrations in soil does not account for reductions in bioavailability or uptake that occur differentially for the individual congeners during ingestion, and for differences in the environmental fate of these compounds in abiotic media (Van den Berg et al. 2006). [Note: Concern was expressed (by the WHO Committee) about direct application of the TEF/total TEQ approach to abiotic matrices, such as soil, sediment, etc., for direct application in human risk assessment. This is problematic as the present TEF scheme and TEQ methodology are primarily intended for estimating exposure and risks via oral ingestion (e.g., by dietary intake).] Similarly, the bird TEFs are calculated based on egg injection studies or *in vitro* exposures where the exposure conditions are not likely to be representative (in terms of the suite of congeners and their relative concentrations) of the *in vivo* exposures that result from dietary uptake of dioxins and furans (Van den berg et al. 1998). Therefore, dioxin TEQs calculated using bird TEFs are relevant only to tissue data in which dioxin/furan congeners were measured. There is significant uncertainty in the application of mammal and bird TEFs to soil data in the dietary models and dioxin TEQ HQs for these receptors may not be predictive of actual risk.

6.7.2.1.2 Total HMW and LMW PAHs

For calculation of total HMW and LMW PAHs, individual PAH concentrations included in each group were summed, assuming ND concentrations were equal to zero. This approach may underestimate total HMW/LMW PAH concentrations when PAHs are present below the RL. To meet DQOs for the protection of human health, PAH RLs are low (range typically in low microgram per kilogram [µg/kg] concentrations) relative to risk-based screening levels protective of ecological receptors and wildlife (ranging from 1.1 to 100 mg/kg for plants, soil invertebrates, and wildlife). Due to the low PAH RLs, the magnitude of any potential underestimates of total HMW / LMW PAH concentrations is expected to be small. The use of zero to represent ND concentrations is preferable for PAHs because they are infrequently detected across most areas outside the TCS and use of one-half or the full RL for calculation of total HMW and LMW PAHs would result in substantial overestimation of the total PAH concentrations present in soil.

6.7.3 Uncertainty in Exposure Estimates

6.7.3.1 Assumption of Bioavailability in Soil

Exposure estimates calculated herein assume that measured concentrations of COPECs in soil are 100% bioaccessible via dietary uptake (dermal absorption via the gut) and direct contact. For many COPECs, this assumption overestimates exposure. The chemical extraction methods used to measure COPEC concentrations in soil result in complete or nearly complete extraction of bound and insoluble COPEC fractions in soil, whereas chemical extraction in the gut of ecological (and human, previously discussed in Section 5.6.3.3) receptors can be far less efficient. The USEPA compiled relative bioaccessibility (RBA) data for arsenic and concluded that the RBA of arsenic can be expected to be less than 100% (USEPA 2012). For arsenic in soil, an RBA factor of 0.6 (upper percentile United States data) is recommended in the absence of site-specific bioaccessibiltiy data (USEPA 2012). Similarly, the USEPA reports an RBA of 0.6 for lead (central value) based on soil data in the United States (USEPA 2007b). DTSC EcoNote4 (2000) also recommends measurement of site-specific bioaccessibility of lead to correct for differences in availability of lead acetate (the form of lead most often tested in the laboratory) relative to lead in site soil, which may be present in various forms including (e.g., lead carbonate, lead oxides, lead sulfate, elemental lead). These chemical forms of lead will have different levels of bioavailability based on water solubility, amount bound to organic/inorganic matter, and particle size. Details of arsenic and lead bioavailability, including recent studies and methodologies are discussed in the ITRC guidance (2017).

Literature bioaccessibility factors are also available for various metals:

- Arsenic: Saunders et al. (2011) evaluated bioaccessibility of total arsenic in soil to meadow voles (*Microtus pennsylvanicu*s) at five locations in Canada. Median bioaccessibility at each location ranged from below detection to 21%, with an average of 13%.
- Lead: Kaufman et al. (2007) used models to simulate gastric conditions of mammalian (i.e., eastern cottontail [Sylvilagus floridanus] and short-tailed shrew [*Blarina brevicauda*]) and avian (i.e., American robin [*Turdus migratorius*]) receptors to investigate the proportion of lead in soil, earthworms, and vegetation mobilized into digestive fluids (i.e., the bioaccessible fraction). In the mammalian gastric model, bioaccessible lead averaged 66% for soil, averaged 77% for earthworm tissue, and averaged 50% for vegetation. In the avian gizzard model, the bioaccessible fraction of lead averaged 53% for soil and 73% for earthworm tissue (Kaufman et al. 2007).
- Zinc: One study by Pelfrene et al. (2010) evaluated the bioaccessibility of cadmium, lead, and zinc in humans exposed to contaminated topsoil near smelters. The study showed that zinc was less bioaccessible than lead. Turner et al. (2000, 2008) investigated zinc bioaccessibility in model marine invertebrate and fish gastric systems. Data indicated less than 1 to 58% of zinc in sediment was potentially bioaccessible to marine invertebrates and fish.
- TCDD: In a study by Fries and Marrow (1975), rats were given TCDD in a laboratory prepared diet continuously for 42 days. Fries and Marrow (1975) reported the absorption of TCDD into the tissue to be 50 to 60%, with an average of 55%.
- Dioxins: Swine and rats have been used most frequently in studies to assess the relative bioavailability of dioxin from soil (Budinsky et al. 2008; Wittsiepe et al. 2007; Finley et al. 2009; Lucier et al. 1986; Shu et al. 1988). In the swine studies, the total TEQ relative bioavailability average was 28%. In the rat studies, the total TEQ relative percent bioavailability average was 41%. The mean of these is 35% (USEPA 2010).

In addition, TRVs are typically based on laboratory dosing studies in which highly soluble forms of the COPECs were used. As a result, these toxicity estimates can overestimate the bioavailability, uptake, and ultimate toxicity of COPECs in the receptors' gut.

To account for the absorbed fraction across the gut wall, DTSC (2015b) recommends reducing dermal uptake estimates for several COPECs (metals, PAHs, PCBs, chlorinated pesticides, dioxins/furans, and other organic compounds). The absorbed fractions range from 0.001 for cadmium to 0.15 for PAHs and PCBs (DTSC 2015b).

While these RBA and dermal absorption (ABSd) values have been calculated for use in HHERAs, they likely also apply to many other mammalian species to varying degrees. A similar assumption that chemical concentrations measured in soil are not 100% bioavailable via dietary uptake can be made for birds. Based on the magnitude of the dermally-available fractions in soil, the assumption that 100% of measured COPEC concentrations are bioavailable can result in substantial overestimation of exposure and risk.

6.7.3.2 Exposure Point Concentration Estimation

Uncertainties associated with estimation of EPCs that are applicable to both the HHRAs and the ERAs are discussed in Section 5.6.3.4. Uncertainties applicable only to the ERAs are provided here. In the ERA, depth-weighted soil datasets were used to calculate EPCs. Three sets of EPCs were used to estimate risk, including maximum depth-weighted concentrations, upper bound on the mean of the depth-weighted concentrations (i.e., depth-weighted 95UCL), and upper bound on the mean of depth- and area-weighted concentrations. When the available dataset for a depth interval and exposure area was composed of less than eight total samples and four detected results, the maximum depth-weighted concentration was selected as the EPC for all three EPC scenarios. In these cases, such as for constituents that were rarely detected or exposure areas where few samples were collected because detected concentrations did not warrant further step-out sampling, use of the maximum may not appropriately characterize site risk.

Uncertainties associated with estimation of EPCs that are applicable to both the HHRAs and the ERAs are discussed in Section 5.6.3.4. Uncertainties applicable only to the ERAs are provided here. In the ERAs, depth-weighted soil datasets were used to calculate EPCs. Three sets of EPCs were used to estimate risk, including maximum depth-weighted concentrations, upper bound on the mean of the depth-weighted concentrations (i.e., depth-weighted 95UCL), and upper bound on the mean of depth- and area-weighted concentrations. When the available dataset for a depth interval and exposure area was composed of less than eight total samples and four detected results, the maximum depth-weighted concentration was selected as the EPC for all three EPC scenarios. In these cases, such as for constituents that were rarely detected or exposure areas where few samples were collected because detected concentrations did not warrant further step-out sampling, use of the maximum may not appropriately characterize site risk.

Use of ½-RL to calculate the depth-weighted soil concentrations for each boring location also introduces uncertainty in the EPCs. As discussed in Section 5.6.3, the magnitude of this uncertainty is relatively small, as most EPCs are the same or differ by a factor of two or less. For example, depth-weighted EPCs for the BCW exposure area (0 to 6 feet bgs interval; Appendix BCW Table BCW-3.1) were recalculated using the full RL in the depth-weighting procedure. For most COPECs, the same UCL method was recommended by ProUCL and the resulting EPCs (using full RL) were less than 20% greater than estimated using ½-RL in the depth-weighting procedure. For those COPECs with FOD at or near 100%, the resulting EPCs using full RLs are the same as using ½-RLs because there are few or no non-detect values in the dataset. Similarly, for those COPCs with fewer than four detected concentrations, the resulting EPCs using the full RLs are the same as using ½-RLs because the EPC is based on the maximum detected concentration. The remaining COPCs with EPCs that differed by more than 20% included antimony (41% or 1.4 times greater), mercury (86% or 1.86 times greater), and TPHd (84% or 1.84 times greater). For TPHd, risk to ecological receptors is evaluated using individual constituents of the TPH mixture, for which EPCs differed by less than 20%. For antimony, and mercury, use of the full RL would result in no or minor changes to the estimated HQs. Ecological receptors potentially exposed to the 0- to 6-foot bgs interval include plants, Gambel's quail, Merriam's kangaroo rat, desert kit fox, and

Nelson's desert bighorn sheep. In the BCW exposure area, antimony and mercury LOAEL-based HQs for these receptors are below 1 using ½-RL or full RL in the depth weighting, except for antimony and plants. The antimony HQ for plants equals 4 in both scenarios (1/2-RL and full RL, as the HQs are based on an EPC of 18 mg/kg, the maximum detected value for surface soil and highest EPC for all depths intervals).

In most cases (as described in the preceding paragraph), use of the full RL in the depth-weighting procedure resulted in the selection of the same UCL method; therefore, the resulting difference in EPCs can be attributed to the use of the full RL value. However, in a small number of cases, a different UCL method was recommended by ProUCL when the full RL was used, which may contribute to the observed change in EPC value. For the example BCW 0- to 6-foot bgs dataset, this occurred for antimony and TPHd. For antimony, use of the full RL results in a 95UCL of 2.339 mg/kg based on the ProUCL-recommended method (95% KM [BcA] UCL), whereas use of ½-RL yields a 95UCL of 1.658 mg/kg based on the ProUCL-recommended method (95% KM Chebyshev UCL).

For shallower depth intervals (e.g., 0 to 3 feet bgs), the effect of using the full RL is similar in that it produces higher EPCs for those COPCs with relatively low FOD. For the 0- to 3-foot bgs BCW dataset, the only COPCs with EPCs that differed by more than 20% included mercury (84% or 1.84 times greater) and TPHd (59% or 1.59 times greater). EPCs for antimony and bis (2-ethylhexyl) phthalate at this depth are based on the maximum detected concentration due to fewer than four detected concentrations for this depth interval.

Overall, the use of ½-RL in the depth-weighting procedure has minimal effect on the risk estimates and does not impact risk conclusions for ecological receptors potentially exposed to soil at the site.

6.7.3.3 Receptor Exposure Assumptions

For avian and mammalian receptors, potential exposure was estimated using a dietary exposure model. This model uses generic assumptions for FIRs, body weight, and dietary composition that were derived from literature sources or estimated from allometric relationships and not actually measured using site-specific data. Variations from natural stresses may result in one or multiple parameter changes (e.g., mean value body weight or dietary consumption). It should also be noted that wildlife exposure factors for these representative species can vary by location, quality of habitat, and season. Conservative values, identified as the published values resulting in the highest exposure estimate, were often selected when conflicting information was presented.

The selected exposure parameters are likely to accurately represent or overestimate, but not underestimate potential exposure to actual wildlife present at the site, as the exposure parameters were selected to be more protective (i.e., high IRs, low body weights, exposure to the upper bound of concentrations, diet consisting of a single prey item).

6.7.3.3.1 Dietary Composition

The assumption that each wildlife receptor consumes one type of diet (e.g., desert shrew eating 100% invertebrates), instead of a mixed diet, is also conservative for most receptors. The assumption that 100% of the receptor's diet is contaminated with site chemicals is also conservative. These assumptions tend to overestimate risk estimated for ecological receptors, especially for wildlife that are omnivorous. Generally, uptake of organics (lipophilic compounds) tend to be higher in prey items such as invertebrates and small mammals than uptake by plants. Risk estimates based on invertivorous and carnivorous receptors likely overestimate risk for omnivorous species with more variable diets.

An additional uncertainty is related to the soil-to-invertebrates BAFs selected in these ERAs, which are based on uptake data or theoretical models for bioaccumulation from soil to earthworm tissue. Use of the earthworm-based BAFs assumes that invertivorous species consume only earthworms. Earthworms ingest soil, are in direct contact with soil, and have few external features that would limit dermal absorption through the skin. As a result, uptake estimates for earthworms are typically higher than observed for many other soil invertebrate species, including terrestrial insects that live along the soil surface or on plants/organic material at or above ground level. Additionally, many of these species feeding habits and external structures, such as hard cuticles, limit dermal absorption of soil constituents. Because of the arid environment at the site, invertebrates that are likely present onsite are spiders, beetles, scorpions, etc. and not earthworms. As a result, the assumption that invertivorous receptors feed solely on earthworms likely overestimates exposure and risk for most invertivorous/insectivorous receptors that consume species other than earthworms as part of their diet. Additional uncertainty related to the earthworm BAFs is discussed in the Section 6.7.4.

6.7.4 Uncertainty in Uptake Assumptions

Bioaccumulation assumptions represent a large source of uncertainty in the ERAs due to the use of literature-derived BAFs. Site-specific tissue residue data, which provide a direct measure of prey tissue concentrations, are unavailable at the sites. Prey concentrations estimated using literature-derived BAFs do not account for assimilation, metabolism, or depuration of constituents, or site-specific factors that may influence uptake. Site-specific factors may include species specific characteristics (e.g., feeding strategy, age, and gender) as well as abiotic factors (e.g., soil organic carbon and mineral content, COPEC weathering, climate). The sandy soil near the sites may not be representative of soils typically used to derive BAFs in the published literature. However, published BAFs are generally thought to be conservative because they are recommended by the USEPA for use in screening-level risk assessments. When USEPA-recommended BAFs were not available, BAFs were developed based on suitable data and/or models available in literature. In general, the use of the generic literature-based BAFs is assumed to overestimate uptake, exposure, and risk, at the sites. However, the magnitude of this effect cannot be estimated without site-specific tissue residue data.

Uncertainties related to bioaccumulation of specific COPECs in prey tissues are discussed in more detail in this section.

6.7.4.1 Uncertainty in PAH Uptake

In the ERAs, uptake of PAHs was modeled using BAFs from USEPA (2007a). Uptake to plant and invertebrate prey tissue was modeled using BAFs or uptake regression equations, whereas uptake to vertebrate prey tissue is negligible due to rapid metabolism of these compounds in mammals and birds. For plants and soil invertebrates, there is uncertainty in the uptake of PAHs, based on site-specific factors and conservative assumptions incorporated into the BAFs.

The soil-to-invertebrate BAFs selected by USEPA (2007a) are based on a theoretical uptake model based on log Kow. As described by USEPA (2007a), uptake of PAHs by earthworms occurs primarily by direct contact with the soluble phase of the soil solution (interstitial porewater) (Fairbrother 2005). Soil porewater concentrations of PAHs are more predictive of biological responses (toxicity and/or bioaccumulation) in soil organisms than are bulk soil concentrations. Several studies show a relationship between bioaccumulation of or toxic effects of PAHs and soil porewater concentrations. The relationships are more predictable for low molecular weight compounds and show significant variability for HMW PAHs (Ma et al. 1998; Fairbrother 2005).

Based on the arid nature of the site, porewater concentrations in soil are expected to be low, limiting bioavailability of PAHs to soil invertebrates. Additionally, the bioavailability of PAHs in soil is influenced by organic carbon quality and quantity, aging and weathering, microbial action, methylation/hydroxylation, adsorption/desorption hysteresis and ultra-violent light interaction (Fairbrother 2005). PAHs can degrade, volatilize, or slowly diffuse into more sorptive and inaccessible phases within the soil matrix. Thus, the bioavailability and toxicity of PAHs remaining in soil may decrease over time (ITRC 2017). The soil organic carbon-water partition coefficients (Koc) for PAHs vary depending on the size of associated soil particles with the highest values in silt (fine particles) followed by sand and clay (Krauss and Wilcke 2002). The PAH source and the presence of black carbon (such as soot or char) in the soil are generally the main factors controlling PAH partitioning (ITRC 2017). The unique soil and climate characteristics at the sites relative to soil used to generate uptake models are likely result in overestimation of bioaccumulation potential in soil invertebrate tissue in the ERA. Because PAHs are a mixture of compounds, methodology for evaluating PAH bioavailability is complex. Details of PAH bioavailability, including recent studies and methodologies are discussed in the ITRC guidance (2017).

For plants, PAH uptake factors from USEPA (2007a) are based on uptake regressions derived from rinsed foliage data for crop plants. For HMW PAHs, the regression equation is a good fit for the data (r2=0.78), whereas for LMW PAHs, the uptake regression predicts only about 20% of expected plant PAH concentrations (r2=0.20). In general, the more-soluble a PAH, the higher the uptake by plants. However, the most important source of PAHs for plants is the atmosphere where the compounds enter via the gaseous phase or deposit bound to particles on the plant surface (USEPA 2007a; Sims and Overcash 1983; Wilcke 2000). As a result, uptake of PAHs to plant tissue is likely overestimated in the ERA.

6.7.4.2 Uncertainty in Uptake of Dioxins/Furans

In the ERA, potential dietary exposure for wildlife receptors to dioxin TEQ was estimated by estimating dioxin TEQ concentrations in their prey tissue. Uptake from soil-to-prey tissue was estimated using an uptake regression for a single congener (2,3,7,8-TCDD) published by Sample et al. (1998a, b) to represent uptake of all 17 dioxin/furan congeners included in dioxin TEQ. This is a critical uncertainty for dioxins/furans, one of the potential risk drivers for the sites, as this approach ignores differential uptake of congeners based on differences in their structure and physico-chemical properties leading to potential and significant overestimation of risks to ecological receptors, especially wildlife receptors. Uptake data available in the literature for earthworms (Fagervold et al. 2010) and published soil-to-invertebrate BAFs (USEPA 1999a) indicate that 2,3,7,8-TCDD has among the highest uptake rates for the dioxin/furan congeners included in TEQ concentrations. Several dioxin/furan impacted sites (e.g., Tittabawasee River

[Galbraith 2004; Kay et al. 2005], Centradale Manor in Rhode Island [Mactec 2004] have demonstrated the overestimation of dioxin TEQ risk resulting from use of a single BAF compared with measured concentrations. Because TEQ uptake was estimated using uptake data for only 2,3,7,8-TCDD, TEQ uptake is likely overestimated in the ERAs.

To evaluate the magnitude of this effect, congener specific BAFs were used to predict individual congener concentrations in prey tissue, which were then used to calculate tissue TEQ concentrations for use in the dietary foodweb models used in the ERA. Congener-specific BAFs are readily available from USEPA (1999a) for soil-to-plant uptake and soil-to-terretrial invertebrate uptake and congener-specific soil-to-invertebrate BAFs are also available from Fagervold et al. (2010). These congener-specific BAFs were used to model congener-specific tissue concentrations from soil concentrations detected at the BCW potential exposure area as an example to demonstrate how the use of the congener-specific BAF approach impacts exposure estimates.

Table 6-33 presents individual congener concentrations in soil for the BCW potential exposure area (depth-weighted EPCs), the plant and invertebrate congener-specific BAFs from USEPA (1999a) and Fagervold et al. (2010) and resulting tissue EPCs for dioxin TEQ. To calculate the dioxin TEQ tissue EPCs, the soil concentrations were first multiplied by the congener-specific BAFs to estimate plant and invertebrate tissue EPCs for each congener. The congener-specific tissue EPCs were then multiplied by the mammalian and avian TEFs (discussed in Section 6.5.3). Dioxin tissue TEQ concentrations were estimated by summing the TEF-adjusted individual congener concentrations, resulting in plant tissue TEQ EPCs and invertebrate tissue TEQ EPCs for use in food web models for mammals and birds. The tissue TEQ EPCs based on congener-specific BAFs were compared to the plant and invertebrate tissue TEQ EPCs used in the ERA estimated using only the 2,3,7,8-TCDD uptake regressions from Sample et al. (1998a,b; i.e., not congener specific), presented at the bottom of Table 6-33. For plants, the congener-specific approach using the USEPA (1999a) plant BAFs results in plant tissue TEQ EPCs of 0.5 ng/kg (for mammals) and 1.3 ng/kg (for birds) which are similar (within a factor of two) to TEQ EPCs used in the ERA (1.1 ng/kg for mammals and 0.61 ng/kg for birds). For invertebrates, however, the congener-specific approach results in dioxin TEQ tissue EPCs of 153 ng/kg for mammals and 371 ng/kg for birds using the USEPA (1999a) invertebrate BAFs, and dioxin TEQ tissue EPCs of 80 ng/kg and 105 ng/kg using the Fagervold et al. (2010) invertebrate BAFs. The dioxin TEQ tissue EPCs based on congener-specific BAFs are about 10 to 19 times lower compared to the for mammalian TEQ and about two to seven times lower for avian TEQ compared to the tissue TEQ EPCs used in the ERA for the BCW potential exposure area (0 to 0.5 foot bgs; 1,491 ng/kg for mammals and 703 ng/kg for birds).

The congener-specific BAFs for invertebrates presented in Table 6-33 were calculated from data presented by Fagervold et al. (2010). These congener-specific BAFs were developed using the Fagervold et al. (2010) data, bioaccumulation equivalency factors (BEFs, Table 6-34) and the 2,3,7,8-TCDD BAF based on a floodplain soil sample (SW-20 containing 0.38% organic carbon; Fagervold et al. 2010). The data from this location are considered the most representative of the Topock site based on the low organic carbon content. However, invertebrate BAFs were not available for some congeners as they were not detected in the SW-20 soil sample. Therefore, invertebrate BAFs for a wetland location (SW-265 containing 5.6% organic carbon; Fagervold et al. 2010) were also included in the development of the overall congener-specific BAFs by calculating BEFs for each soil location. The BEFs assume that the uptake of each congener relative to 2,3,7,8-TCDD in a particular soil sample is dependent on physical/chemical characteristics of the individual congeners and not related to the geochemical characteristics of the soil. BEFs were estimated as a ratio of the congener specific BAF to the TCDD BAF (e.g., BEF for TCDD is 1.65/1.65 =1; BEF for 1,2,3,4,7,8-HxCDF is 0.584/1.65 = 0.35). BEFs were calculated for SW-20 and SW-265 samples and the average of the two were calculated for each congener (e.g., BEF for 1,2,3,4,7,8-HxCDF of 0.29 is the average of the BEF from SW-20 of 0.35 and 0.22 from SW-265). These BEFs were then used to estimate congener-specific invertebrate BAFs by multiplying the invertebrate BAF of 1.65 for 2,3,7,8-TCDD for SW-20 (the most representative of the Topock site) by the average BEF (e.g., the invertebrate BAF for 1,2,3,4,7,8-HxCDF is 1.65 * 0.29 = 0.48). The BEFs and overall congener-specific BAFs developed from Fagervold et al. (2010) are presented in Table 6-34. These refined and robust congener-specific invertebrate BAFs were used to estimate congener tissue concentrations in Table 6-33.

Concentrations of dioxin/furan congeners in tissue were multiplied by mammalian and avian TEFs to calculate dioxin TEQ concentrations in tissue, consistent with the approach used in the ERAs. Tissue dioxin TEQ EPCs and potential wildlife risks were calculated for surface soil (0 to 0.5 foot bgs) in BCW potential exposure area using the congener-specific BAFs and compared to the HQs for the BCW potential exposure area calculated using the 2,3,7,8-TCDD uptake regression selected for the ERA (Table 6-35).

Table 6-35 compares wildlife HQs estimated using the congener-specific approach and the approach used in the ERA, using the 2,3,7,8-TCDD uptake regression. The HQs based on the congener-specific approach were estimated using the tissue TEQ concentrations presented in Table 6-33. For herbivorous receptors, HQs estimated using congener-specific BAFs are similar to those estimated for the ERA. For invertivorous mammals (i.e., shrew), however, HQs estimated using the congener-specific approach are about 10 times lower than those estimated in the ERA. This would especially matter for potential exposure areas where the LOAEL-based HQs ranging from 1 to 10 based on the selected TRVs were estimated for invertivorous receptors (AOC4, AOC11, AOC27, BCWxSWMU1, and TT), which could be reduced to less than or equal to 1 using congener-specific BAFs and thus resulting in no unacceptable risk to small mammals.

The magnitude of the differences between the congener-specific and 2,3,7,8-TCDD only uptake approaches will vary somewhat between potential exposure areas depending on the relative concentrations of the individual congeners in each potential exposure area, but these calculations demonstrate that the overall dioxin TEQ concentrations for invertivorous/insectivorous wildlife receptors are likely substantially overestimated in the ERA for all the potential exposure areas. The congener-specific BAFs presented in Table 6-33 are considered robust and are based on current science, and should be considered in development of RBRGs, instead of the single 2,3,7,8-TCDD uptake regressions from Sample et al. (1998a, b) that are overly conservative and uncertain.

6.7.4.3 Uncertainty in Plant Uptake of Hexavalent Chromium

Uptake of chromium-6 and expected effect on risk estimates for plants and herbivorous wildlife were discussed in the Arrowweed Technical Memorandum (Tech Memo; Arcadis 2013). Specifically, the Arrowweed Tech Memo found that plants can take up hexavalent chromium and trivalent chromium from soil, but much of the hexavalent chromium is converted to trivalent chromium in the plant. As a result, little hexavalent chromium is present in aboveground plant structures relative to the exposure concentration in growth media. For plants, hexavalent chromium toxicity was evaluated using a screening level of 1 mg/kg based on hexavalent chromium applied to various crop plants (Efroymson et al. 1997). This exposure scenario is similar to that evaluated in the ERA. Therefore, toxicity to plants is not likely to be over- or underestimated based on consideration of the chemical form of chromium in plant tissues.

Herbivorous wildlife evaluated in the ERA include Merriam's kangaroo rat, Nelson's desert bighorn sheep, and Gambel's quail (a granivorous bird). For these receptors, the plant dietary fraction was evaluated in the ERA using hexavalent chromium TRVs. However, based on the information presented in the Arrowweed Tech Memo (Arcadis 2013), the chromium in plant tissue is likely to be predominantly trivalent chromium and could be evaluated using trivalent chromium TRVs for the plant dietary fraction. Use of trivalent chromium TRVs to evaluate the plant dietary dose is not expected to change risk conclusions for these receptors.

For birds, the hexavalent chromium LOAEL-based TRV is less than 2 times greater than the trivalent chromium LOAEL-based TRV and use of the trivalent chromium TRVs for the plant dietary fraction would slightly increase the LOAEL-based HQs. For mammals, the hexavalent chromium LOAEL-based TRV for is about four-fold higher than for trivalent chromium; use of the trivalent chromium TRV to evaluate the plant dietary dose would also increase HQs. However, for all herbivorous receptors evaluated in the ERA, hexavalent chromium LOAEL-based HQs for trivalent chromium (total chromium) were less than 1 in all potential exposure areas; therefore, risk conclusions for these receptors are unlikely to change based on consideration of information presented in the Arrowweed Tech Memo (Arcadis 2013).

6.7.5 Uncertainty in Effects Assumptions

There is uncertainty in the effects data, because most of the toxicity data used to derive screening levels and TRVs were based on laboratory studies conducted in settings that do not mimic true field conditions. Laboratory studies typically control various factors in order to isolate one parameter in particular. Although such controlled experiments result in a more valid interpretation of the isolated parameters or relationship, uncertainty is associated with assuming that laboratory exposure conditions are equivalent to in-field exposure conditions. Exposure duration and toxicity characterization are two parameters that exemplify the difficulty in translating literature-derived data to data representing the exposure conditions for receptors. The use of chronic data is preferred in development of TRVs, but available toxicological data were not always associated with chronic exposure durations. Therefore, uncertainties were introduced in extrapolating non-chronic test results to chronic receptor toxicity values. These uncertainties were partially handled through the application of uncertainty factors in the derivation of low TRVs.

Uncertainties are also associated with the quantity and variable quality of literature-derived toxicity data. In order to reduce the uncertainties in the toxicity dataset, most screening values and TRVs were taken from widely accepted sources such as: USEPA EcoSSL documents (USEPA 2008), BTAG TRVs (DTSC 2000, 2002a, b, 2009e), USEPA (1999a), and ORNL (Efroymson et al. 1997a, b; Sample et al. 1996).

Additional uncertainties related to the effects assumptions for specific media and COPECs important in the ERAs are discussed in this section.

6.7.5.1 Uncertainty in Soil Screening Values

Soil screening levels for plants and invertebrates were selected from published sources, including USEPA (2008), ORNL (Efroymson et al. 1997a, b), USEPA (2015b), and literature studies, as described in

Section 6.3. As noted by the authors, these values are conservative estimates of toxicity for plant and invertebrate communities and do not necessarily indicate that adverse effects are occurring. In many cases, the screening levels are based on a limited dataset and there is low confidence in the ability of these screening levels to predict risk to plant and soil invertebrate communities. An ORNL document (Efroymson 1997a) states that "If chemical concentrations reported in field soils that support vigorous and diverse plant communities exceed one or more of the benchmarks presented in this report or if a benchmark is exceeded by background soil concentrations, it is generally safe to assume that the benchmark is a poor measure of risk to the plant community at that site". Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants.

For each COPEC with an HQ greater than 1 in the ERAs, the basis of the selected soil screening values in presented in Table 6-36 for plants and Table 6-37 for soil invertebrates. The soil screening values are also compared to site-specific background concentrations (BTVs; CH2M 2009c, 2013, 2017a). In most cases, the available toxicity data are limited to only one or two studies for which the tested species, soil types, and exposure conditions are unlikely to be present at the Topcock site. For screening levels from Efroymson et al. (1998a, b), the authors caution that the values are conservative and uncertain and recommend using observations of toxicity at the site to confirm risk predictions. Soil screening values based on equilibrium partitioning models from USEPA (2015b) were used to evaluate toxicity of most VOCs and SVOCs to soil invertebrates and are considered to be highly uncertain. Soil screening levels below BTVs also indicate substantial uncertainty in the screening value, as ecological communities have been present at the sites over evolutionary time and exposure to background concentrations of constituents is not expected to result in unacceptable risk. As indicated in the tables, confidence is low in most plant and soil invertebrate screening values. Based on somewhat more robust toxicity datasets, confidence was considered moderate or robust only for a few metals (copper, lead, and zinc; Table 6-36) for plants, and a few metals (copper and zinc) and chlordanes for invertebrates (Table 6-37).

For plants, potential risk drivers are hexavalent chromium and copper. For soil invertebrates, potential risk drivers are hexavalent chromium, total chromium, and copper in a few of the potential exposure areas.

As noted in Table 6-36 for plants, confidence in the screening value for hexavalent chromium is low because Efroymson et al. (1997a) reported tests conducted by Adema and Henzen (1989) where EC_{50} concentrations were reported for effects of chromium added as hexavalent chromium on lettuce, tomato and oats grown in a growth chamber from seed for 14 days. The EC_{50} ranged from 1.4 parts per million (ppm) for lettuce in a loam soil (pH 7.4, % organic matter 1.4) to 31 ppm for oats in humic sand soil. The screening level of 1 ppm (mg/kg) was reported by Efroymson et al. (1997a), assuming it was based on the lowest EC_{50} (based on the lettuce study). Even Efroymson et al. (1997a), reported low confidence in this screening level.

As noted in Table 6-37 for soil invertebrates, confidence in the screening values for hexavalent chromium and total chromium are low. For hexavalent chromium, Efroymson et al. (1997b) reported tests conducted by Abbasi and Soni (1983) using earthworm kept in concrete tanks containing a mixture of soil and animal dung for 60 days to assess the effect of hexavalent chromium, added as K_2Cr_2O, on survival and reproduction. Survival was the most sensitive endpoint measures with a 75% decrease resulting from 2 ppm chromium, the lowest concentration tested (20 ppm was the highest concentration tested). The screening level of 0.4 ppm was estimated using a safety factor of 5 was applied to the 2 ppm. Efroymson et al. (1997b), also reported that the relative toxicity of trivalent chromium and hexavalent chromium was not clear from these studies but believed that hexavalent chromium is reduced to trivalent chromium inside the cell (Molnar et al. 1989) and without a better understanding of Cr transformations in the soil, transport across earthworm cell membranes, and reactions within the cell, it is difficult to separate the effects of the two different forms of chromium. Even Efroymson et al. (1997b), reported low confidence in this screening level. USEPA Region 4 (USEPA 2015b) reports a soil screening value of 7.8 ppm, citing the EcoSSL guidance (USEPA 2008).

For total chromium, the soil invertebrate screening value used in the ERA is based on the soil screening value of 57 ppm, reported in two studies (Van Gestel et al. 1992, 1993) which met USEPA guidelines for use in development of an EcoSSL for soil invertebrates. Van Gestel et al. (1992, 1993) evaluated the exposure of adult earthworms (*Eisenia andrei*) to chromium-3 nitrate in an artificial soil substrate. The most sensitive endpoint was the number of juveniles produced per worm per week, which was significantly reduced at concentrations greater than 100 mg/kg chromium dry soil. Mortality was not observed at any exposure level. Based on a NOAEL concentration of 32 mg/kg chromium and LOAEL of 100 mg/kg, USEPA (2008) provides a toxicity concentration of 57 mg/kg chromium, based on the geometric mean of the two concentrations, which was selected to evaluate potential toxicity to soil invertebrates potentially exposed to total chromium in soil. There is low confidence in the invertebrate screening value because it is based on a single species of earthworm (*Eisenia andrei*) unlikely to be present at the site; and it is considered conservative because it is based on the maximum acceptable toxicant concentration (geometric mean of the NOAEL and LOAEL), instead of the LOAEL. In addition, the study used an artificial test system that may overestimate exposure at the site.

6.7.5.2 Uncertainty in the Selected TRVs

A general lack of wildlife toxicity data with the low probability of new data forthcoming leads to uncertainties in the development of wildlife TRVs (Allard et al. 2009). The potential for adverse effects to wildlife species was evaluated using NOAEL- and LOAEL-based TRVs selected in the RAWP (Arcadis 2008a) and supporting documents (Arcadis 2009a, 2015). Conservative TRVs were selected from published sources, including the USEPA (2008) EcoSSLs, Sample et al. (1998a), and DTSC (2002a, b). By design, these published TRVs provide lower-bound toxicity threshold estimates for use in baseline risk assessments. The USEPA EcoSSLs have been extensively vetted and the listed published sources are widely used to evaluate potential risk to wildlife. As such, the TRVs are not expected to underestimate risk; however, there is potential for overestimation of risk. The basis of the selected TRVs and confidence in their ability to accurately assess risk is presented in Tables 6-38a and 6-38b for key COPECs which were identified as having HQs greater than 1 for one or more receptors and exposure areas. As discussed in this section, in many cases, the selected TRVs likely result in overestimation of risk in the E RA. The magnitude of this overestimation varies by COPEC and is dependent on the quality and quantity of available toxicity data.

The selected TRVs for hexavalent chromium (avian), dioxin TEQ, PCBs, and HMW PAHs have additional sources of uncertainty, as discussed in this section.

6.7.5.2.1 Mammalian TRVs for Antimony

The mammalian TRVs selected for the ERA are from the EcoSSL guidance (USEPA 2008). The selected LOAEL-based TRV (0.59 mg/kg-bw/day) is based on the paired value from the selected NOAEL (0.059 mg/kg-bw/day) in a study by Rossi et al. (1987). Other studies cited in the EcoSSL and ORNL guidance indicate the selected TRVs are the very conservative. ORNL (Sample et al. 1996) reports a LOAEL-based TRV of 1.25 mg/kg-bw/day. The EcoSSL guidance reports paired LOAEL values ranging from 42 mg/kg-bw/day to 835 mg/kg-bw/day, and geometric means of the bounded NOAEL and LOAEL values are 185 mg/kg-bw/day and 279 mg/kg-bw/day, respectively; these NOAEL- and LOAEL-based doses are orders of magnitudes greater than the selected LOAEL. Antimony was not detected frequently onsite, and at low concentrations. HQs were greater than 1 in some areas suggesting that the selected TRVs likely overestimate risks.

6.7.5.2.2 Avian TRVs for Hexavalent Chromium

Due to the paucity of relevant toxicity data for hexavalent chromium in bird species, there is uncertainty in the selected TRVs for this site-related COPEC. Based on the available data (as described in Section 6.5), the selected NOAEL is the highest available NOAEL below the lowest available LOAEL for effects on reproduction, growth, or survival. This TRV selection approach is consistent with the approach used by U SEPA in derivation of the EcoSSLs and is expected to produce a conservative NOAEL-based TRV. For comparison, Conder et al. (2009) derived a NOAEL-based TRV of 16 mg/kg-bw/day from the same study (Butkauskas and Sruoga 2004) to evaluate hexavalent chromium toxicity in birds in the lower Hackensack River, New Jersey.

There is greater uncertainty, however, in the selected LOAEL-based TRV. The lowest LOAEL dose of 4.02 mg/kg-bw/day from Asmatullah et al. (1999) was not selected as the LOAEL-based TRV because it was determined to be overly conservative based on several factors. Although the Asmatullah et al. (1999) study was conducted during a critical life stage of birds, the Butkauskas and Sruoga (2004) study was considered more robust as it was based on a multigenerational exposure design. The dietary composition of the feed used in the Asmatullah et al. (1999) study was not described; as noted previously, lack of sufficient micronutrients in the feed alters susceptibility to chromium toxicity and could explain the apparent effect on hatchability. Additionally, Asmatullah et al. (1999) indicate that reduced hatchability could be due to either direct toxicity or eggshell thickening due to chromium deposition. Data for eggshell thickness and parameters related to egg quality and production in domestic species have uncertain relevance for wild species, as domesticated species have unnatural egg production characteristics that are very different from those of wild bird species. Finally, the relative difference in the LOAEL- and NOAEL-based TRVs for mammals was also considered. The mammalian EcoSSL for hexavalent chromium is 9.24 mg/kg-bw/day and is based on the geometric mean of nine NOAELs representing at least four mammalian species. The mammalian TRVs are considered relatively robust and indicate a roughly 4-fold difference between the expected NOAEL and LOAEL effect levels. Assuming similar relative difference in the NOAEL and LOAEL for birds, use of the Asmatullah et al. (1999) LOAEL was considered overly conservative. Considering the limited dataset for birds and based on the range and magnitude of the mammalian TRVs, the avian TRVs derived in this ERA are expected to result in reasonable estimates of toxicity for bird species potentially using the sites.

6.7.5.2.3 Avian TRVs for Lead

The selected avian TRVs for lead used in this ERA were from the EcoSSL document (USEPA 2008) and may overestimate potential toxicity. The NOAEL-based TRV selected for the EcoSSL development was an order of magnitude lower than the geometric mean of the NOAEL data for reproduction and growth endpoints, indicating that lead toxicity can be highly variable depending on the form of lead administered, the route of exposure, the test species and life stage, and the endpoints assessed. Specifically, the lead TRVs used in this assessment were based on a study conducted with domestic chickens and lead acetate, which is a soluble form of lead that is likely to overstate the bioavailability of lead in soil and prey tissue at the sites. In addition, the conservative nature of the NOAEL-based TRV is demonstrated by the fact that the avian lead EcoSSL developed using this TRV is 11 mg/kg, which is lower than the 50th percentile for reported background soil concentrations in the eastern and western United States. Although the EcoSSL for lead was derived from data for inorganic forms of lead found in soil and are not derived for either organic lead compounds or metallic lead shot, the lead risk estimates for birds still likely overestimate potential risk at the sites.

6.7.5.2.4 Dioxin TEQ TRVs

The selected TRVs for dioxin TEQ warrant additional discussion, as risk for dioxin TEQ is predicted at low ng/kg concentrations associated with typical background levels. Additional information related to the toxicity of dioxin TEQ in mammals and birds is provided in this section.

As mentioned earlier in Section 6.5, the TRVs were developed in the ECV tech memos for use in the RFI/RI site characterization to determine nature and extent and therefore, were based on conservative and readily available literature/published values. These TRVs are generally considered very conservative and therefore, tend to overestimate risk. The “selected” TRVs (i.e., those present in the tech memos) are used in characterizing potential risk to ecological receptors at the site; however, the selected TRVs, with respect to confidence in predicting potential risks are believed to be significantly overestimated. This is especially the case for dioxin TEQ, one of the key potential risk drivers for small mammals. Because of the uncertainties associated with the selected TRVs, alternate and more robust values were developed for small mammals and presented in this section (and summarized earlier in Section 6.6). These alternate and more robust values are recommended for consideration in risk-management decisions (i.e., for developing risk-based goals).

Mammalian TRVs

The mammalian TRVs for dioxin TEQ are based on a three-generation rat study with 2,3,7,8-TCDD conducted by Murray et al. (1979). This study was selected by Sample et al. (1996) to represent mammalian toxicity of 2,3,7,8-TCDD. Rats were fed diets containing 2,3,7,8-TCDD at three dose levels, and reproductive endpoints were measured in this multi-generation chronic study. The LOAEL of 10 ng/kg-bw/day was based on reduced fertility and neonatal survival, whereas no adverse effects were measured after three generations at 1 ng/kg-bw/day (selected NOAEL-based TRV) based on a study by Murray et al. (1979). The NOAEL- and LOAEL-based TRVs derived by Sample et al. (1996) represent a conservative estimate of 2,3,7,8-TCDD toxicity to mammals.

Additional studies conducted in mink, a species known to be particularly sensitive to 2,3,7,8-TCDD and other AHR receptor antagonists, suggest that adverse effects would not be observed until higher exposure doses.

Previous studies of individual PCDD and PCDF congeners or their mixtures have demonstrated that mink are among the more sensitive mammalian species tested, with effects reported on reproduction, development, and morphological lesions of the jaw (Bursian et al. 2006; Heaton et al. 1995; Restum et al. 1998). Studies on mink jaw lesions suggest that this endpoint is considered a sentinel for adverse effects in mink populations (Ellick et al. 2012; Zwiernik et al. 2009). However, from a population impact perspective, adverse effects on reproduction and development are considered more relevant assessment endpoints. While mink are unlikely to be present at the sites, studies with this wild species are more environmentally relevant than those conducted on laboratory species such as mice or rats (e.g., Murray et al. 1979; DeVito et al. 1997), especially with compounds such as PCDDs/PCDFs, which exhibit a high degree of variability in sensitivity among mammalian species. For example, Moore et al. (2012) investigated the effect of TCDD, 2,3,4,7,8-PeCDF, and 2,3,7,8-TCDF on mink reproductive success, and offspring viability and growth. Nine adult female mink were assigned randomly to one of 13 dietary treatments: one control and four doses each of TCDD, PeCDF, and TCDF (2.1 to 8.4, 4 to 15, and 5.2 to 25 ng TEQ/kg-bw/day, respectively). The mink were dosed from two months prior to breeding through weaning of offspring at 6 weeks of age. At least nine kits per treatment group were maintained on these diets through 27 weeks of age. No effects on litter size or viability of offspring were observed at any treatment level. In addition, no consistent effects on body mass or relative organ masses were observed. This recent study by Moore et al. (2012) provides an unbounded NOAEL of 25 ng TEQ/kg-bw/day, the highest dose at which no effects were observed (i.e., 25 times greater [less conservative] than the selected NOAEL-based TRV used in the ERA).

Similarly, Zwiernik et al. (2009) exposed mink to TCDF in diet up to 240 ng TEQ/kg wet weight (ww). These authors reported that doses as high as 30 ng TEQ/kg-bw/day did not affect reproduction and kit viability; although, body masses of offspring through 36 weeks of age were decreased compared to controls at various time points in the experiment. [Note: Dose calculated using the mink food ingestion rate of 0.125 kg/kg-bw/day from Moore et al. (2012).] The results of this study are supported by a review by Blankenship et al. (2008), which indicated 242 ng TEQ/kg ww as the highest diet-based LOAEL for offspring weight.

Toxicity studies that have assessed the effects of TCDD on growth, reproduction, and survival endpoints on mammalian species other than mink, are limited. These studies and the NOAEL- and LOAEL-based doses derived from them are presented in Table 6-39. Kociba et al. (1976) conducted growth studies on rats resulting in reduced body weights and NOAEL- and LOAEL-based doses of 7.1 ng/kg-bw/day and 71 ng/kg-bw/day, respectively. Croutch et al. (2005) conducted growth studies on rats resulting in reduced body weights and NOAEL- and LOAEL-based doses of 54.3 ng/kg-bw/day and 217 ng/kg-bw/day, respectively. Walker et al. (2006) conducted mortality studies on rats resulting in in unbounded NOAEL-based dose of 71 ng/kg bw/day and reduced body weights at bounded NOAEL- and LOAEL-based doses of 7.1 ng/kg-bw/day and 15.7 ng/kg-bw/day, respectively.

In summary, rat studies report NOAEL-based doses that are 7 to 70 times and LOAEL-based doses that are 1.5 to 22 times greater than the selected mammalian TRVs. Additionally, sensitive wildlife receptors, such as mink, have been shown to tolerate exposure doses 25 times greater than the selected NOAEL based TRV without adverse effect. The mammalian TRVs selected to evaluate potential risk associated with dioxin TEQ at the sites are considered to overestimate toxicity for many mammal species potentially present at the sites.

Following the approach used by USEPA in developing TRVs for EcoSSLs, the geometric mean of growth and reproductive endpoints based on the data from the small mammal studies were calculated as shown in Table 6-39. The alternate NOAEL- and LOAEL-based TRVs are 4.9 and 30 ng/kg-bw/day, respectively. The alternate LOAEL-based TRV of 30 ng/kg-bw/day is considered more robust than the value based on a single study (basis for the selected TRVs) and was used in the development of RBRGs.

Avian TRVs

The avian TRVs for dioxin TEQ are based on a 10-week study with 2,3,7,8-TCDD conducted by Nosek et al. (1992) on ring-necked pheasants. This study was selected by Sample et al. (1996) to represent avian toxicity of 2,3,7,8-TCDD. Birds were subjected to weekly intraperitoneal injections at three dose levels before and during egg production, and reproductive endpoints were measured in this chronic-equivalent study. The LOAEL of 1 μg/kg-bw/week was based on reduced egg production and hatchability, whereas no adverse effects were measured 0.1 μg/kg bw/week. The NOAEL- and LOAEL-based TRVs derived by Sample et al. (1996) were calculated using an assumed body weight of 1 kg and were converted to NOAEL- and LOAEL-based TRVs of 14 ng/kg-bw/day and 140 ng/kg-bw/day, respectively. These TRVs represent a conservative estimate of 2,3,7,8-TCDD toxicity to birds.

Field studies, for example, the Tittabawassee River Study (Fredricks et al. 2011) and the Woonasquatucket River Study (Custer et al. 2005), have been conducted in areas contaminated with dioxins, and in general, these studies indicate that wild bird populations are not impacted following exposure to TEQ above the selected TRVs. For example, Fredricks et al. (2011) report that tree swallow hatching success and overall productivity through fledging were not statistically different between sites with dioxins/furans in sediment and floodplain soil along the Tittabawassee River and upstream reference areas. Fredericks et al. (2011) estimated food web-based TEQ doses (34 to 630 ng/kg-bw/day calculated from measured invertebrate residues) and bolus-based dietary doses (24 to 800 ng/kg-bw/day) that were considered NOAEL-based doses. Similarly, Custer et al. (2005) compared dioxin/furan concentrations in eggs, diet, and nestlings and measures of reproductive success at the Woonasquatucket River in Rhode Island for two contaminated ponds and a reference site. Reduced hatching success was observed at one contaminated site in 1 year, but the observed nestling mortality was attributed to a cold period and a dam breach that occurred that year (Custer et al. 2005). Excluding data from that pond and year, survival during the incubation and nestling periods was unaffected at dietary concentrations of 121 ng/kg ww; this can be considered the dietary NOAEL. Assuming that the moisture content of the invertebrate prey of tree swallows is 80%, a dry weight-based dietary NOAEL for TEQ of 605 ng/kg was calculated. [Note: 121 ng/kg ww ÷ 20% solids in diet = 605 ng/kg dw.] Using the body weight-normalized tree swallow ingestion rate of 0.24 kilogram (kg) of food per kg bw/day, a NOAEL dose-based TRV of 145 ng TEQ/kg bw/day was derived. [Note: Refer to exposure parameters provided in Table F-4a.]

These field studies indicate that the selected avian TRVs for the ERA are overly conservative.

HMW PAH TRVs

Mammalian TRVs for HMW PAHs

The selected mammalian TRVs for HMW PAHs, 0.6 mg/kg-bw/day and 3 mg/kg-bw/day for the NOAEL and LOAEL respectively, are based on the EcoSSLs (USEPA 2008). The EcoSSL dataset includes data from multiple studies representing at least three small mammal species and five individual HMW PAHs. The selected NOAEL-based TRV, based on reduced survival in mice exposed to benzo(a)pyrene for 65 weeks (Culp et al. 1998), is based on highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival endpoints. The selected NOAEL-based TRV is 5 times lower than the next available NOAEL (for growth, from the Culp et al. [1998) study]). The authors note poor control survival (56%) in this 2-year carcinogensis investigation, which indicates uncertainty in the resulting toxicity data. The data are derived from studies with individual PAHs, not mixtures observed at the sites that may have lower overall toxicity than assumed based on benzo(a)pyrene alone. The geometric mean NOAEL-based TRV (18 mg/kg) from the EcoSSL dataset is nearly 20 times greater than the selected NOAEL-based TRV value. For HMW PAHs, alternate TRVs are available as well. The BTAG NOAEL- and LOAEL-based TRVs (1.31 mg/kg-bw/day and 32.8 mg/kg-bw/day, respectively) are based on formation of gastric tumors in mice exposed to benzo(a)pyrene (Neal and Rigdon 1967), an endpoint not typically considered in ERAs and likely more sensitive than survival. Sample et al. (1996) selected NOAEL- and LOAEL-based TRVs of 1 and 10 mg/kg-bw/day based on reproductive effects in mice exposed to benzo(a)pyrene during gestation (MacKenzie and Angevine 1981). Overall, the available data indicate that the selected mammalian TRVs for HMW PAHs may overestimate toxicity in the ERAs.

Avian TRVs for HMW PAHs

The selected avian TRVs for HMW PAHs, 10 and 100 mg/kg-bw/day, as described in ECV Tech Memo 3 (Arcadis 2008b), are based on toxicity data from Trust et al. (1994), the only study identified by USEPA (2008) as meeting the data quality requirements for inclusion in the EcoSSL dataset. The LOAEL of 100 mg/kg-bw/day is based on overt signs of toxicity, such as decreased body mass, in European starlings exposed to 7,12-dimethylbenz(a)anthracene. The exposures were via oral gavage, and the study was conducted on nestlings, a sensitive life-stage. Additional toxicity data for birds exposed to HMW PAHs included studies by were not available for comparison, and therefore uncertainty in these TRVs cannot be evaluated.

6.7.5.2.5 Total PCB TRVs

The selected TRVs for PCBs in the ERAs are values derived by BTAG (DTSC 2002b, 2009e) based on reproductive effects in chickens and mice. For birds, the selected NOAEL-based TRV is 0.09 mg/kg-bw/day and the LOAEL-based TRV is 0.36 mg/kg-bw/day based on a study using chickens by Platonow and Reinhart (1973). For birds, there is a large degree of variation in sensitivity to PCBs based on differences in the AHR type present in various bird species. Recent research conducted by Dr. Sean Kennedy and others has focused on identifying specific mechanisms behind avian sensitivities to PCBs and other DLCs (Karchner et al. 2006; Head and Kennedy 2010; Farmahin et al. 2012; Eng et al. 2014). This research has correlated differences in the genetic structure of the AHR in avian species to species-specific sensitivity to DLCs. Specifically, research has demonstrated that there are three primary AHR types that are associated with high (type 1), moderate (type 2), and low sensitivity (type 3) to DLCs. The genetic sequence of the AHR has been identified and classified for more than 85 avian species (Table 6-

40), with the domestic chicken being identified as Type 1/most sensitive (Farmahin et al. 2012). European starling (*Sturnus vulgaris*) was recently also identified as having Type 1 sensitivity (Eng et al. 2014). Other identified species potentially present at the Topock site for which PCB toxicity studies are available include: pheasant (Galliformes; type 2), wild turkey (Meleagris; type 2), mallard (*Anas platyrhynchos*; type 3), red-tailed hawk (*Buteo jamaicensis*; type 3), kestrel (Falco; type 3), and double-crested cormorant (*Phalacrocorax auritus*; type 3). These relative sensitivities have been established based on the correlation between the available toxicological data (primarily embryo lethality endpoints) and the genetic sequences (Head et al. 2008; Head and Kennedy 2010). Two (red-tailed hawk and mallard) of the four avian receptor species for the Topock ERA are included in the wild species genetically sequenced to date and are low sensitivity (type 3) species.

Other available non-chicken studies (Table 6-41) demonstrated a wide range of NOAEL- and LOAEL-based doses, mostly higher than the selected TRVs for the ERA, including Peakall's study dosing ring doves (Peakall 1971) would equate to a NOAEL-based dose of 1.1 mg/kg-bw/day; Dahlgren's study dosing ring-necked pheasants (Dahlgren et al. 1972) would equate to NOAEL- and LOAEL-based doses of 1.8 mg/kg-bw/day and 7.1 mg/kg-bw/day, respectively; Heath et al. (1972) study dosing northern bobwhite quail and mallard duck would equate to NOAEL- based doses of 4.7 mg/kg-bw/day and 7 mg/kg-bw/day, respectively; Peakall and Peakall (1973) study dosing second generation ring doves would equate to a LOAEL-based dose of 1.1 mg/kg-bw/day; Riseborough and Anderson (1975) study using mallard ducks would equate to a NOAEL-based dose of 4 mg/kg-bw/day; Roberts (1978) study using ring-necked pheasants would equate to a LOAEL-based dose of 2.9 mg/kg-bw/day; and Custer et al. (2005) study using tree swallows pheasants would equate to a LOAEL-based dose of 0.55 mg/kg-bw/day.

Based on the available literature, use of the BTAG PCB TRVs based on chicken data likely overestimates potential risk to birds at the site.

6.7.5.2.6 Chromium Speciation

Total chromium (assumed to be trivalent chromium) was identified as a COPEC (see Section 3.4 and Table 3-7). Potential risks to small mammals and birds were estimated for both hexavalent chromium and total chromium. Hexavalent chromium TRVs were developed based on dietary hexavalent chromium exposure, and total chromium TRVs are based on dietary exposure to trivalent chromium. Available wildlife toxicity data for hexavalent chromium are quite limited. Toxicity endpoints for wildlife considered in ERAs generally include population-level effects (i.e., survival, growth, and reproduction), and these data indicate that dietary exposure to trivalent chromium is more toxic than dietary exposure to hexavalent chromium (NOAEL- and LOAEL-based TRVs are generally lower for trivalent chromium). Cancer endpoints are not evaluated for population-level impacts to wildlife. The LOAEL-based HQs for chromium-6 are less than 1 for all the potential exposure areas and LOAEL-based HQ for total chromium is greater than 1 for one area (AOC9) based on the desert shrew; therefore, only total chromium was identified as a potential risk driver.

The EPCs for total chromium are based on the measured concentrations in soil, which include background and site-related inputs. Background total chromium was not removed from the exposure estimates used in the risk calculations (i.e., incremental risks were not estimated).

In the ERA, chromium exposure was assumed to occur as the state/valence measured in soil (i.e., dietary exposure to wildlife receptors for hexavalent chromium is via incidental ingestion of hexavalent chromium in soil and ingestion of prey tissues containing hexavalent chromium). This assumption ignores the potential for hexavalent chromium reduction to trivalent chromium in vivo, which is known to occur in many plant and animal tissues (USEPA 2008). Chromium is an essential nutrient for humans and animals and trivalent chromium has been shown to have antioxidative properties in vivo that are critical for activating enzymes and maintaining stability of proteins and nucleic acids (USEPA 2008). Hexavalent chromium is absorbed better than trivalent chromium and some studies suggest that when ingested orally, most of the hexavalent chromium is reduced to trivalent chromium before reaching the sites of adsorption in the small intestine. However, as noted previously, available wildlife toxicity data suggest that trivalent chromium is more toxic than hexavalent chromium. Thus, risk estimates for hexavalent chromium for mammals and birds may be underestimated by not accounting for this biological reduction in prey tissues. Due to the lack of data for relative proportion of each chromium species present in plants, soil invertebrates, and small mammal prey, the magnitude of this uncertainty cannot be readily assessed.

6.7.5.3 Uncertainty in the BTAG TRVs

The selected TRVs were used preferentially in the ERA when drawing risk conclusions. The selected TRVs are based primarily on USEPA EcoSSLs; however, BTAG TRVs were used when EcoSSL-based TRVs were unavailable, such as for mercury and PCBs for birds and mammals and thallium for mammals. In general, the BTAG TRVs are considered to be less reliable as estimates of toxicity for the reasons discussed in this section.

The approach used by BTAG to derive TRVs includes selecting the single lowest defensible NOAEL as the TRV-low (referred to as the NOAEL-based BTAG TRV in this ERA) and selecting a TRV-high (referred to as the LOAEL-based BTAG TRV in this ERA) to represent a mid-range adverse effects level (DTSC EcoNote 5 [DTSC 2002a]). This differs from the EPA approach for the calculation of EcoSSLs, which are based preferentially on the geometric mean of NOAELs for reproduction and growth endpoints, therefore representing the range of available and relevant data (multiple species and effects endpoints). Whereas the BTAG TRVs are based on one critical study considered the most appropriate by the reviewers, the TRVs presented in USEPA EcoSSL documents (a separate document is published for each chemical) are based on a rigorous review of literature obtained from an extensive literature search. Derivation of the NOAELs on which the EcoSSLs are based was a collaborative effort of a multi-stakeholder team consisting of federal, state, consulting, industry, and academic participants and led by the USEPA OSWER. A WOE process was used to derive the EcoSSL-based TRVs, which is described in Attachment 4-5 to the EcoSSL guidance (USEPA 2007a).

The BTAG TRV-lows are highly uncertain for some COPECs due to the selection of the lowest available NOAEL-based TRV, which may not be representative of the overall toxicity dataset and may greatly overestimate toxicity. As discussed previously, PCB TRVs based on data for chickens, a highly sensitive species with type 1 AHR, likely overestimate toxicity of PCBs for birds found at the sites that do not have high sensitivity to PCBs. For cadmium, use of the mammalian BTAG TRV-low results in HQs greater than 1 at soil concentrations of 0.5 mg/kg, 10 times below the soil BTV of 36.3 mg/kg, and well within the range of background concentrations in western United States soils (0.3 to 1 mg/kg; USEPA 2007a). For nickel, the soil BTV of 27.3 results in an HQ of 41 based on the mammalian BTAG TRV-low, while background nickel concentrations in western soils range up to 58 mg/kg (USEPA 2007a). Resident wildlife have been exposed to background concentrations of metals in soil over evolutionary time, and adverse effects predicted below background concentrations are not reliable risk estimates nor are they useful for remedial decision making.

Additionally, for several metals the BTAG TRVs are based on toxicity data that overestimate potential for adverse effects due to the assumption that COPECs are present in a highly bioavailable or toxic form that is unlikely to be present at the sites. Mercury and lead are two key examples where the BTAG TRVs overestimate potential toxicity due to the form of the metal used as the basis of the TRVs.

Mercury: The BTAG mercury TRVs are based on data for methylmercury, as presented by USEPA (1995b) as part of the Great Lakes Initiative. This conservatively assumes that 100% of the mercury present in abiotic and biotic media is present as methylmercury. However, the proportion of methylmercury in prey tissues at the sites is likely much lower. Methylmercury is unlikely to be present in upland soil (requires anaerobic conditions to transform inorganic mercury into methlylmercury (Jones and Slotton 1996). Although mercury can be converted to organic forms *in vivo*, the proportion of mercury present in tissue as methyl mercury is relatively low for most terrestrial species (Newman et al. 2011; Rieder et al. 2011; Edmonds et al. 2012; Bank et al. 2007; Chumchal et al. 2011) and tends to increase with increasing trophic level. Variability between species was high, however, ranging from 3% for terrestrial plants to 52% to 96% for small mammals (mice, voles, and shrew). Since methylmercury is more toxic than inorganic forms of mercury, assuming that 100% of mercury is present as methylmercury overestimates risk to most ecological receptors. The magnitude of this effect is dependent on the relative toxicity of methylmercury and inorganic mercury, as well as the proportion of methylmercury present in each pretty tissue consumed by wildlife.

The relative toxicity of methylmercury and inorganic forms of mercury can be assessed by comparing literature-based TRVs for these forms of mercury. In the ERAs, dietary mercury BTAG NOAEL-based and LOAEL-based TRVs are 0.039 and 0.18 mg/kg-bw/day respectively for birds. Inorganic mercury NOAEL- and LOAEL-based TRVs of 0.45 and 0.9 mg/kg-bw/day are available from Hill and Schaffner (1976), as cited in Sample et al. (1996). Thus, inorganic mercury appears to be more than 10 times less toxic than methylmercury to birds. For mammals, the BTAG TRVs (0.25 and 4 mg/kg-bw/day) are within the range of toxicity values available for other mammals in the literature. Inorganic mercury NOAEL-based TRVs of 1.0 mg/kg-bw/day as reported by Aulerich et al. (1974) for mink exposed to mercuric chloride, and 13.2 mg/kg-bw/day for mercuric sulfide for mice (Revis et al. 1989) are cited in Sample et al. (1996). OEHHA (2005) selected NOAEL and LOAEL-based TRVs of 0.24 and 0.46 mg/kg bw/day based on 10% reduced weight gain in a subchronic rat study (National Toxicology Program 1993); however, the ecological significance of this effect level is considered to be low.

Lead: Similar to the EcoSSLs, the BTAG avian lead TRVs are based on data for lead acetate. Whereas the avian EcoSSL for lead is based on a TRV of 1.63 mg/kg-bw/day, the BTAG TRV-low is two orders of magnitude lower (0.014 mg/kg-bw/day). To demonstrate the conservative nature of this NOAEL-based TRV, the BTAG advisory group (EcoNote 4) considered avian NOAEL-based TRVs ranging from 0.014 mg/kg-bw/day (selected BTAG TRV-low) to 26 mg/kg-bw/day. Sample et al. (1996) recommend avian NOAEL-based lead TRVs of 3.85 mg/kg-bw/day based on an unbounded NOAEL for kestrels exposed to metallic lead and 1.13 mg/kg-bw/day based on Japanese quail exposed to lead acetate (based on one of the same studies used by BTAG to derive the TRV-low). As noted previously for the selected avian TRVs, lead acetate is highly bioavailable and likely to overestimate exposure and toxicity to lead in site soil. Additionally, the BTAG TRV-low predicts risk at concentrations within the range of background levels in western soils. Risk estimates based on the BTAG TRV-low are likely to substantially overestimate potential exposure and risk for birds exposed to lead at the sites.

For the reasons discussed in this section, the EcoSSL-based TRVs are considered to be more reliable for risk estimation than the BTAG TRVs. Use of the selected TRVs as the basis for drawing risk conclusions at the sites is expected to reduce uncertainty in the ERA conclusions.

6.7.5.4 Species-to-Species Toxicity Extrapolations

One source of uncertainty in this ERA is the lack of applicable species-specific toxicity data. Because of this data limitation, TRVs were developed using available toxicity data for laboratory test species. For example, TRVs for all mammalian receptors were developed primarily from toxicity data for mice and rats. Species vary with respect to sensitivity to specific constituents (USEPA 1998; Calabrese and Baldwin 1993; Venugopal and Luckey 1978). Based on a review of the toxicological data, the sensitivity for members within a class of vertebrates may typically range up to 100-fold. This range of uncertainty is substantiated by Calabrese and Baldwin (1993).

CalEPA does not recommend allometric adjustment of TRVs unless the body weights of the test species and receptor species differ by two orders of magnitude (DTSC 1999). Based on this, TRVs were adjusted for differences in body weights when appropriate. The specific TRVs for which allometric adjustments were made to the TRVs are presented in Section 6.5. For birds, allometric adjustments were not needed for any TRVs, and therefore this source of uncertainty does not apply to birds.

Although no longer typically conducted, allometric conversions were used as discussed in the approved RAWP (Arcadis 2008a) and may increase uncertainty associated with the TRVs. However, no substantial changes to risk conclusions as a result of allometric conversions are expected. For Nelson’s desert bighorn sheep, allometric adjustments were conducted for most COPECs and result in lower TRVs and higher HQs than using unadjusted TRVs. Thus, risk for this receptor is likely overestimated in the ERA. For small mammals (including desert shrew and Merriam’s kangaroo rat), allometric TRVs were applied for a few COPECs only (arsenic, copper, selenium, and silver), resulting in higher TRVs and lower HQs for these COPECs than using unadjusted TRVs. The magnitude of the change in TRVs and HQs is relatively small and does not affect risk conclusions based on a target LOAEL-based HQ of 1 except for the following case:

- AOC27 – Arsenic LOAEL-based HQ with allometric conversion for the desert shrew is 0.8 and would be 1.0 without allometric conversion.

6.7.5.5 Constituents Lacking Toxicity Values

There were several detected constituents for which no toxicity screening values and no TRVs were obtained or developed. For each receptor group, the following constituents lack toxicity values:

- Plants – total chromium, cyanide, most VOCs, some SVOCs (butyl benzylphthalate, isophorone), 2,3,7,8-TCDD, and TPHs
- Soil invertebrates – cobalt, silver, thallium, vanadium, some VOCs (chloromethane, methyl acetate, n-butylbenzene, n-propylbenzene, sec-butylbenzene), isophorone, and TPHs

- Birds – antimony, barium, beryllium, all VOCs, some SVOCs (4-methylphenol, butyl benzylphthalate, isophorone), and TPHs
- Mammals – some VOCs (1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, bromomethane, chloromethane, isopropylbenzene, n-butylbenzene, n-propylbenzene, sec-butylbenzene) and some SVOCs (4-methylphenol, butyl benzylphthalate, isophorone).

Due to the lack of screening values and TRVs, no quantitative assessments of potential ecological risks were performed for these chemicals. With the exception of 2,3,7,8-TCDD for plants and TPHs for all receptors, these chemicals are not known to be site-related and were infrequently detected (for organics). For 2,3,7,8-TCDD, plants have low sensitivity relative to invertebrate and wildlife receptors (USEPA 1999b) and therefore, lack of a plant screening value for 2,3,7,8-TCDD is not expected to substantially affect risk conclusions. Toxicity assessment for TPHs can be challenging and highly variable because the assessment must consider toxicity to a wide range of receptors and groups and extrapolate toxicity data to protect populations or communities rather than individuals (except for specific cases). Additionally, for TPHs, there is no single source of peer-reviewed or agency-approved toxicity values for ecological receptors which, in part, stems from the complexity of TPH toxicity. When available toxicity data are insufficient or inappropriate for use for risk assessment of TPHs at a given site, product-specific or site-specific toxicity testing can provide a means to assess a site’s unique TPH mixture or species sensitivity. However, toxicity testing of petroleum compounds has many limitations and technical challenges (Singer et al. 2000; Redman and Parkerton 2015) that can confound results, and the presence of non-TPH chemical constituents or other stressors (e.g., nutrients) in site media can complicate site-specific testing. TPHs readily degrade and are generally not persistent in environment and/or the food webs/chains.

Potential risk associated with TPHs is addressed in the ERA through evaluation of the individual toxic constituents of the mixtures (i.e., VOCs and PAHs when detected and above background). For the remaining constituents lacking toxicity values, the omission of these constituents may have led to underestimates of potential risk. However, these constituents were, for the most part, infrequently detected at the site, and their omission is considered to have a minimal effect on the overall conclusions reached in this ERA.

Additionally, there are no generally accepted TRVs available for reptiles; therefore, risks were not quantitatively evaluated for these receptors. The magnitude and the direction of potential risks to reptiles are uncertain. However, the range of risks based on NOAEL- and LOAEL-based TRVs estimated for other ecological receptors and conservative assumptions used in the evaluation of risks for other species are assumed to result in risk estimates and cleanup goals that will be protective of reptiles as well.

6.7.6 Uncertainty in the Risk Characterization

The key sources of uncertainty related to the risk characterization are discussed in this section.

6.7.6.1 Uncertainty Related to Use of Individual Effects Data to Extrapolate to Population-Level Effects

The toxicity studies used to derive TRVs for this ERA did not directly evaluate population-level effects (e.g., reduced density, change in age/size class structure, extinction). The available toxicity data describe reproductive and developmental effects on small groups of individuals. Effects on these individuals were then used to infer effects at the population level. Accordingly, these population-level effect extrapolations include uncertainty associated with the extrapolation between a study endpoint (e.g., number of offspring, reduced litter size) to a population-level effect (e.g., abundance, density, persistence, extinction). It should be noted that any adverse effect on reproduction does not necessarily lead to a decrease in population stability or extinction. Clearly, the reproductive effect must be sufficient in magnitude to result in such a population-level effect.

6.7.6.2 Uncertainty in the HQ Approach

In ERA, the primary method to estimate potential risks to ecological receptors is by calculating HQs, with an HQ less than 1 associated with no unacceptable risk to individuals (for NOAEL-based HQs) or populations (for LOAEL-based HQs). Conservative assumptions are used in the risk models to avoid type 2 error (i.e., to conclude no unacceptable risks when in fact there is) and consequently there is a high level of confidence that COPECs with HQ less than 1 do not pose unacceptable risk. Due to the conservative assumptions used, probability of a type 1 error (i.e., to conclude unacceptable risk when in fact there are none) based on an HQ greater than 1 is more likely, and typically requires further evaluation to address uncertainties (Allard et al. 2009). Because there are inherent uncertainties in the exposure and effects assumptions (discussed previously), the resulting HQs are also uncertain and could over- or underestimating unacceptable risk. In the ERAs, HQs were used as a single LOE to characterize risks, a WOE approach using multiple independent LOE provides a more robust prediction of potential risk to ecological receptors.

6.7.6.3 Uncertainty based on Use of the Most Refined Risk Estimates

A range of potential risks were estimated in the ERAs, based on multiple assumptions used for the various input factors. Multiple assumptions were evaluated for EPCs (maximum, depth-weighted, area-weighted), site use (SUF equal to 1 or site-specific SUF), and TRVs (selected or BTAG). Uncertainties related to these assumptions and alternate values are discussed previously in Section 6.7.3 for EPCs, Section 6.7.4 for SUFs, and Sections 6.7.5 for TRVs. The overall risk conclusions were based on a semi-quantitative WOE approach based on the HQs and supporting LOE incorporating the most realistic and refined assumptions to minimize overall uncertainty in the ERA. While less refined evaluations often provided higher risk estimates and indicate greater potential for unacceptable risk at the sites, the likelihood of risk overestimation and overall uncertainty in these conclusions is has been reduced by using refined assumptions. Risk conclusions and risk-management decisions at the sites are supported by the best available assumptions, as presented in the ERAs.

6.7.6.4 Uncertainty Due to Exposure to Chemical Mixtures

Some constituents, such as some metals, are known to have synergistic, antagonistic, or neutral influence on the toxicities of other metals (Calabrese 1991). The degree to which metals influence each other's toxicities depends not only on the mixture, but also on relative concentrations. However, there is a lack of studies required to describe the degree to which toxicity may be affected due to exposures to multiple COPEC compositions present at the sites. The lack of knowledge with regard to specific multiple COPEC interactions does not support the assumption of additive effects. Accordingly, HQs for metals were not added to evaluate cumulative exposures and potential risks to metals. The HQs for chemicals with similar toxicological effects, known to affect the same target organ in an additive matter, were added to estimate HIs including LMW PAHs, HMW PAHs, total DDT, and total TEQ. The effects due to exposure to multiple COPECs are unknown, although, based on the limited number of risk-driving chemicals identified at the sites, the effect of chemical mixtures on the overall toxicity and risk estimates is expected to be small.

6.7.6.5 Uncertainty in the Risk Characterization for Dioxin TEQ

Of the COPECs identified as potential risk drivers in Section 6.6, dioxin TEQ is frequently identified as posing an unacceptable risk. However, risk estimates for this COPEC are likely substantially overestimated. Multiple conservative assumptions were used to estimate risks associated dioxin TEQ. When these assumptions are combined to calculate the HQ, the level of conservatism in the risk estimates is compounded. As discussed in Section 6.7.4.2, use of a 2,3,7,8-TCDD uptake regression for estimating tissue EPCs for dioxin TEQ instead of congener-specific BAFs could overestimate the potential risks to mammals by approximately 10-fold for invertivorous receptors. This conservativeness is compounded by the assumption that invertivorous small mammal diet is based on 100% earthworms, the prey with the highest bioaccumulation potential and unlikely to be present at the site, as discussed in Section 6.7.3.

Furthermore, as discussed in Section 6.7.5, the mammalian TRVs used in the ERA are very conservative, on the low end of the NOAEL- and LOAEL-based TRVs available in literature. Additional toxicity data for rats result in NOAEL-based doses that are 7 to 70 times and LOAEL-based doses that are 1.5 to 22 times greater than the selected mammalian TRVs. Additionally, wildlife receptors sensitive to dioxins, such as mink, have been shown to tolerate exposure doses 25 times greater than the selected NOAEL-based TRV without adverse effect. Therefore, the use of the selected TRVs further adds to the overestimation of risks to small mammals at the sites.

Based on the multiple factors contributing to the conservativeness of the dioxin TEQ risk conclusions, LOAEL-based HQs less than 10 were considered unlikely to result in unacceptable risk at the population level. Alternate and more robust congener-specific BAFs and TRVs were developed as discussed previously and remedial goals are based on these alternate and robust BAFs and TRVs (discussed in Section 8).

7 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the conclusions of the HHRA and ERA for COPCs/COPECs in soil at the site and provides recommendations for the COCs to be addressed in the CMS/FS. For purposes of this HHERA, COCs refer to those chemicals that most significantly contribute to estimates of unacceptable risk (also referred to as 'risk drivers') and that are recommended to be the focus of future remedial planning.

For each potential exposure area in the HHERA, potential exposure to surface (0 to 0.5 foot bgs), shallow (0 to 3 feet bgs), subsurface 1 (0 to 6 feet bgs), and subsurface 2 (0 to 10 feet bgs) soil was evaluated according to the exposure scenarios for specific human and ecological potential receptors. In addition to the baseline scenario (i.e., no scouring) evaluated for all areas, risk evaluations were also conducted for potential 2-foot and 5-foot scouring scenarios for the BCW and AOC10 potential exposure areas.

In general, and consistent with regulatory guidance, conservative approaches and assumptions were used to minimize the underestimation of potential risk in the HHERA. For the HHRA, assumptions regarding the amount of exposure and the toxicity of the compounds were intentionally conservative and were selected to represent upper bound estimates. For the ERA, ECs and parameters were selected to provide a conservative approach for the following: upper bound estimates of exposure; toxicity values based on sensitive endpoints for individual-level effects; and assumptions that each potential exposure area is sufficiently large to support a population/community of ecological receptors. Because of these conservative approaches and other protective assumptions made throughout the HHERA, risk estimates are expected to be overestimated rather than underestimated and risk conclusions presented in this section may overstate the potential for unacceptable risk to human and ecological receptors at the site.

7.1 Human Health Risk Assessment

The HHRA evaluates the likelihood that constituents detected in soil and/or soil gas at the various potential exposure areas of the site could adversely impact human health under the assumed set of current and reasonable future land-use scenarios. As specified in the RAWP and RAWP Addendum 2 (Arcadis 2008a, 2015), the HHRA evaluations were conducted for potential exposure areas outside and inside the compressor station, and the DOI requested evaluation for the NORR potential exposure area. The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil were calculated using depth- and area-weighted EPCs under a baseline scenario for potential receptors identified in this section for each potential exposure area.

The locations of the potential exposure areas (see Figures 3-3 and 3-4a) and associated potentially exposed populations evaluated in the HHRA are as follows:

- Outside the Compressor Station:
    - Receptors evaluated for each potential exposure area are the short-term maintenance worker, long-term maintenance worker, camper, hiker, hunter, OHV rider, and tribal user.
    - Potential exposure areas evaluated are BCW, OCS, OCSxBCW, SWMU1, BCWxSWMU1, AOC 4, AOC9, AOC10, AOC11, AOC12, AOC14, AOC27, AOC28, AOC31, and UA-2.

- Inside the Compressor Station
  - Receptors evaluated for this potential exposure area include the commercial worker, short-term maintenance worker, and long-term maintenance worker.
  - This potential exposure area combines all the investigation areas inside the fenceline into one.
- NORR
  - Receptor evaluated is the hypothetical future resident assumed to have lifetime soil contact in this limited area outside the fenceline. It was assumed the hypothetical future resident would consume the large majority of their diet from food produced on the site.
  - This exposure area is limited to DOI land located in BCW and NORR.

For each potential exposure area outside the TCS, depth- and area-weighted estimated cumulative ILCR and HI results for the relevant potential receptors (i.e., maintenance worker, recreational user, and tribal user) are summarized and displayed in bar charts on Figures 7-1 through 7-7.

In accordance with the RAWP (Arcadis 2008a), the conclusions and recommendations for this HHRA are based on the risks estimated for the ICS and OCS potential exposure areas. The ICS is located inside the TCS fenceline and is part of a currently active industrial facility with access limited to commercial and maintenance workers. The potential risks/hazards for outside the fenceline are evaluated assuming the broader range of potential uses including maintenance workers, recreational users, and tribal users. As requested by DTSC (DTSC 2017a) the risks/hazards estimated for individual AOCs/SWMU/UA potential exposure areas outside the fenceline are based on the assumption that lifetime soil contact for these potential receptors would be limited to that single specific area. It is highly unlikely that activities of the maintenance workers, recreational users, or tribal users would be limited to such a small area. Therefore, the risks/hazards estimated for the OCS potential exposure area are believed to provide a more appropriate representation of the potential exposures for the human populations that could be present in the areas outside the TCS.

Note that the 2-foot and 5-foot potential scouring scenarios were evaluated for both BCW and AOC10 which are located within the OCS potential exposure area. In Appendix BCW, the estimated risks for the baseline and both scouring scenarios are generally similar for each of the receptors evaluated, Likewise, in Appendix AOC10, the estimated risks for the baseline and both scouring scenarios are generally similar for each of the receptors evaluated. Therefore, the baseline scenario for OCS is considered an appropriately conservative basis for the HHRA conclusions.

In addition, potential risks/hazards for COPCs in soil in the NORR potential exposure area are estimated for hypothetical future residents, at the request of the agencies, although future unrestricted land use in this area is highly unlikely. Accordingly, the following sections discuss the estimated risks/hazards for the OCS and ICS potential exposure areas as well as the NORR potential exposure area, and the associated HHRA conclusions.

7.1.1 Potential Exposure Areas Outside the Compressor Station

The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil in the OCS potential exposure area were calculated using depth- and area-weighted EPCs under a baseline scenario for short- and long-term maintenance workers, recreational users (camper, hiker, hunter, and OHV rider), and tribal users. The estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil in the NORR potential exposure area were calculated using depth- and area-weighted EPCs under a baseline scenario for hypothetical future residents. Depth- and area-weighted estimated cumulative ILCR and HI results for the receptors evaluated in the OCS and NORR potential exposure areas are summarized in the tables in this section. As indicated, the area-weighted estimated cumulative ILCRs are marginally lower than the depth-weighted estimated cumulative ILCRs, but the marginal reduction in estimated risk does not materially affect the overall conclusions for the potential receptors in the OCS or NORR potential exposure areas.

Estimated Cumulative Incremental Lifetime Cancer Risk and HI [1,2] for the OCS Potential Exposure Area

Potential Receptor	Estimated Cumulative ILCR Less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR Greater than $1x10^{-6}$ and Less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR Greater than $5x10^{-6}$ and Less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR Greater than $1x10^{-5}$ and Less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR Greater than $1x10^{-4}$	Estimated HI Less than or equal to 1	Estimated HI Greater than 1
Short-Term Maintenance Worker		Yes (depth- and area-weighted)				Yes (depth- and area-weighted)	
Long-Term Maintenance Worker			Yes (area-weighted)	Yes (depth-weighted)		Yes (depth- and area-weighted)	
Camper		Yes (depth- and area-weighted)				Yes (depth- and area-weighted)	
Hiker		Yes (area-weighted)	Yes (depth-weighted)			Yes (depth- and area-weighted)	
Hunter	Yes (depth- and area-weighted)					Yes (depth- and area-weighted)	
OHV Rider			Yes (depth- and area-weighted)			Yes (depth- and area-weighted)	
Tribal User	Yes (depth- and area-weighted)					Yes (depth- and area-weighted)	

Notes:

[1] Represents the maximum depth-weighted and area-weighted estimated cumulative ILCR and HI for the receptor at any applicable exposure depth within the potential exposure area under baseline scenario.

[2] Area-weighted estimates were calculated only for those receptors where the depth-weighted cumulative ILCR was above 1 in 1 million or HI was above 1.

Estimated Cumulative Incremental Lifetime Cancer Risk and HI [1,2] for the NORR Potential Exposure Area

Potential Receptor	Estimated Cumulative ILCR Less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR Greater than $1x10^{-6}$ and Less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR Greater than $5x10^{-6}$ and Less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR Greater than $1x10^{-5}$ and Less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR Greater than $1x10^{-4}$	Estimated HI Less than or equal to 1	Estimated HI Greater than 1
Hypothetical Future Resident			Yes (area-weighted)	Yes (depth-weighted)		Yes (area-weighted)	Yes (depth-weighted)
Hypothetical Future Resident – Consumer of Home-Produced Food					Yes (depth- and area-weighted)		Yes (depth- and area-weighted)

Notes:

[1] Represents the maximum depth-weighted and area-weighted estimated cumulative ILCR and HI for the receptor at any applicable exposure depth within the potential exposure area under baseline scenario.

[2] Area-weighted estimates were calculated only for those receptors where the depth-weighted cumulative ILCR was above 1 in 1 million or HI was above 1.

The estimated cumulative ILCR and HI results and conclusions for the short- and long-term maintenance workers, camper, hiker, hunter, OHV rider, and tribal user (for the OCS potential exposure area), and hypothetical future resident (for the NORR potential exposure area) are summarized by receptor in the following sections.

7.1.1.1 Short-Term Maintenance Worker

The short-term maintenance worker was evaluated for potential contact with COPCs in soil for surface, shallow, subsurface 1, and subsurface 2 potential exposure depths. For the short-term maintenance worker in the OCS potential exposure area, the depth- and area-weighted estimated cumulative ILCRs are above 1 in 1 million, the point of departure for risk management decisions, but below 5 in 1 million, which is well within the risk-management range of 1 in 1 million to 100 in 1 million. Estimated ILCRs above 1 in 1 million are primarily due to hexavalent chromium via the particulate inhalation pathway.

The short-term maintenance worker activities are part of the active facility operations at TCS. Current use of health and safety protocols, required by PG&E as part of routine work practices inside and outside the TCS, limit worker exposure to soil, and provide an added level of protection, above and beyond what is necessary, to ensure full protection of the health of all PG&E workers and subcontractors working at the TCS and in surrounding outside areas. Therefore, the estimated ILCRs associated with potential exposure to COPCs in soil at the OCS potential exposure area for the short-term maintenance worker are overestimated and actual risks are likely at or below 1 in 1 million.

The depth- and area-weighted estimated cumulative HIs for the short-term maintenance worker in the OCS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in OCS potential exposure area not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a short-term maintenance worker. **In sum, the overall WOE supports that the levels of COPCs in OCS soil are safe and protective of the short-term maintenance worker.**

7.1.1.2 Long-Term Maintenance Worker

The long-term maintenance worker was evaluated for potential contact with COPCs in soil for surface, shallow, subsurface 1, and subsurface 2 potential exposure depths. For the long-term maintenance worker in the OCS potential exposure area, the depth-weighted estimated cumulative ILCRs are above 1 in 1 million, the point of departure for risk management decisions, and slightly above 10 in 1 million. The area-weighted estimated cumulative ILCRs for the long-term maintenance worker in the OCS potential exposure area are at 10 in 1 million. The ILCRs are well within the risk-management range of 1 in 1 million to 100 in 1 million. Estimated ILCRs above 1 in 1 million are primarily due to hexavalent chromium via the particulate inhalation pathway.

The long-term maintenance worker activities are part of the active facility operations at TCS. Current use of health and safety protocols, required by PG&E as part of routine work practices inside and outside the TCS, limit worker exposure to soil, and provide an added level of protection, above and beyond what is necessary, to ensure full protection of the health of all PG&E workers and subcontractors working at the TCS and in surrounding outside areas. Therefore, the estimated ILCRs for the long-term maintenance worker are overestimated and actual risks are likely below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted estimated cumulative HIs for the long-term maintenance worker in the OCS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in OCS potential exposure area not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a long-term maintenance worker**. In sum, the overall WOE supports that the levels of COPCs in OCS soil are safe and protective of the long-term maintenance worker.**

7.1.1.3 Recreational User – Camper

The camper was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs for the camper in the OCS potential exposure area are slightly above 1 in 1 million, the point of departure for risk management decisions primarily due to hexavalent chromium and dioxin TEQ via the soil ingestion pathway. The ILCRs are well within the risk-management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted estimated cumulative HIs for campers in the OCS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in the OCS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the child camper.

The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for campers exposed to soil in the OCS potential exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ, in the SWMU 1 and TCS-4 areas in BCW, and in AOC9.

Consistent with the NCP and based on the results of the OCS potential exposure area HHRA for campers, risks are within the risk management range of 1 in 1 million to 100 in 1 million. Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ, would be effective at reducing potential risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million for the camper. No risk management or remediation would be necessary to reduce risks for the camper to levels below 10 in 1 million.

7.1.1.4 Recreational User – Hiker

The hiker was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs for the hiker in the OCS potential exposure area are at or slightly above 5 in 1 million, primarily due to hexavalent chromium and dioxin TEQ via the ingestion pathway. These estimated ILCRs are above 1 in 1 million, the point of departure for risk management decisions, but are well within the risk-management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted estimated cumulative HIs for hikers in the OCS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in the OCS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the child hiker.

The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for hikers exposed to soil in the OCS potential exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ in the SWMU 1 and TCS-4 areas in BCW, and in AOC9.

Consistent with the NCP and based on the results of the OCS potential exposure area HHRA for hikers, risks are within the risk management range of 1 in 1 million to 100 in 1 million. Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ, would be effective at reducing potential risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million for the hiker. No risk management or remediation would be necessary to reduce risks for the hiker to levels below 10 in 1 million.

7.1.1.5 Recreational User – Hunter

The hunter was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs and HIs for hunters in the OCS potential exposure area are below 1 in 1 million, the point of departure for risk management decisions, and an HI of 1, respectively. Furthermore, the depth- and area-weighted EPCs for lead in the OCS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the child camper. **Based on the results of the OCS potential exposure area HHRA for the hunter, levels of COPCs in OCS soil are safe and protective of the hunter.**

7.1.1.6 Recreational User – OHV Rider

The OHV rider was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs for OHV riders in the OCS potential exposure area are at 10 in 1 million and above 5 in 1 million, respectively, primarily due to hexavalent chromium via the inhalation particulate pathway and dioxin TEQ via the ingestion pathway. These estimated ILCRs are above 1 in 1 million, the point of departure for risk management decisions, but are well within the risk-management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted estimated cumulative HIs for OHV riders in the OCS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in OCS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the child OHV rider.

The results of the sensitivity analysis suggest that the majority of the depth- and area-weighted estimated ILCRs above 1 in 1 million for OHV riders exposed to soil in the OCS potential exposure area are attributed to elevated concentrations of hexavalent chromium and/or dioxin TEQ in the SWMU 1 and TCS-4 areas in BCW, and in AOC9.

Consistent with the NCP and based on the results of the OCS potential exposure area HHRA for OHV riders, risks are within the risk management range of 1 in 1 million to 100 in 1 million. Some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin TEQ would be effective at reducing potential risks to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million for the OHV rider. No risk management or remediation would be necessary to reduce risks for the OVH rider to levels below 10 in 1 million.

7.1.1.7 Tribal User

The tribal user was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths. The depth-weighted estimated cumulative ILCRs and HIs for the tribal user in the OCS potential exposure area are below 1 in 1 million, the point of departure for risk management decisions, and an HI of 1, respectively. **Based on the results of the OCS potential exposure area HHRA for tribal users, levels of COPCs in OCS soil are safe and protective of tribal users.**

7.1.1.8 Hypothetical Future Resident

The hypothetical future resident was evaluated for potential contact with COPCs in soil for surface, shallow, subsurface 1, and subsurface 2 potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil and home-produced food in the NORR potential exposure area for hypothetical future residents are above 1 in 1 million, the point of departure for risk management decisions and an HI of 1, respectively, due to hexavalent chromium, cobalt, total PCBs, dioxin TEQ, and/or TPHd. The estimated cumulative ILCRs associated with potential exposure to COPCs in soil and home-produced food are slightly above 10 in 1 million and at 1,000 in 1 million, respectively.

Depth- and area-weighted EPCs for lead in all soils in the NORR potential exposure area are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for a hypothetical future resident child receptor.

Note that cancer risk estimates above the risk management range were primarily attributed to exposure to hexavalent chromium in home-produced food, and that the area of hexavalent chromium detected above background is limited, with only four of 134 samples detected above the BTV.

Non-cancer hazard estimates above 1 were primarily attributed to exposure to TPH as diesel, hexavalent chromium and PCBs in home-produced food. Significant uncertainties associated with the estimation of hypothetical future resident exposure to TPH as diesel, hexavalent chromium, and PCBs in home-produced food may result in an overestimate of potential cancer risks and noncancer hazards calculated for these exposures. These uncertainties are described in detail in Section 4.6.3 of Appendix NORR. The assumption of an infinite source or TPH as diesel and use of maximum depth-weighted concentrations to estimate exposure to PCBs and TPH as diesel likely substantially overestimates potential exposure. In addition, several conservative assumptions associated with food uptake modeling were used for hexavalent chromium and TPH as diesel. When the estimated outdoor vapor concentration of TPH as diesel is adjusted to account for a limited source depth, the depth- and area-weighted estimated HQs for the hypothetical future resident potentially exposed to TPH as diesel in the NORR potential exposure area home-produced food is reduced from 5 to 0.2.

Note that risks/hazards estimated for the NORR potential exposure area are not considered representative of the realistic or likely potential exposures for the human populations that could be present in this area or anywhere at the site. Specifically, it is highly unlikely that the site will ever be used for residential purposes. However, the hypothetical future unrestrictive residential scenario was evaluated for the NORR potential exposure area at the request of the DOI.

The estimated potential risks and hazards for the hypothetical future resident presented for the NORR potential exposure area are likely substantially overestimated and are provided for informational purposes only. As stated in the DOI (2015b) Land Use Memo, “DOI will not utilize a future residential scenario on Federal lands within the project area when evaluating cleanup options in the Feasibility Study phase."

7.1.2 Potential Exposure Area Inside the Compressor Station

The cumulative ILCRs and HIs associated with potential exposure to COPCs in soil in the ICS potential exposure area were estimated using depth- and area-weighted EPCs for commercial and short-and long-term maintenance workers. Depth- and area-weighted estimated cumulative ILCR and HI results for the receptors evaluated in the ICS potential exposure area are summarized in the following table. As indicated in the table in this section, the area-weighted estimated cumulative ILCRs result in marginally lower risks than the depth-weighted estimated cumulative ILCRs, but the marginal reduction in estimated risk does not materially affect the overall conclusions for all receptors in the ICS potential exposure area.

Estimated Cumulative Incremental Lifetime Cancer Risk and HI [1,2]

Potential Receptor	Estimated Cumulative ILCR Less than or equal to $1x10^{-6}$	Estimated Cumulative ILCR Greater than $1x10^{-6}$ and Less than or equal to $5x10^{-6}$	Estimated Cumulative ILCR Greater than $5x10^{-6}$ and Less than or equal to $1x10^{-5}$	Estimated Cumulative ILCR Greater than $1x10^{-5}$ and Less than or equal to $1x10^{-4}$	Estimated Cumulative ILCR Greater than $1x10^{-4}$	Estimated HI Less than or equal to 1	Estimated HI Greater than 1
Commercial Worker			Yes [3] (depth- and area-weighted)			Yes [3] (depth- and area-weighted)	
Short-Term Maintenance Worker	Yes (depth-weighted)					Yes (depth-weighted)	
Long-Term Maintenance Worker		Yes (area-weighted)	Yes (depth-weighted)			Yes (depth- and area-weighted)	

<u>Notes:</u>

[1] Represents the maximum depth- and area-weighted estimated cumulative ILCR and HI for the receptor at any applicable exposure depth within the ICS potential exposure area under baseline scenario.

[2] Area-weighted estimates were calculated only for those receptors where the depth-weighted cumulative ILCR was above 1 in 1 million or HI was above 1.

[3] Represents the estimated cumulative ILCR and HI for the commercial worker associated with COPCs in soil and soil gas.

The estimated cumulative ILCR and HI results and conclusions for the commercial and maintenance workers in the ICS potential exposure area are summarized in the following sections.

7.1.2.1 Commercial Worker

The commercial worker was evaluated for potential contact with COPCs in soil for surface and shallow potential exposure depths, and inhalation of vapors from soil gas. The depth- and area-weighted estimated cumulative ILCRs associated with potential exposure to COPCs in soil in the ICS potential exposure area for the commercial worker are above 1 in 1 million, the point of departure for risk management decisions, but at or below 10 in 1 million which is well within the risk management range of

1 in 1 million to 100 in 1 million. The active TCS facility has work practices in place that limit the amount of potential worker exposure to soil. The overly conservative assumption that all areas in the ICS potential exposure area are uncovered (i.e., not paved) results in an overestimate of the ILCRs for the commercial worker; reasonable upper bound values are likely below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted cumulative HIs for commercial workers for the ICS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in ICS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a commercial worker. The estimated cumulative ILCRs and HIs associated with COPCs in soil gas in the ICS potential exposure area for commercial workers potentially exposed via the inhalation of vapors is well below 1 in 1 million and an HI of 1, respectively.

In sum, the overall WOE supports that the conditions at the facility and levels of COPCs in the ICS potential exposure area soil and soil gas are safe and protective of the commercial worker.

7.1.2.2 Short-Term Maintenance Worker

The short-term maintenance worker was evaluated for potential contact with COPCs in soil for surface, shallow, subsurface 1, and subsurface 2 potential exposure depths. The depth-weighted estimated cumulative ILCRs and HIs associated with potential exposure to COPCs in soil in the ICS potential exposure areas for the short-term maintenance worker are below 1 in 1 million, the point of departure for risk management decisions, and an HI of 1, respectively. Furthermore, the depth-weighted EPCs for lead in the ICS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a short-term maintenance worker.

Based on the results of the ICS HHRA, levels of COPCs in ICS potential exposure area soil are safe and protective of short-term maintenance workers.

7.1.2.3 Long-Term Maintenance Worker

The long-term maintenance worker was evaluated for potential contact with COPCs in soil for surface, shallow, subsurface 1 and subsurface 2 potential exposure depths. The depth- and area-weighted estimated cumulative ILCRs associated with potential exposure to COPCs in soil in the ICS potential exposure areas for the long-term maintenance worker are above 1 in 1 million, the point of departure for risk management decisions, but at or below 10 in 1 million which is well within the risk management range of 1 in 1 million to 100 in 1 million. However, with work practices in place that limit the amount of exposure to soil and the overly conservative assumption that ICS areas are uncovered, estimated ILCRs for the long-term maintenance worker are overestimated and likely well below 10 in 1 million and well within the risk management range of 1 in 1 million to 100 in 1 million.

The depth- and area-weighted estimated cumulative HIs for the long-term maintenance worker in the ICS potential exposure area are below an HI of 1. Furthermore, the depth- and area-weighted EPCs for lead in ICS potential exposure area soil are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for the fetus of a long-term maintenance worker.

In sum, the overall WOE supports that the levels of COPCs in the ICS potential exposure area soil are safe and protective of the long-term maintenance worker.

7.1.3 Summary and Overall Conclusions and Recommendations for the HHRA

Below is a summary of the conclusions and recommendations for the HHRA evaluation.

Conclusions for the HHRA

- The depth- and area-weighted EPCs for lead in all potential exposure areas evaluated are not expected to result in an increase in blood lead levels above the OEHHA benchmark value of 1 µg/dL for child receptors or the fetus of any of the adult receptors evaluated. **Based on the results of the HHRA, the levels of lead in soil are safe and protective for all potential receptors evaluated.**
- The HHRA results for the ICS potential exposure area support that the levels of COPCs in ICS soil and/or soil gas are safe and protective of commercial and short- and long-term maintenance workers for current and anticipated future operational conditions and practices.
- While **AOC-specific evaluations provide useful information regarding limited areas or areas of highest impact, they are not suitable as the sole basis for the conclusions of the HHRA** or risk management decisions going forward. Assuming lifetime soil contact is limited to these specific individual potential exposure areas is not representative of either the potential receptors evaluated, or the likely future land use for the site.
- **The OCS potential exposure area is considered the most representative baseline scenario for potential human exposures and associated risks for soil contact outside TCS.** Human populations that could be present at the site would more likely be exposed randomly, over the course of a lifetime, to soil present in all areas located outside the TCS, rather than have a lifetime of contact limited to a single AOC/SWMU/UA.
- HIs for the maintenance workers, recreational users, and tribal users were all less than or equal to 1 for both depth- and area-weighted EPCs for the OCS potential exposure area. **Based on the results of the HHRA, the levels of COPCs in OCS soil are safe and protective of potential noncancer health effects.**
- Estimated lifetime cancer risks for the tribal users and hunters were at or below *de minimis* levels for the OCS potential exposure area. **Based on the results of the HHRA, levels of COPCs in soil are safe and protective of tribal users and hunters.**
- The HHRA results of the OCS potential exposure area support that the **levels of COPCs in OCS soil are safe and protective of short- and long-term maintenance workers** for current and anticipated future operational conditions and practices.
- **For all potential human receptors evaluated, COPCs in soil driving risks or hazards above *de minimis* levels are hexavalent chromium and dioxin TEQ, located predominately in the top 3 feet of soil.** Soil risk drivers appear to be predominately located in SWMU 1/TCS 4 and AOC9.
- **The ILCR and HI estimates for the hypothetical future resident are likely highly overestimated.** Multiple conservative factors contributing to this overestimation include: the use of maximum depth-weighted concentrations to estimate exposure to PCBs and TPH as diesel and several conservative assumptions associated with food uptake modeling for hexavalent chromium and TPH as diesel.

- **The hypothetical future resident is not representative of likely future land use on DOI land or other areas of the site.** This evaluation was included in the HHRA for informational purposes only. As stated in the DOI (2015b) Land Use Memo, "DOI will not utilize a future residential scenario on Federal lands within the project area when evaluating cleanup options in the Feasibility Study phase."

Recommendations for the HHRA

- For this HHRA, the OCS potential exposure area evaluation is the most representative scenario for the basis of HHRA conclusions and recommendations for the protection and safety of potential human receptors outside the fenceline.
- Based on the estimated cumulative ILCRs calculated for the HHRA, for the protection of human health, COPCs to be carried forward for developing RBRGs for soil are hexavalent chromium and dioxin TEQ.
- RBRGs for the potential recreational users are the most appropriate benchmarks for the protection of human health and associated risk management decisions going forward.
- Risks are within the risk management range of 1 in 1 million to 100 in 1 million. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. This approach to response actions at the site is consistent with the NCP (40 CFR 300). Some targeted form of risk management or remediation, addressing elevated soil levels of hexavalent chromium and dioxin TEQ would be effective at reducing risks for the potential camper, hiker, and OHV rider to levels below the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million. No risk management or remediation would be necessary to reduce risks for the the potential camper, hiker, and OHV rider to levels below 10 in 1 million.

RBRGs calculated for the protection of human health are presented in Section 8.

7.2 Ecological Risk Assessment

The ERA evaluates the likelihood that assumed exposure to constituents detected in soil at the various potential exposure areas of the site could result in unacceptable potential risk to ecological receptors. The methodology used to conduct the ERAs for each potential exposure area was presented and approved in the RAWP documents (Arcadis 2008a, 2009a, 2015). The assumptions, input values, and risk characterization methodology are presented previously in Section 6. As specified in the RAWP documents (Arcadis 2008a, 2009a, 2015) and subsequent direction from DTSC (2017a), 17 potential exposure areas were evaluated individually.

Estimated terrestrial exposures (soil) for ecological communities and small home-range wildlife receptors were evaluated for the following potential exposure areas:

- BCW
- SWMU 1
- BCW excluding SWMU1
- AOC4

- AOC9
- AOC10
- AOC11
- AOC12
- AOC14
- AOC27
- AOC28
- AOC31
- UA-2
- Tamarisk Thicket.

Potential ecological communities included terrestrial plants and soil invertebrates. Potential small home-range wildlife receptors included granivorous small mammals (represented by Merriam's kangaroo rat), invertivorous small mammals (represented by the desert shrew), granivorous birds (represented by Gambel's quail), and insectivorous birds (represented by the cactus wren).

Estimated terrestrial exposures (soil) for large home-range wildlife receptors were evaluated for the following potential exposure areas:

- OCS
- BCW and AOC4
- OCS excluding BCW and AOC4.

Potential large home-range wildlife receptors included desert kit fox (carnivorous mammal), red-tailed hawk (carnivorous bird), and Nelson's desert bighorn sheep (herbivorous mammal).

In addition to evaluations for each potential exposure area identified in the RAWP, ERAs for SWMU 1, BCWxSWMU1, Tamarisk Thicket, and OCS potential exposure areas were conducted at the direction of DTSC (2017a). These additional evaluations helped further understanding of potential risk to ecological receptors in SWMU1 and in the unique habitat/physical characteristics present in the Tamarisk Thicket. However, the additional potential exposure areas (SWMU 1, BCWxSWMU1, and the Tamarisk Thicket) contained within the BCW potential exposure area are not suitable as the primary basis for risk management decisions for ecological receptors; the BCW potential exposure area was used for this purpose.

COPECs identified as risk drivers in each potential exposure area were selected based on community/population-level risk estimates (HQs for plants and invertebrates; LOAEL-based HQs for mammal and bird populations) and a semi-quantitative WOE evaluation supporting the conclusion of unacceptable risk. The risk characterization approach and process for identifying risk drivers are described in detail in Section 6.4.1. Risk drivers for each potential exposure area and receptor are presented in this section and in Table 7-1a for plants, soil invertebrates, and small home-range receptors and Table 7-1b for large home-range receptors.

7.2.1 Risk Conclusions for Plants and Soil Invertebrates

For all COPECs evaluated, no unacceptable risk was identified for plants in the following potential exposure areas (Table 7-1a): BCW excluding SWMU 1, AOC4, AOC11, AOC12, AOC14, AOC27, AOC 28, AOC31, and UA-2 (see related exposure area-specific appendices for additional details).

For all COPECs evaluated, no unacceptable risk was identified for soil invertebrates in the following potential exposure areas: AOC4, AOC11, AOC12, AOC14, AOC27, AOC28, AOC31, and UA-2 (see related exposure area-specific appendices for additional details).

The potential for unacceptable risk was identified for communities of plants and soil invertebrates in a few potential exposure areas that are adjacent to the TCS fenceline (BCW, SWMU1, AOC9, and AOC10; Table 7-1a). Risk drivers in these potential exposure areas were limited to total chromium, hexavalent chromium, and copper.

For plants:

- Hexavalent chromium at the SWMU 1, AOC9, and AOC10 potential exposure areas (baseline and 2-foot scouring scenarios only)
- Copper at the AOC9 potential exposure area.

A plant screening value is unavailable for total chromium; therefore, risks to plants were not estimated for this COPEC.

For soil invertebrates:

- Hexavalent chromium at the SWMU 1, AOC9, and AOC10 potential exposure areas (baseline and 2-foot scouring scenarios only)
- Copper at the AOC9 potential exposure area
- Total chromium at the SWMU 1, AOC9, and AOC10 potential exposure areas (baseline and 2-foot scouring scenarios only).

7.2.2 Risk Conclusions for Small Home-Range Wildlife Receptors

For all the COPECs evaluated in the ERA, no unacceptable risk was identified in any potential exposure area for granivorous small mammal populations represented by Merriam's kangaroo rat, granivorous bird populations represented by Gambel's quail, and insectivorous bird populations represented by the cactus wren. For all COPECs evaluated, no unacceptable risk was identified for the invertivorous small mammal populations represented by the desert shrew for the following potential exposure areas: BCW excluding SWMU 1, AOC4, AOC11, AOC12, AOC14, AOC27, AOC28, AOC31, and UA-2 (see related exposure-area specific appendices for additional details).

For small home-range wildlife receptors, potential unacceptable risk was identified only for populations of invertivorous small mammals, represented by the desert shrew, in a few potential exposure areas that are adjacent to the TCS fenceline (BCW, SWMU1, AOC9, and AOC10; Table 7-1a). Risk drivers and potential exposure areas with unacceptable risk included:

- Total chromium in surface soil (0 to 0.5 foot bgs) at the SWMU 1, AOC9, and AOC10 potential exposure areas (2-foot scouring scenario only)

- Copper in surface soil (0 to 0.5 foot bgs) at the AOC9 potential exposure area
- Dioxin TEQ in surface soil (0 to 0.5 foot bgs) at the BCW (baseline and 2-foot scouring scenarios), SWMU 1, AOC9, and AOC10 potential exposure areas (baseline, 2-foot scouring, and 5-foot scouring scenarios).

No risk drivers were identified in the evaluation of the BCWxSWMU1 potential exposure area. Therefore, unacceptable risk to invertivorous small mammals is not likely in areas of BCW outside the SWMU 1 potential exposure area.

As discussed previously in Section 6.7.6, due to multiple specific conservative assumptions incorporated in the risk estimates for dioxin TEQ, risks are likely significantly overestimated (by at least a factor of 10) for this COPEC in the ERAs. As a result, dioxin TEQ was identified as a risk driver based on LOAEL-based HQs greater than 10 and a WOE evaluation supporting the conclusion of unacceptable population-level risk.

7.2.3 Risk Conclusions for Large Home-Range Wildlife Receptors

For all COPECs evaluated for all potential exposure areas, no unacceptable risk was identified for large home-range wildlife receptors (Table 7-1b). Therefore, no risk drivers were identified for these receptors. Large home-range wildlife were represented by desert kit fox (carnivorous mammal), red-tailed hawk (carnivorous birds), and Nelson's desert bighorn sheep (herbivorous mammals).

7.2.4 Risk Conclusions for Special-Status Species

The risk estimates presented in this ERA, as noted previously, are considered to be protective of special-status species due to the conservative parameters used. Although potential habitat exists for special-status species at or near the site, none have been recorded as observed in the upland potential exposure areas except for parts of BCW. The primary vegetation present is sparse creosote bush. No federal or state listed endangered or threatened plants or candidates for listing were found at the site, and no federal listed T&E wildlife (birds and mammals) species with small home ranges are considered to be resident at the site. A single observation of the federal listed T&E species, the southwestern willow flycatcher was made in the Tamarisk Thicket area (north end of BCW) in 2009 but not observed in subsequent surveys (CH2M 2014a; GANDA 2014, 2017). However, it was concluded by GANDA (2014, 2017) that this species was transient and is not expected to nest or reside at the site. (Other federal listed species including desert tortoise, yellow-bellied cuckoo, and Yuma clapper rail were not directly observed at the site [CH2M 2014a; Konecny 2012]). Special status species include state- and federal-listed fully protected T&E species, state and federal species of concern, and traditionally culturally significant plants; however, protection at the NOAEL level is warranted only for fully protected species.

Two large home range species have been observed at the site (BCW): the ring-tail cat and Nelson's desert bighorn sheep. The ring-tailed cat is a California fully protected species. To be consistent with the GWRA (Arcadis 2009b) and observations made by PG&E employees at the site, Nelson's desert bighorn sheep was evaluated. Bat surveys indicated presence of the Yuma myotis (not formally listed), cave myotis and pallid bat (state species of concern) at BCW (Harvey 2015). Townsend big-eared bats have not been directly observed at the site (CH2M 2015b; Brown and Rainey 2015). As described in Section 6.6.2.15, no unacceptable risk was identified at the individual level (i.e., NOAEL-based HQs greater than

1) based on qualitative evaluation of ring-tail cat (based on the desert kit fox and desert shrew, adjusted for site-use). Therefore, further evaluation of special-status species was not required.

7.2.5 Summary and Overall Conclusions of the ERA

Potentially unacceptable risk was identified for a few receptors (plants, soil invertebrates, and invertivorous small mammals) based on estimated exposure to a small number of COPECs (primarily hexavalent chromium, total chromium, and dioxin TEQ) in three potential exposure areas near the TCS: BCW/SWMU1, AOC9, and AOC10 potential exposure areas. Unacceptable risk to plants, soil invertebrates, and invertivorous small mammal populations from risk drivers at the BCW potential exposure area is due to elevated concentrations of hexavalent chromium, total chromium, and dioxin TEQ within the SWMU 1 potential exposure area. Copper was also identified as a risk driving COPEC for plants, soil invertebrates, and invertivorous small mammals in AOC9. The risk-driving COPECs detected in soil in these areas are associated with known historical site releases and/or activities (Section 2). Unacceptable risk was not expected (based on HQs less than 1) or considered unlikely (based on the WOE) for all other potential receptors including granivorous small mammals, small home-range birds, and all large home-range receptors. Based on the conservative assumptions incorporated in ERA, these risk conclusions likely overestimate the potential for unacceptable risk at the site.

Some targeted form of risk management or remediation, addressing elevated levels of the following risk drivers in the following potential exposure areas, would be effective at reducing potential exposures and thus risks to acceptable levels. This is consistent with the NCP.

- Total chromium and dioxin TEQ in BCW: Targeted soil remediation for these risk drivers (identified based on the BCW potential exposure area) at locations within SWMU 1, would be effective at reducing potential exposures and thus risks to acceptable levels within the BCW potential exposure area (the potential exposure area considered to be the reasonable exposure area for ecological receptor populations). [Note: As directed by DTSC (2017a), an ERA was conducted for ecological receptors for the SWMU 1 potential exposure area, which is within the BCW potential exposure area. The SWMU 1 potential exposure area (and BCWxSWMU1 potential exposure area) was evaluated only to further our understanding of the locations associated with potential risk in the BCW potential exposure area. The BCW potential exposure area encompasses the SWMU 1 potential exposure area and is the relevant exposure area for ecological receptors, as defined in the RAWP (Arcadis 2008a, 2009a, 2015). Therefore, SWMU 1 was not considered for the identification of risk drivers and associated development of RBRGs.]
- Hexavalent chromium, total chromium, copper, and dioxin TEQ in AOC9: Targeted soil remediation for these risk drivers at locations along the TCS fenceline, would be effective at reducing potential exposures and thus risks to acceptable levels within the AOC9 potential exposure area.
- Hexavalent chromium, total chromium, and dioxin TEQ in AOC10: Targeted soil remediation for these risk drivers at locations within the AOC10c subarea (i.e., drainage depression behind the middle berm in East Ravine), would be effective at reducing potential exposures and thus risks to acceptable levels within the AOC10 potential exposure area.

Ecological RBRGs were developed for risk drivers and potential exposure areas identified as having unacceptable risk. The ecological RBRGs are presented in Section 8.

8 RISK-BASED REMEDIATION GOALS FOR RISK DRIVERS IN SOIL

As stated in the RAWP (Arcadis 2008a), risk management decisions to be made in the CMS/FS step of the regulatory process will be focused on COPCs/COPECs that contribute most significantly to risk and/or that exceed *de minimis* risk levels for soil for the potential receptors being evaluated (i.e., the risk drivers). The overall remedial action goal is to ensure that residual concentrations of chemicals remaining at the site are protective of human health and the environment for the reasonable anticipated future land uses.

This section presents the RBRGs that can be used in the upcoming remedial planning, including the Soil CMS/FS, to identify those areas of the site that may warrant some form of remedial or risk management action. RBRGs are concentrations that do not present unacceptable risk to human health and ecological receptors. A RBRG is a proposed health protective target cleanup concentration that can be used, in combination with other factors such as background concentrations, as a starting point for making risk management decisions. RBRGs are calculated for constituents in soil for a given potential receptor where the findings of the HHERA suggest some form of risk management or remediation may be warranted. Consistent with the HHERA approach, RBRGs are applied based on the potential exposure area of interest (i.e., the 95UCL for the potential exposure area should be less than or equal to the RBRG).

The approach for the derivation of RBRGs and the calculated RBRGs for potential human and ecological receptors are discussed in the following sections. Additionally, an example is provided showing one method to identify specific soil locations that, when removed from the potential exposure area dataset, result in EPCs at or below RBRGs. This evaluation also constitutes a hot spot analysis in that it identifies the locations with elevated COPC/COPEC concentrations associated with unacceptable risk for an area. At these locations, deep impacts that potentially represent a threat to groundwater will be further identified in the forthcoming RFI/RI Report Volume 3 (currently being prepared by Jacobs).

8.1 Human Health RBRGs

Based on the results of the soil HHRA, the concentrations of COPCs in OCS soil are safe and protective of short- and long-term maintenance workers, hunters, and tribal users. Concentrations of COPCs in ICS soils are safe and protective of commercial workers and short- and long-term maintenance workers. Concentrations of COPCs in OCS soils result in calculated risks for the potential campers, hikers, and OHV riders that are within the risk management range of 1 in 1 million to 100 in 1 million. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health. However, some targeted form of risk management or remediation, addressing elevated levels of hexavalent chromium and dioxin, would be effective at reducing calculated risks for the potential campers, hikers and OHV riders to levels below CalEPA DTSC point of departure for excess ILCR of 1 in 1 million. No risk management or remediation would be necessary to reduce risks for the the potential camper, hiker, and OHV rider to levels below 10 in 1 million. The result of the NORR HHRA for hypothetical future residents are presented at the request of the DOI and for informational purposes only; the hypothetical future residential land use is not a reasonable anticipated future land use for the NORR potential exposure area.

Consistent with USEPA guidance (1991b), a risk-based process was used to estimate RBRGs for COPCs that drive soil risk concerns above *de minimis* risk levels. For compounds identified as carcinogens negligible or *de minimis* risk levels are defined in accordance with state and federal guidance as 1 in 1 million. This will be the point of departure, recognizing that DTSC and USEPA ultimately have authority to allow for residual risks to be within the risk management range of 1 in 1 million to 100 in 1 million. RBRGs are a tool to aid in risk management decisions and are not intended to provide a bright line for remediation.

For dioxins TEQ, DTSC's HERO supports the use of residential and indoor commercial worker remedial goals equal to 10 times the theoretical potential cancer risk of 1 in 1 million (equal to that associated with a theoretical potential cancer risk of 10 in 1 million). This regulatory approach is based on studies of bioavailability of dioxins that demonstrate exposure to soil under normal residential and indoor commercial conditions has minimal influence on the serum of exposed individuals. The 10 in 1 million potential risk level is considered by DTSC to be a likely overestimate of the actual potential risk for exposure to soil with dioxin TEQ (DTSC 2017b). For outdoor workers with direct contact with site soils such that regular incidental ingestion of soil impacted with dioxin TEQs may occur, DTSC recommends RBRGs equal to a theoretical potential cancer risk of 1 in 1 million (DTSC 2017b). Note that recreational users are assumed to have the same intake rates via ingestion, dermal contact, and inhalation exposure pathways as under a residential scenario, but exposure occurs on a less frequent basis than assumed under a residential scenario. Therefore, potential exposure to dioxin TEQ in soil for the recreational users over a lifetime would be less than for a hypothetical resident. As such, the RBRGs for recreational users equal to 10 times the theoretical potential cancer risk of 1 in 1 million may be appropriate for the site.

For noncancer health effects, an HQ of less than or equal to 1 implies that the predicted exposure for a given population and chemical is not expected to result in adverse noncancer health effects; an HI of less than or equal to 1 implies the same for multi-chemical exposures (USEPA 1989).

The identification of risk drivers in the HHRA was based on the summary of results and overall conclusions of the HHRA as presented in Section 7.1.3 and Table 5-6. RBRGs were calculated for hexavalent chromium and dioxin TEQ, the significant contributors to soil risks above *de minimis* levels, under the camper, hiker, and OHV rider potential exposure scenarios. [Note: In accordance with the RAWP (Arcadis 2008a), the conclusions and recommendations for this HHRA are based on the risks estimated for the ICS and OCS potential exposure areas.] The approach for the derivation of the human health RBRGs, the calculated RBRGs for recreational users, and soil locations that contribute most significantly to calculated unacceptable risks for recreational users are discussed in the following sections.

8.1.1 Methodology for Deriving Human Health RBRGs and Values

RBRGs for soil are developed by combining information regarding the level of assumed intake of the constituent, the levels of acceptable risk, and the relationship between the assumed intake of constituent and the calculated incidence of an adverse health effect as a function of human exposure to the constituent. The methodology used to develop the RBRGs for the COPCs in soil at the site is based on USEPA and DTSC guidance and the specific equations provided in the following guidance documents:

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A) (USEPA 1989)

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B: Development of Risk-Based Preliminary Remediation Goals) (USEPA 1991b)
- Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (DTSC 1992)
- Preliminary Endangerment Assessment Guidance Manual (DTSC 2015b).

Section 5.5 presents the estimated ILCRs and noncancer hazards posed by a representative concentration of constituent present at the site for potential recreational user scenarios. Assumptions for potential exposure, transport, and toxicity remain unchanged from those described and used in Section 5.0. Rearranging the equations used to estimate the ILCRs and noncancer hazards and using the target ILCRs at the lower and upper bounds the risk management range of 1in 1 million and 100 in 1 million and the target noncancer HQ of 1, the concentration of each constituent associated with the target ILCR and HQ levels can be determined. This is the common method used to estimate RBRGs for a site, where the results of the risk assessment indicate that some form of remediation or risk management may be warranted. The soil RBRGs for the potential recreational user scenarios presented in Table 8-1 were developed using the equations in this section. RBRGs are rounded to two significant figures. Note that RBCs were developed for the list of COPCs identified in the HHERA using the same approach and equations as for the development of the human health RBRGs. The RBCs were developed for the Soil Management Plan to be used to support decisions for the handling, management, and storage of potentially contaminated and displaced soil at the site during implementation of a groundwater remedy at the site to address chromium contamination in groundwater. The RBCs are presented in Appendix RBC.

For carcinogenic effects, the following equation is used to derive the soil RBRG for assumed incidental ingestion of soil, dermal contact with soil, and inhalation of particulates and VOC vapors in ambient outdoor air from soil:

$$RBRG_{a,carcinogen} = \frac{Target\ Risk\ Level}{\left[\frac{Risk_{a,inhv}}{Conc_{a,inhv}}\right] + \left[\frac{Risk_{a,inhp}}{Conc_{a,inhp}}\right] + \left[\frac{Risk_{a,ing}}{Conc_{a,ing}}\right] + \left[\frac{Risk_{a,der}}{Conc_{a,der}}\right]}$$

Equation 8-1

Where:

$RBRG_{a,carcinogen}$ = Risk-based remediation goal for constituent a, for carcinogenic effects, (mg/kg)

Target Risk Level = Target cancer risk level (unitless)

$Risk_{a,inhv}$ = calculated cancer risk for constituent a for the vapor inhalation pathway, developed as described previously (unitless)

$Risk_{a,inhp}$ = calculated cancer risk for constituent a for the particulate inhalation pathway, developed as described previously (unitless)

$Risk_{a,ing}$ = calculated cancer risk for constituent a for the soil ingestion pathway, developed as described previously (unitless)

$Risk_{a,der}$ = calculated cancer risk for constituent a for the dermal contact pathway, developed as described previously (unitless)

$Conc_{a,inhv}$ = Representative exposure concentration of constituent a for the vapor inhalation pathway; mg/kg

$Conc_{a,inhp}$ = Representative exposure concentration of constituent a for the particulate inhalation pathway; mg/kg

$Conc_{a,ing}$ = Representative exposure concentration of constituent a for the soil ingestion pathway; mg/kg

$Conc_{a,der}$ = Representative exposure concentration of constituent a for the dermal contact pathway; mg/kg

For noncarcinogenic effects, the following equation was used to derive the soil RBRG for incidental ingestion of soil, dermal contact with soil, and inhalation of particulates and VOC vapors in ambient outdoor air from soil:

$$RBRG_{a,noncarcinogen} = \frac{Target\ HQ}{\left[\frac{HQ_{a,inhv}}{Conc_{a,inhv}}\right] + \left[\frac{HQ_{a,inhp}}{Conc_{a,inhp}}\right] + \left[\frac{HQ_{a,ing}}{Conc_{a,ing}}\right] + \left[\frac{HQ_{a,der}}{Conc_{a,der}}\right]}$$

Equation 8-2

Where:

$RBRG_{a,noncarcinogen}$ = Risk-based remediation goal for constituent a, for noncarcinogenic effects, (mg/kg)

Target HQ = Target hazard quotient level (unitless)

$HQ_{a,inhv}$ = calculated hazard quotient for constituent a for the vapor inhalation pathway, developed as described previously (unitless)

$HQ_{a,inhp}$ = calculated hazard quotient for constituent a for the particulate inhalation pathway, developed as described previously (unitless)

$HQ_{a,ing}$ = calculated hazard quotient for constituent a for the soil ingestion pathway, developed as described previously (unitless)

$HQ_{a,der}$ = calculated hazard quotient for constituent a for the dermal contact pathway, developed as described previously (unitless)

$Conc_{a,inhv}$ = Representative exposure concentration of constituent a for the vapor inhalation pathway; mg/kg

$Conc_{a,inhp}$ = Representative exposure concentration of constituent a for particulate inhalation pathway; mg/kg

$Conc_{a,ing}$ = Representative exposure concentration of constituent a for soil ingestion pathway; mg/kg

$Conc_{a,der}$ = Representative exposure concentration of constituent a for dermal contact pathway; mg/kg

The RBRGs for hexavalent chromium and dioxin TEQ for the potential camper, hiker, and OHV rider are presented in Table 8-1 and the lowest recreational user RBRGs for hexavalent chromium and dioxin TEQ are summarized in the table in this section.

Lowest Recreational User RBRGs For Hexavalent Chromium and Dioxin TEQ

Risk Drivers for Potential Recreational Users	Human Health RBRG	RBRG Basis
Chromium-6	3.1 mg/kg	OHV rider at 1 x 10^{-6} risk
Chromium-6	31 mg/kg	OHV rider at 1 x 10^{-5} risk
Chromium-6	310 mg/kg	OHV rider at 1 x 10^{-4} risk
Dioxin TEQ	100 ng/kg	Hiker at 1 x 10^{-6} risk
Dioxin TEQ	1,000 ng/kg	Hiker at 1 x 10^{-5} risk
Dioxin TEQ	10,000 ng/kg	Hiker at 1 x 10^{-4} risk

The RBRGs calculated for hexavalent chromium (3.1 mg/kg) and dioxin TEQ (ranging from 100 to 1,000 ng/kg) were used to identify soil locations associated with calculated levels of risk above the CalEPA DTSC point of departure for excess ILCR of 1 in 1 million , as described in following section. RBRGs are a tool and not intended as a ”bright line” for remediation.

8.1.2 Soil Locations Contributing to Calculated Risks Above *De Minimis* Levels for Potential Human Receptors

This section discusses the locations that drive risk for the HHRA for the OCS potential exposure area and is provided as an example of one method that can be used to apply the RBRGs and assist with identifying remedial design possibilities. This is not intended to substitute for actual remedial design and comprises part of the set of tools available to risk managers to make site-specific decisions regarding risk.

As previously stated in Section 8.1, based on the results of the HHRA, some targeted form of risk management or remediation, addressing elevated levels of the calculated risk drivers, hexavalent chromium and dioxin TEQ, would be effective at reducing calculated risks for potential campers, hikers, and OHV riders to levels below 1 in 1 million. As indicated in Table 8-1, the lowest recreational user RBRGs for hexavalent chromium and dioxin TEQ are 3.1 mg/kg (for OHV rider at the 1 in 1 million risk level) and 0.00010 mg/kg (or 100 ng/kg; for hiker at the 1 in 1 million risk level), respectively.

To further refine the locations that could be considered for targeted risk management in the OCS potential exposure area, depth-weighted concentrations of the risk drivers, hexavalent chromium and dioxin TEQ, were ranked and the highest concentrations were iteratively removed from the baseline soil dataset. Using the remaining data, depth-weighted EPCs were calculated for the 0 to 0.5 foot bgs and 0 to 3 feet bgs exposure depths and compared to the respective RBRGs. Table 8-2 identifies soil locations at three investigation areas (SWMU 1, AOC9, and AOC10) within the OCS potential exposure area where the depth-weighted concentrations of hexavalent chromium and/or dioxin TEQ in the top 0 to 3 feet bgs of soil exceed the RBRGs. If removed from the OCS potential exposure area baseline dataset (i.e., mimicking a hypothetical remediation), the resulting residual depth-weighted 95UCL for the OCS potential exposure area is at or below the RBRG. These locations were identified based on depth-weighted EPCs for simplicity and as a conservative approach to identifying the areas/locations that if removed, would result in residual concentrations of chromium-6 and dioxin TEQ in soil that are calculated to be protective of the potential camper, hiker, and OHV rider. As mentioned previously, this is just one example of the application of RBRGs, and the specific locations identified in Table 8-2 are not intended to be used either for remedial design without further consideration or as a post remediation risk evaluation. Confirmation sampling and a post-remediation risk assessment may be necessary to demonstrate that residual contamination is not of concern if removal of soil is implemented as a remedial and risk management decision at the site.

To summarize, this example included removal of soil data for the following locations:

- **SWMU 1**
    - SWMU1-25 to meet the RBRG of 100 ng/kg for dioxin TEQ based on target cancer risk of 1 in 1 million for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths; no sample data need to be removed to meet the RBRG of 1,000 ng/kg for dioxin TEQ based on target cancer risk of 10 in 1 million for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths.
- **AOC9**
    - AOC10-20 to meet the RBRG of 3.1 mg/kg for hexavalent chromium for both the 0- to 0.5-foot bgs and 0- to 3-foot bgs exposure depths
    - #10 to meet the RBRG of 3.1 mg/kg for hexavalent chromium for the 0- to 3-foot bgs exposure depth.
- **AOC10**
    - MW-58BR_S to meet the RBRG of 3.1 mg/kg for hexavalent chromium for the 0- to 3-foot bgs exposure depth.

8.2 Ecological RBRGs

Ecological RBRGs are calculated health protective concentrations below which no potentially unacceptable calculated risk to potential ecological receptor populations is expected. RBRGs protective of potential ecological receptors are developed for risk drivers; that is, those COPECs, and potential exposure areas for which potential unacceptable risk to receptor populations was concluded in the ERA (Section 7.2.5). For COPECs with HQs greater than 1 using the most refined exposure and effects assumptions (i.e., area-weighted EPCs, selected screening levels/TRVs, and site-specific SUFs), a WOE assessment was used to draw risk conclusions and identify potential risk drivers for each potential exposure area. The various LOEs considered in the WOE assessment and risk conclusions are presented in Table 6-11.

The ERA calculated the following risk drivers and potential exposure areas as presenting potentially unacceptable risk to one or more ecological receptors:

- BCW –dioxin TEQ for small invertivorous mammals (desert shrew)
- AOC9 – hexavalent chromium and copper for plants; hexavalent chromium, total chromium, and copper for invertebrates; total chromium, copper, and dioxin TEQ for small invertivorous mammals
- AOC10 – hexavalent chromium and total chromium for plants; total chromium for invertebrates (baseline and 2-foot scouring scenarios only); and total chromium and dioxin TEQ for small invertivorous mammals.

For potential ecological communities of plants and soil invertebrates, only generic risk-based screening levels (Table 6-6) are available as RBRGs. As discussed in Section 6.7.5, screening levels for the risk-driving COPECs are often below BTVs and there is low confidence in their ability to predict risk at the site. The screening levels are published values based on toxicity data (typically using agriculturally important produce or crop species and conducted in laboratory settings) that have limited relevance for the Topock site. The screening levels are designed for use in conservative screening level risk assessments and for site-characterization purposes (as was done for determining nature and extent for the RFI/RI).

Surveys were conducted for special-status species only, not for general populations. The results of these special-status species surveys are summarized in Section 2.4.5 and in the individual potential exposure area appendices.

Vegetation communities observed at the site during the floristic surveys conducted in 2013 (GANDA and CH2M 2013) and 2017 (CH2M 2017) is typical of Mojave Desert plant communities (summarized in Section 2.4.2). More than 100 different vascular plant species have been observed at the site and documented in these survey reports (GANDA and CH2M 2013; CH2M 2017). The floristic surveys report a diverse assemblage of plants species found in typical abundance, density, cover, and vigor of plant communities in undisturbed desert habitat. These observations are not consistent with impairment of the plant community at the site. The floristic surveys provide site-specific observations that support the health of plant communities at the site and is considered a stronger LOE than the exceedances of low-confidence generic plant screening values, which are widely acknowledged to have low ability to predict toxicity in plants. Therefore, these generic screening levels for plants and soil invertebrates are not recommended for use as RBRGs at the site. Because the key risk drivers for plants and soil invertebrates (hexavalent chromium and total chromium) tend to be co-located, risk-management or remedial actions considered for the protection of wildlife receptors (i.e., mammals and birds) potentially exposed to total chromium will also reduce risk to plants and invertebrates.

The methodology for the derivation of ecological RBRGs, the calculated RBRGs for potential ecological receptors, and soil locations associated with calculated unacceptable risk to potential ecological receptors are discussed in the following sections.

8.2.1 Methodology for Deriving Ecological RBRGs and Values

Ecological RBRGs based on protection of wildlife populations (i.e., based on LOAEL-based TRVs) were derived for invertivorous small mammals (desert shrew), the only wildlife receptor identified with the potential for unacceptable risk associated with assumed exposure to COPECs in soil at this site. Based on the conclusion of no unacceptable risk for T&E species potentially present at the site, RBRGs based on the protection of individual potential receptors (i.e., based on the NOAEL-based TRVs) were not warranted.

The RBRGs (Table 8-3) for small home-range invertivorous mammals (desert shrew) were derived following USEPA guidance (1997a, 2008) and using the dietary dose model integrating exposure assumptions and LOAEL-based TRVs used to estimate HQs in the predictive ERAs, as described in Sections 6.2 and 6.3, respectively. Note that RBCs were developed for the list of COPECs identified in the HHERA using the same approach and equations as for the development of the ecological RBRGs. The RBCs were developed for the Soil Management Plan to be used to support decisions for the handling, management, and storage of potentially contaminated and displaced soil at the site during implementation of a groundwater remedy at the site to address chromium contamination in groundwater. The RBCs are presented in Appendix RBC.

Ecological RBRGs were developed by re-arranging the standard USEPA (1997a) HQ model (i.e., Equation 6-7 presented in Section 6.4) to solve for a target HQ of 1:

$$RBRG = C_{soil} = \frac{HQ \times TRV \times BW}{(SIR + [FIR \times BAF]) \times SUF}$$

Equation 8-3

Where:

HQ = hazard quotient (unitless) = 1

TRV = toxicity reference value (mg/kg-bw/day)

C_{soil} = concentration of constituent in soil (mg/kg soil) = RBRG

SIR = soil ingestion rate (kg soil/day)

FIR = food or biota ingestion rate (kg tissue/day)

SUF = site-use factor (unitless) = 1 (home range for shrews are less than the size of all the exposure areas)

BW = body weight of receptor (kg bw)

BAF = bioaccumulation factor or regression for media-to-biota uptake (kg soil/kg tissue)

Incorporating uptake regressions in lieu of a simple BAF in the dose equation significantly complicates the overall dose calculation and, therefore, the Ecological RBRGs were calculated using Microsoft® Excel Solver™ software that determines the soil concentration for a target HQ equal to 1.

For dioxin TEQ, as discussed in detail in Section 6.7.6, the uncertainties associated with the calculated baseline risk estimates for the desert shrew are mainly driven by use of conservative uptake and toxicity assumptions. For desert shrew, these uncertainties together can overestimate risk by at least 10 times. Therefore, for remediation and risk-management considerations, alternate and more robust uptake models and TRVs were developed for dioxin TEQ. These alternate values are based on more defensible science (e.g., congener-specific uptake approach for dioxin TEQ BAFs) and/or more recent and comprehensive literature search and data. The alternate BAF and TRV approaches used to develop dioxin TEQ RBRGs for desert shrew have been used at various dioxin impacted sites (e.g., Tittabawasee River, MI; Rolling Knolls, NJ; Centredale Manor, RI; San Jacinto River, TX; and St. Helens, OR).

For dioxin TEQ, a range of RBRGs was calculated using the alternate and more robust approaches/values. The congener-specific BAFs (USEPA 1999a; Fagervold et al. 2010) and a recommended mammalian dioxin TEQ LOAEL-based TRV of 30 ng/kg-bw/day were used to calculate the RBRGs protective of invertivorous small mammals. As noted in Section 6.7.4, the congener-specific BAF approach is based on current scientific understanding of uptake for dioxin TEQ mixtures and is more scientifically defensible than assuming all congener uptake is the same as 2,3,7,8-TCDD. The recommended TRV is based on the geometric mean of reproduction and growth LOAELs for rodents. This approach, used by USEPA (2008) for development of the EcoSSLs, is widely accepted as it accounts for a range of values and reduces the uncertainty associated with using toxicity data from a single study. The dioxin LOAEL-based TRV of 10 ng/kg-bw/day used in the ERA (cited in Sample et al. [1996] and based on a study by Murray et al. [1979]) is included in the toxicity dataset used to derive the alternate TRV of 30 ng/kg-bw/day (Section 6.7.5). Ecological RBRGs are summarized in the table in this section and details of the RBRG calculations are presented in Table 8-3.

Ecological Risk-Based Remedial Goals

Risk Driver for Shrew	BAF	LOAEL-based Mammalian TRV	Ecological RBRG
Total Chromium	ERA / RAWP	ERA / RAWP	145 mg/kg
Copper	ERA / RAWP	ERA / RAWP	145 mg/kg
Dioxin TEQ	USEPA 1999a	30 ng/kg-day (geomean of rodent studies)	190 ng/kg
Dioxin TEQ	Fagervold et al. 2010	30 ng/kg-day (geomean of rodent studies)	360 ng/kg

A dioxin TEQ RBRG based on the 2,3,7,8-TCDD uptake regression and the TRV used in the ERA (10 ng/kg; lowest available LOAEL-based TRV) was not calculated. The BAF approach based on the 2,3,7,8-TCDD regression is not supported by available science related to the uptake and toxicity of dioxin/furans (i.e., dioxin TEQ mixtures), and the TRV does not account for variability in species sensitivity to dioxin TEQ. The RBRGs calculated for total chromium (145 mg/kg), copper (145 mg/kg), and dioxin TEQ (ranging from 190 ng/kg to 360 ng/kg) were used to identify soil locations associated with potentially unacceptable risk, as described in the following section.

8.2.2 Soil Locations Associated with Calculated Levels of Unacceptable Risk to Potential Ecological Receptors

This section discusses the locations that drive risk for the ERA and is provided as an example of one method that can be used to apply the RBRGs and assist with identifying remedial design possibilities. This is not intended to substitute for actual remedial design and comprises part of the set of tools available to the risk manager to make site-specific decisions regarding risk.

As previously discussed in Section 7.2, based on the conclusions of the ERA, some targeted form of risk management or remediation, addressing elevated concentrations of total chromium, copper, and dioxin TEQ in the SWMU 1 within BCW, AOC9, and AOC10 would be effective at reducing calculated risks for potential ecological receptors to acceptable risk levels. [Note: As elevated concentrations of hexavalent chromium and total chromium tend to be co-located, remediation for other risk drivers (e.g., total chromium) and potential receptors (human health and wildlife) will reduce exposure and risk for plants and soil invertebrates as well.] The Ecological RBRGs based on invertivorous small mammals (desert shrew) include 145 mg/kg for total chromium; 145 mg/kg for copper; and 190 to 360 ng/kg for dioxin TEQ (based on the range of alternate RBRGs).

For each potential exposure area, depth-weighted concentrations of the risk-driving COPECs were ranked and the highest concentrations were iteratively removed from the baseline soil dataset. Using the remaining data, depth-weighted EPCs were calculated and compared to the respective RBRGs. Table

8-4 identifies soil locations at the three potential exposure areas (BCW, AOC9, and AOC10) where depth-weighted concentrations of total chromium, copper, and/or dioxin TEQ in the top 0 to 0.5 foot bgs of soil exceed the RBRGs and, if removed from the potential exposure area baseline dataset (i.e., mimicking a hypothetical remediation), the resulting residual depth-weighted 95UCL for the potential exposure area is below the RBRG. These locations were identified based on depth-weighted EPCs for simplicity and as a conservative approach to identifying the areas/locations that, if removed, would result in residual soil concentrations of total chromium, copper, and dioxin TEQ that are protective of potential ecological receptors. As mentioned previously, this is just one example of the application of RBRGs and the specific locations identified in Table 8-4 are not intended to be used either for remedial design without further consideration or as a post remediation risk evaluation. Confirmation sampling and a post-remediation risk assessment may be necessary to demonstrate that residual contamination is not of concern if excavation and removal of soil is implemented as a remedial and risk management decision at the site.

To summarize, this example included removal of soil data for the following locations:

- **BCW**
    - SWMU1-25 at 0 to 0.5 foot bgs to meet the RBRG of 190 ng/kg for dioxin TEQ; No sample data needs to be removed to meet the RBRG of 360 ng/kg for dioxin TEQ.
- **AOC9**
    - AOC10-21 at 0 to 0.5 foot bgs to meet the RBRG of 145 mg/kg for copper.
    - AOC10-20 at 0 to 0.5 foot bgs to meet the RBRG of 145 mg/kg for total chromium.
    - PA-20, AOC10-23, and PA-21 at 0 to 0.5 foot bgs to meet the RBRG of 190 ng/kg for dioxin TEQ; and locations PA-20 and AOC10-23 at 0 to 0.5 foot bgs to meet the RBRG of 360 ng/kg for dioxin TEQ.
- **AOC10**
    - AOC10c-4 at 0 to 0.5 foot bgs to meet the RBRG of 190 ng/kg for dioxin TEQ; no sample data need to be removed to meet the RBRG of 360 ng/kg for dioxin TEQ.

9 KEY FINDINGS

Overall, the HHERA conducted herein found no unacceptable risk to most human and ecological receptors potentially exposed to COPCs/COPECs in soil at the site, both within the TCS (ICS potential exposure area) and outside the TCS (potential exposure areas located outside the TCS). No unacceptable risk was identified for all relevant potential exposure areas for the following receptors:

- **Potential Human Receptors**
  - Tribal users
  - Hunter
  - Workers (commercial and short- and long-term maintenance workers).
- **Potential Ecological Receptors**
  - Special-status species (state- and federal-listed T&E wildlife species and state species of concern), including ring-tailed cat, cave myotis, and pallid bats
  - Large home-range receptors (desert kit fox, Nelson's desert bighorn sheep, red-tailed hawk, and Yuma myotis)
  - Herbivorous and insectivorous birds (Gambel's quail and cactus wren)
  - Herbivorous small mammals (Merriam's kangaroo rat).

For the remaining potential receptors (various human recreators and desert shrew), the potential for unacceptable risk for ecological receptors and risks above *de minimis* levels for potential human recreators was identified for a limited number of COPCs/COPECs (i.e., dioxin TEQ and hexavalent chromium for human health; dioxin TEQ, total chromium, and copper for ecological receptors) in areas in SWMU1, AOC9, and/or AOC10. These risk drivers were identified based on potential exposure areas specified in the RAWP (Arcadis 2008a, 2009a, 2015).

For the HHRA, the OCS potential exposure area was used as the basis for identifying the compounds that contribute significantly to calculated estimates of risk above *de minimis* levels for potential individual human receptors (i.e., the risk drivers). The target risk level for identifying the chemical risk drivers was based on a target ILCR of 1 in 1 million (or target ILCR of 10 in 1 million for workers) and target HI of 1. As indicated in the NCP (40 CFR 300), cancer risks between 1 in 1 million and 100 in 1 million fall within a risk management range. This is generally referred to as the acceptable risk range. Within this estimated cancer risk range, there is flexibility for risk managers in deciding what action, if any, is necessary and appropriate for the protection of human health.

For ecological receptors, potential risk drivers for small home-range wildlife were estimated based on evaluation of individual potential exposure areas. Potential risk drivers for large home-range wildlife were identified based on larger, combined potential exposure areas. Risk drivers were identified based on a target HQ of 1 (or 10 for dioxin TEQ based on consideration of the most current science related to uptake and toxicity of these mixtures) *and* additional LOE supporting the conclusion of unacceptable risk.

RBRGs were developed for each of the chemical risk drivers and potential receptors with calculated unacceptable risk for ecological receptors and risks above *de minimis* levels for potential human receptors (Section 8). For dioxin TEQ, a range of RBRGs were developed for both potential human and ecological receptors. RBRGs were not developed for plants and soil invertebrates due to the high degree of uncertainty associated with risk estimates and available screening levels for these potential ecological receptors. Due to co-location of risk-driving COPECs, remedial action for the protection of human health and wildlife will reduce potential exposure and risk to plants and soil invertebrates as well.

The RBRGs were used to identify the locations associated with unacceptable risk and risks above *de minimis* levels for consideration in remedial decision making. For simplicity, depth-weighted concentrations of the risk drivers were ranked, and the highest concentrations were iteratively removed from the baseline soil dataset. Using the remaining data, residual depth-weighted EPCs were calculated and compared with respective RBRGs. The results of this iterative analysis support that the locations associated with calculated unacceptable risk for ecological receptors and risks above *de minimis* levels for human receptors are limited in number and spatial extent (mostly close to the TCS). Note that for human receptors, these locations were identified using a *de minimis* cancer risk level of 1 in 1 million and risk management or remediation may not be necessary to reduce risks for the recreational users (hiker, camper, and OHV rider) to levels below 10 in 1 million which is the midpoint of the risk management range of 1 in 1 million to 100 in 1 million. The following locations are associated with potentially unacceptable risk for ecological receptors and risks above *de minimis* levels for potential human receptors:

Protection of potential human recreators (four total locations for the 0- to 3-foot bgs depth interval)

- Dioxin TEQ: SWMU1-25 in OCS / SWMU1
- Hexavalent chromium: AOC10-20, #10 in AOC9, and MW-58BR_S in AOC10.

Protection of desert shrew (up to seven total locations for the 0- to 0.5-foot bgs depth interval)

- Dioxin TEQ (based on RBRG of 190 ng/kg): SWMU1-25 in BCW; PA-20, AOC10-23, and PA-21 in AOC9; and AOC10c-4 in AOC10
    - Based on dioxin TEQ RBRG of 360 ng/kg: PA-20 and AOC10-23 in AOC9
- Total chromium: AOC10-20 in AOC9
- Copper: AOC10-21 in AOC9.

In total, the nine locations fall within three main areas: SWMU1 near SWMU1-25, AOC9 along the TCS fenceline, and AOC10 within the AOC10c subarea (i.e., drainage depression behind the middle berm in the East Ravine). These locations are shown on Figure 9-1. The scouring scenarios for the BCW and AOC10 potential exposure areas support the finding that the risk drivers are located in the top 2 to 3 feet of soil outside the TCS fenceline.

The locations identified in this example are intended to help focus upcoming remedial planning efforts on those areas and COPCs/COPECs that contribute most significantly to levels of calculated unacceptable risk for ecological receptors and risks above *de minimis* levels for potential human receptors. The overall results of the HHERA support that focusing remedial planning on these locations, as demonstrated by the hypothetical remediation, should be effective in reducing overall calculated risks to levels that are protective of human health and potential ecological receptors.

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TABLES

Table 2-1
Upland Plant Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
Alkali heliotrope	*Heliotropium curassavicum*	Native	Yes (observed during the March 2017 pre-construction surveys)
Anderson’s desert-thorn	*Lycium andersonii*	Native	Yes (observed during the March 2017 pre-construction surveys)
Anderson's desert thorn (wolfberry)	*Lycium andersonii*	Ethnobotanical	Yes; BCW Upland
apricot mallow	*Sphaeralcea ambigua var. ambigua*	Native	Yes (observed during the March 2017 pre-construction surveys)
Arabian schismus	*Schismus arabicus*	Naturalized (Cal-IPC Inventory rating: Limited)	Yes (observed during the March 2017 pre-construction surveys)
Arizona lupine	*Lupinus arizonicus*	Native	Yes (observed during the March 2017 pre-construction surveys)
athel tamarisk	*Tamarix aphylla*	Naturalized (Cal-IPC Inventory rating: Limited)	Yes (observed during the March 2017 pre-construction surveys)
Bearded cryptantha	*Cryptantha barbigera var. barbigera*	Native	Yes (observed during the March 2017 pre-construction surveys)
Beavertail	*Opuntia basilaris*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
Bermuda grass	*Cynodon dactylon*	Naturalized (Cal-IPC Inventory rating: Moderate)	Yes (observed during the March 2017 pre-construction surveys)
big galleta	*Hilaria rigida*	Native	Yes (observed during the March 2017 pre-construction surveys)
big saltbush	*Atriplex lentiformis*	Native	Yes (observed during the March 2017 pre-construction surveys)
Big saltbush	*Atriplex lentiformis*	Ethnobotanical	Yes (but not at Topock site)
bird-cage evening primrose	*Oenothera deltoides ssp. deltoides*	Native	Yes (observed during the March 2017 pre-construction surveys)
blue palo verde	*Parkinsonia florida*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
Blue palo verde	*Parkinsonia florida*	Ethnobotanical	Yes; BCW Upland, East Ravine, AOC 10, and AOC 11
Booth’s shredding suncup	*Eremothera boothii*	Native	Yes (observed during the March 2017 pre-construction surveys)
brittle spineflower	*Chorizanthe brevicornu var. brevicornu*	Native	Yes (observed during the March 2017 pre-construction surveys)
Brittlebush	*Encelia farinosa*	Native	Yes (observed during the March 2017 pre-construction surveys)
Brittlebush hybrid	*Encelia farinosa x frutescens*	Native	Yes (observed during the March 2017 pre-construction surveys)
broadfruited combseed	Pectocarya platycarpa	Native	Yes (observed during the March 2017 pre-construction surveys)
Broom baccharis	*Baccharis sarothroides*	Native	Yes (observed during the March 2017 pre-construction surveys)
brown-eyed evening primrose	*Chylismia claviformis*	Native	Yes (observed during the March 2017 pre-construction surveys)
buckhorn cholla	*Cylindropuntia acanthocarpa*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
bush seepweed	*Suaeda nigra*	Native	Yes (observed during the March 2017 pre-construction surveys)
Button brittlebush	*Encelia frutescens*	Native	Yes (observed during the March 2017 pre-construction surveys)
California barrel cactus	*Ferocactus cylindraceus*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
California bulrush	*Schoenoplectus californicus*	Native	Yes (observed during the March 2017 pre-construction surveys)
California draba	*Draba californica*	Native	Yes (observed during the March 2017 pre-construction surveys)

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Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
California fan palm	*Washingtonia filifera*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
California mustard	*Caulanthus lasiophyllus*	Native	Yes (observed during the March 2017 pre-construction surveys)
California poppy	*Eschscholzia californica*	Native	Yes (observed during the March 2017 pre-construction surveys)
catclaw acacia	*Senegalia greggii*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
cattle saltbush	*Atriplex polycarpa*	Native	Yes (observed during the March 2017 pre-construction surveys)
Cattle saltbush (also known as allscale)	*Atriplex polycarpa*	Ethnobotanical	Yes; Upland BCW and AOC 11
Cheesebush	*Hymenoclea salsola*	Native	Yes (observed during the March 2017 pre-construction surveys)
Climbing milkweed	*Sarcostemma cynanchoides ssp. hartwegii*	Native	Yes (observed during the March 2017 pre-construction surveys)
common ditaxis	*Ditaxis neomexicana*	Native	Yes (observed during the March 2017 pre-construction surveys)
Common fiddleneck	*Amsinckia menziesii*	Native	Yes (observed during the March 2017 pre-construction surveys)
corkseed mammillaria	*Mammillaria tetrancistra*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
coyote gourd	*Cucurbita palmata*	Native	Yes (observed during the March 2017 pre-construction surveys)
creosote bush	*Larrea tridentata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Curvednut combseed	*Pectocarya recurvata*	Native	Yes (observed during the March 2017 pre-construction surveys)
desert evening primrose	*Oenothera premieres ssp. bufonis*	Native	Yes (observed during the March 2017 pre-construction surveys)
desert golden poppy	*Eschscholzia glyptosperma*	Native	Yes (observed during the March 2017 pre-construction surveys)
desert holly	*Atriplex hymenelytra*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
desert lily	*Hesperocallis undulata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Desert lily	*Hesperocallis undulata*	Ethnobotanical	Yes (but not at Topock site)
desert smoke tree	*Psorothamnus spinosus*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)
desert spurge	*Euphorbia micromera*	Native	Yes (observed during the March 2017 pre-construction surveys)
Desert star	*Monoptilon bellioides*	Native	Yes (observed during the March 2017 pre-construction surveys)
Desert sunflower	*Geraea cansescens*	Native	Yes (observed during the March 2017 pre-construction surveys)
desert tobacco	*Nicotiana obtusifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
Desert tobacco	*Nicotiana obtusifolia*	Ethnobotanical	Yes; BCW Upland and AOC 10/East Ravine

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Upland Plant Species

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Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
desert-lavender	*Condea emoryi*	Native	Yes (observed during the March 2017 pre-construction surveys)
Devil's lettuce	*Amsinckia tessellata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Distant phacelia	*Phacelia distans*	Native	Yes (observed during the March 2017 pre-construction surveys)
dodder	*Cuscuta sp.*	Native	Yes (observed during the March 2017 pre-construction surveys)
downy dalea	*Dalea mollissima*	Native	Yes (observed during the March 2017 pre-construction surveys)
Dwarf cottonrose	*Logfia depressa*	Native	Yes (observed during the March 2017 pre-construction surveys)
Emory rock daisy	*Perityle emoryi*	Native	Yes (observed during the March 2017 pre-construction surveys)
feathertop	*Pennisetum setaceum*	Naturalized (Cal-IPC Inventory rating: Moderate)	Yes (observed during the March 2017 pre-construction surveys)
flat-crown buckwheat	*Eriogonum deflexum var. deflexum*	Native	Yes (observed during the March 2017 pre-construction surveys)
fluff grass	*Dasyochloa pulchella*	Native	Yes (observed during the March 2017 pre-construction surveys)
four-wing saltbush	*Atriplex canescens*	Native	Yes (observed during the March 2017 pre-construction surveys)
Fremont pincushion	*Chaenactis fremontii*	Native	Yes (observed during the March 2017 pre-construction surveys)
Fringed amaranth	*Amaranthus fimbriatus*	Native	Yes (observed during the March 2017 pre-construction surveys)
fringepod	*Thysanocarpus curvipes*	Native	Yes (observed during the March 2017 pre-construction surveys)
golden suncup	*Chylismia brevipes*	Native	Yes (observed during the March 2017 pre-construction surveys)
Golden suncup	*Chylismia breviflora*	Ethnobotanical	Between TCS and Moabi Regional Park on the California side
Gravel-ghost	*Atrichoseris platyphylla*	Native	Yes (observed during the March 2017 pre-construction surveys)
Gudalupe Cyrptantha	*Cryptantha Maritima*	Native	Yes (observed during the March 2017 pre-construction surveys)
hairy indigo-pea	*Dalea mollis*	Native	Yes (observed during the March 2017 pre-construction surveys)
hare barley	*Hordeum murinum ssp. leporinum*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
heartleaf sun-cup	*Chylismia cardiophylla var. cardiophylla*	Native	Yes (observed during the March 2017 pre-construction surveys)
hedgehog cactus	*Echinocereus engelmannii*	Native	Yes (observed during the March 2017 pre-construction surveys)
hillside palo verde	*Parkinsonia microphylla*	Native (CDNPA Protection / CA Rare Plant Ranking 4.3)	Yes (observed during the March 2017 pre-construction surveys)
Hillside palo verde	*Parkinsonia microphylla*	CRPR 4.3/Ethnobotanical	Yes; AOC 10 and AOC 11
honey mesquite	*Prosopis glandulosa var. torreyana*	Native (CDNPA Protection)	Yes (observed during the March 2017 pre-construction surveys)

Table 2-1
Upland Plant Species

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Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
Honeysweet	*Tidestromia olbongifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
inflated desert trumpet	*Eriogonum inflatum*	Native	Yes (observed during the March 2017 pre-construction surveys)
Ives' phacelia	*Phacelia ivesiana*	Native	Yes (observed during the March 2017 pre-construction surveys)
James' galleta	*Hilaria jamesii*	Native	Yes (observed during the March 2017 pre-construction surveys)
jimson weed	*Datura wrightii*	Native	Yes (observed during the March 2017 pre-construction surveys)
Jimson weed	*Datura wrightii*	Ethnobotanical	Yes (but not at Topock site)
jointed charlock	*Raphanus raphanistrum*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
linear-leaved oligomeris	*Oligomeris linifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
little desert buckwheat	*Eriogonum trichopes*	Native	Yes (observed during the March 2017 pre-construction surveys)
Mediterranean grass	*Schismus barbatus*	Naturalized (Cal-IPC Inventory rating: Limited)	Yes (observed during the March 2017 pre-construction surveys)
Moapa bladderpod	*Physaria tenella*	Native	Yes (observed during the March 2017 pre-construction surveys)
Mojave ghost-flower	*Mohavea confertiflora*	Native	Yes (observed during the March 2017 pre-construction surveys)
Mojave groundsel	*Senecio mohavensis*	Native	Yes (observed during the March 2017 pre-construction surveys)
Mojave popcorn flower	*Plagiobothrys jonesii*	Native	Yes (observed during the March 2017 pre-construction surveys)
Mousetail suncup	*Chylismia arenaria*	CRPR 2.2	Yes; upland BCW
mouse-tail suncup	*Chylismia arenaria*	Native (CNPS Rare Plant Rank 2B.2)	Yes (observed during the March 2017 pre-construction surveys)
Mulefat	*Baccharis salicifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
narrow-leaf suncup	*Eremothera refracta*	Native	Yes (observed during the March 2017 pre-construction surveys)
Narrow-leaved cryptantha	*Cryptantha angustifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
needle gamma	*Bouteloua aristidoides*	Native	Yes (observed during the March 2017 pre-construction surveys)
New Mexico desert chicory	*Rafinesquia neomexicana*	Native	Yes (observed during the March 2017 pre-construction surveys)
ocotillo	*Fouquieria splendens ssp. splendens*	Native (C D N P A Protection)	Yes but not at the Topock site
Oleander	*Nerium oleander*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
onyx flower	*Achyronychia cooperi*	Native	Yes (observed during the March 2017 pre-construction surveys)
oriental hedge-mustard	*Sisymbrium orientale*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
ovate plantain	*Plantago ovata*	Native	Yes (observed during the March 2017 pre-construction surveys)

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Upland Plant Species

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Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
Parry's marina	*Marina parryi*	Native	Yes (observed during the March 2017 pre-construction surveys)
Pebble pincushion	*Chaenactis carphoclinia*	Native	Yes (observed during the March 2017 pre-construction surveys)
Pectocarya heterocarpa	*chuckwalla combseed*	Native	Yes (observed during the March 2017 pre-construction surveys)
pepperweed	*Lepidium lasiocarpum*	Native	Yes (observed during the March 2017 pre-construction surveys)
Pima rhatany	*Krameria erecta*	Native	Yes (observed during the March 2017 pre-construction surveys)
pinnate tansy mustard	*Descurainia pinnata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Pygmy-cedar	*Peucephyllum schottii*	Native	Yes (observed during the March 2017 pre-construction surveys)
rat-tail fescue	*Festuca myuros*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
red brome	*Bromus madritensis ssp. rubens*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
Red-root cyptantha	*Cryptantha micrantha*	Native	Yes (observed during the March 2017 pre-construction surveys)
red-stemmed filaree	*Erodium cicutarium*	Naturalized (Cal-IPC Inventory rating: Limited)	Yes (observed during the March 2017 pre-construction surveys)
rescue brome	*Bromus catharticus*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
retrorse desert four-o'clock	*Mirabilis laevis*	Native	Yes (observed during the March 2017 pre-construction surveys)
Ridged Crytantha	*Cryptantha nevadensis var. Rigida*	Native	Yes (observed during the March 2017 pre-construction surveys)
rigid spineflower	*Chorizanthe rigida*	Native	Yes (observed during the March 2017 pre-construction surveys)
rock gilia	*Gilia scopulorum*	Native	Yes (observed during the March 2017 pre-construction surveys)
Rush milkweed	*Asclepias subulata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Russian thistle	*Salsola tragus*	Naturalized (Cal-IPC Inventory rating: Limited)	Yes (observed during the March 2017 pre-construction surveys)
Sahara mustard	*Brassica tournefortii*	No status	Yes (observed during the March 2017 pre-construction surveys)
salt cedar	*Tamarix ramosissima*	Naturalized (Cal-IPC Inventory rating: High)	Yes (observed during the March 2017 pre-construction surveys)
sand verbena	*Abronia villosa*	Native	Yes (observed during the March 2017 pre-construction surveys)
screwbean mesquite	*Prosopis pubescens*	Native (C D N P A Protection)	Yes (observed during the March 2017 pre-construction surveys)
Screwbean mesquite	*Prosopis pubescens*	Ethnobotanical	Yes (but not at Topock site)

Table 2-1
Upland Plant Species

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Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
silver cholla	*Cylindropuntia echinocarpa*	Native (C D N P A Protection)	Yes (observed during the March 2017 pre-construction surveys)
silver-sheathed knotweed	*Polygonum argyrocoleon*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
six-weeks three awn	*Aristida adscensionis*	Native	Yes (observed during the March 2017 pre-construction surveys)
Skeletonweed	*Stephanomeria* spp.	Native	Yes (observed during the March 2017 pre-construction surveys)
Slender porelaef	*Porophyllum gracile*	Native	Yes (observed during the March 2017 pre-construction surveys)
small-flowered androstephium	*Androstephium breviflorum*	Native (CNPS Rare Plant Rank 2B.2)	Yes (observed during the March 2017 pre-construction surveys)
Small-flowered androstephium	*Androstephium breviflorum*	CRPR 2.2	Yes but only in Arizona
small-flowered California poppy	*Eschscholzia minutiflora*	Native	Yes (observed during the March 2017 pre-construction surveys)
small-flowered cheeseweed	*Malva parviflora*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
small-seeded spurge	*Euphorbia polycarpa*	Native	Yes (observed during the March 2017 pre-construction surveys)
Smooth desert dandelion	*Malacothrix glabrata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Spanish needle	*Palafoxia arida*	Native	Yes (observed during the March 2017 pre-construction surveys)
spiny-hair blazing star	*Mentzelia tricuspis*	Native (CNPS Rare Plant Rank 2B.1)	Yes (observed during the March 2017 pre-construction surveys)
Spiny-haired blazing star	*Mentzelia tricuspis*	CRPR 2.1	Yes but not at the Topock site
Stevia pincushion	*Chaenactis stevioides*	Native	Yes (observed during the March 2017 pre-construction surveys)
strigose bird's foot trefoil	*Acmispon strigosus*	Native	Yes (observed during the March 2017 pre-construction surveys)
Sweetbush	*Bebbia juncea aspera*	Native	Yes (observed during the March 2017 pre-construction surveys)
teddy-bear cholla	*Cylindropuntia bigelovii*	Native (C D N P A Protection)	Yes (but not at Topock site)
thick-leaf ground cherry	*Physalis crassifolia*	Native	Yes (observed during the March 2017 pre-construction surveys)
Thomas's wild buckwheat	*Eriogonum thomasii*	Native	Yes (observed during the March 2017 pre-construction surveys)
trailing windmills	*Allionia incarnata var. incarnata*	Native	Yes (observed during the March 2017 pre-construction surveys)
tumble mustard	*Sisymbrium altissimum*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
twining snapdragon	*Antirrhinum filipes*	Native	Yes (observed during the March 2017 pre-construction surveys)
Western honey mesquite	*Prosopis glandulosa* var. *torreyana*	Ethnobotanical	Yes; BCW, East Ravine, A O C 10, and A O C 11
western pellitory	*Parietaria hespera var. hespera*	Native	Yes (observed during the March 2017 pre-construction surveys)

Table 2-1
Upland Plant Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
White bursage	*Ambrosia dumosa*	Native	Yes (observed during the March 2017 pre-construction surveys)
white goosefoot	*Chenopodium album*	Naturalized	Yes (observed during the March 2017 pre-construction surveys)
white rhatany	*Krameria bicolor*	Native	Yes (observed during the March 2017 pre-construction surveys)
White tacstem	*Calycoseris wrightii*	Native	Yes (observed during the March 2017 pre-construction surveys)
White woolly eriophyllum	*Eriophyllum lanosum*	Native	Yes (observed during the March 2017 pre-construction surveys)
white-bract mentzelia	*Mentzelia involucrata*	Native	Yes (observed during the March 2017 pre-construction surveys)
white-stemmed blazing star	*Mentzelia albicaulis*	Native	Yes (observed during the March 2017 pre-construction surveys)
White-stemmed milkweed	*Asclepias albicans*	Native	Yes (observed during the March 2017 pre-construction surveys)
Winged-nut Cryptantha	*Cryptantha pterocarya*	Native	Yes (observed during the March 2017 pre-construction surveys)
Wright's spiderling	*Boerhavia wrightii*	Native	Yes (observed during the March 2017 pre-construction surveys)
Yuma spurge	*Euphorbia setiloba*	Native	Yes (observed during the March 2017 pre-construction surveys)

Notes:
[a.] No federal- or state-listed endangered, threatened, or rare plants, or candidates for listing, were found at the Topock site or adjacent area.
[b.] The "Action Area," as defined in the Final Programmatic Biological Assessment (PBA; CH2M Hill 2014), is "all areas to be affected directly or indirectly by the federal action and not area involved in the action (50 Code of Federal Regulations [CFR] 402.02)." In the 2007 PBA (CH2M Hill 2007), the Action Area was referred to as the Area of Potential Effect (APE). The Action Area is approximately 1,434.4 acres and includes land in California and Arizona, separated by the Colorado River, and open water makes up approximately 157.13 acres.
[c.] Surveys with maps documenting locations of observations were only available for some special-status species. If observations were made and documented for areas of concern Topock Compressor Station, it is noted here in this table and in the main text.
[d.] Information populated from several sources (listed below), including surveys and incidental observations.

Acronyms and Abbreviations:
AOC = Area of Concern
BCW = Bat Cave Wash
CA = California
CAL-IPC = California Invasive Plant Council Invasive Plant Inventory. Accessed at: http://cal-ipc.org/ip/inventory/index.php (March 15, 2017)
CDNPA = California Desert Native Plants Act; protects California desert native plants from unlawful harvesting on both public and privately owned lands.
CNPS = California Native Plant Society Inventory of Rare, Threatened, and Endangered Plants of California. Accessed at: http://www.rareplants.cnps.org/ (March 15, 2017).
CRPR = California Rare Plant Rank (http://www.cnps.org/cnps/rareplants/ranking.php)
TCS = Topock Compressor Station

Source:
CH2M. 2017. Topock Groundwater Remediation Project Pre-Construction Floristic Survey Report - Spring 2017. October

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Abert's towhee	*Melozone aberti*	No status	Cottonwood and willow woodlands with dense shrubs along desert streams and rivers	Insectivore	No	2017 southwestern willow flycatcher survey
Bird	American towhee	*Pipilo aberti*	No status	Chaparral and other tangled, shrubby, and dry habitats	Insectivore	Yes	2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	American kestrel	*Falco sparverius*	No status	Habitats ranging from deserts and grasslands to alpine meadows	Carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 desert tortoise survey
Bird	Anna's hummingbird	*Calypte anna*	No status	Urban and suburban settings as well as chaparral, coastal scrub, oak savannahs, and open woodland	Nectivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Ash-throated flycatcher	*Myiarchus cinerascens*	No status	Dry scrub, open woodlands and deserts from sea level to 9,000 feet elevation	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Bewick's wren	*Thryomanes bewickii*	No status	Brushy areas, scrub, and thickets in open country or open woodland	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Black-tailed gnatctacher	*Polioptila melanura*	No status	Semiarid and desert thorn scrub at elevations up to 7,000 feet, often among creosote bush, salt bush, mesquite, palo verde, ocotillo, and spiny hackberry	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	Black-chinned hummingbird	*Archilochus alexandri*	No status	Canyons and along rivers; also arid areas near cottonwood, sycamore, willow, salt-cedar, sugarberry, and oak	Omnivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Black-throated sparrow	*Amphispiza bilineata*	No status	Scrub shrub environments	Insectivore	Yes	2006 desert tortoise survey
Bird	Brewer’s blackbird	*Euphagus cyanocephalus*	No status	Open trees and shrubs	Omnivore	No	Included in Havasu species list; uncommon

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Brown-headed cowbird	*Molothrus ater*	No status	Grasslands, woodland edges, brushy thickets, prairies, fields, pastures, orchards, and residential areas	Omnivore	Yes	2017 southwestern willow flycatcher survey; 2012 survey of Yuma clapper rails; 2015 western yellow-billed cuckoo survey; and 2006 southwestern willow flycatcher survey
Bird	Bushtit	*Psaltriparus minimus*	No status	Open woods or scrubby areas, particularly pine-oak woodlands and chaparral	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Cactus wren	*Campylorhyncus brunneicapillus*	No status	Desert succulent shrub, desert wash, and Joshua tree habitats	Omnivore	No	Included in Havasu species list; uncommon
Bird	Canyon wren	*Catherpes mexicanus*	No status	Canyons and cliffs	Insectivore	Yes	2006 desert tortoise survey
Bird	Cliff swallow	*Petrochelidon pyrrhonota*	No status	Canyons, foothills, river valleys with natural cliff faces and overhangs	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Common ground dove	*Columbina passerina*	No status	Arid, open woodlands, pine woods, hammocks, forest edges, mesquite flats, deserts, desert scrublands, oak scrublands, and savannas	Herbivore	Yes	2006 southwestern willow flycatcher survey
Bird	Common raven	*Corvus corax*	No status	Open terrain with cliffs	Omnivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Common yellowthroat	*Geothlypis trichas*	No status	Thick, tangled vegetation in upland pine forests, palmetto thickets, drainage ditches, shrub-covered hillsides, river edges, and disturbed sites	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Costa's hummingbird	*Calypte costae*	No status	Sonoran and Mojave desert scrub, coastal California chaparral and sage scrub	Omnivore	Yes	2006 desert tortoise survey
Bird	Downey woodpecker	*Picoides pubescens*	No status	Open woodlands, deciduous woods and along streams	Omnivore	Yes	2015 western yellow-billed cuckoo survey

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Eurasian-collared dove	*Streptopelia decaocto*	No status	Urban and suburban settings, agricultural areas	Herbivore	No	2017 southwestern willow flycatcher survey
Bird	European starling	*Sturnus vulgaris*	No status	Developed, open urban and suburban areas	Omnivore	Yes	2006 southwestern willow flycatcher survey
Bird	Gambel's quail	*Callipepla gambelii*	No status	Desert habitats	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey
Bird	Great horned owl	*Bubo virginianus*	No status	Forests throughout North America	Carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Great-tailed grackle	*Quiscalus mexicanus*	No status	Agricultural and urban settings that provide open foraging areas	Omnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Greater roadrunner	*Geococcyx californianus*	No status	Trees and arid open land	Carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	House finch	*Haemorhous mexicanus*	No status	Developed areas throughout North America	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	House sparrow	*Passer domesticus*	No status	Cities, towns, suburbs, and farms	Herbivore	Yes	2006 desert tortoise survey
Bird	Inca dove	*Columbina inca*	No status	Dry areas with open ground and scattered trees and shrubs such as palo verde and oak	Herbivore	Yes	2006 southwestern willow flycatcher survey
Bird	Ladder-backed woodpecker	*Picoides scalaris*	No status	Desert environments	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Lazuli bunting	*Passerina amoena*	No status	Brushy hillsides and chaparral	Insectivore	Yes	2006 southwestern willow flycatcher survey
Bird	Lesser goldfinch	*Carduelis psaltria*	No status	Scrubby habitats in oak, cottonwood, and willow groves	Herbivore	Yes	2006 southwestern willow flycatcher survey

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Lesser nighthawk	*Chordeiles acutipennis*	No status	Large open areas with level topography	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Loggerhead shrike	*Lanius ludovicianus*	No status	Grasslands and open habitats	Omnivore	Yes	2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	Lucy's warbler	*Vermivora luciae*	No status	Sonoran desert	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Mourning dove	*Zenaida macroura*	No status	Open woodland or desert	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	Northern mockingbird	*Mimus polyglottos*	No status	Open ground with shrubby vegetation	Omnivore	No	2017 southwestern willow flycatcher survey
Bird	Northern rough-winged swallow	*Stelgidopteryx serripennis*	No status	Common throughout North America	Insectivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Phainopepla	*Phainopepla nitens*	No status	Desert, riparian woodlands, and chaparral	Omnivore	No	2017 southwestern willow flycatcher survey
Bird	Orange-crowned warbler	*Vermivora celata*	No status	Low, dense shrub habitats	Insectivore	Yes	2006 southwestern willow flycatcher survey
Bird	Red-tailed hawk	*Buteo jamencensis*	No status	Adaptable	Carnivore	Yes	2006 desert tortoise survey
Bird	Red-winged blackbird	*Agelaius phoeniceus*	No status	Marshes and wetlands	Insectivore	Yes	2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Rock dove or pigeon	*Clumba livia*	No status	Urban areas, adaptable	Omnivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Purple finch	*Carpodacus purpureus*	No status	Forests and suburban areas	Herbivore	Yes	2006 southwestern willow flycatcher survey
Bird	Say's phoebe	*Sayornis saya*	No status	Urban and desert areas	Insectivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Song sparrow	*Melospiza melodia*	LC in Alameda and San Pablo counties	Wetland edges and dense, low vegetation	Herbivore, carnivore	Yes	2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Townsend's warbler	*Setophaga townsendi*	No status	Tall coniferous and mixed coniferous forests, chaparral, suburban gardens and parks	Insectivore	No	2017 southwestern willow flycatcher survey
Bird	Turkey vulture	*Cathartes aura*	No status	Open with large tree and cliffs	Carnivore; carrion	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	Verdin	*Auriparus flaviceps*	No status	Scrub shrub environments	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	Western kingbird	*Tyrannus verticalus*	No status	Open habitats across North America	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	White-winged dove	*Zenaida asiatica*	No status	Desert thickets and towns	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Bird	White-throated swift	*Aeronautes saxatalis*	No status	Canyons, foothills, and mountains of western North and Central America	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Wilson's warbler	*Cardellina pusilla*	No status	Scrub-shrub habitats, willow and alder thickets near water	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	No status	Freshwater wetlands and nearby farm fields	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Yellow-rumped warbler	*Setophaga coronata*	No status	Mature coniferous and mixed coniferous-deciduous woodlands in mountainous areas	Insectivore	No	2017 southwestern willow flycatcher survey
Bird	Yellow warbler	*Dendroica petechia*	No status	Open woodlands, willows, wet thickets, and roadsides	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Reptile	Chuckwalla	*Sauromalus obesus*	No status	Rocky outcrops and rocky hillsides	Herbivore	No	2007 PBA reported this species may occur in this area
Reptile	Coachwhip	*Masticophis flagellum*	No status	Wide range of habitats: desert, prairie, scrubland, juniper-grassland, woodland, thornforest, farmland, creek valleys, and swamps; usually in dry open terrain	Carnivore	Yes	2006 desert tortoise survey
Reptile	Desert iguana	*Dipsosaurus dorsalis*	No status	Creosote scrub, sandy creosote flats	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Reptile	Desert tortoise	*Gopherus agassizii*	State and federally threatened	Mohave Desert scrub	Herbivore	No	2013 and 2015 desert tortoise surveys; No suitable habitat or foraging vegetation
Reptile	Mohave rattlesnake	*Crotalus scutulatus*	No status	Desert, grassland/herbaceous, shrubland/chaparral, woodland/conifer, woodland/hardwood, woodland/mixed	Carnivore	Yes	2006 desert tortoise survey
Reptile	Morafkai desert tortoise	*Gopherus morafkai*	State and federally threatened	Mohave Desert scrub	Herbivore	No	2013 and 2015 desert tortoise surveys; No suitable habitat or foraging vegetation

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Reptile	Pine-gopher snake	*Pituophis melanoleucus*	No status	All habitats; absent from densely forested areas	Carnivore	No	2014 PBA reported this species may occur in this area
Reptile	Side-blotched lizard	*Uta stansburiana*	No status	Desert scrub, desert wash, creosote	Invertivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Reptile	Western diamondback rattlesnake	*Crotalus atrox*	No status	Flats and foothills, prefers brushy areas, riparian habitats	Carnivore	Yes	2006 desert tortoise survey
Reptile	Western whiptail lizard	*Cnemidorphorus tigris*	No status	Valley foothills (hardwoods, mixed conifer, pine-juniper)	Invertivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Reptile	Zebra-tailed lizard	*Callisaurus draconoides*	No status	Sandy and gravelly desert flats, creosote scrub	Invertivore	No	2007 PBA reported this species may occur in this area
Reptile	Western patch-nosed snake	*Salvadora hexalepsis*	No status	Sandy scrub-shrub areas	Carnivore	Yes	2006 desert tortoise survey
Mammal	Audubon's cottontail	*Sylvilagus audubonii*	No status	Arid regions, woodlands and grasslands	Herbivore	Yes	2006 desert tortoise survey
Mammal	American badger	*Taxidea taxus*	No status	Dry, open grassfields and pastures from high alpine meadows to sea level	Carnivore	No	2017 southwestern willow flycatcher survey
Mammal	Black-tailed hare	*Lepus californicus*	No status	Cropland/hedgerow, desert, grassland/herbaceous, savanna	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Mammal	Bobcat	*Lynx rufus*	No status	Brushy stages of low/mid elevation conifer, oak, riparian	Carnivore	No	2007 PBA reported this species may occur in this area
Mammal	Burro	*Equus asinus*	No status	Tropical savannas and arid hill country	Herbivore	No	2017 southwestern willow flycatcher survey; 2014 PBA reported this species may occur in this area
Mammal	California ground squirrel	*Spermophilus beecheyi*	No status	Found in a wide variety of habitats; usually in open areas in many plant communities	Herbivore	No	2007 PBA reported this species may occur in this area

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Mammal	Coyote	*Canis latrans*	No status	Open brush, scrub, herbaceous habitats	Carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Mammal	Deer mouse	*Peromyscus maniculatus*	No status	All habitats	Herbivore, invertivore	No	2007 PBA reported this species may occur in this area
Mammal	Desert cottontail	*Sylvilagus audubonii*	No status	Grasslands, open forests, desert shrub	Herbivore, granivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey; and 2006 desert tortoise survey
Mammal	Desert kit fox	*Vulpes macrotis*	No status	Annual grasslands or grassy open stages of vegetation w/scattered brush	Carnivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Mammal	Desert shrew	*Notiosorex crawfordi*	No status	Desert wash, desert scrub, desert riparian, mixed chaparral, and pinyon/juniper habitats	Invertivore	No	2014 PBA reported this species may occur in this area
Mammal	Desert woodrat	*Neotoma lepida*	No status	Joshua tree, pinyon-juniper, most desert habitats	Herbivore, granivore	No	2007 PBA reported this species may occur in this area
Mammal	Feral hog	*Sus scrofa*	No status	Grassy savanna areas, wooded forests, agricultural areas, shrublands and marshy swamplands	Omnivore	No	2017 southwestern willow flycatcher survey
Mammal	Gray fox	*Urocyon cinereoargenteus*	No status	Deciduous forests with brushy, woodland areas	Omnivore	No	2017 southwestern willow flycatcher survey
Mammal	Merriam kangaroo rat	*Dipodomys merriami*	No status	Desert scrub and alkali desert shrub, sagebrush, Joshua tree, prefers sparse habitat	Granivore	No	2014 PBA reported this species may occur in this area
Mammal	Nelson's bighorn sheep	*Ovis canadesis nelsoni*	No status	Desert mountain ranges, alpine dwarf shrub, low sage, desert shrub	Herbivore	Yes	Sightings by PG&E staff (CH2MHill 2013, 2015a,b)
Mammal	Raccoon	*Procyon lotor*	No status	All habitats except alpine and desert without water	Carnivore, frugivore, granivore, invertivore, piscivore	No	2007 PBA reported this species may occur in this area

Table 2-2
Upland Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Class	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Mammal	Stripped skunk	*Mephitis mephitis*	No status	Earlier successional stages of conifer and deciduous forest, intermediate canopy	Carnivore, frugivore, invertivore	No	2007 PBA reported this species may occur in this area
Mammal	Whitetail antelope squirrel	*Ammospermophilus leucurus*	No status	Desert scrub	Omnivore	Yes	2006 desert tortoise survey

Notes:

[a.] The "Action Area," as defined in the Final Programmatic Biological Assessment (PBA; CH2MHill 2014), is "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] 402.02)." In the 2007 PBA (CH2M Hill 2007), the Action Area was referred to as the Area of Potential Effect (A P E). The Action Area is approximately 1,434.4 acres and includes land in California and Arizona, separated by the Colorado River, and open water makes up approximately 157.13 acres.

[b.] Surveys with maps documenting locations of observations were only available for some special-status species. If observations were made and documented for areas of concern outside the Topock Compressor Station, it is noted here in this table and in the main text.

[c.] Information populated from several sources (listed below), including surveys and incidental observations.

Acronyms and Abbreviation:

LC = Least Concern
PBA = Programmatic Biological Assessment
U S F W S = U.S. Fish and Wildlife Service

Sources:

CH2M Hill. 2007. Programmatic Biological Assessment for Pacific Gas and Electric Topock Compressor Station Remedial and Investigative Actions. January.
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Table 2-3
Riparian Plant Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Common Name	Scientific Name	Conservation Status [a]	Confirmed Present at the Action Area [b,c,d]
Arrow weed	*Pluchea sericea*	Ethnobotanical	Yes; East Ravine
Broad-leaved cattail	*Typha latifolia*	Ethnobotanical	Yes (but not at Topock site)
Bulrush	*Scirpus* sp.	No status	Yes (but not at Topock site)
Common reed	*Phragmites australis*	Ethnobotanical/Native [e]	Yes; mouth of East Ravine
Giant reed	*Arundo donax*	Naturalized (Cal-IPC Inventory rating: High)	Yes; mouth of East Ravine
Marsh fleabane	*Pluchea odorata*	Native	Yes (observed during the March 2017 pre-construction surveys)
Southern cattail	*Typha domingensis*	Ethnobotanical	No [f]
Tamarisk (also known as salt cedar)	*Tamarix* sp.	No status	Yes; BCW

Notes:

a. No federal- or state-listed endangered, threatened, or rare plants, or candidates for listing, were found at the Topock site or adjacent area.

b. The "Action Area," as defined in the Final Programmatic Biological Assessment (PBA; CH2M Hill 2014), is “all areas to be affected directly or indirectly by the federal action not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] 402.02).” In the 2007 PBA (CH2M Hill 2007), the Action Area was referred to as the Area of Potential Effect (A P E). The Action Area is approximately 1,434.4 acres and includes land in California and Arizona, separated by the Colorado River, and open water makes up approximately 157.13 acres.

c. Surveys with maps documenting locations of observations were only available for some special-status species. If observations were made and documented for areas of outside the Topock Compressor Station, it is noted here in this table and in the main text.

d. Information populated from several sources (listed below), including surveys and incidental observations.

e. Generally considered native, but global genetic issues make it uncertain which strains may be non-native in California and unclear whether it was historically present in this

f. Both *Typha angustifolia* (narrow-leaved cattail), a naturalized species and *Typha domingensis* (southern cattail) a native species have been recorded from the site, but no were present at the time of the surveys so the species could not be conclusively determined.

Acronyms and Abbreviations:

BCW = Bat Cave Wash
CAL-IPC = California Invasive Plant Council Invasive Plant Inventory. Accessed at: http://cal-ipc.org/ip/inventory/index.php (March 15, 2017)

Sources:

Garcia and Associates and CH2M. 2013. opock Groundwater Remediation Project Floristic Survey Report. December
CH2M. 2017. Topock Groundwater Remediation Project Pre-Construction Floristic Survey Report - Spring 2017. October

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	American avocet	*Recurvirostra americana*	No status	Wetlands and marshes	Invertivore	Yes	2006 southwestern willow flycatcher survey
Bird	American coot	*Fulica americana*	No status	Dense emergent aquatic vegetation; commonly associated with Colorado River	Omnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Arizona Bell's vireo	*Vireo bellii arisonae*	State endangered	Dense vegetation	Insectivore	Yes (incidental observation) but on the Arizona side	2017 southwestern willow flycatcher survey; PBA reported incidental observations on the Arizona side during the 2012 southwestern willow flycatcher survey
Bird	American bittern	*Botaurus lentiginosus*	No status	Marshes	Piscivore	Yes	2006 southwestern willow flycatcher survey
Bird	Bank swallow	*Riparia riparia*	No status	Lakes and ponds	Insectivore	Yes	2006 desert tortoise survey and 2006 southwestern willow flycatcher survey
Bird	Belted kingfisher	*Ceryle alcyon*	No status	Riparian or aquatic	Carnivore	No	PBA 2007 reported this species may occur in this area
Bird	Black-crowned night heron	*Nycticorax nycticorax*	No status	Wetlands and marshes	Piscivore	Yes	2006 southwestern willow flycatcher survey
Bird	Black phoebe	*Sayornis nigricans*	No status	Near water sources in developed areas, edges of streams	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Blue Grosbeak	*Passerina caerulea*	No status	In more-arid areas, they often use the shrubby growth along watercourses	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Canada goose	*Branta canadensis*	Recovered	Marshes, open fields and waterbodies	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Caspian tern	*Hydropogne caspia*	No status	Shorelines	Piscivore	Yes	2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Clarke's grebe	*Aechmophorus clarkia*	No status	Marshes	Piscivore	Yes	2006 southwestern willow flycatcher survey
Bird	Crissal thrasher	*Toxostoma crissale*	CSC (no formal protection)	Dense thickets	Omnivore	No	2006 southwestern willow flycatcher survey
Bird	Double-crested cormorant	*Phalacrocorax auritus*	No status	Lakes, ponds, and coastlines	Piscivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Eared grebe	*Podiceps nigricollis*	No status	Lakes and ponds	Insectivore	No	2017 southwestern willow flycatcher survey;

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Gambel's quail	*Callipepla gambelii*	No status	Desert habitats	Herbivore	Yes	2006 desert tortoise survey
Bird	Great blue heron	*Ardea herodias*	LC, CDF sensitive	Requires trees for nesting	Carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Great egret	*Casmerodius albus*	LC, CDF sensitive	Requires trees for nesting	Carnivore, insectivore	No	2006 southwestern willow flycatcher survey
Bird	Great-tailed grackle	*Quiscalus mexicanus*	No status	Open near water	Omnivore	Yes	2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Green heron	*Butorides virecens*	No status	Marshes and wetlands near shallow water	Piscivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Killdeer	*Charadrius vociferous*	No status	Grasslands and open low-lying vegetation	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 desert tortoise survey; and 2006 southwestern willow flycatcher survey
Bird	Least bittern	*Ixobrychus exilis*	No status	Marshes	Piscivore	Yes	2006 southwestern willow flycatcher survey
Bird	Lesser nighthawk	*Chordeiles acutipennis*	No status	Riparian and open low lands	Insectivore	Yes	2006 desert tortoise survey
Bird	Long-billed curlew	*Numenius americanus*	No status	Grasslands and tidal mudflats	Invertivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Mallard	*Anas platyrhynchos*	No status	River, riparian vegetation	90% herbivore, 10% insectivore	No	2017 southwestern willow flycatcher survey; 2006 southwestern willow flycatcher survey
Bird	Marsh wren	*Cistothorus palustris*	No status	Marshes	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Northern harrier	*Circus cyaneus*	No status	Fields, savannas, meadows, marshes, upland prairies, desert steppe	Carnivore	Yes	2015 western yellow-billed cuckoo survey
Bird	Northern rough-winged swallow	*Stegidopteryx serripennis*	No status	Trees or cliffs	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2006 desert tortoise survey
Bird	Osprey	*Pandion haliaetus*	No status	Lakes, ponds, rivers, coastlines	Piscivore	Yes	2006 southwestern willow flycatcher survey
Bird	Pied-billed grebe	*Podilymbus podiceps*	No status	Open water and vegetation	Omnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Rose-breasted grosbeak	*Pheucticus ludovicianus*	No status	Forest edges and woodlands	Insectivore	Yes	2006 southwestern willow flycatcher survey

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Bird	Song sparrow	*Melospiza melodia*	LC in Alameda and San Pablo counties	Riparian	Herbivore, carnivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Bird	Sonoran yellow warbler	*Dendroica petechia sonorana*	CSC (no formal protection)	Riparian woodlands, coastal/desert lowlands	Insectivore, herbivore	No	2007 PBA reported this species may occur in this area
Bird	**Southwestern willow flycatcher**	***Epidonax tailli extimus***	**Federally endangered**	**Dense riparian vegetation**	**Insectivore**	**Yes**	**2017 southwestern willow flycatcher survey; 2014 southwestern willow flycatcher survey (two single detections; one in the Tamarisk Thicket (2009) and one near the mouth of BCW (2012)**
Bird	Summer tanager	*Piranga rubra*	No status	Open woodlands of oak and other deciduous trees	Insectivore	Yes	2006 southwestern willow flycatcher survey
Bird	Western grebe	*Aechmorphous occidentalis*	No status	Lakes and ponds	Piscivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Western least bittern	*Ixobryhus exilis hesperis*	CSC (no formal protection)	Marshes and wetlands	Omnivore	Yes	2015 western yellow-billed cuckoo survey
Bird	**Western yellow-billed cuckoo**	***Coccyzus americanus occidentalis***	**Federal and state endangered**	**Densely foliated deciduous trees esp. willows; large blocks of Riparian woodland**	**Insectivore**	**Yes**	**One potential but unconfirmed observation (likely transient and not breeding); 2015 western yellow-billed cuckoo survey**
Bird	White-faced ibis	*Plegadis chihi*	No status	Marshes	Invertivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Yellow-breasted chat	*Icteria virens*	LC, DFG-CSC	Riparian thickets	Insectivore, herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey and 2006 southwestern willow flycatcher survey
Bird	Yuma clapper rail	*Rallus longirostris yumanensis*	State and federally endangered	Fresh water and brackish marshes	Insectivore	No	2017 southwestern willow flycatcher survey; 2012 rail survey
Reptile	Pine-gopher snake	*Pituophis melanoleucus*	No status	All habitats; absent from densely forested areas	Carnivore	No	2014 PBA reported this species may occur in this area

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Reptile	Western diamondback rattlesnake	*Crotalus atrox*	No status	Flats and foot hills, prefers brushy areas, riparian habitats	Carnivore	Yes	2006 desert tortoise survey
Amphibian	American bullfrog	*Rana catesbeiana*	No status	Desert riparian	Insectivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey
Fish	Bluegill	*Lepomis macrochirus*	No status	Lakes and slow-moving rocky streams	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	**Bonytail chub**	***Gila elegans***	**State and federally endangered**	**Warm, swift, turbid mainstem rivers of the Colorado River basin**	**Omnivore**	**Yes**	Individuals captured and released near Park Moabi in 2005; stocking efforts in place (2014 PBA)
Fish	Channel catfish	*Ictalurus punctatus*	No status	Lakes, reservoirs, ponds, streams, creeks, and rivers	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	Flannel-mouthed sucker	*Catostomus latipinnis*	LCR MSCP	Upper and lower Colorado River basin	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	Flathead catfish	*Pylodictis olivaris*	No status	Pools, rivers, and streams with debris	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	Largemouth bass	*Micropterus salmoides*	No status	Colorado River	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	**Razorback sucker**	***Xyrauchen texanus***	**State and federally endangered**	**Riverine and lacustrine areas; generally not in fast-moving waters and may use backwaters**	**Benthic invertebrates**	**Yes**	2005 (2014 PBA); stocking efforts in place
Fish	Striped bass	*Morone saxatilis*	No status	Colorado River	Omnivore	No	2007 PBA reported this species may occur in this area
Fish	White crappie	*Pomoxis annularis*	No status	Colorado River	Omnivore	No	2007 PBA reported this species may occur in this area
Mammal	Arizona myotis	*Myotis occultus*	CDFW-SC; USFWS-SC	Deserts, woodlands, and caves	Insectivore	No	2015 bat surveys
Mammal	Beaver	*Castor canadesis*	No status	Riparian	Herbivore	Yes	2017 southwestern willow flycatcher survey; 2015 western yellow-billed cuckoo survey; 2006 southwestern willow flycatcher survey

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Mammal	Bobcat	*Lynx rufus*	No status	Brushy stages of low/mid elevation conifer, oak, riparian	Carnivore	No	2007 PBA reported this species may occur in this area
Mammal	California leaf-nosed bat	*Macrotus californicus*	CDFW-SC; USFWS-SC	Microphyllic woodland of palo verde and ironwood trees within BCW and the East Ravine	Insectivore	No	2015 bat surveys
Mammal	California myotis	*Myotis californicus*	No status	Desert, chaparral, woodland, and forest from sea level up to ponderosa pine, mixed conifer, and Jeffery pine	Invertivore	Yes	2015 bat surveys; observed in BCW, BCW culverts, and railroad culverts (Harvey 2015)
Mammal	**Cave myotis**	***Myotis velifer***	**CDFW-SC**	**Desert scrub, desert wash, desert succulent scrub, and desert riparian**	**Insectivore**	**Yes**	**Recorded through acousting monitoring at BCW; 2015 bat surveys**
Mammal	Deer mouse	*Peromyscus maniculatus*	No status	All habitats	Herbivore, invertivore	No	2007 PBA reported this species may occur in this area
Mammal	Desert shrew	*Notiosorex crawfordi*	No status	Desert wash, desert scrub, desert riparian, mixed chaparral, and pinyon/juniper habitats	Invertivore	No	2007 PBA reported this species may occur in this area
Mammal	Hoary bat	*Lasiurus cinereus*	No status	Urban areas, heavy forests, and open wooded glades	Insectivore	No	2015 bat surveys
Mammal	Mexican free-tailed bat	*Tadarida brasiliensis*	No status	Caves and manmade structures	Insectivore	Yes	2015 bat surveys

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Mammal	Nelson’s bighorn sheep	*Ovis canadesis nelsoni*	No status	Desert mountain ranges, alpine dwarf shrub, low sage, desert shrub	Herbivore	Yes	Sightings by PG&E staff at the Topock site (CH2M Hill 2013a, 2015a,b); tend to avoid dense tamarisk thicket areas
Mammal	**Pallid bat**	***Antrozous pallidus***	**CDFW-SC**	**Common in open dry habitats with rocky areas for roosting**	**Invertivore**	**Yes**	**2015 bat surveys; observed in BCW and BCW culverts (Harvey 2015)**
Mammal	Pocketed free-tailed bat	*Nyctinomops femorosaccus*	CSC; no federal status	Semi-arid desertlands	Insectivore	No	2015 bat surveys
Mammal	Raccoon	*Procyon lotor*	No status	All habitats except alpine and desert w/out water	Carnivore, frugivore, granivore, invertivore, piscivore	No	2007 PBA reported this species may occur in this area
Mammal	**Ring-tailed cat**	***Bassariscus astutus***	**California fully protected**	**Semi-arid oak forests, pine or juniper woodland, montane conifer forest, chaparral, deserts and rocky or cliff areas**	**Omnivore**	**Yes**	**Two siting made at the Topock site, one in 2007 and another a few years later (no date provided; CH2M Hill 2015a,b)**
Mammal	Southern yellow bat	*Lasiurus xanthinus*	No status	Open grassy areas and scrub, canyons and riparian areas	Insectivore	No	2015 bat surveys
Mammal	Townsend's big-eared bat	*Corynorhinus townsendii*	CDFW-SC	Microphyllic woodland of palo verde and ironwood trees within BCW and the East Ravine	Insectivore	No	2015 bat surveys; None have been observed at the Topock site (CH2MHill 2015b)
Mammal	Western canyon bat	*Parastrellus hesperus*	No status	Rocky canyons, cliffs, and creosote bush flats	Insectivore	Yes	2015 bat surveys
Mammal	Western mastiff bat	*Eumops perotis*	CDFW-SC	Open, semi-arid to arid areas with rocky outfaces or cliff faces	Insectivore	No	2015 bat surveys

Table 2-4
Riparian Avian, Mammalian, and Reptilian Species

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Species	Common Name	Scientific Name	Conservation Status	Habitat	Feeding Guild	Confirmed Present at the Action Area [a,b]	Documented Observation(s) [c]
Mammal	Yuma myotis	*Myotis yumanensis*	No status	Wide variety of habitats, optimally open forest and woodlands with a source of water over which to feed	Insectivore	Yes	2015 bat surveys; observed in BCW, BCW culverts, and railroad culverts (Harvey 2015)

Notes:

[a] The "Action Area" as defined in the Final Programmatic Biological Assessment (PBA; CH2M Hill 2014): The Action Area term is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] 402.02)." The 2007 PBA (CH2M Hill 2007) the Action Area was referred to as the Area of Potential Effect (APE). The Action Area is approximately 1,434.4 acres and includes land in California and Arizona, separated by the Colorado River and open water makes up approximately 157.13 acres.

[b] Surveys with maps documenting locations of observations were only available for some special-status species. If observations were made and documented for areas of concern outside the Topock Compressor Station, it is noted here in this table and in the main text.

[c] Information populated from several sources (listed below), including surveys and incidental observations.

Threatened and endangered (T&E) species potentially present/observed onsite are **bolded**.

Acronyms and Abbreviations:

BCW = Bat Cave Wash
CDF = California Department of Forestry and Fire Protection: Sensitive
CDFW-SC = California Department of Fish and Wildlife Species of Concern
CSC = California Special Concern Species
DFG-CSC = Department of Fish and Game - California Special Concern Species
LC = Least Concern
LCR MSCP = Lower Colorado River - Multi-Species Conservation Program
USFWS-SC = U.S. Fish and Wildlife Species of Concern

Sources:

Brown. 2015. Preliminary Habitat Analysis for Bat Use at PG&E Topock Remediation Project, San Bernardino County, CA. March.
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Table 3-1
Comparison of Analytical Reporting Limits to Background Threshold Limits - Inside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	BTV [c]	Number of Non-Detects Above the BTV	Percent of Non-Detects Above the BTV
Inorganics	Aluminum	mg/kg	82	82	0	Not applicable	Not applicable	670	20000	16400	Not applicable	Not applicable
Inorganics	Arsenic	mg/kg	644	611	33	1	2	1.2	18	11	0	0%
Inorganics	Barium	mg/kg	644	643	1	1	1	17	1100	410	0	0%
Inorganics	Beryllium	mg/kg	644	4	640	0.1	1.4	0.28	0.61	0.672	614	96%
Inorganics	Cadmium	mg/kg	644	35	609	0.1	1.4	0.23	10	1.1	11	2%
Inorganics	Chromium, hexavalent	mg/kg	665	317	348	0.16	4.2	0.21	170	0.83	2	1%
Inorganics	Chromium, total	mg/kg	690	689	1	1	1	2.5	2100	39.8	0	0%
Inorganics	Cobalt	mg/kg	642	634	8	1	5.1	1.1	28	12.7	0	0%
Inorganics	Copper	mg/kg	681	670	11	2	4.1	1.7	1500	16.8	0	0%
Inorganics	Iron	mg/kg	84	84	0	Not applicable	Not applicable	2400	38000	29303	Not applicable	Not applicable
Inorganics	Lead	mg/kg	654	647	7	1	1.4	1.1	1100	8.39	0	0%
Inorganics	Manganese	mg/kg	84	84	0	Not applicable	Not applicable	64	520	402	Not applicable	Not applicable
Inorganics	Molybdenum	mg/kg	654	153	501	0.27	4.2	0.57	1300	1.37	20	4%
Inorganics	Nickel	mg/kg	679	678	1	1	1	1.7	210	27.3	0	0%
Inorganics	Selenium	mg/kg	644	10	634	0.26	1.4	0.52	3	1.47	0	0%
Inorganics	Vanadium	mg/kg	642	641	1	1	1	4.4	82	52.2	0	0%
Inorganics	Zinc	mg/kg	690	689	1	1	1	3.4	1900	58	0	0%
Polycyclic aromatic hydrocarbons	P A H Low molecular weight	µg/kg	536	188	348	0	0	0	33000	267.4	0	0%
Polycyclic aromatic hydrocarbons	P A H High molecular weight	µg/kg	534	319	215	0	0	0	34400	37.6	0	0%
Polycyclic aromatic hydrocarbons	B (a) P Equivalent	µg/kg	534	323	211	5.8	420	5.8	5800	55	41	19%
Dioxins	TEQ Avian	ng/kg	179	171	8	0.17	21	0.18	1500	5.98	1	13%
Dioxins	TEQ Human	ng/kg	179	171	8	0.13	16	0.1	2200	5.58	1	13%
Dioxins	TEQ Mammals	ng/kg	179	171	8	0.13	16	0.1	2200	5.58	1	13%

Notes:
[a] Includes soil data representative of locations inside the Topock Compressor Station (see Section 3.3).
[b] Statistics are calculated from raw data for the 0- to 10-foot bgs interval.
[c] BTVs obtained from Tables 3-6a through 3-6n.

Abbreviations:
B (a) P = benzo(a)pyrene
bgs = below ground surface
BTV = background threshold value
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
P A H = polycyclic aromatic hydrocarbon
TEQ = toxic equivalent

Table 3-2
Comparison of Analytical Reporting Limits to Background Threshold Limits - Outside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	BTV [c]	Number of Non-Detects Above the BTV	Percent of Non-Detects Above the BTV
Inorganics	Aluminum	mg/kg	100	100	0	Not applicable	Not applicable	2600	20000	16400	0	0%
Inorganics	Arsenic	mg/kg	1181	1061	120	1	5.5	1	24	11	0	0%
Inorganics	Barium	mg/kg	1194	1194	0	Not applicable	Not applicable	14	1900	410	0	0%
Inorganics	Beryllium	mg/kg	1181	0	1181	0.1	11	Not applicable	Not applicable	0.672	1179	99.8%
Inorganics	Cadmium	mg/kg	1181	54	1127	1	9.8	0.3	7.4	1.1	49	4%
Inorganics	Chromium, hexavalent	mg/kg	1301	427	874	0.05	4.7	0.06	2700	0.83	6	1%
Inorganics	Chromium, total	mg/kg	1313	1313	0	Not applicable	Not applicable	2.9	4400	39.8	0	0%
Inorganics	Cobalt	mg/kg	1180	1174	6	4.4	11	1.6	36	12.7	0	0%
Inorganics	Copper	mg/kg	1306	1300	6	2	23	1.8	3100	16.8	2	33%
Inorganics	Iron	mg/kg	126	126	0	Not applicable	Not applicable	425	32000	29303	0	0%
Inorganics	Lead	mg/kg	1198	1173	25	1	5.5	1	1600	8.39	0	0%
Inorganics	Manganese	mg/kg	120	120	0	Not applicable	Not applicable	67.4	1300	402	0	0%
Inorganics	Molybdenum	mg/kg	1197	163	1034	0.2	11	0.071	63	1.37	196	19%
Inorganics	Nickel	mg/kg	1306	1303	3	4.4	4.9	0.28	270	27.3	0	0%
Inorganics	Selenium	mg/kg	1181	16	1165	1	5.5	1.1	9.1	1.47	19	2%
Inorganics	Vanadium	mg/kg	1194	1194	0	Not applicable	Not applicable	9.2	100	52.2	0	0%
Inorganics	Zinc	mg/kg	1306	1305	1	11	11	1.9	2000	58	0	0%
Polycyclic aromatic hydrocarbons	PAH Low molecular weight	µg/kg	1053	261	792	0	0	0	3880	267.4	0	0%
Polycyclic aromatic hydrocarbons	PAH High molecular weight	µg/kg	1053	429	624	0	0	0	32900	37.6	0	0%
Polycyclic aromatic hydrocarbons	B(a)P Equivalent	µg/kg	1053	432	621	0	400	5.8	8200	55	22	4%
Dioxins	TEQ Avian	ng/kg	545	524	21	0.079	3.4	0.025	11000	5.98	0	0%
Dioxins	TEQ Human	ng/kg	545	524	21	0.062	2.3	0.021	12000	5.58	0	0%
Dioxins	TEQ Mammals	ng/kg	545	524	21	0.062	2.3	0.021	12000	5.58	0	0%

Notes:

[a] Includes locations representative of areas outside the Topock Compressor Station which consists of the following exposure areas: Bat Cave Wash (including the Tamarisk Thicket), AOCs 4, 9, 10, 11, 12, 14, 27, 28 (a, b, c, and d), 31, and UA-2/300B (see Section 3.3).

[b] Statistics are calculated from raw data for the 0- to 15-foot bgs interval to account for potential scouring in BCW and AOC 10 and the 0- to 10-foot bgs interval for all other samples in the OCS.

[c] BTVs obtained from Tables 3-6a through 3-6n.

Abbreviations:

AOC = area of concern
B(a)P = benzo(a)pyrene
BCW = Bat Cave Wash
bgs = below ground surface
BTV = background threshold value
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
OCS = outside the compressor station
PAH = polycyclic aromatic hydrocarbon
TEQ = toxic equivalent
UA = Undesignated Area

Table 3-3
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Inside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Risk-Based Screening Values Human Health (Commercial/ Industrial) [c]	Non-Detect Samples Above the SL Number of Samples	Non-Detect Samples Above the SL Percent of Samples	Maximum RL Greater than Selected SL	FOD
Inorganics	Aluminum	mg/kg	82	82	0	Not applicable	Not applicable	670	20000	1100000	0	0%	No	100%
Inorganics	Antimony	mg/kg	644	5	639	0.26	6.40	0.77	6.1	470	0	0%	No	1%
Inorganics	Arsenic	mg/kg	644	611	33	1.00	2.00	1.2	18	0.25	33	100%	Yes	95%
Inorganics	Barium	mg/kg	644	643	1	1.00	1.00	17	1100	220000	0	0%	No	100%
Inorganics	Beryllium	mg/kg	644	4	640	0.10	1.40	0.28	0.61	210	0	0%	No	1%
Inorganics	Cadmium	mg/kg	644	35	609	0.10	1.40	0.23	10	980	0	0%	No	5%
Inorganics	Chromium, hexavalent	mg/kg	665	317	348	0.16	4.20	0.21	170	6.3	0	0%	No	48%
Inorganics	Chromium, total	mg/kg	690	689	1	1.00	1.00	2.5	2100	3900	1	100%	No	100%
Inorganics	Cobalt	mg/kg	642	634	8	1.00	5.10	1.1	28	350	0	0%	No	99%
Inorganics	Copper	mg/kg	681	670	11	2.00	4.10	1.7	1500	47000	0	0%	No	98%
Inorganics	Iron	mg/kg	84	84	0	Not applicable	Not applicable	2400	38000	820000	0	0%	No	100%
Inorganics	Lead	mg/kg	654	647	7	1.00	1.40	1.1	1100	320	0	0%	No	99%
Inorganics	Manganese	mg/kg	84	84	0	Not applicable	Not applicable	64	520	26000	0	0%	No	100%
Inorganics	Mercury	mg/kg	644	71	573	0.10	0.14	0.1	25	4.5	0	0%	No	11%
Inorganics	Molybdenum	mg/kg	654	153	501	0.27	4.20	0.57	1300	5800	0	0%	No	23%
Inorganics	Nickel	mg/kg	679	678	1	1.00	1.00	1.7	210	3100	0	0%	No	100%
Inorganics	Selenium	mg/kg	644	10	634	0.26	1.40	0.52	3	5800	0	0%	No	2%
Inorganics	Silver	mg/kg	644	5	639	0.25	1.40	1.2	3.4	1500	0	0%	No	1%
Inorganics	Thallium	mg/kg	644	11	633	0.26	2.80	1.2	2.4	12	0	0%	No	2%
Inorganics	Vanadium	mg/kg	642	641	1	1	1	4.4	82	1000	0	0%	No	100%
Inorganics	Zinc	mg/kg	690	689	1	1	1	3.4	1900	350000	0	0%	No	100%
Polycyclic aromatic hydrocarbons	P A H Low molecular weight	µg/kg	536	535	1	0	0	0	33000	Not available	0	0%	No	100%
Polycyclic aromatic hydrocarbons	P A H High molecular weight	µg/kg	534	533	1	0	0	0	34400	Not available	0	0%	No	100%
Polycyclic aromatic hydrocarbons	1-Methyl naphthalene	µg/kg	485	19	466	5	130	5.1	2400	73000	0	0%	No	4%
Polycyclic aromatic hydrocarbons	2-Methyl naphthalene	µg/kg	498	42	456	5	360	5	2900	3000000	0	0%	No	8%
Polycyclic aromatic hydrocarbons	Acenaphthene	µg/kg	518	18	500	5	520	5.4	440	45000000	0	0%	No	3%
Polycyclic aromatic hydrocarbons	Acenaphthylene	µg/kg	514	6	508	5	370	5.4	2000	45000000	0	0%	No	1%
Polycyclic aromatic hydrocarbons	Anthracene	µg/kg	521	51	470	5	520	5.4	660	230000000	0	0%	No	10%
Polycyclic aromatic hydrocarbons	Benzo (a) anthracene	µg/kg	533	215	318	5	360	5.1	4600	2900	0	0%	No	40%
Polycyclic aromatic hydrocarbons	Benzo (a) pyrene	µg/kg	531	187	344	5	560	5.3	1900	290	14	4%	Yes	35%
Polycyclic aromatic hydrocarbons	Benzo (b) fluoranthene	µg/kg	533	244	289	5	560	5.1	4400	2900	0	0%	No	46%
Polycyclic aromatic hydrocarbons	Benzo (ghi) perylene	µg/kg	528	167	361	5	560	5.1	1800	23000000	0	0%	No	32%
Polycyclic aromatic hydrocarbons	Benzo (k) fluoranthene	µg/kg	532	173	359	5	560	5	1300	29000	0	0%	No	33%
Polycyclic aromatic hydrocarbons	Chrysene	µg/kg	532	231	301	5	520	5.1	2600	290000	0	0%	No	43%
Polycyclic aromatic hydrocarbons	Dibenzo (a,h) anthracene	µg/kg	520	20	500	5	560	5.1	310	290	15	3%	Yes	4%
Polycyclic aromatic hydrocarbons	Fluoranthene	µg/kg	532	285	247	5	520	5.1	9400	30000000	0	0%	No	54%
Polycyclic aromatic hydrocarbons	Fluorene	µg/kg	517	10	507	5	520	5.3	320	30000000	0	0%	No	2%
Polycyclic aromatic hydrocarbons	Indeno (1,2,3-cd) pyrene	µg/kg	528	146	382	5	560	5.2	1500	2900	0	0%	No	28%
Polycyclic aromatic hydrocarbons	Naphthalene	µg/kg	519	13	506	4.4	520	5.4	1100	17000	0	0%	No	3%

Table 3-3
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Inside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Risk-Based Screening Values Human Health (Commercial/ Industrial) [c]	Non-Detect Samples Above the SL Number of Samples	Non-Detect Samples Above the SL Percent of Samples	Maximum RL Greater than Selected SL	FOD
Polycyclic aromatic hydrocarbons	Phenanthrene	µg/kg	530	169	361	5	360	5	29000	23000000	0	0%	No	32%
Polycyclic aromatic hydrocarbons	Pyrene	µg/kg	532	285	247	5	360	5	28000	23000000	0	0%	No	54%
Polycyclic aromatic hydrocarbons	B (a) P Equivalent	µg/kg	534	323	211	5	360	5.8	5800	290	6	3%	Yes	60%
Dioxins	TEQ Avian	ng/kg	179	171	8	25	500	0.18	1500	Not available	8	100%	No	96%
Dioxins	TEQ Human	ng/kg	179	171	8	25	500	0.1	2200	200	0	0%	Yes	96%
Dioxins	TEQ Mammals	ng/kg	179	171	8	25	500	0.1	2200	Not available	8	100%	No	96%
PCBs	Aroclor 1248	µg/kg	477	4	473	16	34	420	2900	950	0	0%	No	1%
PCBs	Aroclor 1254	µg/kg	484	208	276	17	34	18	6600	970	0	0%	No	43%
PCBs	Aroclor 1260	µg/kg	483	107	376	16	34	17	4300	990	0	0%	No	22%
PCBs	Total PCBs	µg/kg	486	223	263	33	180	42.5	13800	Not available	254	97%	No	46%
Pesticides	4,4-DDE	µg/kg	40	1	39	2	2.2	7.2	7.2	9300	0	0%	No	3%
Pesticides	4,4-DDT	µg/kg	40	2	38	2	2.2	5.6	6	8500	0	0%	No	5%
Pesticides	alpha-Chlordane	µg/kg	40	3	37	1	1.1	1.3	1.7	1500	0	0%	No	8%
Pesticides	gamma-Chlordane	µg/kg	40	3	37	1	1.1	1.6	2.8	1500	0	0%	No	8%
Organics	Acetone	µg/kg	240	4	236	44.0	160	140	2200	670000000	0	0%	No	2%
Organics	bis (2-ethylhexyl) phthalate	µg/kg	309	2	307	330.0	34000	360	460	160000	0	0%	No	1%
Organics	Chloroform	µg/kg	240	2	238	4.4	16	5.8	12	1400	0	0%	No	1%
Organics	Methyl acetate	µg/kg	57	3	54	4.4	12	25	1800	130000000	0	0%	No	5%
Organics	Methylene chloride	µg/kg	240	2	238	4.4	16	5.6	5.7	24000	0	0%	No	1%
Organics	Toluene	µg/kg	240	2	238	4.4	400	5.8	5.9	5400000	0	0%	No	1%
Organics	Xylene, m,p-	µg/kg	240	1	239	4.4	16	12	12	2400000	0	0%	No	0%
Organics	Xylenes, total	µg/kg	240	1	239	4.4	16	17	17	2500000	0	0%	No	0%

Notes:
[a] Includes soil data representative of locations inside the Topock Compressor Station (see Section 3.3).
[b] Statistics are calculated from raw data for the 0- to 10-foot bgs interval.
[c] Risk-based screening levels are the Regional Screening Levels for Commercial/Industrial Land Use (U S E P A 2017).

Abbreviations:
B (a) P = benzo(a)pyrene
bgs = below ground surface
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
FOD = frequency of detection
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
P A H = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RL = reporting limit
SL = screening level
TEQ = toxic equivalent
U S E P A = United States Environmental Protection Agency

References:

Arcadis. 2008. Human Health and Ecological Risk Assessment Work Plan, Topock Compressor Station, Needles, California. August.
Arcadis. 2009. Revised Addendum to the Revised Human Health and Ecological Risk Assessment Work Plan (August 2008), Topock Compressor Station, Needles, California. February.
U S E P A. 2017. Regional Screening Levels. November. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table 3-4
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Outside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Risk-Based Screening Values - Ecological Screening Value	Risk-Based Screening Values - Human Health (Commercial/ Industrial)	Risk-Based Screening Values - Selected SL [c]	Non-Detect Samples Above the SL - Number of Samples	Non-Detect Samples Above the SL - Percent of Samples	Maximum RL Greater than Selected SL	FOD
Inorganics	Aluminum	mg/kg	100	100	0	Not applicable	Not applicable	2600	20000	Not available	1100000	1100000	0	0%	No	100%
Inorganics	Antimony	mg/kg	1181	17	1164	0.40	11	2.1	19	0.285	470	0.285	1164	100%	Yes	1%
Inorganics	Arsenic	mg/kg	1181	1061	120	1	5.5	1	24	11.4	0.25	0.25	120	100%	Yes	90%
Inorganics	Barium	mg/kg	1194	1194	0	Not applicable	Not applicable	14	1900	330	220000	330	0	0%	No	100%
Inorganics	Cadmium	mg/kg	1181	54	1127	1	9.78	0.3	7.4	0.0151	980	0.0151	1127	100%	Yes	5%
Inorganics	Chromium, hexavalent	mg/kg	1300	427	873	0.05	4.70	0.06	2700	139.6	6.3	6.3	0	0%	No	33%
Inorganics	Chromium, total	mg/kg	1312	1312	0	Not applicable	Not applicable	2.9	4400	36.3	3900	36.3	0	0%	No	100%
Inorganics	Cobalt	mg/kg	1180	1174	6	4.41	11	1.6	36	13	350	13	0	0%	No	99%
Inorganics	Copper	mg/kg	1305	1299	6	2	23	1.8	3100	20.6	47000	20.6	2	33%	Yes	100%
Inorganics	Iron	mg/kg	125	125	0	Not applicable	Not applicable	425	32000	Not available	820000	820000	0	0%	No	100%
Inorganics	Lead	mg/kg	1198	1173	25	1	5.5	1	1600	0.0166	320	0.0166	25	100%	Yes	98%
Inorganics	Manganese	mg/kg	119	119	0	Not applicable	Not applicable	67.4	1300	220	26000	220	0	0%	No	100%
Inorganics	Mercury	mg/kg	1184	71	1113	0.02	0.15	0.1	180	0.0125	4.5	0.0125	1113	100%	Yes	6%
Inorganics	Molybdenum	mg/kg	1197	163	1034	0.20	11	0.071	63	2.25	5800	2.25	35	3%	Yes	14%
Inorganics	Nickel	mg/kg	1305	1302	3	4.41	4.89	0.28	270	0.607	3100	0.607	3	100%	Yes	100%
Inorganics	Selenium	mg/kg	1181	16	1165	1	5.5	1.1	9.1	0.177	5800	0.177	1165	100%	Yes	1%
Inorganics	Thallium	mg/kg	1181	13	1168	1	23	2.1	6.1	2.32	12	2.32	234	20%	Yes	1%
Inorganics	Vanadium	mg/kg	1194	1194	0	Not applicable	Not applicable	9.2	100	13.9	1000	13.9	0	0%	No	100%
Inorganics	Zinc	mg/kg	1305	1304	1	11	11	1.9	2000	0.164	350000	0.164	1	100%	Yes	100%
Polycyclic aromatic hydrocarbons	P A H Low molecular weight	µg/kg	1053	1053	0	Not applicable	Not applicable	0	3880	10000	Not available	10000	0	0%	No	100%
Polycyclic aromatic hydrocarbons	P A H High molecular weight	µg/kg	1053	1053	0	Not applicable	Not applicable	0	32900	1160	Not available	1160	0	0%	No	100%
Polycyclic aromatic hydrocarbons	1-Methyl naphthalene	µg/kg	1043	11	1032	5	260	5.8	220	Not available	73000	73000	0	0%	No	1%
Polycyclic aromatic hydrocarbons	2-Methyl naphthalene	µg/kg	1050	17	1033	5	350	5	240	Not available	3000000	3000000	0	0%	No	2%
Polycyclic aromatic hydrocarbons	Acenaphthene	µg/kg	1050	11	1039	5	350	5.1	53	Not available	45000000	45000000	0	0%	No	1%
Polycyclic aromatic hydrocarbons	Acenaphthylene	µg/kg	1050	8	1042	5	350	5.1	26	Not available	45000000	45000000	0	0%	No	1%
Polycyclic aromatic hydrocarbons	Anthracene	µg/kg	1050	51	999	5	350	5	710	Not available	230000000	230000000	0	0%	No	5%
Polycyclic aromatic hydrocarbons	Benzo (a) anthracene	µg/kg	1052	280	772	5	3800	5	3400	Not available	2900	2900	1	0%	Yes	27%

Table 3-4
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Outside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Risk-Based Screening Values - Ecological Screening Value	Risk-Based Screening Values - Human Health (Commercial/ Industrial)	Risk-Based Screening Values - Selected SL [c]	Non-Detect Samples Above the SL - Number of Samples	Non-Detect Samples Above the SL - Percent of Samples	Maximum RL Greater than Selected SL	FOD
Polycyclic aromatic hydrocarbons	Benzo (a) pyrene	µg/kg	1052	290	762	5	350	5	4400	Not available	290	290	7	1%	Yes	28%
Polycyclic aromatic hydrocarbons	Benzo (b) fluoranthene	µg/kg	1053	368	685	5	350	5	15000	Not available	2900	2900	0	0%	No	35%
Polycyclic aromatic hydrocarbons	Benzo (ghi) perylene	µg/kg	1051	270	781	5	3800	5	1500	Not available	23000000	23000000	0	0%	No	26%
Polycyclic aromatic hydrocarbons	Benzo (k) fluoranthene	µg/kg	1052	274	778	5	520	5.1	5800	Not available	29000	29000	0	0%	No	26%
Polycyclic aromatic hydrocarbons	Chrysene	µg/kg	1052	347	705	5	350	5.1	5200	Not available	290000	290000	0	0%	No	33%
Polycyclic aromatic hydrocarbons	Dibenzo (a,h) anthracene	µg/kg	1050	88	962	5	3800	5	530	Not available	290	290	10	1%	Yes	8%
Polycyclic aromatic hydrocarbons	Fluoranthene	µg/kg	1053	389	664	5	350	5.1	8600	Not available	30000000	30000000	0	0%	No	37%
Polycyclic aromatic hydrocarbons	Fluorene	µg/kg	1050	8	1042	5	350	5.1	29	Not available	30000000	30000000	0	0%	No	1%
Polycyclic aromatic hydrocarbons	Indeno (1,2,3-cd) pyrene	µg/kg	1050	244	806	5	3800	5.1	1200	Not available	2900	2900	1	0%	Yes	23%
Polycyclic aromatic hydrocarbons	Naphthalene	µg/kg	1050	17	1033	3.5	330	5	32	Not available	17000	17000	0	0%	No	2%
Polycyclic aromatic hydrocarbons	Phenanthrene	µg/kg	1052	253	799	5	350	5.1	3100	Not available	23000000	23000000	0	0%	No	24%
Polycyclic aromatic hydrocarbons	Pyrene	µg/kg	1053	379	674	5	350	5	6600	Not available	23000000	23000000	0	0%	No	36%
Polycyclic aromatic hydrocarbons	B (a) P Equivalent	µg/kg	1053	432	621	5	350	5.8	8200	Not available	290	290	6	1%	Yes	41%
Dioxins	TEQ Avian	ng/kg	545	524	21	25	25	0.025	11000	16	Not available	16	0	0%	Yes	96%
Dioxins	TEQ Human	ng/kg	545	524	21	25	25	0.021	12000	Not available	200	200	0	0%	No	96%
Dioxins	TEQ Mammals	ng/kg	545	524	21	25	25	0.021	12000	1.6	Not available	1.6	1	5%	Yes	96%
PCBs	Aroclor 1016	µg/kg	630	9	621	16	33	25	70	Not available	27000	27000	0	0%	No	1%
PCBs	Aroclor 1248	µg/kg	630	1	629	16	33	320	320	Not available	950	950	0	0%	No	0%
PCBs	Aroclor 1254	µg/kg	631	190	441	16	33	17	5900	Not available	970	970	0	0%	No	30%
PCBs	Aroclor 1260	µg/kg	630	40	590	16	33	19	1000	Not available	990	990	0	0%	No	6%
PCBs	Total PCBs	µg/kg	631	193	438	31	66	17	6280	204	Not available	204	0	0%	No	31%
Pesticides	4,4-DDE	µg/kg	262	5	257	2	4	2.6	6.1	2.1	9300	2.1	41	16%	Yes	2%
Pesticides	4,4-DDT	µg/kg	262	1	261	2	4	3	3	2.1	8500	2.1	42	16%	Yes	0%
Pesticides	alpha-Chlordane	µg/kg	262	1	261	1	2	12	12	470	1500	470	0	0%	No	0%
Pesticides	Dieldrin	µg/kg	262	1	261	2	4	6.7	6.7	5	140	5	0	0%	No	0%
Pesticides	gamma-Chlordane	µg/kg	262	1	261	1	2	13	13	470	1500	470	0	0%	No	0%
Organics	4-Methylphenol	µg/kg	675	2	673	330	84000	430	460	500	82000000	500	21	3%	Yes	0%
Organics	bis (2-ethylhexyl) phthalate	µg/kg	675	5	670	330	85000	370	2000	2870	160000	2870	19	3%	Yes	1%
Organics	Bromomethane	µg/kg	443	3	440	3.5	1100	11	26	Not available	30000	30000	0	0%	No	1%
Organics	Butylbenzylphthalate	µg/kg	675	1	674	330	85000	630	630	Not available	1200000	1200000	0	0%	No	0%
Organics	Chloro methane	µg/kg	443	4	439	3.5	1100	5.3	11	Not available	460000	460000	0	0%	No	1%

Table 3-4
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Outside Topock Compressor Station Soil
(See Notes a, b)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Risk-Based Screening Values - Ecological Screening Value	Risk-Based Screening Values - Human Health (Commercial/ Industrial)	Risk-Based Screening Values - Selected SL [c]	Non-Detect Samples Above the SL - Number of Samples	Non-Detect Samples Above the SL - Percent of Samples	Maximum RL Greater than Selected SL	FOD
Organics	Chloroform	µg/kg	443	1	442	3.5	1100	11	11	Not available	1400	1400	0	0%	No	0%
Organics	Isophorone	µg/kg	675	2	673	330	84000	2200	2800	Not available	2400000	2400000	0	0%	No	0%
Organics	Methyl acetate	µg/kg	71	3	68	3.80	19	6.6	17	Not available	130000000	130000000	0	0%	No	4%

Notes:
[a] Includes locations representative of areas outside the Topock Compressor Station which consists of the following exposure areas: Bat Cave Wash (including the Tamarisk Thicket), AOCs 4, 9, 10, 11, 12, 14, 27, 28 (a, b, c, and d), 31, and UA-2/300B (see Section 3.3).
[b] Statistics are calculated from raw data for the 0- to 15-foot bgs interval to account for potential scouring in BCW and AOC 10 and the 0- to 10-foot bgs interval for all other samples in the OCS.
[c] Risk-based screening levels are the minimum Ecological Comparison Value (Arcadis 2008, 2009) and Regional Screening Levels for Commercial/Industrial Land Use (USEPA 2017).

Abbreviations:
AOC = area of concern
B(a)P = benzo(a)pyrene
BCW = Bat Cave Wash
bgs = below ground surface
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
FOD = frequency of detection
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
OCS = outside the compressor station
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SL = screening level
TEQ = toxic equivalent
UA = Undesignated Area
USEPA = United States Environmental Protection Agency

References:
Arcadis. 2008. Human Health and Ecological Risk Assessment Work Plan, Topock Compressor Station, Needles, California. August.
Arcadis. 2009. Revised Addendum to the Revised Human Health and Ecological Risk Assessment Work Plan (August 2008), Topock Compressor Station, Needles, California. February.
USEPA. 2017. Regional Screening Levels. November. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table 3-5
Comparison of Analytical Reporting Limits to Risk-Based Screening Levels - Inside Topock Compressor Station Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Units	Total Number of Samples	Total Number of Detects	Total Number of Non-Detects	Non-Detects - Minimum	Non-Detects - Maximum	Detects - Minimum	Detects - Maximum	Selected SL [a]	Non-Detect Samples Above the SL - Number of Samples	Non-Detect Samples Above the SL - Percent of Samples	Maximum RL Greater than Selected SL	FOD
Volatile Organic Compounds	1,1-Dichloroethene	$\mu g/m^3$	14	1	13	2.65	26.7	4.57	4.57	880000	0	0%	No	7%
Volatile Organic Compounds	1,3-Dichlorobenzene	$\mu g/m^3$	14	3	11	4.03	40.6	6.4	8.72	Not available	0	0%	No	21%
Volatile Organic Compounds	2-Butanone (MEK)	$\mu g/m^3$	14	9	5	4.22	39.8	5.05	38.3	22000000	0	0%	No	64%
Volatile Organic Compounds	Acetone	$\mu g/m^3$	14	14	0	Not applicable	Not applicable	18.3	210	140000000	0	0%	No	100%
Volatile Organic Compounds	Benzene	$\mu g/m^3$	14	5	9	2.14	2.83	3.35	178	1600	0	0%	No	36%
Volatile Organic Compounds	Carbon Disulfide	$\mu g/m^3$	14	10	4	2.23	2.76	4.06	73.5	3100000	0	0%	No	71%
Volatile Organic Compounds	Carbon Tetrachloride	$\mu g/m^3$	14	2	12	4.22	42.5	11.1	61.4	2000	0	0%	No	14%
Volatile Organic Compounds	Chloroform	$\mu g/m^3$	14	2	12	3.27	32.9	5.04	47.2	530	0	0%	No	14%
Volatile Organic Compounds	Chloromethane	$\mu g/m^3$	14	3	11	1.38	13.9	2.76	4.23	390000	0	0%	No	21%
Volatile Organic Compounds	Ethylbenzene	$\mu g/m^3$	14	2	12	2.91	3.84	3.28	115	4900	0	0%	No	14%
Volatile Organic Compounds	m,p-Xylenes	$\mu g/m^3$	14	1	13	5.82	7.68	199	199	440000	0	0%	No	7%
Volatile Organic Compounds	Methylene Chloride	$\mu g/m^3$	14	1	13	4.65	46.8	8.84	8.84	1200000	0	0%	No	7%
Volatile Organic Compounds	o-Xylene	$\mu g/m^3$	14	1	13	2.91	3.84	68	68	440000	0	0%	No	7%
Volatile Organic Compounds	Tetrachloroethene	$\mu g/m^3$	14	6	8	4.54	6	6.62	344	47000	0	0%	No	43%
Volatile Organic Compounds	Toluene	$\mu g/m^3$	14	9	5	2.52	2.86	6.68	624	22000000	0	0%	No	64%
Volatile Organic Compounds	Trichloroethene	$\mu g/m^3$	14	1	13	3.6	36.3	7.56	7.56	3000	0	0%	No	7%

Notes:
[a] The soil gas screening level is based on the industrial air regional screening level (USEPA 2017) adjusted for indoor air using DTSC vapor intrusion guidance (DTSC 2011) subsurface attenuation factor for existing commercial building (i.e., 0.001).

Abbreviations:
DTSC = Department of Toxic Substances Control
FOD = frequency of detection
$\mu g/m^3$ = micrograms per cubic meter
RL = reporting limit
SL = screening level
USEPA = United States Environmental Protection Agency

References:
DTSC. 2011. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). Department of Toxic Substances Control California Environmental Protection Agency. October. Available at: http://www.dtsc.ca.gov/AssessingRisk/upload/Final_VIG_Oct_2011.pdf.
USEPA. 2017. Regional Screening Levels. November. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Table 3-6a
Background Screening Evaluation: Bat Cave Wash (BCW)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Unit	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	47 / 47	5700 to 14000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	9 / 506	2.4 to 18	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	454 / 506	1.1 to 19	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	519 / 519	22 to 1900	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 506	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	23 / 506	1 to 1.5	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	53 / 53	6000 to 280000	55 / 55	4100 to 67000	66500	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Chromium, Hexavalent	mg/kg	171 / 585	0.06 to 80	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	578 / 578	7.1 to 4400	70 / 70	4.2 to 53	39.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Cobalt	mg/kg	505 / 505	3.3 to 19	58 / 59	2.3 to 14	12.7	Yes	NA	Site Greater than Background	Site Less than or Equal to Background	NA	NA	Include	Above Background
Inorganics	Copper	mg/kg	578 / 579	3 to 85	69 / 69	2.1 to 18	16.8	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Iron	mg/kg	66 / 66	4760 to 29000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	499 / 519	1 to 120	59 / 60	1.9 to 10	8.39	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Magnesium	mg/kg	53 / 53	4500 to 14700	55 / 55	2500 to 13000	12100	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Manganese	mg/kg	66 / 66	67.4 to 720	57 / 57	140 to 450	402	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Mercury	mg/kg	18 / 505	0.1 to 0.35	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	75 / 519	0.071 to 20	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Nickel	mg/kg	579 / 579	3.6 to 51	70 / 70	2.6 to 31	27.3	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	53 / 53	1040 to 4900	54 / 54	540 to 4300	4400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Selenium	mg/kg	5 / 506	1.1 to 2.5	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 506	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected

Table 3-6a
Background Screening Evaluation: Bat Cave Wash (BCW)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituent	Unit	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Sodium	mg/kg	42 / 53	140 to 2700	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Thallium	mg/kg	4 / 506	2.3 to 2.6	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	519 / 519	15 to 70	60 / 60	9.4 to 59	52.2	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Zinc	mg/kg	579 / 579	6.4 to 673	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	372 / 372	0 to 2870	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	372 / 372	0 to 182	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	79 / 370	5.8 to 490	14 / 42	6.1 to 55	55	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Dioxins	TEQ Avian	ng/kg	215 / 227	0.099 to 11000	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	215 / 227	0.074 to 12000	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	215 / 227	0.074 to 12000	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M HILL. 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.
CH2M Engineers, Inc. (CH2M). 2017. Ambient Study of Dioxins and Furans at the Pacific Gas and Electric Company, Topock Compressor Station, Needles, California. July 20, Revised October 13.
R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at https://www.R-project.org/.
U.S. Environmental Protection Agency (USEPA). 2010. ProUCL Version 4.1.00. Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. May.
U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6b
Background Screening Evaluation: AOC 4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Antimony	mg/kg	3 / 97	2.1 to 2.7	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	33 / 97	1.2 to 8.5	58 / 59	0.884 to 12	11	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Barium	mg/kg	97 / 97	63 to 1300	60 / 60	48.4 to 660	410	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Beryllium	mg/kg	0 / 97	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	7 / 97	1.1 to 1.7	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	20 / 92	0.49 to 16	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	97 / 97	11 to 160	70 / 70	4.2 to 53	39.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Cobalt	mg/kg	97 / 97	4.3 to 20	58 / 59	2.3 to 14	12.7	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Copper	mg/kg	97 / 97	5.7 to 790	69 / 69	2.1 to 18	16.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Lead	mg/kg	96 / 97	2.4 to 220	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Mercury	mg/kg	6 / 97	0.22 to 0.74	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	0 / 97	ND	11 / 60	0.383 to 2.8	1.37	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Nickel	mg/kg	97 / 97	9.8 to 75	70 / 70	2.6 to 31	27.3	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Selenium	mg/kg	0 / 97	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 97	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Thallium	mg/kg	0 / 97	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	97 / 97	19 to 100	60 / 60	9.4 to 59	52.2	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Zinc	mg/kg	97 / 97	29 to 410	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	101 / 101	0 to 10200	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	101 / 101	0 to 1340	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B (a) P Equivalent	µg/kg	68 / 101	5.8 to 1100	14 / 42	6.1 to 55	55	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Avian	ng/kg	101 / 102	0.025 to 280	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Table 3-6b
Background Screening Evaluation: AOC 4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Dioxins	TEQ Human	ng/kg	101 / 102	0.021 to 250	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	101 / 102	0.021 to 250	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:
CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6c
Background Screening Evaluation: AOC 9

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	7 / 7	2600 to 13000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	1 / 96	15	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	96 / 96	1.5 to 17	58 / 59	0.884 to 12	11	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Barium	mg/kg	96 / 96	52 to 590	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 96	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	7 / 96	1.1 to 7.4	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	7 / 7	17000 to 38000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	49 / 93	0.2 to 2700	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	106 / 106	3.6 to 2800	70 / 70	4.2 to 53	39.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Cobalt	mg/kg	95 / 96	1.9 to 36	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	105 / 105	2.6 to 3100	69 / 69	2.1 to 18	16.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Iron	mg/kg	7 / 7	5800 to 32000	59 / 59	5570 to 34000	29303	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Lead	mg/kg	100 / 100	1.7 to 920	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	7 / 7	3300 to 9600	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	7 / 7	130 to 310	57 / 57	140 to 450	402	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	24 / 100	0.11 to 35	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	11 / 97	1 to 19	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Nickel	mg/kg	105 / 105	2.7 to 51	70 / 70	2.6 to 31	27.3	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background
Inorganics	Potassium	mg/kg	7 / 7	600 to 2500	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	0 / 96	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 96	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	7 / 7	200 to 810	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	1 / 96	4.1	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	96 / 96	9.3 to 47	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	105 / 105	9.5 to 1000	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background

Table 3-6c
Background Screening Evaluation: AOC 9

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH High molecular weight	µg/kg	100 / 100	0 to 32900	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	100 / 100	0 to 1770	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	64 / 100	6 to 8200	14 / 42	6.1 to 55	55	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Avian	ng/kg	40 / 41	0.26 to 1100	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	40 / 41	0.15 to 1600	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	40 / 41	0.15 to 1600	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:
CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6d
Background Screening Evaluation: AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	10 / 10	4900 to 18000	55 / 55	2600 to 18000	16400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Antimony	mg/kg	1 / 124	3.5	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	121 / 124	1.2 to 12	58 / 59	0.884 to 12	11	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
Inorganics	Barium	mg/kg	124 / 124	44 to 1300	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 124	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	1 / 124	1.5	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	14 / 14	18000 to 265000	55 / 55	4100 to 67000	66500	Yes	SiteGreater than Background	NA	NA	NA	NA	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Chromium, Hexavalent	mg/kg	73 / 143	0.24 to 150	3 / 70	0.504 to 0.83	0.83	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	143 / 143	4.9 to 4000	70 / 70	4.2 to 53	39.8	Yes	SiteGreater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Cobalt	mg/kg	121 / 124	2.3 to 11	58 / 59	2.3 to 14	12.7	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Copper	mg/kg	137 / 137	4.1 to 300	69 / 69	2.1 to 18	16.8	Yes	SiteGreater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Iron	mg/kg	14 / 14	540 to 28000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	123 / 124	1.5 to 160	59 / 60	1.9 to 10	8.39	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	14 / 14	4700 to 14300	55 / 55	2500 to 13000	12100	Yes	Site Less than or Equal to Background	NA	NA	NA	SiteGreater than Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Manganese	mg/kg	10 / 10	160 to 1300	57 / 57	140 to 450	402	Yes	Site Less than or Equal to Background	NA	NA	NA	SiteGreater than Background	Include	Above Background
Inorganics	Mercury	mg/kg	2 / 124	0.15 to 0.33	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	23 / 125	1 to 14	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Nickel	mg/kg	134 / 137	4.3 to 28	70 / 70	2.6 to 31	27.3	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	13 / 13	990 to 4100	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	3 / 124	1.1 to 9.1	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 124	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	14 / 14	170 to 2790	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background

Table 3-6d
Background Screening Evaluation: AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Thallium	mg/kg	1 / 124	6.1	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	124 / 124	12 to 52	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	137 / 137	14 to 300	70 / 70	8.4 to 66.1	58	Yes	SiteGreater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	119 / 119	0 to 3060	14 / 42	5.1 to 267.4	267.4	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	119 / 119	0 to 279	6 / 42	6.9 to 37.6	37.6	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	45 / 116	5.8 to 430	14 / 42	6.1 to 55	55	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	reater than Backgr	Include	Above Background
Dioxins	TEQ Avian	ng/kg	41 / 44	0.35 to 300	33 / 35	0.13 to 3	5.98	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	41 / 44	0.2 to 410	33 / 35	0.096 to 3.6	5.58	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	41 / 44	0.2 to 410	33 / 35	0.096 to 3.6	5.58	Yes	NA	SiteGreater than Background	SiteGreater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6e
Background Screening Evaluation: AOC 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	21 / 21	3500 to 20000	55 / 55	2600 to 18000	16400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Antimony	mg/kg	0 / 159	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	159 / 159	2.2 to 13	58 / 59	0.884 to 12	11	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Barium	mg/kg	159 / 159	37 to 1300	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 159	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	1 / 159	1.2	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	22 / 22	14000 to 45000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	59 / 157	0.22 to 16	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	159 / 159	7.9 to 320	70 / 70	4.2 to 53	39.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background
Inorganics	Cobalt	mg/kg	159 / 159	2.6 to 9.6	58 / 59	2.3 to 14	12.7	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Copper	mg/kg	159 / 159	4.3 to 44	69 / 69	2.1 to 18	16.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background
Inorganics	Iron	mg/kg	22 / 22	6800 to 26000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	158 / 159	1.7 to 220	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	22 / 22	2900 to 12000	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	22 / 22	130 to 440	57 / 57	140 to 450	402	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Mercury	mg/kg	2 / 159	0.18 to 0.37	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	25 / 159	1 to 7.1	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Nickel	mg/kg	159 / 159	4.3 to 22	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Potassium	mg/kg	22 / 22	860 to 5300	54 / 54	540 to 4300	4400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Selenium	mg/kg	2 / 159	1.6 to 3.2	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 159	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	21 / 22	170 to 4300	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 159	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected

Table 3-6e
Background Screening Evaluation: AOC 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Vanadium	mg/kg	159 / 159	13 to 55	60 / 60	9.4 to 59	52.2	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Zinc	mg/kg	159 / 159	17 to 1100	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	163 / 163	0 to 18200	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	163 / 163	0 to 1380	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	106 / 162	5.8 to 2300	14 / 42	6.1 to 55	55	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Avian	ng/kg	60 / 63	0.13 to 680	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	60 / 63	0.09 to 940	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	60 / 63	0.09 to 940	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6f
Background Screening Evaluation: AOC 12

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	2 / 2	4500 to 12000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	0 / 14	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	14 / 14	3.6 to 8.4	58 / 59	0.884 to 12	11	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Barium	mg/kg	14 / 14	14 to 240	60 / 60	48.4 to 660	410	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 14	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	0 / 14	ND	1 / 55	1.1	1.1	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Calcium	mg/kg	2 / 2	10000 to 31000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	0 / 14	ND	3 / 70	0.504 to 0.83	0.83	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Chromium, total	mg/kg	14 / 14	4.9 to 28	70 / 70	4.2 to 53	39.8	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Cobalt	mg/kg	14 / 14	1.6 to 14	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	13 / 14	5.6 to 18	69 / 69	2.1 to 18	16.8	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Iron	mg/kg	2 / 2	9900 to 23000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	14 / 14	2.4 to 8.3	59 / 60	1.9 to 10	8.39	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Magnesium	mg/kg	2 / 2	3000 to 8300	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	2 / 2	130 to 290	57 / 57	140 to 450	402	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	0 / 14	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Molybdenum	mg/kg	1 / 14	1	11 / 60	0.383 to 2.8	1.37	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Nickel	mg/kg	14 / 14	2.7 to 20	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Potassium	mg/kg	2 / 2	1300 to 2700	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	1 / 14	2.5	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 14	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	2 / 2	210 to 340	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 14	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	14 / 14	13 to 42	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	14 / 14	9 to 77	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	14 / 14	0 to 407	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Table 3-6f
Background Screening Evaluation: AOC 12

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH Low molecular weight	µg/kg	14 / 14	0 to 14	6 / 42	6.9 to 37.6	37.6	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	B(a)P Equivalent	µg/kg	5 / 14	5.9 to 61	14 / 42	6.1 to 55	55	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:
CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M HILL. 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6g
Background Screening Evaluation: AOC 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	9 / 9	3000 to 9000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	2 / 105	3.3 to 19	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	102 / 105	1 to 19	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	105 / 105	60 to 410	60 / 60	48.4 to 660	410	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 105	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	5 / 105	1.3 to 7.1	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	11 / 11	11000 to 379000	55 / 55	4100 to 67000	66500	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Chromium, Hexavalent	mg/kg	33 / 136	0.21 to 20	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	136 / 136	8.2 to 420	70 / 70	4.2 to 53	39.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Cobalt	mg/kg	103 / 105	2.4 to 17	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	134 / 136	1.8 to 1800	69 / 69	2.1 to 18	16.8	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Iron	mg/kg	11 / 11	425 to 23100	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	104 / 105	1.1 to 1600	59 / 60	1.9 to 10	8.39	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Magnesium	mg/kg	11 / 11	2600 to 23000	55 / 55	2500 to 13000	12100	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Manganese	mg/kg	9 / 9	120 to 290	57 / 57	140 to 450	402	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	6 / 105	0.22 to 180	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	19 / 105	1 to 63	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Nickel	mg/kg	136 / 136	0.28 to 270	70 / 70	2.6 to 31	27.3	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	11 / 11	89.6 to 2800	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	3 / 105	1.2 to 1.6	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 105	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	10 / 11	190 to 6590	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Thallium	mg/kg	7 / 105	2.1 to 2.6	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	105 / 105	11 to 58	60 / 60	9.4 to 59	52.2	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Zinc	mg/kg	135 / 136	1.9 to 2000	70 / 70	8.4 to 66.1	58	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background

Table 3-6g
Background Screening Evaluation: AOC 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH High molecular weight	µg/kg	95 / 95	0 to 8070	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	95 / 95	0 to 380	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	22 / 95	5.9 to 740	14 / 42	6.1 to 55	55	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Dioxins	TEQ Avian	ng/kg	38 / 39	0.12 to 780	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	38 / 39	0.075 to 480	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	38 / 39	0.075 to 480	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
applicable; not
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M HILL. 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6h
Background Screening Evaluation: AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	1 / 1	8100	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	1 / 60	3.5	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	59 / 60	1.1 to 20	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	60 / 60	28 to 210	60 / 60	48.4 to 660	410	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 60	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	10 / 60	0.3 to 4.5	1 / 55	1.1	1.1	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Calcium	mg/kg	1 / 1	21000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	21 / 60	0.2 to 4.8	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	60 / 60	10 to 290	70 / 70	4.2 to 53	39.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Cobalt	mg/kg	60 / 60	3.2 to 16	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	60 / 60	5.6 to 1000	69 / 69	2.1 to 18	16.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background
Inorganics	Iron	mg/kg	1 / 1	28000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	59 / 60	1.4 to 630	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	1 / 1	6200	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	1 / 1	310	57 / 57	140 to 450	402	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	13 / 60	0.1 to 0.95	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	6 / 60	0.63 to 26	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Nickel	mg/kg	60 / 60	5.2 to 97	70 / 70	2.6 to 31	27.3	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	1 / 1	2900	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	2 / 60	1.4 to 6.2	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	0 / 60	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	1 / 1	460	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 60	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	60 / 60	17 to 38	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	60 / 60	16 to 1300	70 / 70	8.4 to 66.1	58	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background

Table 3-6h
Background Screening Evaluation: AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH High molecular weight	µg/kg	60 / 60	0 to 31500	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	60 / 60	0 to 3880	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	34 / 60	6.1 to 3300	14 / 42	6.1 to 55	55	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Avian	ng/kg	31 / 32	0.17 to 260	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	31 / 32	0.12 to 230	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	31 / 32	0.12 to 230	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
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µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

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Table 3-6i
Background Screening Evaluation: AOC 28

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Antimony	mg/kg	0 / 1	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	1 / 1	9.3	58 / 59	0.884 to 12	11	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Barium	mg/kg	1 / 1	240	60 / 60	48.4 to 660	410	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 1	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	0 / 1	ND	1 / 55	1.1	1.1	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Chromium, Hexavalent	mg/kg	0 / 3	ND	3 / 70	0.504 to 0.83	0.83	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Chromium, total	mg/kg	2 / 2	17 to 24	70 / 70	4.2 to 53	39.8	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Cobalt	mg/kg	1 / 1	9.1	58 / 59	2.3 to 14	12.7	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Copper	mg/kg	0 / 1	ND	69 / 69	2.1 to 18	16.8	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Lead	mg/kg	1 / 1	7.2	59 / 60	1.9 to 10	8.39	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	0 / 1	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Molybdenum	mg/kg	2 / 2	3.7 to 5	11 / 60	0.383 to 2.8	1.37	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Nickel	mg/kg	1 / 1	17	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	0 / 1	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 1	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Thallium	mg/kg	0 / 1	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	1 / 1	45	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	1 / 1	70	70 / 70	8.4 to 66.1	58	Yes	NA	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	13 / 13	0 to 167	14 / 42	5.1 to 267.4	267.4	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	PAH Low molecular weight	µg/kg	13 / 13	0 to 7.8	6 / 42	6.9 to 37.6	37.6	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	B(a)P Equivalent	µg/kg	5 / 13	6.2 to 23	14 / 42	6.1 to 55	55	No	NA	NA	NA	NA	NA	Exclude	Within Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M Engineers, Inc. (CH2M). 2017. Ambient Study of Dioxins and Furans at the Pacific Gas and Electric Company, Topock Compressor Station, Needles, California. July 20, Revised October 13.
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Table 3-6j
Background Screening Evaluation: AOC 31

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	1 / 1	9000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	0 / 5	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	5 / 5	1.5 to 4.8	58 / 59	0.884 to 12	11	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Barium	mg/kg	5 / 5	22 to 330	60 / 60	48.4 to 660	410	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 5	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	0 / 5	ND	1 / 55	1.1	1.1	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Calcium	mg/kg	1 / 1	21000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	2 / 5	0.26 to 0.82	3 / 70	0.504 to 0.83	0.83	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, total	mg/kg	5 / 5	2.9 to 26	70 / 70	4.2 to 53	39.8	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Cobalt	mg/kg	5 / 5	1.7 to 10	58 / 59	2.3 to 14	12.7	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Copper	mg/kg	4 / 5	4.8 to 62	69 / 69	2.1 to 18	16.8	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Iron	mg/kg	1 / 1	19000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	5 / 5	1.2 to 19	59 / 60	1.9 to 10	8.39	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	1 / 1	6800	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	1 / 1	260	57 / 57	140 to 450	402	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Mercury	mg/kg	0 / 5	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Molybdenum	mg/kg	0 / 5	ND	11 / 60	0.383 to 2.8	1.37	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Nickel	mg/kg	5 / 5	4.2 to 20	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Potassium	mg/kg	1 / 1	3700	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	0 / 5	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 5	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	1 / 1	300	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 5	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	5 / 5	9.2 to 35	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	5 / 5	6.9 to 94	70 / 70	8.4 to 66.1	58	Yes	NA	NA	NA	NA	NA	Include	Above Background

Table 3-6j
Background Screening Evaluation: AOC 31

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH High molecular weight	µg/kg	8 / 8	0 to 840	14 / 42	5.1 to 267.4	267.4	Yes	NA	NA	NA	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	8 / 8	0 to 57	6 / 42	6.9 to 37.6	37.6	Yes	NA	NA	NA	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	2 / 8	5.8 to 150	14 / 42	6.1 to 55	55	Yes	NA	NA	NA	NA	NA	Include	Above Background

Notes:
AOC = area of concern.
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:
CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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Table 3-6k
Background Screening Evaluation: UA-2

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	2 / 2	11000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	0 / 17	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	17 / 17	8 to 24	58 / 59	0.884 to 12	11	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Barium	mg/kg	17 / 17	150 to 890	60 / 60	48.4 to 660	410	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Beryllium	mg/kg	0 / 17	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	0 / 17	ND	1 / 55	1.1	1.1	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Calcium	mg/kg	2 / 2	21000 to 26000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	0 / 17	ND	3 / 70	0.504 to 0.83	0.83	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Chromium, total	mg/kg	17 / 17	17 to 35	70 / 70	4.2 to 53	39.8	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Cobalt	mg/kg	17 / 17	6.7 to 11	58 / 59	2.3 to 14	12.7	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Copper	mg/kg	17 / 17	9.4 to 15	69 / 69	2.1 to 18	16.8	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Iron	mg/kg	2 / 2	20000 to 27000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	17 / 17	3.2 to 13	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	2 / 2	7400 to 8900	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	2 / 2	670 to 840	57 / 57	140 to 450	402	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Mercury	mg/kg	0 / 17	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Molybdenum	mg/kg	1 / 17	1.1	11 / 60	0.383 to 2.8	1.37	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Nickel	mg/kg	17 / 17	13 to 25	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Potassium	mg/kg	2 / 2	2400 to 2900	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	0 / 17	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 17	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	2 / 2	210 to 230	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 17	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	17 / 17	22 to 38	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	17 / 17	46 to 65	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background

Table 3-6k
Background Screening Evaluation: UA-2

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
PAHs	PAH High molecular weight	µg/kg	17 / 17	0 to 11.5	14 / 42	5.1 to 267.4	267.4	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	PAH Low molecular weight	µg/kg	17 / 17	0 to 11	6 / 42	6.9 to 37.6	37.6	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	B(a)P Equivalent	µg/kg	2 / 17	5.8 to 6.1	14 / 42	6.1 to 55	55	No	NA	NA	NA	NA	NA	Exclude	Within Background

Notes:
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M HILL. 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6I
Background Screening Evaluation: Outside of Compressor Station (OCS)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	100 / 100	2600 to 20000	55 / 55	2600 to 18000	16400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Antimony	mg/kg	17 / 1181	2.1 to 19	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	1061 / 1181	1 to 24	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	1194 / 1194	14 to 1900	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 1181	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	54 / 1181	0.3 to 7.4	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Calcium	mg/kg	113 / 113	6000 to 379000	55 / 55	4100 to 67000	66500	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Chromium, Hexavalent	mg/kg	427 / 1301	0.06 to 2700	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	1313 / 1313	2.9 to 4400	70 / 70	4.2 to 53	39.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Cobalt	mg/kg	1174 / 1180	1.6 to 36	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	1300 / 1306	1.8 to 3100	69 / 69	2.1 to 18	16.8	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Iron	mg/kg	126 / 126	425 to 32000	59 / 59	5570 to 34000	29303	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Lead	mg/kg	1173 / 1198	1 to 1600	59 / 60	1.9 to 10	8.39	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Magnesium	mg/kg	113 / 113	2600 to 23000	55 / 55	2500 to 13000	12100	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Manganese	mg/kg	120 / 120	67.4 to 1300	57 / 57	140 to 450	402	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Mercury	mg/kg	71 / 1184	0.1 to 180	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	163 / 1197	0.071 to 63	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Nickel	mg/kg	1303 / 1306	0.28 to 270	70 / 70	2.6 to 31	27.3	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	112 / 112	89.6 to 5300	54 / 54	540 to 4300	4400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Selenium	mg/kg	16 / 1181	1.1 to 9.1	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background

Table 3-6l
Background Screening Evaluation: Outside of Compressor Station (OCS)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Silver	mg/kg	0 / 1181	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	100 / 113	140 to 6590	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Thallium	mg/kg	13 / 1181	2.1 to 6.1	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	1194 / 1194	9.2 to 100	60 / 60	9.4 to 59	52.2	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Zinc	mg/kg	1305 / 1306	1.9 to 2000	70 / 70	8.4 to 66.1	58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	1059 / 1059	0 to 32900	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	1059 / 1059	0 to 3880	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	393 / 1053	5.8 to 8200	14 / 42	6.1 to 55	55	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Dioxins	TEQ Avian	ng/kg	524 / 545	0.025 to 11000	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	524 / 545	0.021 to 12000	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	524 / 545	0.021 to 12000	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6m
Background Screening Evaluation: Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPEC?	Include/Exclude as COPEC Basis
Inorganics	Aluminum	mg/kg	2 / 2	9500 to 14000	55 / 55	2600 to 18000	16400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Antimony	mg/kg	0 / 83	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Arsenic	mg/kg	77 / 83	1.3 to 13	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	83 / 83	53 to 420	60 / 60	48.4 to 660	410	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	0 / 83	ND	4 / 59	0.459 to 0.672	0.672	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Cadmium	mg/kg	1 / 83	1.1	1 / 55	1.1	1.1	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Calcium	mg/kg	2 / 2	20000 to 35000	55 / 55	4100 to 67000	66500	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Chromium, Hexavalent	mg/kg	19 / 85	0.22 to 2.6	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Less than or Equal to Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	85 / 85	9.6 to 71	70 / 70	4.2 to 53	39.8	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Greater than Background	Include	Above Background
Inorganics	Cobalt	mg/kg	83 / 83	4.6 to 14	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	85 / 85	5.7 to 23	69 / 69	2.1 to 18	16.8	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
Inorganics	Iron	mg/kg	2 / 2	18000 to 20000	59 / 59	5570 to 34000	29303	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Lead	mg/kg	82 / 83	1 to 23	59 / 60	1.9 to 10	8.39	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Magnesium	mg/kg	2 / 2	7700 to 11000	55 / 55	2500 to 13000	12100	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Manganese	mg/kg	2 / 2	300 to 420	57 / 57	140 to 450	402	Yes	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Mercury	mg/kg	0 / 83	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Molybdenum	mg/kg	1 / 83	1.5	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Nickel	mg/kg	85 / 85	6.8 to 19	70 / 70	2.6 to 31	27.3	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Potassium	mg/kg	2 / 2	3900 to 4000	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	0 / 83	ND	7 / 59	0.738 to 2.7	1.47	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Silver	mg/kg	0 / 83	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Sodium	mg/kg	1 / 2	660	51 / 55	170 to 4500	2070	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Thallium	mg/kg	0 / 83	ND	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Exclude	Not Detected
Inorganics	Vanadium	mg/kg	83 / 83	22 to 46	60 / 60	9.4 to 59	52.2	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Zinc	mg/kg	85 / 85	24 to 84	70 / 70	8.4 to 66.1	58	Yes	Site Greater than Background	NA	NA	NA	NA	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	24 / 24	0 to 223	14 / 42	5.1 to 267.4	267.4	No	NA	NA	NA	NA	NA	Exclude	Within Background
PAHs	PAH Low molecular weight	µg/kg	24 / 24	0 to 14	6 / 42	6.9 to 37.6	37.6	No	NA	NA	NA	NA	NA	Exclude	Within Background

Table 3-6m
Background Screening Evaluation: Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPEC?	Include/Exclude as COPEC Basis
Dioxins	TEQ Avian	ng/kg	51 / 53	0.17 to 110	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	51 / 53	0.12 to 180	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:
CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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CH2M Engineers, Inc. (CH2M). 2017. Ambient Study of Dioxins and Furans at the Pacific Gas and Electric Company, Topock Compressor Station, Needles, California. July 20, Revised October 13.
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U.S. Environmental Protection Agency. 2018. ProUCL Version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software.

Table 3-6n
Background Screening Evaluation: Inside of Compressor Station (ICS)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Aluminum	mg/kg	82 / 82	670 to 20000	55 / 55	2600 to 18000	16400	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Antimony	mg/kg	5 / 644	0.77 to 6.1	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Arsenic	mg/kg	611 / 644	1.2 to 18	58 / 59	0.884 to 12	11	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Barium	mg/kg	643 / 644	17 to 1100	60 / 60	48.4 to 660	410	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Beryllium	mg/kg	4 / 644	0.28 to 0.61	4 / 59	0.459 to 0.672	0.672	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Cadmium	mg/kg	35 / 644	0.23 to 10	1 / 55	1.1	1.1	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Calcium	mg/kg	95 / 95	6900 to 310000	55 / 55	4100 to 67000	66500	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Chromium, Hexavalent	mg/kg	317 / 665	0.21 to 170	3 / 70	0.504 to 0.83	0.83	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Chromium, total	mg/kg	689 / 690	2.5 to 2100	70 / 70	4.2 to 53	39.8	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Cobalt	mg/kg	634 / 642	1.1 to 28	58 / 59	2.3 to 14	12.7	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Copper	mg/kg	670 / 681	1.7 to 1500	69 / 69	2.1 to 18	16.8	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
Inorganics	Iron	mg/kg	84 / 84	2400 to 38000	59 / 59	5570 to 34000	29303	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Lead	mg/kg	647 / 654	1.1 to 1100	59 / 60	1.9 to 10	8.39	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Magnesium	mg/kg	81 / 81	2600 to 17000	55 / 55	2500 to 13000	12100	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Manganese	mg/kg	84 / 84	64 to 520	57 / 57	140 to 450	402	Yes	Site Less than or Equal to Background	NA	NA	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Mercury	mg/kg	71 / 644	0.1 to 25	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Molybdenum	mg/kg	153 / 654	0.57 to 1300	11 / 60	0.383 to 2.8	1.37	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Inorganics	Nickel	mg/kg	678 / 679	1.7 to 210	70 / 70	2.6 to 31	27.3	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Potassium	mg/kg	81 / 81	170 to 4000	54 / 54	540 to 4300	4400	No	NA	NA	NA	NA	NA	Exclude	Within Background
Inorganics	Selenium	mg/kg	10 / 644	0.52 to 3	7 / 59	0.738 to 2.7	1.47	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	Site Less than or Equal to Background	No Analysis	Exclude	Within Background
Inorganics	Silver	mg/kg	5 / 644	1.2 to 3.4	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background

Table 3-6n
Background Screening Evaluation: Inside of Compressor Station (ICS)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	Constituents	Units	Exposure Area - Detection Frequency	Exposure Area - Range	Background - Detection Frequency	Background - Range	Background - BTV	Exposure Area Maximum Detection Above BTV?	Mean/Median Test Conclusion - WMW Test	Mean/Median Test Conclusion - TW Test	Mean/Median Test Conclusion - Gehan Test	Mean/Median Test Conclusion - Test of Proportions	Quantile Test	Include as a COPC or COPEC?	Include/Exclude as COPC or COPEC Basis
Inorganics	Sodium	mg/kg	94 / 95	58 to 3400	51 / 55	170 to 4500	2070	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Essential Nutrient (No Toxicity Values Available)
Inorganics	Thallium	mg/kg	11 / 644	1.2 to 2.4	0 / 55	ND	NC	NA	NA	NA	NA	NA	NA	Include	Above Background
Inorganics	Vanadium	mg/kg	641 / 642	4.4 to 82	60 / 60	9.4 to 59	52.2	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Less than or Equal to Background	Exclude	Within Background
Inorganics	Zinc	mg/kg	689 / 690	3.4 to 1900	70 / 70	8.4 to 66.1	58	Yes	NA	Site Less than or Equal to Background	Site Less than or Equal to Background	NA	Site Greater than Background	Include	Above Background
PAHs	PAH High molecular weight	µg/kg	535 / 535	0 to 34400	14 / 42	5.1 to 267.4	267.4	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	PAH Low molecular weight	µg/kg	537 / 537	0 to 33000	6 / 42	6.9 to 37.6	37.6	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
PAHs	B(a)P Equivalent	µg/kg	286 / 534	6.1 to 2900	14 / 42	6.1 to 55	55	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Avian	ng/kg	171 / 179	0.18 to 1500	33 / 35	0.13 to 3	5.98	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Human	ng/kg	171 / 179	0.1 to 2200	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background
Dioxins	TEQ Mammals	ng/kg	171 / 179	0.1 to 2200	33 / 35	0.096 to 3.6	5.58	Yes	NA	Site Greater than Background	Site Greater than Background	NA	NA	Include	Above Background

Notes:
B(a)P = benzo(a)pyrene.
BTV = background threshold value (CH2M, 2009, 2013, 2017).
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
Gehan = Gehan two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
mg/kg = milligrams per kilogram.
NA = not applicable; not detected, no BTV available, maximum detection is below BTV, site dataset is fewer than 10 samples, or test not applicable for WMW test (see text for details).
NC = not calculated; no detections in background dataset.
ND = not detected.
ng/kg = nanograms per kilogram.
PAH = polycyclic aromatic hydrocarbon.
Quantile = Quantile two-sample hypothesis test conducted using ProUCL 4.1 (USEPA, 2010), and R script (R Core Team, 2017) for datasets where ProUCL 4.1 Quantile test could not be conducted. "No Analysis" indicates that Quantile test was not able to calculate an alpha value (see text for details).
TEQ = toxic equivalent.
Test of Proportions = Test of proportions conducted using R script (R Core Team, 2017) developed for two sample hypothesis testing when Quantile test was not able to calculate an alpha value (see text for details).
TW = Tarone-Ware two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).
µg/kg = micrograms per kilogram.
USEPA = U.S. Environmental Protection Agency.
WMW = Wilcoxon-Mann Whitney two-sample hypothesis test conducted using ProUCL 5.1 (USEPA, 2018).

References:

CH2M HILL. (CH2M). 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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Table 3-7
COPC/COPEC Summary for Potential Exposure Areas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	COPC/COPEC	Bat Cave Wash (BCW)	SWMU 1 and TCS-4	BCW Excluding SWMU 1 and TSC-4	AOC 4	AOC 9	AOC 10	AOC 11	AOC 12	AOC 14	AOC 27	AOC 28	AOC 31	UA-2	Tamarisk Thicket	Outside of Compressor Station (OCS)	OCS Excluding BCW	BCW and AOC 4	OCS Excluding BCW and AOC 4	North of Railroad	Inside of Compressor Station (ICS)
Inorganicss	Antimony	x	x		x	x	x			x	x					x	x	x	x		x
Inorganics	Arsenic					x	x	x						x							
Inorganics	Barium				x									x				x			
Inorganics	Cadmium										x										
Inorganics	Chromium, Hexavalent	x	x	x	x	x	x	x		x	x				x	x	x	x	x	x	x
Inorganics	Chromium, total	x	x	x	x	x	x	x							x	x	x	x	x	x	x
Inorganics	Cobalt	x	x	x	x													x		x	
Inorganics	Copper	x	x	x	x	x	x	x		x	x		x		x	x	x	x	x	x	x
Inorganics	Cyanide						x									x	x		x		x
Inorganics	Lead	x	x	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x
Inorganics	Manganese						x							x	x						
Inorganics	Mercury (inorganic)	x	x	x	x	x	x	x		x	x					x	x	x	x		x
Inorganics	Molybdenum											x									x
Inorganics	Nickel				x	x												x			
Inorganics	Nitrate	x	x							x						x	x	x	x		
Inorganics	Orthophosphate	x	x	x												x				x	
Inorganics	Phosphate	x	x							x						x	x	x	x		
Inorganics	Silver																				x
Inorganics	Thallium	x		x		x	x			x						x	x	x	x		x
Inorganics	Vanadium				x													x			
Inorganics	Zinc	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
Volatile Organic Compounds	Acetone																				x
Volatile Organic Compounds	Bromomethane										x					x	x		x		
Volatile Organic Compounds	Chloro methane										x					x	x		x		
Volatile Organic Compounds	Chloroform												x			x	x		x		x
Volatile Organic Compounds	Isophorone					x										x	x		x		
Volatile Organic Compounds	Methyl acetate	x		x				x								x	x	x	x		x
Volatile Organic Compounds	Methylene chloride																				x
Volatile Organic Compounds	Toluene																				x
Volatile Organic Compounds	Xylenes, total																				x
Semi-Volatile Organic Compounds	4-Methylphenol									x				x		x	x		x		
Semi-Volatile Organic Compounds	bis (2-ethylhexyl) phthalate	x		x						x				x		x	x	x	x		x
Semi-Volatile Organic Compounds	Butylbenzylphthalate									x						x	x				
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	x	x	x	x	x	x	x	x	x	x		x			x		x	x		
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	x	x	x	x	x	x	x		x	x		x			x		x	x		
Polycyclic Aromatic Hydrocarbons	1-Methyl naphthalene				x	x	x	x								x	x				x
Polycyclic Aromatic Hydrocarbons	2-Methyl naphthalene	x	x		x	x	x	x					x			x	x				x
Polycyclic Aromatic Hydrocarbons	Acenaphthene				x	x		x			x					x	x				x
Polycyclic Aromatic Hydrocarbons	Acenaphthylene				x	x		x		x	x					x	x				x
Polycyclic Aromatic Hydrocarbons	Anthracene	x	x	x	x	x	x	x		x	x					x	x				x
Polycyclic Aromatic Hydrocarbons	Benzo (a) anthracene				x	x	x	x			x		x								x
Polycyclic Aromatic Hydrocarbons	Benzo (a) pyrene				x	x	x	x			x		x								x
Polycyclic Aromatic Hydrocarbons	Benzo (b) fluoranthene				x	x	x	x			x		x								x
Polycyclic Aromatic Hydrocarbons	Benzo (ghi) perylene	x	x	x	x	x	x	x	x	x	x			x		x	x			x	x
Polycyclic Aromatic Hydrocarbons	Benzo (k) fluoranthene				x	x	x	x			x		x								x
Polycyclic Aromatic Hydrocarbons	Chrysene				x	x	x	x			x		x								x
Polycyclic Aromatic Hydrocarbons	Dibenzo (a,h) anthracene				x	x	x	x			x										x
Polycyclic Aromatic Hydrocarbons	Fluoranthene	x	x	x	x	x	x	x	x	x	x	x	x			x	x			x	x

Table 3-7
COPC/COPEC Summary for Potential Exposure Areas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	COPC/COPEC	Bat Cave Wash (BCW)	SWMU 1 and TCS-4	BCW Excluding SWMU 1 and TSC-4	AOC 4	AOC 9	AOC 10	AOC 11	AOC 12	AOC 14	AOC 27	AOC 28	AOC 31	UA-2	Tamarisk Thicket	Outside of Compressor Station (OCS)	OCS Excluding BCW	BCW and AOC 4	OCS Excluding BCW and AOC 4	North of Railroad	Inside of Compressor Station (ICS)
Polycyclic Aromatic Hydrocarbons	Fluorene	x	x		x	x		x			x					x	x				x
Polycyclic Aromatic Hydrocarbons	Indeno (1,2,3-cd) pyrene				x	x	x	x			x										x
Polycyclic Aromatic Hydrocarbons	Naphthalene	x	x	x	x	x	x	x			x	x				x	x				x
Polycyclic Aromatic Hydrocarbons	Phenanthrene	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x			x	x
Polycyclic Aromatic Hydrocarbons	Pyrene	x	x	x	x	x	x	x	x	x	x	x	x			x	x			x	x
Polycyclic Aromatic Hydrocarbons	B (a) P Equivalent				x	x	x	x			x		x								x
Pesticides	4,4-DDE					x		x		x						x	x		x		x
Pesticides	4,4-DDT									x						x	x		x		x
Pesticides	alpha-Chlordane							x								x	x		x		x
Pesticides	Dieldrin							x								x	x		x		
Pesticides	gamma-Chlordane							x								x	x		x		x
Polychlorinated Biphenyls	Total PCBs	x	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x
Total Petroleum Hydrocarbons	TPH as diesel	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Total Petroleum Hydrocarbons	TPH as motor oil	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Dioxins/Furans	TEQ Avian	x	x	x	x	x	x	x		x	x				x	x		x	x		
Dioxins/Furans	TEQ Human	x	x	x	x	x	x	x		x	x					x	x			x	x
Dioxins/Furans	TEQ Mammals	x	x	x	x	x	x	x		x	x				x	x		x	x		

Abbreviations:

AOC = area of concern.
B (a) P equivalent = benzo(a)pyrene equivalent.
BCW = Bat Cave Wash.
COPC = constituent of potential concern.
COPEC = constituent of potential ecological concern.
x = Chemical included as COPC or COPEC in human health and ecological risk assessment (HHERA). Blank cells indicate that chemical is either: (1) not analyzed for, (2) not detected if analyzed for, (3) detected within background levels, or (4) detected, but with no toxicity value available.
DDE = dichlorodiphenyldichloroethylene.
DDT = dichlorodiphenyltrichloroethane.
ICS = inside the compressor station.
OCS = outside the compressor station.
PAH = polycyclic aromatic hydrocarbon.
PCB = polychlorinated biphenyl.
SWMU = solid waste management unit.
TCS = Topock Compressor Station.
TEQ = toxic equivalent.
TPH = total petroleum hydrocarbon.
UA = undesignated area.

Table 4-1
UCL Decision Tree

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

ProUCL: Potential UCL(s) to Use Combination of Multiple UCL Methods Selected by ProUCL	Upper Confidence Limit (UCL) Method Used for Topock Exposure Point Concentrations (EPCs)	Rationale
95% KM (t) UCL KM H-UCL	95% KM (t) UCL	H-UCL can often be inflated.
95% KM (t) UCL KM H-UCL 95% KM (BCa) UCL	95% KM (BCa) UCL	H-UCL can often be inflated. BCa is more robust and is consistent with the area-weighting approach.
95% KM Adjusted Gamma UCL 95% G R O S Adjusted Gamma UCL	95% KM Adjusted Gamma UCL	G R O S Adjusted Gamma is more vulnerable to the effects of outliers.
95% KM Approximate Gamma UCL 95% G R O S Approximate Gamma UCL	95% KM Approximate Gamma UCL	G R O S Approximate Gamma is more vulnerable to the effects of outliers.
95% KM Bootstrap t UCL Gamma Adjusted KM-UCL (use when k less than or equal to 1 and 15 less than n less than 50 but k less than or equal to 1)	Gamma Adjusted KM-UCL (use when k less than or equal to 1 and 15 less than n less than 50 but k less than or euql to 1)	Gamma Adjusted KM-UCL is more robust.
95% Student's-t UCL 95% Modified-t UCL	95% Student's-t UCL	95% Student's-t is a simpler model with similar results.
95% Student's-t UCL 95% Modified-t UCL 95% H-UCL	95% Student's-t UCL	H-UCL can often be inflated. 95% Student's-t is a simpler model with similar results as the modified-t.
97.5% KM (Chebyshev) UCL 99% KM (Chebyshev) UCL	97.5% KM (Chebyshev) UCL	97.5% KM (Chebyshev) UCL is closer to the intended confidence level for EPCs, i.e., 95%.
KM Student's t KM H-UCL	KM Student's t	H-UCL can often be inflated.
95% KM Bootstrap t UCL 95% Hall's Bootstrap	95% KM Bootstrap t UCL	Hall’s UCL can be inflated by outliers resulting in an impractically large and unstable value.

Acronyms and Abbreviations:
BCa = bias-corrected, accelerated
EPC = exposure point concentration
G R O S = Gamma Regression on order statistics
H-UCL = upper confidence limit based upon Land’s H-statistic
k = the number of nondetect observations present in a dataset
KM = Kaplan-Meier
Modified-t = Student’s t-statistics adjusted for skewness
n = number of observations/measurements in a population
Student's-t = Student’s t-statistics
t = Student’s t-statistics
UCL = upper confidence limit

Table 4-2
Comparison of BCa Outputs

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Statistic	ProUCL output	R Bootstrap output
Sample mean	336.05	336.05
Area-weighted mean	Not applicable	117.42
BCa bootstrap 95% UCL	535.6	535.48
Area-weighted BCa bootstrap 95% UCL	Not applicable	192.5

Acronyms and Abbreviations:
BCa = bias-corrected, accelerated
R = R language subroutine (used to generate bootstrap value)
UCL = upper confidence limit

Table 5-1
Human Health Exposure Parameters

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Exposure Parameter Category	Exposure Parameter	Symbol	Units	Potential Receptor Scenario - Short-Term Maintenance Worker	Potential Receptor Scenario - Long-Term Maintenance Worker	Potential Receptor Scenario - Child Camper	Potential Receptor Scenario - Adult Camper	Potential Receptor Scenario - Age-Adjusted Adult Camper	Potential Receptor Scenario - Child Hiker	Potential Receptor Scenario - Adult Hiker	Potential Receptor Scenario - Age-Adjusted Adult Hiker
Inhalation of Soil Particulates	Particulate Emission Factor [a]	PEF	m^3/kg	1000000	1000000	1360000000	1360000000	1360000000	1360000000	1360000000	1360000000
Dermal Contact with Soil	Surface Area [b]	SA	cm^2/day	6032	6032	2900	6032	6032	2900	6032	6032
Dermal Contact with Soil	Adherence Factor [c]	AF	mg/cm^2	0.8	0.8	0.2	0.07	0.07	0.2	0.07	0.07
Dermal Contact with Soil	Absorption Factor-P A H /PCBs [d]	ABS-P A H	unitless	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Dermal Contact with Soil	Absorption Factor-Metals [d]	ABS-Met	unitless	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Arsenic [d]	ABS-As	unitless	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dermal Contact with Soil	Absorption Factor-Cadmium [d]	ABS-Cd	unitless	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Dermal Contact with Soil	Absorption Factor-Chromium VI [d]	ABS-CrVI	unitless	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact with Soil	Absorption Factor-Cyanide [d]	ABS-CN	unitless	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Mercury [d]	ABS-Hg	unitless	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Organochlorine Pesticides [d]	ABS-Pest	unitless	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dermal Contact with Soil	Absorption Factor-Organics [d]	ABS-Org	unitless	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Dermal Contact with Soil	Conversion Factor	CF	kg/mg	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
Ingestion of Soil	Ingestion Rate [e]	IR	mg/day	330	330	200	100	100	200	100	100
Ingestion of Soil	Conversion Factor	CF	kg/mg	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
Population-Specific Intake Parameters	Exposure Time (ingestion) [f]	ET_{ing}	hours/day	8	4	16	16	16	16	16	16
Population-Specific Intake Parameters	Exposure Time (inhalation) [g]	ET_{inh}	hours/day	8	4	24	24	24	24	24	24
Population-Specific Intake Parameters	Time Conversion Factor (ingestion)	TCF_{ing}	hours/day	8	8	16	16	16	16	16	16
Population-Specific Intake Parameters	Time Conversion Factor (inhalation)	TCF_{inh}	hours/day	24	24	24	24	24	24	24	24
Population-Specific Intake Parameters	Exposure Frequency [h]	EF	days/year	40	20	8	8	8	16	16	16
Population-Specific Intake Parameters	Exposure Duration [i]	ED	years	1	30	6	26	20	6	26	20
Population-Specific Intake Parameters	Body Weight [k]	BW	kg	80	80	15	80	80	15	80	80
Population-Specific Intake Parameters	Averaging Time-Carcinogens [l]	AT_c	days	25550	25550	25550	25550	25550	25550	25550	25550
Population-Specific Intake Parameters	Averaging Time-Noncarcinogens [l]	AT_{nc}	days	365	10950	2190	9490	7300	2190	9490	7300

Table 5-1
Human Health Exposure Parameters

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Exposure Parameter Category	Exposure Parameter	Symbol	Units	Potential Receptor Scenario - Hunter	Potential Receptor Scenario - Child O H V Rider	Potential Receptor Scenario - Adult O H V Rider	Potential Receptor Scenario - Age-Adjusted Adult O H V Rider	Potential Receptor Scenario - Tribal User	Potential Receptor Scenario - Hypothetical Future Child Resident	Potential Receptor Scenario - Hypothetical Future Adult Resident	Potential Receptor Scenario - Hypothetical Future Age-Adjusted Adult Resident
Inhalation of Soil Particulates	Particulate Emission Factor [a]	PEF	m^3/kg	1360000000	847000	847000	847000	1360000000	1360000000	1360000000	1360000000
Dermal Contact with Soil	Surface Area [b]	SA	cm^2/day	6032	2900	6032	6032	NA	2900	6032	6032
Dermal Contact with Soil	Adherence Factor [c]	AF	mg/cm^2	0.07	0.8	0.8	0.8	NA	0.2	0.07	0.07
Dermal Contact with Soil	Absorption Factor-P A H /PCBs [d]	ABS-P A H	unitless	0.15	0.15	0.15	0.15	NA	0.15	0.15	0.15
Dermal Contact with Soil	Absorption Factor-Metals [d]	ABS-Met	unitless	0.01	0.01	0.01	0.01	NA	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Arsenic [d]	ABS-As	unitless	0.03	0.03	0.03	0.03	NA	0.03	0.03	0.03
Dermal Contact with Soil	Absorption Factor-Cadmium [d]	ABS-Cd	unitless	0.001	0.001	0.001	0.001	NA	0.001	0.001	0.001
Dermal Contact with Soil	Absorption Factor-Chromium VI [d]	ABS-CrVI	unitless	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact with Soil	Absorption Factor-Cyanide [d]	ABS-CN	unitless	0.01	0.01	0.01	0.01	NA	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Mercury [d]	ABS-Hg	unitless	0.01	0.01	0.01	0.01	NA	0.01	0.01	0.01
Dermal Contact with Soil	Absorption Factor-Organochlorine Pesticides [d]	ABS-Pest	unitless	0.05	0.05	0.05	0.05	NA	0.05	0.05	0.05
Dermal Contact with Soil	Absorption Factor-Organics [d]	ABS-Org	unitless	0.1	0.1	0.1	0.1	NA	0.1	0.1	0.1
Dermal Contact with Soil	Conversion Factor	CF	kg/mg	0.000001	0.000001	0.000001	0.000001	NA	0.000001	0.000001	0.000001
Ingestion of Soil	Ingestion Rate [e]	IR	mg/day	100	330	330	330	NA	200	100	100
Ingestion of Soil	Conversion Factor	CF	kg/mg	0.000001	0.000001	0.000001	0.000001	NA	0.000001	0.000001	0.000001
Population-Specific Intake Parameters	Exposure Time (ingestion) [f]	ET_{ing}	hours/day	16	1.5	1.5	1.5	2	16	16	16
Population-Specific Intake Parameters	Exposure Time (inhalation) [g]	ET_{inh}	hours/day	24	1.5	1.5	1.5	2	24	24	24
Population-Specific Intake Parameters	Time Conversion Factor (ingestion)	TCF_{ing}	hours/day	16	16	16	16	16	16	16	16
Population-Specific Intake Parameters	Time Conversion Factor (inhalation)	TCF_{inh}	hours/day	24	24	24	24	24	24	24	24
Population-Specific Intake Parameters	Exposure Frequency [h]	EF	days/year	8	16	16	16	12	350	350	350
Population-Specific Intake Parameters	Exposure Duration [i]	ED	years	26	6	26 [j]	20 [j]	60 [j]	6 [j]	26	20
Population-Specific Intake Parameters	Body Weight [k]	BW	kg	80	33	80	80	80	15	80	80
Population-Specific Intake Parameters	Averaging Time-Carcinogens [l]	AT_c	days	25550	25550	25550	25550	25550	25550	25550	25550
Population-Specific Intake Parameters	Averaging Time-Noncarcinogens [l]	AT_{nc}	days	9490	2190	9490	7300	21900	2190	9490	7300

Table 5-1
Human Health Exposure Parameters

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

[a] A default particulate emission factor of 1,360,000,000 cubic meters per kilogram as recommended by (D T S C 2014) was used for hypothetical future residents, recreational users (campers, hikers, and hunters), and tribal users. A particulate emission factor of 84,700 cubic meters per kilogram was used for recreational users (off-highway vehicle rider) as calculated in United States Environmental Protection Agency (2008, 2009) and recommended in Revised Technical Memorandum, Recreational Visitor Exposure Scenario for Federal Land, PG&E Topock Compressor Station Remediation Project, California prepared by the Department of the Interior. A default particulate emission factor of 1,000,000 cubic meters per kilogram was used for maintenance workers (short-term and long-term) as recommended by D T S C (2014).

[b] The default area of exposed skin as recommended by D T S C (2014) was used for hypothetical future residents, recreational users (campers, hikers, and hunters), and tribal users. For long-term and short-term worker scenarios, corresponds to the area of exposed skin recommended by D T S C for construction workers (D T S C 2014).

[c] Soil adherence factors as recommended by D T S C (2014) was used for hypothetical future residents, recreational users (campers, hikers, and hunters), and tribal users. For long-term and short-term worker scenarios, corresponds to the adherence factor recommended by D T S C for construction workers (D T S C 2014).

[d] Dermal absorption factors for specific compound classes from D T S C (2015).

[e] Default incidental soil ingestion rates as recommended by D T S C (2014) used for hypothetical future residents, recreational users (campers, hikers, and hunters), and tribal users. For long-term and short-term worker scenarios, corresponds to the incidental soil ingestion rate recommended by D T S C for construction workers (D T S C 2014).

[f] Exposure time for ingestion for all potential receptor scenarios consistent with that defined in the Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015). For hikers, hunters, and hypothetical future residents, 16 hours is assumed to be awake hours where ingestion will occur.

[g] Exposure time for inhalation for all potential receptor scenarios consistent with that defined in the Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015). For child hikers, an assumed 24-hour per day exposure time is provided to generate a 10 cubic meters daily inhalation volume, based on an assumed elevated activity rate for hiking. The actual expected exposure time is more likely between 8 to 12 hours per day (for example, daylight hours). For adult hikers and hunters, an assumed 24-hour per day exposure time is provided to generate a 20 cubic meters daily inhalation volume, based on an assumed elevated activity rate for hiking and hunting. The actual expected exposure time is more likely between 8 to 12 hours per day (for example, daylight hours).

[h] Exposure frequency for all potential receptor scenarios consistent with that defined in the Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015).

[i] Exposure duration for all potential receptor scenarios consistent with that defined in the Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015).

[j] Per U S E P A guidance (2002), cancer risks for receptors potentially exposed during childhood and adult years (that is, hypothetical future residents) are calculated using an age-adjusted approach to account for the higher exposures per body weight that occur during the childhood years. Accordingly, for carcinogenic effects, hypothetical future residents are evaluated as children for the first 6 years of potential exposure and adults for the remaining 20 years (for a total exposure duration of 26 years). For noncarcinogenic hazards, potential child and adult resident receptors are evaluated separately (6-year exposure duration for child, 26-year exposure duration for adult).

[k] Body weight values correspond to the CalEPA default values for potential adult and child receptors (D T S C 2014).

[l] Averaging times correspond to the CalEPA default values (that is, 70-year lifetime × 365 days per year for carcinogens; exposure duration × 365 days per year for noncarcinogens) (D T S C 2014).

Abbreviations:

Cal EPA	California Environmental Protection Agency
cm^2/day =	square centimeters per day
D T S C	Department of Toxic Substances Control
kg/mg =	kilograms per milligram
m^3/kg =	cubic meters per kilogram
mg/cm^2 =	milligrams per square centimeter
mg/day =	milligrams per day
NA =	Not applicable; parameter not applicable to exposure scenario for potential exposure pathways evaluated in the Human Health Risk Assessment. Hexavalent chromium is not absorbed via dermal contact.
O H V =	off-highway vehicle
P A H =	polycyclic aromatic hydrocarbon
U S E P A =	United States Environmental Protection Agency

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Table 5-2
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Worker Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Exposure Concentration: Vapor Inhalation

Noncancer Equation:

$$EC_{inhv,\ worker,\ nc} = \frac{C_a \times ET \times (1/TCF_{inh}) \times EF \times ED_{worker}}{AT_{nc,\ worker}}$$

where $C_a = C_s$ x 1/Volatilization Factor for soil to outdoor air pathway
where $C_a = C_{sg}$ x α for soil gas to indoor air pathway
where $C_a = C_{sg}$ x Transfer Factor for soil gas to outdoor air pathway

Exposure Concentration: Vapor Inhalation

Cancer Equation:

$$EC_{inhv,\ worker,\ c} = \frac{C_a \times ET \times (1/TCF_{inh}) \times EF \times ED_{worker}}{AT_c}$$

where $C_a = C_s$ x 1/Volatilization Factor for soil to outdoor air pathway
where $C_a = C_{sg}$ x α for soil gas to indoor air pathway
where $C_a = C_{sg}$ x Transfer Factor for soil gas to outdoor air pathway

Exposure Concentration: Soil Particulate Inhalation

Noncancer Equation:

$$EC_{inhp,\ worker,\ nc} = \frac{C_s \times (1/PEF) \times ET \times 1/(TCF_{inh}) \times EF \times ED_{worker}}{AT_{nc,\ worker}}$$

Exposure Concentration: Soil Particulate Inhalation

Cancer Equation:

$$EC_{inhp,\ worker,\ c} = \frac{C_s \times (1/PEF) \times ET \times (1/TCF_{inh}) \times EF \times ED_{worker}}{ATc}$$

Table 5-2
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Worker Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Chronic Daily Intake: Dermal Contact

Noncancer Equation:

$$CDI_{derm,\ worker,\ nc} = \frac{C_s \times SA_{worker} \times AF_{worker} \times ABS \times EF \times ED_{worker} \times CF}{BW_{worker} \times AT_{nc,\ worker}}$$

Chronic Daily Intake: Dermal Contact

Cancer Equation:

$$CDI_{derm,\ worker,\ c} = \frac{C_s \times SA_{worker} \times AF_{worker} \times ABS \times EF \times ED_{worker} \times CF}{BW_{worker} \times AT_c}$$

Chronic Daily Intake: Soil Ingestion

Noncancer Equation:

$$CDI_{ing,\ worker,\ nc} = \frac{C_s \times IR_{worker} \times CF \times EF \times ED_{worker}}{BW_{worker} \times AT_{nc,\ worker}}$$

Chronic Daily Intake: Soil Ingestion

Cancer Equation:

$$CDI_{ing,\ worker,\ c} = \frac{C_s \times IR_{worker} \times CF \times EF \times ED_{worker}}{BW_{worker} \times AT_c}$$

Table 5-2
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Worker Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Equation Notes:
where ABS = Absorption Factor [unitless]
where α = Soil Gas-to-Indoor Air Attenuation Factor [unitless]
where AF = Soil to Skin Adherence Factor [milligrams per square centimeter]
where AT_c = Averaging Time for Carcinogenic Compounds [days]
where AT_{nc} = Averaging Time for Noncarcinogenic Compounds [days]
where BW = Body Weight [kilograms]
where C_a = Concentration of Chemical in Air [milligrams per cubic meter]
where C_s = Concentration of Chemical in Soil [milligrams per kilogram]
where C_{sg} = Concentration of Chemical in Soil Gas [milligrams per cubic meter]
where CDI_{derm} = Chronic Daily Intake: Dermal Contact [milligrams of the chemical per kilogram of body weight per day]
where CDI_{ing} = Chronic Daily Intake: Ingestion [milligrams of the chemical per kilogram of body weight per day]
where CF = Conversion Factor [kilograms per milligram]
where EC_{inhp} = Exposure Concentration: Soil Particulate Inhalation [milligrams of the chemical per cubic meter of air]
where EC_{inhv} = Exposure Concentration: Vapor Inhalation [milligrams of the chemical per cubic meter of air]
where ED = Exposure Duration [years]
where EF = Exposure Frequency [days per year]
where ET = Exposure Time [hours per day]
where IR = Soil Ingestion Rate [milligrams per day]
where PEF = Soil-to-Air Particulate Emission Factor [cubic meter per kilogram]
where SA = Surface Area of Exposed Skin [square centimeters per day]
where TCF_{inh} = Time Conversion Factor: Inhalation [hours per day]
where TF = Soil Gas-to-Air Transfer Factor [milligrams per cubic meter of soil gas]/[milligrams per cubic meter of air]
where VF = Soil-to-Air Volatilization Factor [cubic meters per kilogram]
where worker = Commercial or Maintenance Worker

Table 5-3a
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Recreational Users, Tribal Users, and Hypothetical Future Residential Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Exposure Concentration: Vapor Inhalation

Noncancer Equation:

$$EC_{inhv,\ nc} = \frac{C_a \times ET \times (1/TCF_{inh}) \times EF \times ED_{adult}}{AT_{nc,\ adult}}$$

where $C_a = C_s \times 1/VF$ for soil to outdoor air pathway

Exposure Concentration: Vapor Inhalation

Cancer Equation:

$$EC_{inhv,\ c} = \frac{C_a \times ET \times (1/TCF_{inh}) \times EF \times ED_{adult}}{AT_c}$$

where $C_a = C_s \times 1/VF$ for soil to outdoor air pathway

Exposure Concentration: Soil Particulate Inhalation

Noncancer Equation:

$$EC_{inhp,\ nc} = \frac{C_s \times (1/TCF_{inh}) \times (1/PEF) \times EF \times ED_{adult}}{AT_{nc,\ adult}}$$

Exposure Concentration: Soil Particulate Inhalation

Cancer Equation:

$$EC_{inhp,\ c} = \frac{C_s \times (1/TCF_{inh}) \times (1/PEF) \times EF \times ED_{adult}}{AT_c}$$

Table 5-3a
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Recreational Users, Tribal Users, and Hypothetical Future Residential Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Chronic Daily Intake: Dermal Contact

Noncancer Equation:

$$CDI_{derm,\ child,\ nc} = \frac{C_s \times SA_{child} \times AF_{child} \times ABS \times EF \times ED_{child} \times CF}{BW_{child} \times AT_{nc,\ child}} \qquad CDI_{derm,\ adult} = \frac{C_s \times SA_{adult} \times AF_{adult} \times ABS \times EF \times ED_{adult} \times CF}{BW_{adult} \times AT_{nc,\ adult}}$$

Chronic Daily Intake: Dermal Contact

Cancer Equation:

$$CDI_{derm,\ age\ adjusted,\ c} = \frac{C_s \times SA_{child} \times AF_{child} \times ABS \times EF \times ED_{child} \times CF}{BW_{child} \times AT_c} + \frac{C_s \times SA_{adult} \times AF_{adult} \times ABS \times EF \times ED_{adult,\ age\ adjusted} \times CF}{BW_{adult} \times AT_c}$$

Chronic Daily Intake: Soil Ingestion

Noncancer Equation:

$$CDI_{ing,\ child,\ nc} = \frac{C_s \times IR_{child} \times CF \times ET \times (1/TCF_{ing}) \times EF \times ED_{child}}{BW_{child} \times AT_{nc,\ child}} \qquad CDI_{ing,\ adult} = \frac{C_s \times IR_{adult} \times CF \times ET \times (1/TCF_{ing}) \times EF \times ED_{adult}}{BW_{adult} \times AT_{nc,\ adult}}$$

Chronic Daily Intake: Soil Ingestion

Cancer Equation:

$$CDI_{ing,\ age\ adjusted,\ c} = \frac{C_s \times IR_{child} \times CF \times ET \times (1/TCF_{ing}) \times EF \times ED_{child}}{BW_{child} \times AT_c} + \frac{C_s \times IR_{adult} \times CF \times ET \times (1/TCF_{ing}) \times EF \times ED_{adult,\ age\ adjusted}}{BW_{adult} \times AT_c}$$

Table 5-3a
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes: Recreational Users, Tribal Users, and Hypothetical Future Residential Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Equation Notes:

where ABS = Absorption Factor [unitless]
where AF = Soil to Skin Adherence Factor [milligrams per square centimeter]
where AT_c = Averaging Time for Carcinogenic Compounds [days]
where AT_{nc} = Averaging Time for Noncarcinogenic Compounds [days]
where BW = Body Weight [kilograms]
where C_a = Concentration of Chemical in Air [milligrams per cubic meter]
where C_s = Concentration of Chemical in Soil [milligrams per kilogram]
where CDI_{derm} = Chronic Daily Intake: Dermal Contact [milligrams of the chemical per kilogram of body weight per day]
where CDI_{ing} = Chronic Daily Intake: Ingestion [milligrams of the chemical per kilogram of body weight per day]
where CF = Conversion Factor [kilograms per milligram]
where EC_{inhp} = Exposure Concentration: Soil Particulate Inhalation [milligrams of the chemical per cubic meter of air]
where EC_{inhv} = Exposure Concentration: Vapor Inhalation [milligrams of the chemical per cubic meter of air]
where ED = Exposure Duration [years]
where EF = Exposure Frequency [days per year]
where ET = Exposure Time [hours per day]
where IR = Soil Ingestion Rate [milligrams per day]
where PEF = Soil-to-Air Particulate Emission Factor [cubic meters per kilogram]
where SA = Surface Area of Exposed Skin [square centimeters per day]
where TCF_{ing} = Time Conversion Factor: Ingestion [hours per day]
where TCF_{inh} = Time Conversion Factor: Inhalation [hours per day]
where VF = Soil-to-Air Volatilization Factor [cubic meters per kilogram]

Table 5-3b
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes for Mutagens: Recreational Users and Hypothetical Future Residential Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Exposure Concentration: Vapor Inhalation

Mutagenic Equation:

$$EC_{inhv,mut} = C_a \times ET \times \frac{1}{TCF_{inh}} \times \frac{1}{AT_c} \times \begin{pmatrix} (EF_{0-2} \times ED_{0-2} \times 10) + \\ (EF_{2-6} \times ED_{2-6} \times 3) + \\ (EF_{6-16} \times ED_{6-16} \times 3) + \\ (EF_{16-26} \times ED_{16-26} \times 1) \end{pmatrix}$$

where C_a = C_s x 1/Volatilization Factor for soil to outdoor air pathway

Exposure Concentration: Soil Particulate Inhalation

Mutagenic Equation:

$$EC_{inhp,mut} = C_s \times ET \times \frac{1}{TCF_{inh}} \times \frac{1}{PEF} \times \frac{1}{AT_c} \times \begin{pmatrix} (EF_{0-2} \times ED_{0-2} \times 10) + \\ (EF_{2-6} \times ED_{2-6} \times 3) + \\ (EF_{6-16} \times ED_{6-16} \times 3) + \\ (EF_{16-26} \times ED_{16-26} \times 1) \end{pmatrix}$$

Chronic Daily Intake: Dermal Contact

Mutagenic Equation:

$$CDI_{derm,mut} = C_s \times ABS \times CF \times \frac{1}{AT_c} \times$$
$$\begin{pmatrix} \frac{SA_{0-2} \times AF_{0-2} \times EF_{0-2} \times ED_{0-2} \times 10}{BW_{0-2}} + \\ \frac{SA_{2-6} \times AF_{2-6} \times EF_{2-6} \times ED_{2-6} \times 3}{BW_{2-6}} + \\ \frac{SA_{6-16} \times AF_{6-16} \times EF_{6-16} \times ED_{6-16} \times 3}{BW_{6-16}} + \\ \frac{SA_{16-26} \times AF_{16-26} \times EF_{16-26} \times ED_{16-26} \times 1}{BW_{16-26}} \end{pmatrix}$$

Table 5-3b
Equations Used to Calculate Exposure Concentrations and Chronic Daily Intakes for Mutagens: Recreational Users and Hypothetical Future Residential Scenarios

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Chronic Daily Intake: Soil Ingestion

Mutagenic Equation:

$$\mathrm{CDI_{ing,mut}} = \mathrm{C_s} \times \mathrm{CF} \times \mathrm{ET} \times \frac{1}{\mathrm{TCF_{ing}}} \times \frac{1}{\mathrm{AT_c}} \times \left(\frac{\mathrm{IR_{0-2}} \times \mathrm{EF_{0-2}} \times \mathrm{ED_{0-2}} \times 10}{\mathrm{BW_{0-2}}} + \frac{\mathrm{IR_{2-6}} \times \mathrm{EF_{2-6}} \times \mathrm{ED_{2-6}} \times 3}{\mathrm{BW_{2-6}}} + \frac{\mathrm{IR_{6-16}} \times \mathrm{EF_{6-16}} \times \mathrm{ED_{6-16}} \times 3}{\mathrm{BW_{6-16}}} + \frac{\mathrm{IR_{16-26}} \times \mathrm{EF_{16-26}} \times \mathrm{ED_{16-26}} \times 1}{\mathrm{BW_{16-26}}} \right)$$

Equation Notes:
where ABS = Absorption Factor [unitless]
where AF = Soil to Skin Adherence Factor [milligrams per square centimeter]
where AT_c = Averaging Time for Carcinogenic Compounds [days]
where BW = Body Weight [kilograms]
where C_a = Concentration of Chemical in Air [milligrams per cubic meter]
where C_s = Concentration of Chemical in Soil [milligrams per kilogram]
where CDI_{derm} = Chronic Daily Intake: Dermal Contact [milligrams of the chemical per kilogram of body weight per day]
where CDI_{ing} = Chronic Daily Intake: Ingestion [milligrams of the chemical per kilogram of body weight per day]
where CF =Conversion Factor [kilograms per milligram]
where EC_{inhp} = Exposure Concentration: Soil Particulate Inhalation [milligrams of the chemical per cubic meter of air]
where EC_{inhv} = Exposure Concentration: Vapor Inhalation [milligrams of the chemical per cubic meter of air]
where ED = Exposure Duration [years]
where EF = Exposure Frequency [days per year]
where ET = Exposure Time [hours per day]
where IR = Soil Ingestion Rate [milligrams per day]
where PEF = Soil-to-Air Particulate Emission Factor [cubic meters per kilogram]
where SA = Surface Area of Exposed Skin [square centimeters per day]
where TCF_{ing} = Time Conversion Factor: Ingestion [hours per day]
where TCF_{inh} = Time Conversion Factor: Inhalation [hours per day]
where VF = Soil-to-Air Volatilization Factor [cubic meters per kilogram]

Table 5-4
Chemical Properties for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

C O P C Category	C O P C	Diffusivity in air, D_a (cm^2/s)	Source	Diffusivity in water, D_w (cm^2/s)	Source	Henry's Law Constant at Reference Temperature (25°C), H ($atm\text{-}m^3/mol$)	Source	Dimensionless Henry's Law Constant at Reference Temperature (25° C), H' (unitless)	Source	Enthalpy of Vaporization at the Normal Boiling Point, $DH_{v,b}$ (cal/mol)	Source	Normal Boiling Point, T_B (K)	Source	Critical Temperature, T_C (K)	Source
Inorganics	Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Chromium, Hexavalent	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Chromium, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Mercury (inorganic)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Orthophosphate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Phosphate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	1,1-Dichloroethene	0.086	1	0.000011	1	0.026	1	1.1	1	6247	1	305	1	576	1
Volatile Organic Compounds	1,3-Dichlorobenzene	0.056	1	0.0000088	1	0.0022	1	0.089	1	9230	1	446	1	684	1
Volatile Organic Compounds	Acetone	0.11	1	0.000012	1	0.000035	1	0.0014	1	6955	1	329	1	508	1
Volatile Organic Compounds	Benzene	0.090	1	0.000010	1	0.0056	1	0.23	1	7342	1	353	1	562	1
Volatile Organic Compounds	Bromomethane	0.10	1	0.000014	1	0.0073	1	0.30	1	5714	1	277	1	467	1
Volatile Organic Compounds	Carbon disulfide	0.11	1	0.000013	1	0.014	1	0.59	1	6391	1	319	1	552	1
Volatile Organic Compounds	Carbon tetrachloride	0.057	1	0.000010	1	0.028	1	1.1	1	7127	1	350	1	557	1
Volatile Organic Compounds	Chloro methane	0.12	1	0.000014	1	0.0088	1	0.36	1	5115	1	249	1	416	1
Volatile Organic Compounds	Chloroform	0.077	1	0.000011	1	0.0037	1	0.15	1	6988	1	334	1	536	1
Volatile Organic Compounds	Ethyl-benzene	0.068	1	0.0000085	1	0.0079	1	0.32	1	8501	1	409	1	617	1
Volatile Organic Compounds	Isophorone [b]	0.053	2	0.0000075	2	0.0000066	2	0.00027	2	NA		NA		NA	
Volatile Organic Compounds	Methyl acetate	0.096	1	0.000011	1	0.00012	1	0.0047	1	7260	1	330	1	507	1
Volatile Organic Compounds	Methyl ethyl ketone	0.091	1	0.000010	1	0.000057	1	0.0023	1	7481	1	353	1	537	1
Volatile Organic Compounds	Methylene chloride	0.10	1	0.000013	1	0.0033	1	0.13	1	6706	1	313	1	510	1
Volatile Organic Compounds	Tetrachloroethene	0.050	1	0.0000095	1	0.018	1	0.72	1	8288	1	394	1	620	1
Volatile Organic Compounds	Toluene	0.078	1	0.0000092	1	0.0066	1	0.27	1	7930	1	384	1	592	1
Volatile Organic Compounds	Trichloroethene	0.069	1	0.000010	1	0.0099	1	0.40	1	7505	1	360	1	544	1
Volatile Organic Compounds	Xylenes, total	0.069	2	0.0000085	2	0.0066	2	0.27	2	8661	1	418	1	630	1
Semi-Volatile Organic Compounds	4-Methylphenol	0.072	2	0.0000092	2	0.0000010	2	0.000041	2	NA		475	3	NA	
Semi-Volatile Organic Compounds	bis (2-ethylhexyl) phthalate	0.017	2	0.0000042	2	0.00000027	2	0.000011	2	NA		657	3	NA	
Semi-Volatile Organic Compounds	Butylbenzylphthalate	0.021	2	0.0000052	2	0.0000013	2	0.000052	2	NA		643	3	NA	

Table 5-4
Chemical Properties for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

C O P C Category	C O P C	Diffusivity in air, D_a (cm^2/s)	Source	Diffusivity in water, D_w (cm^2/s)	Source	Henry's Law Constant at Reference Temperature (25°C), H ($atm\text{-}m^3/mol$)	Source	Dimensionless Henry's Law Constant at Reference Temperature (25° C), H' (unitless)	Source	Enthalpy of Vaporization at the Normal Boiling Point, $DH_{v,b}$ (cal/mol)	Source	Normal Boiling Point, T_B (K)	Source	Critical Temperature, T_C (K)	Source
Polycyclic Aromatic Hydrocarbons	1-Methyl naphthalene	0.053	2	0.0000078	2	0.00051	2	0.021	2	NA		518	3	NA	
Polycyclic Aromatic Hydrocarbons	2-Methyl naphthalene	0.052	1	0.0000078	1	0.00052	1	0.021	1	12600	1	514	1	761	1
Polycyclic Aromatic Hydrocarbons	Acenaphthene	0.051	1	0.0000083	1	0.00018	1	0.0075	1	12155	1	551	1	803	1
Polycyclic Aromatic Hydrocarbons	Acenaphthylene	0.066	3	NA		0.00011	3	0.0047	3	NA		280	3	NA	
Polycyclic Aromatic Hydrocarbons	Anthracene	0.039	2	0.0000079	2	0.000056	2	0.0023	2	NA		613	3	NA	
Polycyclic Aromatic Hydrocarbons	Benzo (a) anthracene	0.026	2	0.0000067	2	0.000012	2	0.00049	2	NA		711	3	NA	
Polycyclic Aromatic Hydrocarbons	Benzo (a) pyrene	0.048	2	0.0000056	2	0.00000046	2	0.000019	2	NA		NA		NA	
Polycyclic Aromatic Hydrocarbons	Benzo (b) fluoranthene	0.048	1	0.0000056	1	0.00000066	1	0.000027	1	17000	1	716	1	969	1
Polycyclic Aromatic Hydrocarbons	Benzo (ghi) perylene	0.050	3	NA		0.00000033	3	0.000014	3	NA		NA		NA	
Polycyclic Aromatic Hydrocarbons	Benzo (k) fluoranthene	0.048	2	0.0000056	2	0.00000058	2	0.000024	2	NA		753	3	NA	
Polycyclic Aromatic Hydrocarbons	Chrysene	0.026	1	0.0000067	1	0.0000052	1	0.00021	1	16455	1	714	1	979	1
Polycyclic Aromatic Hydrocarbons	Dibenzo (a,h) anthracene	0.045	2	0.0000052	2	0.00000014	2	0.000006	2	NA		797	3	NA	
Polycyclic Aromatic Hydrocarbons	Fluoranthene	0.028	2	0.0000072	2	0.0000089	2	0.00036	2	NA		657	3	NA	
Polycyclic Aromatic Hydrocarbons	Fluorene	0.044	1	0.0000079	1	0.000096	1	0.0039	1	12666	1	570	1	870	1
Polycyclic Aromatic Hydrocarbons	Indeno (1,2,3-cd) pyrene	0.045	2	0.0000052	2	0.00000035	2	0.000014	2	NA		809	3	NA	
Polycyclic Aromatic Hydrocarbons	Naphthalene	0.060	1	0.0000084	1	0.00044	1	0.018	1	10373	1	491	1	748	1
Polycyclic Aromatic Hydrocarbons	Phenanthrene	0.060	3	NA		0.000042	3	0.0017	3	NA		613	3	NA	
Polycyclic Aromatic Hydrocarbons	Pyrene	0.028	1	0.0000072	1	0.000012	1	0.00049	1	14370	1	668	1	936	1
Polycyclic Aromatic Hydrocarbons	B(a)P Equivalent [c]	0.048	2	0.0000056	2	0.00000046	2	0.000019	2	NA		NA		NA	
Pesticides	4,4-DDE	0.041	1	0.0000048	1	0.000042	1	0.0017	1	15000	1	636	1	860	1
Pesticides	4,4-DDT	0.038	2	0.0000044	2	0.0000083	2	0.00034	2	NA		379	3	NA	
Pesticides	alpha-Chlordane	0.044	3	NA		0.00035	3	0.014	3	NA		NA		NA	
Pesticides	Dieldrin	0.023	1	0.0000060	1	0.000010	1	0.00041	1	17000	1	613	1	842	1
Pesticides	gamma-Chlordane	0.044	3	NA		0.00048	3	0.020	3	NA		NA		NA	
Polychlorinated Biphenyls (PCBs)	Total PCBs	0.024	2	0.0000063	2	0.00042	2	0.017	2	NA		NA		NA	
Total Petroleum Hydrocarbons (TPH)	TPH as diesel	0.070	5	0.000010	5	0.78	5	32	5	NA		NA		NA	
Total Petroleum Hydrocarbons	TPH as motor oil	NA		NA		NA		NA		NA		NA		NA	
Dioxins/Furans	Toxic Equivalent Human	0.047	2	0.0000068	2	0.000050	2	0.0020	2	NA		NA		NA	

Table 5-4
Chemical Properties for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

C O P C Category	C O P C	Enthalpy of Vaporization at Average Soil Temperature, $DH_{v,TS}$ (cal/mol)	Source	Henry's Law Constant at Average Soil Temperature, H_{TS} (atm-m3/mol)	Source	Dimensionless Henry's Law Constant at Average Soil Temperature, H'_{TS} (unitless)	Source	Vadose Zone Effective Diffusion Coefficient, D_{effV} (cm^2/s)	Source	Organic Carbon Partition Coefficient, K_{oc} (cm^3/g)	Source	Pure Component Water Solubility (mg/L)	Source	Vapor Pressure, (mmHg)	Source	Soil Saturation Concentration, C_{sat}, calculated [a] (mg/kg)
Inorganics	Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Chromium, Hexavalent	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Chromium, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Mercury (inorganic)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Orthophosphate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Phosphate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	1,1-Dichloroethene	6299	J&E	0.025	J&E	1.0	J&E	0.0067	J&E	32	1	2420	1	495	1	1171
Volatile Organic Compounds	1,3-Dichlorobenzene	11029	J&E	0.0020	J&E	0.084	J&E	0.0043	J&E	379	1	119	1	2.3	5	284
Volatile Organic Compounds	Acetone	7384	J&E	0.000034	J&E	0.0014	J&E	0.0083	J&E	2	1	1000000	1	458	1	114441
Volatile Organic Compounds	Benzene	7977	J&E	0.0053	J&E	0.22	J&E	0.0070	J&E	146	1	1790	1	97	1	1818
Volatile Organic Compounds	Bromomethane	5508	J&E	0.0071	J&E	0.29	J&E	0.0078	J&E	13	1	15223	1	894	1	3559
Volatile Organic Compounds	Carbon disulfide	6572	J&E	0.014	J&E	0.57	J&E	0.0083	J&E	22	1	2160	1	311	1	727
Volatile Organic Compounds	Carbon tetrachloride	7716	J&E	0.026	J&E	1.1	J&E	0.0045	J&E	44	1	793	1	108	1	449
Volatile Organic Compounds	Chloro methane	4578	J&E	0.0086	J&E	0.35	J&E	0.0097	J&E	13	1	5320	1	706	1	1304
Volatile Organic Compounds	Chloroform	7407	J&E	0.0035	J&E	0.14	J&E	0.0060	J&E	32	1	7950	1	186	1	2527
Volatile Organic Compounds	Ethyl-benzene	9994	J&E	0.0074	J&E	0.31	J&E	0.0053	J&E	446	1	169	1	9.5	1	479
Volatile Organic Compounds	Isophorone [b]	NA		0.0000066	J&E	0.00027	J&E	0.0044	J&E	65	2	12000	2	0.44	2	5891
Volatile Organic Compounds	Methyl acetate	7724	J&E	0.00011	J&E	0.0045	J&E	0.0075	J&E	3.1	1	243000	1	287	1	28972
Volatile Organic Compounds	Methyl ethyl ketone	8244	J&E	0.000054	J&E	0.0022	J&E	0.0072	J&E	4.5	1	223000	1	134	1	28427
Volatile Organic Compounds	Methylene chloride	6884	J&E	0.0031	J&E	0.13	J&E	0.0078	J&E	22	1	13030	1	379	1	3314
Volatile Organic Compounds	Tetrachloroethene	9410	J&E	0.017	J&E	0.69	J&E	0.0039	J&E	95	1	206	1	17	1	164
Volatile Organic Compounds	Toluene	9001	J&E	0.0063	J&E	0.26	J&E	0.0061	J&E	234	1	526	1	29	1	816
Volatile Organic Compounds	Trichloroethene	8382	J&E	0.0094	J&E	0.39	J&E	0.0054	J&E	61	1	1280	1	73	1	686
Volatile Organic Compounds	Xylenes, total	10245	J&E	0.0063	J&E	0.26	J&E	0.0053	J&E	383	2	106	2	8.0	2	259
Semi-Volatile Organic Compounds	4-Methylphenol	NA		0.0000010	J&E	0.000041	J&E	0.0078	J&E	300	2	21500	2	0.11	2	40902
Semi-Volatile Organic Compounds	bis (2-ethylhexyl) phthalate	NA		0.00000027	J&E	0.000011	J&E	0.0050	J&E	119600	2	0.27	2	0.00000014	2	194
Semi-Volatile Organic Compounds	Butylbenzylphthalate	NA		0.0000013	J&E	0.000052	J&E	0.0026	J&E	7155	2	2.7	2	0.0000083	2	116

Table 5-4
Chemical Properties for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
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Needles, California

C O P C Category	C O P C	Enthalpy of Vaporization at Average Soil Temperature, $DH_{v,TS}$ (cal/mol)	Source	Henry's Law Constant at Average Soil Temperature, H_{TS} (atm-m3/mol)	Source	Dimensionless Henry's Law Constant at Average Soil Temperature, H'_{TS} (unitless)	Source	Vadose Zone Effective Diffusion Coefficient, D_{effV} (cm^2/s)	Source	Organic Carbon Partition Coefficient, K_{oc} (cm^3/g)	Source	Pure Component Water Solubility (mg/L)	Source	Vapor Pressure, (mmHg)	Source	Soil Saturation Concentration, C_{sat}, calculated [a] (mg/kg)
Polycyclic Aromatic Hydrocarbons	1-Methyl naphthalene	NA		0.00051	J&E	0.021	J&E	0.0041	J&E	2528	2	26	2	0.067	2	394
Polycyclic Aromatic Hydrocarbons	2-Methyl naphthalene	16057	J&E	0.00047	J&E	0.019	J&E	0.0041	J&E	2478	1	25	1	0.068	1	368
Polycyclic Aromatic Hydrocarbons	Acenaphthene	15951	J&E	0.00017	J&E	0.0069	J&E	0.0040	J&E	5027	1	3.9	1	0.0035	1	118
Polycyclic Aromatic Hydrocarbons	Acenaphthylene	NA		0.00011	J&E	0.0047	J&E	NA		3634	3	16	3	0.00091	3	353
Polycyclic Aromatic Hydrocarbons	Anthracene	NA		0.000056	J&E	0.0023	J&E	0.0031	J&E	16360	2	0.043	2	0.0000065	2	4.3
Polycyclic Aromatic Hydrocarbons	Benzo (a) anthracene	NA		0.000012	J&E	0.00049	J&E	0.0022	J&E	176900	2	0.0094	2	0.00000021	2	10
Polycyclic Aromatic Hydrocarbons	Benzo (a) pyrene	NA		0.00000046	J&E	0.000019	J&E	0.0066	J&E	587400	2	0.0016	2	0.0000000055	2	5.7
Polycyclic Aromatic Hydrocarbons	Benzo (b) fluoranthene	25361	J&E	0.00000057	J&E	0.000023	J&E	0.0060	J&E	599400	1	0.0015	1	0.0000000030	1	5.4
Polycyclic Aromatic Hydrocarbons	Benzo (ghi) perylene	NA		0.00000033	J&E	0.000014	J&E	NA		1893782	3	0.00026	3	0.00000000024	3	3.0
Polycyclic Aromatic Hydrocarbons	Benzo (k) fluoranthene	NA		0.00000058	J&E	0.000024	J&E	0.0060	J&E	587400	2	0.00080	2	0.00000000097	2	2.8
Polycyclic Aromatic Hydrocarbons	Chrysene	24248	J&E	0.0000046	J&E	0.00019	J&E	0.0024	J&E	180500	1	0.0020	1	0.0000000062	2	2.2
Polycyclic Aromatic Hydrocarbons	Dibenzo (a,h) anthracene	NA		0.00000014	J&E	0.0000058	J&E	0.012	J&E	1912000	2	0.0025	2	0.00000000096	2	29
Polycyclic Aromatic Hydrocarbons	Fluoranthene	NA		0.0000089	J&E	0.00036	J&E	0.0023	J&E	55450	2	0.26	2	0.0000092	2	87
Polycyclic Aromatic Hydrocarbons	Fluorene	16091	J&E	0.000088	J&E	0.0036	J&E	0.0035	J&E	9160	1	1.7	1	0.00074	1	93
Polycyclic Aromatic Hydrocarbons	Indeno (1,2,3-cd) pyrene	NA		0.00000035	J&E	0.000014	J&E	0.0071	J&E	1951000	2	0.00019	2	0.00000000013	2	2.2
Polycyclic Aromatic Hydrocarbons	Naphthalene	12768	J&E	0.00041	J&E	0.017	J&E	0.0047	J&E	1544	1	31	1	0.081	1	290
Polycyclic Aromatic Hydrocarbons	Phenanthrene	NA		0.000042	J&E	0.0017	J&E	NA		12180	3	1.2	3	0.00011	3	84
Polycyclic Aromatic Hydrocarbons	Pyrene	20516	J&E	0.000011	J&E	0.00043	J&E	0.0023	J&E	54340	1	0.14	1	0.0000060	1	44
Polycyclic Aromatic Hydrocarbons	B(a)P Equivalent [c]	NA		0.00000046	J&E	0.000019	J&E	0.0066	J&E	587400	2	0.0016	2	0.0000000055	2	5.7
Pesticides	4,4-DDE	21894	J&E	0.000037	J&E	0.0015	J&E	0.0032	J&E	117500	1	0.040	1	0.0000040	1	28
Pesticides	4,4-DDT	NA		0.0000083	J&E	0.00034	J&E	0.0031	J&E	168600	2	0.0055	2	0.00000016	2	5.6
Pesticides	alpha-Chlordane	NA		0.00035	J&E	0.014	J&E	NA		250628	3	0.056	3	0.000036	3	84
Pesticides	Dieldrin	24262	J&E	0.0000087	J&E	0.00036	J&E	0.0020	J&E	20090	1	0.20	1	0.0000039	1	24
Pesticides	gamma-Chlordane	NA		0.00048	J&E	0.020	J&E	NA		319617	3	0.056	3	0.000050	3	107
Polychlorinated Biphenyls (PCBs)	Total PCBs	NA		0.00042	J&E	0.017	J&E	0.0019	J&E	78100	2	0.70	2	0.00049	2	328
Total Petroleum Hydrocarbons (TPH)	TPH as diesel	NA		0.78	J&E	32	J&E	0.0055	J&E	5000	5	5.0	5	0.50	5	180
Total Petroleum Hydrocarbons	TPH as motor oil	NA		NA		NA		NA		NA		NA		NA		NA
Dioxins/Furans	Toxic Equivalent Human	NA		0.000050	J&E	0.0021	J&E	0.0037	J&E	249100	2	0.00020	2	0.0000000015	2	0.30

Table 5-4
Chemical Properties for COPCs in Soil and Soil Gas

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Notes:
a = Csat, 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 (U S E P A 2018).
The equation used to calculate Csat is:
$Csat = S / \rho b \times (Kd \times \rho b + \theta w + H' \times \theta a)$, where:
S = solubility in water
ρb = dry bulk density (1.5 grams per cubic meter [default, D T S C 2018])
Kd = soil-water partition coefficient (Koc × foc, where foc = 0.006 grams per gram [default, U S E P A 2002])
θw = water-filled soil porosity (0.15 cubic centimeters per cubic centimeter [default, D T S C 2018])
H' = dimensionless Henry's Law constant
θa = air-filled soil porosity (0.28 cubic centimeters per cubic centimeter [default, D T S C 2018])
b = Although isophorone is listed under volatile organic compounds, the chemical properties for isophorone do not meet the U S E P A criteria to be evaluated as a volatile for purposes of the human health risk assessment.
c = Benzo(a)pyrene values used as surrogate.

Abbreviations:
C O P C = constituent of potential concern
D T S C = Department of Toxic Substances Control
J&E = Calculated using Johnson and Ettinger model (D T S C 2014)
NA = Not applicable
U S E P A = United States Environmental Protection Agency

Sources:
1 = D T S C. 2014. Johnson and Ettinger SG-SCREEN Model, E P A Version 2.0, dated April 2003, as modified by D T S C. December.
2 = U S E P A. 2018. Regional Screening Levels (R S Ls). May. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls.
3 = SRC PhysProp Database. 2002. Found at http://esc.syrres.com/interkow/physdemo.htm and methods from Schwarzenback R. P. et al. 1993. Environmental Organic Chemistry. John Wiley and Sons, Inc., New York, NY.
4 = U S E P A. 2006. Water9, Version 3. June 29. Available at: http://www.epa.gov/ttn/chief/software/water/water9_3.
5 = California Regional Water Quality Control Board, San Francisco Bay Region. 2016. Environmental Screening Levels. Table IP-1. Physical-Chemical Values. February.
Available at: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml.

References:
D T S C. 2018. Human and Ecological Risk Office Human Health Risk Assessment Note Number 3. D T S C-modified Screening Levels. June.
U S E P A. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response. Washington, D.C., December.
U S E P A. 2018. Regional Screening Levels - User's Guide. May. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide.

Table 5-5
Carcinogenic and Noncarcinogenic Toxicity Values for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

COPC Category	COPC	Unit Risk Factor $(mg/m^3)^{-1}$ Value	Unit Risk Factor $(mg/m^3)^{-1}$ Source	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Value	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Source	Reference Concentration (mg/m^3) Chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Concentration (mg/m^3) Sub-chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Dose (mg/kg-day) Chronic RfD Value	Reference Dose (mg/kg-day) Source	Reference Dose (mg/kg-day) Sub-chronic RfD Value	Reference Dose (mg/kg-day) Source
Inorganics	Antimony	NC	NC	NC	NC	0.0016	Route	0.00016	Route-I R I S	0.0004	I R I S	0.00004	P P R T V
Inorganics	Arsenic	3.3	Note 3	9.5	Note 3	0.000015	O E H H A	Value not available	Value not available	0.0000035	O E H H A	0.0003	H E A S T
Inorganics	Barium	NC	NC	NC	NC	0.0005	H E A S T	0.005	H E A S T	0.2	I R I S	Value not available	Value not available
Inorganics	Cadmium [a]	4.2	O E H H A	NC	NC	0.00001	A T S D R	0.0009	A T S D R	0.0000063 / 0.0005	D T S C / I R I S (a)	0.0005	A T S D R
Inorganics	Chromium, Hexavalent	150	O E H H A	0.5	O E H H A	0.0001	I R I S	Value not available	Value not available	0.003	I R I S	Value not available	Value not available
Inorganics	Chromium, total	NC	NC	NC	NC	6	Surrogate	Value not available	Value not available	1.5	Surrogate	Value not available	Value not available
Inorganics	Cobalt	9	P P R T V	NC	NC	0.000006	P P R T V	0.00002	P P R T V	0.0003	P P R T V	0.003	P P R T V
Inorganics	Copper [b]	NC	NC	NC	NC	0.16	Route	Value not available	Value not available	0.04	H E A S T (b)	Value not available	Value not available
Inorganics	Cyanide	NC	NC	NC	NC	0.0008	RSL User's Guide	Value not available	Value not available	0.00063	I R I S	0.02	H E A S T
Inorganics	Lead	na	na	na	na	na	na	Value not available	Value not available	na	na	Value not available	Value not available
Inorganics	Manganese	NC	NC	NC	NC	0.00009	O E H H A	Value not available	Value not available	0.024	non-diet; I R I S	Value not available	Value not available
Inorganics	Mercury (inorganic)	NC	NC	NC	NC	0.00003	O E H H A	Value not available	Value not available	0.00016	O E H H A	Value not available	Value not available
Inorganics	Molybdenum	NC	NC	NC	NC	0.02	Route	Value not available	Value not available	0.005	I R I S	Value not available	Value not available
Inorganics	Nickel	0.26	O E H H A	NC	NC	0.000014	O E H H A	0.0002	A T S D R	0.011	O E H H A	Value not available	Value not available
Inorganics	Nitrate	NC	NC	NC	NC	6.4	Route	Value not available	Value not available	1.6	I R I S	Value not available	Value not available
Inorganics	Phosphate	NC	NC	NC	NC	196	Surrogate	Value not available	Value not available	49	Surrogate	Value not available	Value not available
Inorganics	Silver	NC	NC	NC	NC	0.02	Route	Value not available	Value not available	0.005	I R I S	Value not available	Value not available
Inorganics	Thallium	NC	NC	NC	NC	0.00004	Route	Value not available	Value not available	0.00001	P P R T V-SCREEN	Value not available	Value not available
Inorganics	Vanadium	NC	NC	NC	NC	0.0001	A T S D R	Value not available	Value not available	0.005	RSL User's Guide	0.01	A T S D R
Inorganics	Zinc	NC	NC	NC	NC	1.2	Route	Value not available	Value not available	0.3	I R I S	Value not available	Value not available
Volatile Organic Compounds	1,1-Dichloroethene	NC	NC	NC	NC	0.07	O E H H A	Value not available	Value not available	0.05	I R I S	Value not available	Value not available
Volatile Organic Compounds	1,3-Dichlorobenzene	NC	NC	NC	NC	0.12	Route	Value not available	Value not available	0.03	N C E A	Value not available	Value not available
Volatile Organic Compounds	Acetone	NC	NC	NC	NC	31	A T S D R	Value not available	Value not available	0.9	I R I S	2	A T S D R
Volatile Organic Compounds	Benzene	0.029	O E H H A	0.1	O E H H A	0.003	O E H H A	Value not available	Value not available	0.004	I R I S	Value not available	Value not available
Volatile Organic Compounds	Bromomethane	NC	NC	NC	NC	0.005	O E H H A	0.19	A T S D R	0.0014	I R I S	0.003	A T S D R
Volatile Organic Compounds	Carbon disulfide	NC	NC	NC	NC	0.7	I R I S	Value not available	Value not available	0.1	I R I S	Value not available	Value not available
Volatile Organic Compounds	Carbon tetrachloride	0.042	O E H H A	0.15	O E H H A	0.04	O E H H A	Value not available	Value not available	0.004	I R I S	Value not available	Value not available

Table 5-5
Carcinogenic and Noncarcinogenic Toxicity Values for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

COPC Category	COPC	Unit Risk Factor $(mg/m^3)^{-1}$ Value	Unit Risk Factor $(mg/m^3)^{-1}$ Source	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Value	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Source	Reference Concentration (mg/m^3) Chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Concentration (mg/m^3) Sub-chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Dose (mg/kg-day) Chronic RfD Value	Reference Dose (mg/kg-day) Source	Reference Dose (mg/kg-day) Sub-chronic RfD Value	Reference Dose (mg/kg-day) Source
Volatile Organic Compounds	Chloro methane	NC	NC	NC	NC	0.09	IRIS	0.41	ATSDR	0.0225	Route	0.1025	Route-ATSDR
Volatile Organic Compounds	Chloroform	0.023	IRIS	0.031	OEHHA	0.098	ATSDR	0.24	ATSDR	0.01	IRIS	0.1	ATSDR
Volatile Organic Compounds	Ethyl-benzene	0.0025	OEHHA	0.011	OEHHA	1	IRIS	Value not available	Value not available	0.1	IRIS	Value not available	Value not available
Volatile Organic Compounds	Isophorone	NC	NC	0.00095	IRIS	2	OEHHA	Value not available	Value not available	0.2	IRIS	3	ATSDR
Volatile Organic Compounds	Methyl acetate	NC	NC	NC	NC	4	Route	0.1	PPRTV	1	PPRTV-SCREEN	10	HEAST
Volatile Organic Compounds	Methyl ethyl ketone	NC	NC	NC	NC	5	IRIS	Value not available	Value not available	0.6	IRIS	Value not available	Value not available
Volatile Organic Compounds	Methylene chloride	0.001	OEHHA	0.014	OEHHA	0.4	OEHHA	1.04	ATSDR	0.006	IRIS	0.06	HEAST
Volatile Organic Compounds	Tetrachloroethene	0.0061	OEHHA	0.54	OEHHA	0.04	IRIS	Value not available	Value not available	0.006	IRIS	Value not available	Value not available
Volatile Organic Compounds	Toluene	NC	NC	NC	NC	0.3	OEHHA	Value not available	Value not available	0.08	IRIS	0.8	PPRTV
Volatile Organic Compounds	Trichloroethene	0.0048	IRIS	0.046	IRIS	0.002	IRIS	Value not available	Value not available	0.0005	IRIS	Value not available	Value not available
Volatile Organic Compounds	Xylenes, total	NC	NC	NC	NC	0.1	IRIS	Value not available	Value not available	0.2	IRIS	Value not available	Value not available
Semi-Volatile Organic Compounds	4-Methylphenol	NC	NC	NC	NC	0.6	OEHHA	Value not available	Value not available	0.1	ATSDR	Value not available	Value not available
Semi-Volatile Organic Compounds	bis (2-ethylhexyl) phthalate	0.0024	OEHHA	0.014	IRIS	0.08	Route	Value not available	Value not available	0.02	IRIS	0.1	ATSDR
Semi-Volatile Organic Compounds	Butylbenzylphthalate	NC	NC	0.0019	PPRTV	0.8	Route	8	Route-HEAST	0.2	IRIS	2	HEAST
Polycyclic Aromatic Hydrocarbons	1-Methyl naphthalene	0.00725	Route	0.029	PPRTV	0.28	Route	Value not available	Value not available	0.07	ATSDR	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	2-Methyl naphthalene	NC	NC	NC	NC	0.016	Route	Value not available	Value not available	0.004	IRIS	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Acenaphthene	NC	NC	NC	NC	0.24	Route	2.4	Route-ATSDR	0.06	IRIS	0.6	ATSDR
Polycyclic Aromatic Hydrocarbons	Acenaphthylene	NC	NC	NC	NC	0.24	Surrogate	2.4	Surrogate	0.06	Surrogate	0.6	Surrogate
Polycyclic Aromatic Hydrocarbons	Anthracene	NC	NC	NC	NC	1.2	Route	40	Route	0.3	IRIS	10	ATSDR
Polycyclic Aromatic Hydrocarbons	Benzo (a) anthracene	NA	NA	NA	NA	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Benzo (a) pyrene	NA	NA	NA	NA	0.000002	IRIS	Value not available	Value not available	0.0003	IRIS	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Benzo (b) fluoranthene	NA	NA	NA	NA	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Benzo (ghi) perylene	NC	NC	NC	NC	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Benzo (k) fluoranthene	NA	NA	NA	NA	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Chrysene	NA	NA	NA	NA	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Dibenzo (a,h) anthracene	NA	NA	NA	NA	0.000002	Surrogate	Value not available	Value not available	0.0003	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Fluoranthene	NC	NC	NC	NC	0.16	Route	1.6	Route-ATSDR	0.04	IRIS	0.4	ATSDR
Polycyclic Aromatic Hydrocarbons	Fluorene	NC	NC	NC	NC	0.16	Route	1.6	Route-ATSDR	0.04	IRIS	0.4	ATSDR
Polycyclic Aromatic Hydrocarbons	Indeno (1,2,3-cd) pyrene	NA	NA	NA	NA	0.12	Surrogate	Value not available	Value not available	0.03	Surrogate	Value not available	Value not available
Polycyclic Aromatic Hydrocarbons	Naphthalene	0.034	OEHHA	0.12	OEHHA	0.003	IRIS	Value not available	Value not available	0.02	IRIS	0.6	ATSDR

Table 5-5
Carcinogenic and Noncarcinogenic Toxicity Values for COPCs in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

COPC Category	COPC	Unit Risk Factor $(mg/m^3)^{-1}$ Value	Unit Risk Factor $(mg/m^3)^{-1}$ Source	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Value	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ Source	Reference Concentration (mg/m^3) Chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Concentration (mg/m^3) Sub-chronic RfC Value	Reference Concentration (mg/m^3) Source	Reference Dose (mg/kg-day) Chronic RfD Value	Reference Dose (mg/kg-day) Source	Reference Dose (mg/kg-day) Sub-chronic RfD Value	Reference Dose (mg/kg-day) Source
Polycyclic Aromatic Hydrocarbons	Phenanthrene	NC	NC	NC	NC	1.2	Surrogate	40	Surrogate-Route	0.3	Surrogate	10	Surrogate
Polycyclic Aromatic Hydrocarbons	Pyrene	NC	NC	NC	NC	0.12	Route	1.2	Route-ATSDR	0.03	IRIS	0.3	PPRTV
Polycyclic Aromatic Hydrocarbons	B(a)P Equivalent	1.1	OEHHA	1	IRIS	NA	NA	Value not available	Value not available	NA	NA	Value not available	Value not available
Pesticides	4,4-DDE	0.097	OEHHA	0.34	OEHHA	0.0012	Route	Value not available	Value not available	0.0003	PPRTV-SCREEN	Value not available	Value not available
Pesticides	4,4-DDT	0.097	OEHHA	0.34	OEHHA	0.002	Route	Value not available	Value not available	0.0005	IRIS	Value not available	Value not available
Pesticides	alpha-Chlordane	0.34	Surrogate	1.3	Surrogate	0.0007	Surrogate	0.0002	ATSDR	0.0005	Surrogate	0.0006	ATSDR
Pesticides	Dieldrin	4.6	OEHHA	16	OEHHA	0.0002	Route	0.0004	Route-ATSDR	0.00005	IRIS	0.0001	ATSDR
Pesticides	gamma-Chlordane	0.34	Surrogate	1.3	Surrogate	0.0007	Surrogate	Value not available	Value not available	0.0005	Surrogate	Value not available	Value not available
Polychlorinated Biphenyls	Total PCBs	0.57	OEHHA	2	OEHHA	0.00008	Surrogate	Value not available	Value not available	0.00002	Surrogate	Value not available	Value not available
Total Petroleum Hydrocarbons	TPH as diesel	NC	NC	NC	NC	0.13	ESL	Value not available	Value not available	0.02	ESL	Value not available	Value not available
Total Petroleum Hydrocarbons	TPH as motor oil	NC	NC	NC	NC	0.68	Route	Value not available	Value not available	0.17	ESL	Value not available	Value not available
Dioxins/Furans	TEQ Human	38000	Surrogate	130000	Surrogate	0.00000004	Surrogate	Value not available	Value not available	0.0000000007	Surrogate	0.00000002	Surrogate

Table 5-5
Carcinogenic and Noncarcinogenic Toxicity Values for C O P C s in Soil and Soil Gas

Soil Human Health and Ecological Risk Assessment
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Notes:

(a) = For cadmium, the reference dose of 6.3×10^{-6} milligrams per kilogram per day is recommended for adult exposures, while the Integrated Risk Information System reference dose of 5.0×10^{-4} milligrams per kilogram per day is used for potential child exposures, per Note 3.

(b) = The reference dose for copper is based on a drinking water standard of 1.3 milligrams per liter.

Abbreviations:

C O P C = constituent of potential concern

NA = Not applicable. Potential carcinogenic effects of carcinogenic polycyclic aromatic hydrocarbons are evaluated using benzo(a)pyrene equivalents. Potential noncarcinogenic effects of carcinogenic polycyclic aromatic hydrocarbons are evaluated for each of the carcinogenic polycyclic aromatic hydrocarbon individually.

na = Not applicable. Potential exposure to lead is evaluated using the United States Environmental Protection Agency's Adult Lead Methodology or the California Environmental Protection Agency Department of Toxic Substances Control's LeadSpread model. Please see text for discussion.

NC = Not considered to be a carcinogen by either the United States Environmental Protection Agency or the California Environmental Protection Agency.

PCBs = polychlorinated biphenyls

RfC = Reference Concentration

RfD = Reference Dose

Surrogate = In the absence of available toxicity values for chemicals of potential concern, surrogate chemicals were chosen based on structural similarity to avoid underestimating potential carcinogenic risks/noncarcinogenic hazards:

- Total chromium was represented by chromium 3.
- Phosphate was represented by aluminum metaphosphate.
- Acenaphthylene was represented by acenaphthene.
- Potential noncarcinogenic effects of benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene, were represented by pyrene.
- Potential noncarcinogenic effects of dibenz(a,h)anthracene was represented by benzo(a)pyrene.
- Benzo(g,h,i)perylene was represented by pyrene.
- Phenanthrene was represented by anthracene.
- Alpha- and gamma-chlordane was represented by technical chlordane.
- Potential noncarcinogenic effects of Total P C Bs was represented by Aroclor 1254.
- Toxic Equivalent human was represented by 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

Route = Route-to-route extrapolation from reference dose (R f D o) or reference concentration (R f C) using the following equations:

R f C = R f D o / (InhR / B W) or R f D o = R f C / (B W / Inhr), where:
Adult daily inhalation rate (InhR) = 20 cubic meters per day (D T S C 2014), and
Adult body weight (B W) = 80 kilograms (D T S C 2014).

TPH = total petroleum hydrocarbon

TEQ = toxic equivalent

U S E P A United States Environmental Protection Agency

Value not available = Subchronic toxicity value not available.

Sources:

A T S D R = Agency for Toxic Substances and Disease Registry (A T S D R). 2018. Minimal Risk Levels for Hazardous Substances. Available at: http://www.atsdr.cdc.gov/mrls/mrllist.asp

E S L = San Francisco Bay Regional Water Quality Control Board. 2016. Environmental Screening Levels. Interim Final (Rev. 3). February. Available at: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml

H E A S T = U S E P A. 1997. Health Effects Assessment (HEAST) Summary Tables. Fiscal Year 1997 Update. July. Office of Solid Waste and Emergency Response.

I R I S = U S E P A. 2018. Integrated Risk Information System Database (I R I S). Maintained online at http://www.epa.gov/iris/index.html.

Note 3 = Department of Toxic Substances Control (D T S C). 2018. D T S C-modified Screening Levels. Human Health Risk Assessment Note Number: 3. Human and Ecological Risk Office. June.

O E H H A = Office of Environmental Health Hazard Assessment (O E H H A). 2018. Toxicity Criteria Database.
Table of cancer slope factors maintained at http://www.oehha.ca.gov/risk/ChemicalDB/index.asp; table of chronic RELs maintained online at http://www.oehha.ca.gov/air/allrels.html.

P P R T V = Superfund Health Risk Technical Support Center. 2018. Provisional Peer Reviewed Toxicity Values (P P R T V). Maintained online at: http://hhpprtv.ornl.gov/index.html.

R S L = U S E P A. 2018. Regional Screening Levels (R S L s) for Chemical Contaminants, May. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls.

Table 5-6
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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
BCW	Baseline (depth-weighted)	**NE**	**NE**	0.0000006	0.0000006	0.0000009	0.0000009	**0.000005**	**0.000005**	**0.000007**	**0.000008**
BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.000002), TEQ human (0.000002)	Cr-6 (0.000002), TEQ human (0.000003)	Cr-6 (0.000003), TEQ human (0.000004)	Cr-6 (0.000004), TEQ human (0.000004)
BCW	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000009**	**0.000005**	**0.000003**	**0.000003**
BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000006), TEQ human (0.000009)	Cr-6 (0.0000006), TEQ human (0.000004)	Cr-6 (0.0000007), TEQ human (0.000002)	Cr-6 (0.0000007), TEQ human (0.000002)
BCW	2-foot Scouring (depth-weighted)	**NE**	**NE**	0.0000005	0.0000008	0.0000008	0.0000007	**0.000004**	**0.000006**	**0.000006**	**0.000006**
BCW	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.000002), TEQ human (0.000002)	Cr-6 (0.000003), TEQ human (0.000003)	Cr-6 (0.000004), TEQ human (0.000002)	Cr-6 (0.000004), TEQ human (0.000002)
BCW	2-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000002**	**0.000002**	**0.000002**	**0.000002**
BCW	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000005), TEQ human (0.000002)	Cr-6 (0.0000007), TEQ human (0.000001)	Cr-6 (0.0000007), TEQ human (0.0000007)	Cr-6 (0.0000007), TEQ human (0.0000006)
BCW	5-foot Scouring (depth-weighted)	**NE**	**NE**	0.0000004	0.0000003	0.0000007	**NE**	**0.000004**	**0.000003**	**0.000006**	**NE**
BCW	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.000002), TEQ human (0.0000008)	Cr-6 (0.000001), TEQ human (0.000001)	Cr-6 (0.000004), TEQ human (0.000002)	NA
BCW	5-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	0.000001	0.000001	0.000001	**NE**
BCW	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (depth-weighted)	**NE**	**NE**	**0.00001**	**0.000003**	**0.000002**	**0.000006**	**0.0001**	**0.00003**	**0.00002**	**0.00005**
SWMU1-TCS4	Baseline (depth-weighted)	NA	NA	Cr-6 (0.0000005), TEQ human (0.00001)	Cr-6 (0.0000005), TEQ human (0.000003)	Cr-6 (0.0000008), TEQ human (0.000001)	Cr-6 (0.000005), TEQ human (0.0000007)	Cr-6 (0.000004), TEQ human (0.0001)	Cr-6 (0.000003), TEQ human (0.00003)	Cr-6 (0.000006), TEQ human (0.00001)	Cr-6 (0.00004), TEQ human (0.000007)
SWMU1-TCS4	Baseline (area-weighted)	**NE**	**NE**	**0.000004**	**0.000003**	**0.000002**	0.000001	**0.00003**	**0.00002**	**0.00001**	**0.00001**
SWMU1-TCS4	Baseline (area-weighted)	NA	NA	Cr-6 (0.0000004), TEQ human (0.000003)	Cr-6 (0.0000004), TEQ human (0.000002)	Cr-6 (0.0000005), TEQ human (0.000001)	NA	Cr-6 (0.000003), TEQ human (0.00003)	Cr-6 (0.000003), TEQ human (0.00002)	Cr-6 (0.000004), TEQ human (0.00001)	Cr-6 (0.000004), TEQ human (0.000007)
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	**NE**	**NE**	0.0000001	0.0000001	0.0000001	0.0000001	0.000001	0.000001	0.000001	0.000001

Table 5-6
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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
BCW	Baseline (depth-weighted)	0.000001	0.000001	**0.000003**	**0.000003**	0.0000004	0.0000004	**0.000002**	**0.000002**
BCW	Baseline (depth-weighted)	NA	NA	Cr-6 (0.0000005), TEQ human (0.000002)	Cr-6 (0.0000005), TEQ human (0.000002)	NA	NA	Cr-6 (0.000001), TEQ human (0.000001)	Cr-6 (0.000001), TEQ human (0.000001)
BCW	Baseline (area-weighted)	**NE**	**NE**	**0.000007**	**0.000003**	**NE**	**NE**	**0.000004**	**0.000002**
BCW	Baseline (area-weighted)	NA	NA	TEQ human (0.000007)	TEQ human (0.000003)	NA	NA	Cr-6 (0.0000003), TEQ human (0.000004)	Cr-6 (0.0000003), TEQ human (0.000002)
BCW	2-foot Scouring (depth-weighted)	0.000001	0.000001	**0.000002**	**0.000003**	0.0000003	0.0000004	**0.000002**	**0.000003**
BCW	2-foot Scouring (depth-weighted)	NA	NA	Cr-6 (0.0000004), TEQ human (0.000002)	Cr-6 (0.0000008), TEQ human (0.000002)	NA	NA	Cr-6 (0.0000009), TEQ human (0.000001)	Cr-6 (0.000002), TEQ human (0.000001)
BCW	2-foot Scouring (area-weighted)	**NE**	**NE**	0.000001	0.000001	**NE**	**NE**	0.000001	0.000001
BCW	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (depth-weighted)	0.0000006	0.0000007	0.000001	0.000001	0.0000001	0.0000002	**0.000002**	0.000001
BCW	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.000001), TEQ human (0.0000003)	NA
BCW	5-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	0.0000006	0.0000006
BCW	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (depth-weighted)	**0.00004**	**0.00001**	**0.00008**	**0.00002**	**0.00001**	**0.000003**	**0.00004**	**0.00001**
SWMU1-TCS4	Baseline (depth-weighted)	TEQ human (0.00004)	TEQ human (0.00001)	TEQ human (0.00008)	TEQ human (0.00002)	TEQ human (0.00001)	TEQ human (0.000003)	Cr-6 (0.000002), TEQ human (0.00004)	Cr-6 (0.000002), TEQ human (0.00001)
SWMU1-TCS4	Baseline (area-weighted)	**0.00001**	**0.000008**	**0.00002**	**0.00002**	**0.000004**	**0.000003**	**0.00001**	**0.00001**
SWMU1-TCS4	Baseline (area-weighted)	TEQ human (0.00001)	TEQ human (0.000008)	TEQ human (0.00002)	TEQ human (0.00002)	TEQ human (0.000004)	TEQ human (0.000003)	Cr-6 (0.000002), TEQ human (0.00001)	Cr-6 (0.000002), TEQ human (0.000009)
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	0.0000003	0.0000003	0.0000006	0.0000006	0.0000001	0.00000009	0.0000005	0.0000006

Table 5-6
HHRA Cancer Risk Estimate Summary

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Exposure Area	Scenario	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	Baseline (depth-weighted)	0.000000009	0.000000009	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (depth-weighted)	0.000000004	0.000000005	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (depth-weighted)	0.000000004	0.000000004	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (depth-weighted)	0.00000002	0.00000002	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
SWMU1-TCS4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
SWMU1-TCS4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	0.000000001	0.000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (depth-weighted)	**NE**	**NE**	0.0000002	0.0000002	**NE**	**NE**	**0.000002**	**0.000002**	**NE**	**NE**
A O C 4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000003), C o (0.0000004), Total PCBs (0.0000004), TEQ human (0.0000007)	Cr-6 (0.0000003), C o (0.0000004), Total PCBs (0.0000004), TEQ human (0.0000007)	NA	NA
A O C 4	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000002**	**0.000002**	**NE**	**NE**
A O C 4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000006), C o (0.0000003), Total PCBs (0.0000003), TEQ human (0.0000003)	Cr-6 (0.0000006), C o (0.0000003), Total PCBs (0.0000003), TEQ human (0.0000003)	NA	NA
A O C 9	Baseline (depth-weighted)	**NE**	**NE**	**0.00003**	**0.00002**	**0.00001**	**0.000006**	**0.0002**	**0.0001**	**0.00007**	**0.00005**
A O C 9	Baseline (depth-weighted)	NA	NA	Cr-6 (0.00003)	Cr-6 (0.00002)	Cr-6 (0.000009)	Cr-6 (0.000005)	A s (0.000005), Cr-6 (0.0002), TEQ human (0.000007)	A s (0.000005), Cr-6 (0.0001), TEQ human (0.000005)	A s (0.000005), Cr-6 (0.00006), TEQ human (0.000005)	A s (0.000004), Cr-6 (0.00004), TEQ human (0.000005)
A O C 9	Baseline Excluding Background A s (depth-weighted)	**NE**	**NE**	**0.00003**	**0.00002**	**0.000009**	**0.000006**	**0.0002**	**0.0001**	**0.00007**	**0.00005**
A O C 9	Baseline (area-weighted)	**NE**	**NE**	**0.00002**	**0.00002**	**0.000008**	**0.000005**	**0.0002**	**0.0001**	**0.00006**	**0.00004**
A O C 9	Baseline (area-weighted)	NA	NA	Cr-6 (0.00002)	Cr-6 (0.00002)	Cr-6 (0.000008)	Cr-6 (0.000005)	A s (0.000004), Cr-6 (0.0002), TEQ human (0.000003)	A s (0.000004), Cr-6 (0.0001), TEQ human (0.000002)	A s (0.000004), Cr-6 (0.00006), TEQ human (0.000002)	A s (0.000004), Cr-6 (0.00003), TEQ human (0.000002)
A O C 9	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	**0.00002**	**0.00002**	**0.000008**	**0.000005**	**0.0002**	**0.0001**	**0.00006**	**0.00004**
A O C 10	Baseline (depth-weighted)	**NE**	**NE**	0.000001	**0.000003**	**0.000003**	**0.000002**	**0.000013**	**0.000021**	**0.000023**	**0.000019**
A O C 10	Baseline (depth-weighted)	NA	NA	NA	CrV I (0.000002)	Cr-6 (0.000002)	CrV I (0.000002)	A s (0.000005), Cr-6 (0.000003), TEQ human (0.000004)	A s (0.000005), Cr-6 (0.00001), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.00002), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.00001), TEQ human (0.000002)

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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (depth-weighted)	0.0000004	0.0000004	0.0000008	0.0000008	0.0000001	0.0000001	0.0000009	0.0000009
A O C 4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline (depth-weighted)	**0.00003**	**0.00002**	**0.00006**	**0.00004**	**0.000004**	**0.000003**	**0.0001**	**0.00008**
A O C 9	Baseline (depth-weighted)	A s (0.000002), Cr-6 (0.00002), TEQ human (0.000003)	A s (0.000002), Cr-6 (0.00002), TEQ human (0.000002)	A s (0.000004), Cr-6 (0.00005), TEQ human (0.000006)	A s (0.000004), Cr-6 (0.00003), TEQ human (0.000004)	A s (0.0000006), Cr-6 (0.000002), TEQ human (0.000001)	A s (0.0000006), Cr-6 (0.000001), TEQ human (0.0000007)	A s (0.000002), Cr-6 (0.0001), TEQ human (0.000003)	A s (0.000002), Cr-6 (0.00007), TEQ human (0.000002)
A O C 9	Baseline Excluding Background A s (depth-weighted)	**0.00003**	**0.00002**	**0.00006**	**0.00004**	**0.000003**	**0.000002**	**0.0001**	**0.00007**
A O C 9	Baseline (area-weighted)	**0.00003**	**0.00002**	**0.00005**	**0.00004**	**0.000003**	**0.000002**	**0.0001**	**0.00007**
A O C 9	Baseline (area-weighted)	A s (0.000002), Cr-6 (0.00002), TEQ human (0.000001)	A s (0.000001), Cr-6 (0.00002), TEQ human (0.000001)	A s (0.000003), Cr-6 (0.00005), TEQ human (0.000002)	A s (0.000003), Cr-6 (0.00003), TEQ human (0.000002)	A s (0.0000005), Cr-6 (0.000002), TEQ human (0.0000004)	A s (0.0000005), Cr-6 (0.000001), TEQ human (0.0000003)	A s (0.000002), Cr-6 (0.0001), TEQ human (0.000001)	A s (0.000002), Cr-6 (0.00006), TEQ human (0.000001)
A O C 9	Baseline Excluding Background A s (area-weighted)	**0.00002**	**0.00002**	**0.00005**	**0.00003**	**0.000002**	**0.000002**	**0.000002**	**0.00007**
A O C 10	Baseline (depth-weighted)	**0.000004**	**0.000004**	**0.000008**	**0.000009**	0.000001	0.000001	**0.000006**	**0.00001**
A O C 10	Baseline (depth-weighted)	A s (0.000002), TEQ human (0.000002)	A s (0.000002), Cr-6 (0.000002)	A s (0.000004), TEQ human (0.000003)	A s (0.000004), Cr-6 (0.000003), TEQ human (0.000002)	NA	NA	A s (0.000002), Cr-6 (0.000002), TEQ human (0.000002)	A s (0.000002), Cr-6 (0.000007)

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Exposure Area	Scenario	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (depth-weighted)	0.000000003	0.000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline (depth-weighted)	0.00000009	0.00000007	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 9	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (depth-weighted)	0.00000009	0.00000007	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 9	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 9	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	Baseline (depth-weighted)	0.000000005	0.00000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
A O C 10	Baseline Excluding Background A s (depth-weighted)	**NE**	**NE**	0.000001	**0.000002**	**0.000002**	**0.000002**	**0.000009**	**0.00002**	**0.00002**	**0.00002**
A O C 10	Baseline (area-weighted)	**NE**	**NE**	0.000001	**0.000002**	**0.000002**	**0.000002**	**0.00001**	**0.00001**	**0.00001**	**0.00001**
A O C 10	Baseline (area-weighted)	NA	NA	NA	Cr-6 (0.000001)	Cr-6 (0.000001)	Cr-6 (0.000001)	A s (0.000005), Cr-6 (0.000003), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.000008), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.000009), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.000008), TEQ human (0.000001)
A O C 10	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	0.0000007	0.000001	0.000001	0.000001	**0.000006**	**0.00001**	**0.00001**	**0.00001**
A O C 10	2-foot Scouring (depth-weighted)	**NE**	**NE**	**0.000003**	**0.000003**	**0.000003**	**0.000003**	**0.00003**	**0.00002**	**0.00002**	**0.00002**
A O C 10	2-foot Scouring (depth-weighted)	NA	NA	Cr-6 (0.000003)	Cr-6 (0.000002)	Cr-6 (0.000002)	Cr-6 (0.000002)	A s (0.000004), Cr-6 (0.00002), TEQ human (0.000002)	A s (0.000004), Cr-6 (0.00002), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.00002), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.00002), TEQ human (0.000001)
A O C 10	2-foot Scouring Excluding Background A s (depth-weighted)	**NE**	**NE**	**0.000003**	**0.000003**	**0.000003**	**0.000003**	**0.00002**	**0.00002**	**0.00002**	**0.00002**
A O C 10	2-foot Scouring (area-weighted)	**NE**	**NE**	**0.000002**	**0.000002**	**0.000002**	**0.000002**	**0.00002**	**0.00002**	**0.00001**	**0.00001**
A O C 10	2-foot Scouring (area-weighted)	NA	NA	Cr-6 (0.000001)	Cr-6 (0.000001)	Cr-6 (0.000001)	Cr-6 (0.000001)	A s (0.000004), Cr-6 (0.000009), TEQ human (0.000002)	A s (0.000004), Cr-6 (0.000009), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.000009), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.000009), TEQ human (0.000001)
A O C 10	2-foot Scouring Excluding Background A s (area-weighted)	**NE**	**NE**	0.000001	0.000001	0.000001	0.000001	**0.00001**	**0.00001**	**0.00001**	**0.00001**
A O C 10	5-foot Scouring (depth-weighted)	**NE**	**NE**	0.0000009	0.0000009	0.0000008	**NE**	**0.000009**	**0.000008**	**0.000008**	**NE**
A O C 10	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	A s (0.000005), Cr-6 (0.000001), TEQ human (0.000002)	A s (0.000005), TEQ human (0.000002)	A s (0.000006), TEQ human (0.000001)	NA
A O C 10	5-foot Scouring Excluding Background A s (depth-weighted)	**NE**	**NE**	0.0000005	0.0000005	0.0000004	**NE**	**0.000005**	**0.000004**	**0.000004**	**NE**
A O C 10	5-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000007**	**0.000007**	**0.000007**	**NE**
A O C 10	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	A s (0.000005), TEQ human (0.000001)	A s (0.000005), TEQ human (0.000001)	A s (0.000006), TEQ human (0.000001)	NA
A O C 10	5-foot Scouring Excluding Background A s (area-weighted)	NE	NE	NE	NE	NE	NE	**0.000003**	**0.000003**	**0.000003**	NE

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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
A O C 10	Baseline Excluding Background A s (depth-weighted)	**0.000003**	**0.000003**	**0.000005**	**0.000006**	0.0000008	0.0000005	**0.000004**	**0.000009**
A O C 10	Baseline (area-weighted)	**0.000003**	**0.000003**	**0.000006**	**0.000007**	**NE**	**NE**	**0.000005**	**0.000007**
A O C 10	Baseline (area-weighted)	A s (0.000002)	A s (0.000002), Cr-6 (0.000001)	A s (0.000004), TEQ human (0.000001)	A s (0.000004), Cr-6 (0.000002), TEQ human (0.000001)	NA	NA	A s (0.000002), Cr-6 (0.000002),	A s (0.000002), Cr-6 (0.000005)
A O C 10	Baseline Excluding Background A s (area-weighted)	**0.000002**	**0.000002**	**0.000003**	**0.000004**	**NE**	**NE**	**0.000003**	**0.000006**
A O C 10	2-foot Scouring (depth-weighted)	**0.000005**	**0.000005**	**0.00001**	**0.000009**	0.000001	0.0000009	**0.00001**	**0.00001**
A O C 10	2-foot Scouring (depth-weighted)	A s (0.000002), Cr-6 (0.000002)	A s (0.000002), Cr-6 (0.000002)	A s (0.000003), Cr-6 (0.000005), TEQ human (0.000001)	A s (0.000003), Cr-6 (0.000005), TEQ human (0.000001)	NA	NA	A s (0.000002), Cr-6 (0.00001)	A s (0.000002), Cr-6 (0.00001)
A O C 10	2-foot Scouring Excluding Background A s (depth-weighted)	**0.000003**	**0.000003**	**0.000007**	**0.000006**	0.0000005	0.0000004	**0.00001**	**0.00001**
A O C 10	2-foot Scouring (area-weighted)	**0.000003**	**0.000003**	**0.000007**	**0.000007**	**NE**	**NE**	**0.000008**	**0.000008**
A O C 10	2-foot Scouring (area-weighted)	A s (0.000002), Cr-6 (0.000001)	A s (0.000002), Cr-6 (0.000001)	A s (0.000003), Cr-6 (0.000002), TEQ human (0.000001)	A s (0.000003), Cr-6 (0.000002), TEQ human (0.000001)	NA	NA	A s (0.000002), Cr-6 (0.000005)	A s (0.000002), Cr-6 (0.000005)
A O C 10	2-foot Scouring Excluding Background A s (area-weighted)	**0.000002**	**0.000002**	**0.000004**	**0.000004**	**NE**	**NE**	**0.000006**	**0.000006**
A O C 10	5-foot Scouring (depth-weighted)	**0.000003**	**0.000003**	**0.000006**	**0.000006**	0.000001	0.0000009	**0.000004**	**0.000004**
A O C 10	5-foot Scouring (depth-weighted)	A s (0.000002)	A s (0.000002)	A s (0.000004), TEQ human (0.000002)	A s (0.000004), TEQ human (0.000002)	NA	NA	A s (0.000002), TEQ human (0.000001)	A s (0.000002), TEQ human (0.0000008)
A O C 10	5-foot Scouring Excluding Background A s (depth-weighted)	**0.000002**	0.000001	**0.000003**	**0.000003**	0.0000005	0.0000004	**0.000002**	**0.000002**
A O C 10	5-foot Scouring (area-weighted)	**0.000003**	**0.000003**	**0.000005**	**0.000005**	**NE**	**NE**	**0.000003**	**0.000003**
A O C 10	5-foot Scouring (area-weighted)	A s (0.000002)	A s (0.000002)	A s (0.000004)	A s (0.000004)	NA	NA	A s (0.000002)	A s (0.000002)
A O C 10	5-foot Scouring Excluding Background A s (area-weighted)	0.000001	0.000001	**0.000002**	**0.000002**	NE	NE	**0.000002**	0.000001

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Exposure Area	Scenario	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	Baseline Excluding Background A s (depth-weighted)	0.000000005	0.00000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	2-foot Scouring (depth-weighted)	0.00000001	0.00000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (depth-weighted)	0.00000001	0.00000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	2-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	5-foot Scouring (depth-weighted)	0.000000003	0.000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (depth-weighted)	0.000000003	0.000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	5-foot Scouring (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 10	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
A O C 11	Baseline (depth-weighted)	**NE**	**NE**	0.0000008	0.0000008	0.0000010	0.0000008	**0.000008**	**0.000008**	**0.000009**	**0.000008**
A O C 11	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	A s (0.000005), Cr-6 (0.0000005), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.0000005), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.000001), TEQ human (0.000003)	A s (0.000005), Cr-6 (0.0000006), TEQ human (0.000003)
A O C 11	Baseline Excluding Background A s (depth-weighted)	NE	NE	0.0000004	0.0000004	0.0000005	0.0000004	**0.000004**	**0.000004**	**0.000005**	**0.000004**
A O C 11	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000007**	**0.000008**	**0.000008**	**0.000008**
A O C 11	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	A s (0.000005), Cr-6 (0.000001), TEQ human (0.0000009)	A s (0.000005), Cr-6 (0.000001), TEQ human (0.000001)	A s (0.000005), Cr-6 (0.000001), TEQ human (0.000002)	A s (0.000005), Cr-6 (0.000001), TEQ human (0.000001)
A O C 11	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.000003**	**0.000004**	**0.000004**	**0.000004**
A O C 12	Baseline (depth-weighted)	**NE**	**NE**	0.000000001	0.000000001	0.0000000007	0.0000000006	0.00000002	0.00000001	0.000000008	0.000000007
A O C 12	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (depth-weighted)	**NE**	**NE**	0.00000005	0.0000002	0.0000002	0.0000001	0.0000004	**0.000002**	**0.000002**	0.000001
A O C 14	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000006), TEQ human (0.000002)	Cr-6 (0.0000008), TEQ human (0.000001)	NA
A O C 14	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	0.0000004	0.000001	0.000001	0.0000009
A O C 14	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (depth-weighted)	**NE**	**NE**	0.0000003	0.0000002	0.0000002	0.0000001	**0.000003**	**0.000002**	**0.000002**	0.0000009
A O C 27	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000007), B(a)PEQ (0.0000006), TEQ human (0.000001)	Cr-6 (0.0000005), B(a)PEQ (0.0000004), TEQ human (0.000001)	Cr-6 (0.0000008), B(a)PEQ (0.0000002), TEQ human (0.0000008)	NA
A O C 27	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	0.0000009	0.0000007	0.0000006	0.0000004
A O C 27	Baseline (area-weighted)	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
A O C 11	Baseline (depth-weighted)	**0.000003**	**0.000003**	**0.000006**	**0.000006**	0.0000009	0.0000009	**0.000003**	**0.000003**
A O C 11	Baseline (depth-weighted)	A s (0.000002), TEQ human (0.0000008)	A s (0.000002), TEQ human (0.000001)	A s (0.000004), TEQ human (0.000002)	A s (0.000004), TEQ human (0.000002)	NA	NA	A s (0.000002), TEQ human (0.0000009)	A s (0.000002), TEQ human (0.000001)
A O C 11	Baseline Excluding Background A s (depth-weighted)	0.000001	0.000001	**0.000003**	**0.000003**	0.0000004	0.0000004	**0.000002**	**0.000002**
A O C 11	Baseline (area-weighted)	**0.000003**	**0.000003**	**0.000005**	**0.000005**	**NE**	**NE**	**0.000003**	**0.000003**
A O C 11	Baseline (area-weighted)	A s (0.000002), TEQ human (0.0000004)	A s (0.000002), TEQ human (0.0000005)	A s (0.000004), TEQ human (0.0000007)	A s (0.000004), TEQ human (0.000001)	NA	NA	A s (0.000002), Cr-6 (0.0000006), TEQ human (0.0000004)	A s (0.000002), Cr-6 (0.0000006), TEQ human (0.0000005)
A O C 11	Baseline Excluding Background A s (area-weighted)	0.000001	0.000001	**0.000002**	**0.000002**	**NE**	**NE**	**0.000002**	**0.000002**
A O C 12	Baseline (depth-weighted)	0.000000003	0.000000002	0.000000006	0.000000005	0.000000001	0.0000000009	0.00000001	0.000000008
A O C 12	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (depth-weighted)	0.0000001	0.0000007	0.0000001	0.000001	0.00000002	0.0000002	0.0000002	0.000001
A O C 14	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 14	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (depth-weighted)	0.000001	0.0000008	**0.000002**	**0.000002**	0.0000002	0.0000002	**0.000002**	0.000001
A O C 27	Baseline (depth-weighted)	NA	NA	Cr-6 (0.0000002), B(a)PEQ (0.000001), TEQ human (0.000001)	Cr-6 (0.0000001), B(a)PEQ (0.0000007), TEQ human (0.0000008)	NA	NA	Cr-6 (0.0000004), B(a)PEQ (0.0000007), TEQ human (0.0000006)	NA
A O C 27	Baseline (area-weighted)	**NE**	**NE**	0.0000007	0.0000004	**NE**	**NE**	0.0000005	0.0000004
A O C 27	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA

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	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 11	Baseline (depth-weighted)	0.000000006	0.000000006	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 11	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s (depth-weighted)	0.000000006	0.000000006	NE	NE	NE	NE	NE	NE
A O C 11	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 11	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 12	Baseline (depth-weighted)	0.00000000002	0.00000000002	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 12	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (depth-weighted)	0.000000001	0.000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 14	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 14	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (depth-weighted)	0.000000001	0.000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 27	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 27	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
A O C 28	Baseline (depth-weighted)	**NE**	**NE**	0.00000000002	0.00000000002	0.00000000002	0.00000000002	0.0000000002	0.0000000002	0.0000000001	0.0000000001
A O C 28	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 31	Baseline (depth-weighted)	**NE**	**NE**	0.000000006	0.000000005	0.000000003	0.000000003	0.00000007	0.00000006	0.00000004	0.00000004
A O C 31	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline (depth-weighted)	**NE**	**NE**	0.000001	**0.000002**	**0.000002**	0.000001	**0.00001**	**0.00002**	**0.00002**	**0.00001**
UA-2	Baseline (depth-weighted)	NA	NA	NA	A s (0.000002)	A s (0.000002)	NA	A s (0.00001)	A s (0.00002)	A s (0.00002)	A s (0.00001)
UA-2	Baseline Excluding A s (depth-weighted)	**NE**	**NE**	**ND**	0.00000000008	0.0000000002	0.0000000001	**ND**	0.000000	0.000000002	0.000000001
All AOCs Outside Compressor Station	Baseline (depth-weighted)	**NE**	**NE**	**0.000003**	**0.000002**	0.000001	0.0000009	**0.00002**	**0.00002**	**0.000009**	**0.000007**
All AOCs Outside Compressor Station	Baseline (depth-weighted)	NA	NA	Cr-6 (0.000003)	Cr-6 (0.000002)	NA	NA	Cr-6 (0.00002), TEQ human (0.000001)	Cr-6 (0.00001), TEQ human (0.000001)	Cr-6 (0.000008), TEQ human (0.000001)	Cr-6 (0.000005), TEQ human (0.000001)
All AOCs Outside Compressor Station	Baseline (area-weighted)	**NE**	**NE**	**0.000002**	0.000001	0.0000007	0.0000005	**0.00001**	**0.000009**	**0.000005**	**0.000004**
All AOCs Outside Compressor Station	Baseline (area-weighted)	NA	NA	Cr-6 (0.000002)	Cr-6 (0.000001)	NA	NA	Cr-6 (0.00001), TEQ human (0.000003)	Cr-6 (0.000008), TEQ human (0.000002)	Cr-6 (0.000004), TEQ human (0.000001)	Cr-6 (0.000003), TEQ human (0.0000009)
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	**NE**	**NE**	**0.000004**	**0.000003**	**0.000002**	0.000001	**0.00003**	**0.00002**	**0.00001**	**0.000009**
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	NA	NA	Cr-6 (0.000004)	Cr-6 (0.000003)	Cr-6 (0.000001)	NA	Cr-6 (0.00003), TEQ human (0.000001)	Cr-6 (0.00002), TEQ human (0.000001)	Cr-6 (0.00001), TEQ human (0.000001)	Cr-6 (0.000007), TEQ human (0.000001)
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	**NE**	**NE**	**0.000002**	**0.000002**	0.000001	0.0000007	**0.00002**	**0.00001**	**0.000008**	**0.000006**
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	NA	NA	Cr-6 (0.000002)	Cr-6 (0.000001)	NA	NA	Cr-6 (0.00002), TEQ human (0.0000007)	Cr-6 (0.00001), TEQ human (0.0000008)	Cr-6 (0.000007), TEQ human (0.0000008)	Cr-6 (0.000005), TEQ human (0.0000008)
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	**NE**	**NE**	0.0000003	0.0000005	0.0000005	0.0000004	**0.000003**	**0.000004**	**0.000004**	**0.000004**

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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
A O C 28	Baseline (depth-weighted)	0.00000000005	0.00000000005	0.0000000001	0.0000000001	0.00000000003	0.00000000003	0.0000000001	0.0000000001
A O C 28	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 31	Baseline (depth-weighted)	0.00000004	0.00000003	0.00000008	0.00000006	0.000000005	0.000000004	0.00000007	0.00000005
A O C 31	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline (depth-weighted)	**0.000005**	**0.000007**	**0.00001**	**0.00001**	**0.000002**	**0.000002**	**0.000005**	**0.000008**
UA-2	Baseline (depth-weighted)	A s (0.000005)	A s (0.000007)	A s (0.00001)	A s (0.00001)	A s (0.000002)	A s (0.000002)	A s (0.000005)	A s (0.000008)
UA-2	Baseline Excluding A s (depth-weighted)	**ND**	0.0000000002	**ND**	0.0000000004	**ND**	0.00000000007	**ND**	0.0000000005
All AOCs Outside Compressor Station	Baseline (depth-weighted)	**0.000003**	**0.000002**	**0.000006**	**0.000005**	0.0000004	0.0000003	**0.00001**	**0.000008**
All AOCs Outside Compressor Station	Baseline (depth-weighted)	Cr-6 (0.000003), TEQ human (0.0000005)	Cr-6 (0.000002), TEQ human (0.0000005)	Cr-6 (0.000005), TEQ human (0.000001)	Cr-6 (0.000003), TEQ human (0.000001)	NA	NA	Cr-6 (0.00001), TEQ human (0.0000005)	Cr-6 (0.000007), TEQ human (0.0000006)
All AOCs Outside Compressor Station	Baseline (area-weighted)	**0.000002**	**0.000002**	**0.000005**	**0.000003**	**NE**	**NE**	**0.000007**	**0.000005**
All AOCs Outside Compressor Station	Baseline (area-weighted)	Cr-6 (0.000001), TEQ human (0.000001)	Cr-6 (0.000001), TEQ human (0.0000007)	Cr-6 (0.000003), TEQ human (0.000002)	Cr-6 (0.000002), TEQ human (0.000001)	NA	NA	Cr-6 (0.000006), TEQ human (0.000001)	Cr-6 (0.000004), TEQ human (0.0000008)
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	**0.000004**	**0.000003**	**0.000009**	**0.000006**	0.0000005	0.0000004	**0.00002**	**0.00001**
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	Cr-6 (0.000004), TEQ human (0.0000004)	Cr-6 (0.000003), TEQ human (0.0000005)	Cr-6 (0.000008), TEQ human (0.0000009)	Cr-6 (0.000005), TEQ human (0.000001)	NA	NA	Cr-6 (0.00002), TEQ human (0.0000005)	Cr-6 (0.00001), TEQ human (0.0000005)
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	**0.000002**	**0.000002**	**0.000005**	**0.000003**	**NE**	**NE**	**0.00001**	**0.000006**
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	Cr-6 (0.000002), TEQ human (0.0000003)	Cr-6 (0.000001), TEQ human (0.0000003)	Cr-6 (0.000004), TEQ human (0.0000006)	Cr-6 (0.000003), TEQ human (0.0000006)	NA	NA	Cr-6 (0.000009), TEQ human (0.0000003)	Cr-6 (0.000006), TEQ human (0.0000003)
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	0.0000007	0.0000008	0.000001	**0.000002**	0.0000002	0.0000002	0.000001	**0.000002**

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Exposure Area	Scenario	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 28	Baseline (depth-weighted)	0.000000000004	0.000000000004	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 28	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
A O C 31	Baseline (depth-weighted)	0.0000000001	0.0000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
A O C 31	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline (depth-weighted)	0.00000000008	0.0000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
UA-2	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline Excluding A s (depth-weighted)	**ND**	0.000000000000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station	Baseline (depth-weighted)	0.00000001	0.000000009	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	0.00000002	0.00000001	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	0.000000003	0.000000004	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2
	Background as Estimated LCR [a]	**NE**	**NE**	0.0000004	0.0000004	0.0000004	0.0000004	**0.000004**	**0.000004**	**0.000004**	**0.000004**
All A OCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.000002), TEQ human (0.000001)	Cr-6 (0.000003), TEQ human (0.000001)	Cr-6 (0.000003), TEQ human (0.000001)	Cr-6 (0.000002), TEQ human (0.0000009)
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	0.000001	**0.000002**	**0.000002**	**0.000002**
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	Cr-6 (0.0000005), TEQ human (0.0000006)	Cr-6 (0.000001), TEQ human (0.0000007)	Cr-6 (0.000001), TEQ human (0.0000007)	Cr-6 (0.000001), TEQ human (0.0000006)
North of RailRoad	Baseline (depth-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
North of RailRoad	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
North of RailRoad	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
North of RailRoad	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inside Compressor Station	Baseline (depth-weighted)	**0.00001**	**0.000009**	0.0000008	0.0000007	0.0000005	0.0000004	**0.000007**	**0.000006**	**0.000004**	**0.000003**
Inside Compressor Station	Baseline (depth-weighted)	Cr-6 (0.000001), Total PCBs (0.0000009), TEQ human (0.000009)	Cr-6 (0.0000008), Total PCBs (0.0000008), TEQ human (0.000007)	NA	NA	NA	NA	Cr-6 (0.000004), Total PCBs (0.0000004), TEQ human (0.000002)	Cr-6 (0.000003), Total PCBs (0.0000004), TEQ human (0.000002)	Cr-6 (0.000002), Total PCBs (0.0000003), TEQ human (0.000001)	Cr-6 (0.000002), Total PCBs (0.0000003), TEQ human (0.000001)
Inside Compressor Station	Baseline (area-weighted)	**0.000008**	**0.000007**	**NE**	**NE**	**NE**	**NE**	**0.000003**	**0.000003**	**0.000002**	**0.000002**
Inside Compressor Station	Baseline (area-weighted)	Cr-6 (0.0000003), Total PCBs (0.0000009), TEQ human (0.000007)	Cr-6 (0.0000002), Total PCBs (0.0000009), TEQ human (0.000006)	NA	NA	NA	NA	Cr-6 (0.000001), Total PCBs (0.0000005), TEQ human (0.000002)	Cr-6 (0.0000009), Total PCBs (0.0000004), TEQ human (0.000002)	Cr-6 (0.0000007), Total PCBs (0.0000004), TEQ human (0.000001)	Cr-6 (0.0000006), Total PCBs (0.0000004), TEQ human (0.000001)

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Exposure Area	Scenario	Camper- 'Surface	Camper - Shallow	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow
	Background as Estimated LCR [a]	**0.000002**	**0.000002**	**0.000003**	**0.000003**	0.0000005	0.0000005	**0.000002**	**0.000002**
All A OCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	NA	NA	NA	Cr-6 (0.0000007), TEQ human (0.0000008)	NA	NA	Cr-6 (0.0000009), TEQ human (0.0000004)	Cr-6 (0.000001), TEQ human (0.0000005)
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (area-weighted)	**NE**	**NE**	0.0000007	0.0000009	**NE**	**NE**	0.0000006	0.0000009
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
North of RailRoad	Baseline (depth-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
North of RailRoad	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
North of RailRoad	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
North of RailRoad	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
Inside Compressor Station	Baseline (depth-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Inside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
Inside Compressor Station	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Inside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background as Estimated LCR [a]	0.00000000003	0.00000000003	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All A OCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A O C10-20	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
North of RailRoad	Baseline (depth-weighted)	**NE**	**NE**	**0.00002**	**0.00001**	**0.000009**	**0.000007**	**0.001**	**0.001**
North of RailRoad	Baseline (depth-weighted)	NA	NA	Cr-6 (0.000001), TEQ human (0.00001)	Cr-6 (0.000001), Total PCBs (0.000001), TEQ human (0.00001)	Cr-6 (0.000001), Total PCBs (0.000002), TEQ human (0.000006)	Cr-6 (0.0000007), Total PCBs (0.000001), TEQ human (0.000006)	Cr-6 (0.001), Total PCBs (0.000002), TEQ Human (0.000002)	Cr-6 (0.001) Total PCBs (0.000002), TEQ Human (0.000002)
North of RailRoad	Baseline (area-weighted)	**NE**	**NE**	**0.00001**	**0.00001**	**0.000007**	**0.000006**	**0.001**	**0.0009**
North of RailRoad	Baseline (area-weighted)	NA	NA	Cr-6 (0.000001), TEQ human (0.000009)	Cr-6 (0.000001), Total PCBs (0.000001), TEQ human (0.000007)	Cr-6 (0.0000008), Total PCBs (0.000002), TEQ human (0.000005)	Cr-6 (0.0000007), Total PCBs (0.000001), TEQ human (0.000004)	Cr-6 (0.001), Total PCBs (0.000002), TEQ Human (0.000001)	Cr-6 (0.0009) Total PCBs (0.000002), TEQ Human (0.000001)
Inside Compressor Station	Baseline (depth-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Inside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA
Inside Compressor Station	Baseline (area-weighted)	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Inside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA

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Note:

[a] Estimated LCR for exposure to arsenic background concentrations in soil was calculated using the 95% UCL on the mean background arsenic concentration as an estimate of the EPC.

Abbreviations:

NE = Scenario not evaluated for this exposure area.
- Area-weighted EPCs are evaluated only for receptors and exposure areas where depth-weighted EPCs result in estimated ILCRs and hazard indices above 0.000001 and 1, respectively, per the RAWP (Arcadis 2008).
- Subsurface 2 soil is not evaluated for the 5-foot scouring scenarios.
- Commercial worker receptor only evaluated for Inside Compressor Station exposure area as described in Section 5.3 of the main report.
- Hypothetical future resident receptor and hypothetical future resident consumer of home-produced food only evaluated for North of Railroad exposure area as described in Section 5.3 of the main report.
- AOC 4: subsurface 1 and subsurface 2 soil not included in the evaluation because bedrock is encountered and 3 feet bgs in AOC 4.
- BCW Sediment Area: surface soil is not included in the evaluation due to limited sampling in this depth interval. Additionally, no carcinogenic constituents of potential concern (COPCs) were detected in the BCW Sediment Area so cancer risks are not calculated for commercial workers in this exposure area.
- East Ravine Sediment Area: the shallow soil depth interval is not included in the evaluation because COPCs were not detected in shallow soil.
- Inside Compressor Station: only worker receptors (commercial worker, short- and long-term maintenance worker) scenarios were evaluated for this exposure area as described in Section 5.3 of the main report.

AOC = area of concern.
Area-weighted = results presented are for area-weighted EPCs.
As = arsenic.
BCW = Bat Cave Wash.
bgs = below ground surface.
Co = cobalt.
COPC = constituent of potential concern.
Cr-6 = hexavalent chromium.
Depth-weighted = results presented are for depth-weighted EPCs.
EPC = exposure point concentration.
HI = hazard index.
ILCRs = incremental lifetime cancer risks.
LCR = lifetime cancer risk.
NA = Not applicable. ILCR and HI drivers are presented only for the scenarios included in the exposure area-specific evaluation and only for estimated ILCRs above 0.000001 and estimated HIs above 1.
ND = Not detected. No carcinogenic COPCs were detected in this depth interval.
RAWP = Risk Assessment Work Plan.
SWMU = solid waste management unit.
TCS = Topock Compressor Station.
TEQ human = dioxin toxicity equivalents for humans.
Total PCBs = total polychlorinated biphenyls.
UCL = upper confidence limit.

Reference:

Arcadis. 2008. Human Health and Ecological Risk Assessment Work Plan (RAWP), Topock Compressor Station, Needles, California. August.

Table 5-7
HHRA Noncancer Hazard Estimate Summary

Soil Human Health and Ecological Risk Assessment
PG&&E Topock Compressor Station
Needles, California

Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2	Camper - Surface	Camper - Shallow
	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
BCW	Baseline (depth-weighted)	NE	NE	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2
BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	0.3	0.2	0.1	0.09	NE	NE
BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (depth-weighted)	NE	NE	0.2	0.1	0.2	0.2	0.09	0.1	0.1	0.09	0.1	0.2
BCW	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (area-weighted)	NE	NE	NE	NE	NE	NE	0.06	0.07	0.07	0.07	NE	NE
BCW	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (depth-weighted)	NE	NE	0.3	0.3	0.3	NE	0.08	0.09	0.1	NE	0.1	0.1
BCW	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (area-weighted)	NE	NE	NE	NE	NE	NE	0.07	0.07	0.07	NE	NE	NE
BCW	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (depth-weighted)	NE	NE	0.5	0.3	0.1	0.1	**3**	0.7	0.3	0.2	**4**	1
SWMU1-TCS4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	TEQ human (3)	NA	NA	NA	TEQ human (4)	NA
SWMU1-TCS4	Baseline (area-weighted)	NE	NE	0.4	0.3	0.08	0.07	0.8	0.5	0.3	0.2	1	0.8

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	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
BCW	Baseline (depth-weighted)	0.4	0.4	0.02	0.02	0.07	0.07	0.0001	0.0001	NE	NE	NE	NE	NE	NE
BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	Baseline (area-weighted)	0.8	0.5	NE	NE	0.2	0.09	NE	NE	NE	NE	NE	NE	NE	NE
BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (depth-weighted)	0.2	0.3	0.01	0.02	0.05	0.06	0.0001	0.0001	NE	NE	NE	NE	NE	NE
BCW	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	2-foot Scouring (area-weighted)	0.2	0.2	NE	NE	0.04	0.04	NE	NE	NE	NE	NE	NE	NE	NE
BCW	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (depth-weighted)	0.2	0.3	0.02	0.02	0.04	0.05	0.0007	0.0007	NE	NE	NE	NE	NE	NE
BCW	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW	5-foot Scouring (area-weighted)	NE	NE	NE	NE	0.03	0.04	NE	NE	NE	NE	NE	NE	NE	NE
BCW	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (depth-weighted)	**8**	**2**	0.4	0.1	**2**	0.4	0.00005	0.00005	NE	NE	NE	NE	NE	NE
SWMU1-TCS4	Baseline (depth-weighted)	TEQ human (8)	TEQ human (2)	NA	NA	TEQ human (2)	NA	NA	NA	NA	NA	NA	NA	NA	NA
SWMU1-TCS4	Baseline (area-weighted)	**2**	**2**	0.1	0.08	0.5	0.3	NE	NE	NE	NE	NE	NE	NE	NE

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	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
SWMU1-TCS4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NE	NE	0.2	0.1	0.1	0.1	0.07	0.07	0.06	0.06	0.1	0.1
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (depth-weighted)	NE	NE	0.2	0.2	NE	NE	0.1	0.1	NE	NE	0.06	0.06
A O C 4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	0.08	0.08	NE	NE	NE	NE
A O C 4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline (depth-weighted)	NE	NE	0.6	0.6	0.5	0.4	0.6	0.6	0.5	0.5	0.9	0.8
A O C 9	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (depth-weighted)	NE	NE	0.6	0.5	0.4	0.4	0.4	0.3	0.2	0.2	0.5	0.4
A O C 9	Baseline (area-weighted)	NE	NE	0.5	0.5	0.4	0.3	0.4	0.4	0.4	0.4	0.6	0.6
A O C 9	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (area-weighted)	NE	NE	0.5	0.5	0.4	0.3	0.2	0.1	0.1	0.1	0.2	0.2
A O C 10	Baseline (depth-weighted)	NE	NE	0.3	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8
A O C 10	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
SWMU1-TCS4	Baseline (area-weighted)	TEQ human (2)	TEQ human (2)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	0.2	0.2	0.01	0.01	0.04	0.03	0.0001	0.0001	NE	NE	NE	NE	NE	NE
BCW Excluding SWMU1-TSC4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (depth-weighted)	0.1	0.1	0.006	0.006	0.05	0.05	0.00004	0.00004	NE	NE	NE	NE	NE	NE
A O C 4	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 4	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
A O C 4	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline (depth-weighted)	**2**	**2**	0.1	0.09	0.4	0.3	0.001	0.001	NE	NE	NE	NE	NE	NE
A O C 9	Baseline (depth-weighted)	A s (1), TEQ human (0.6)	A s (1), TEQ human (0.4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (depth-weighted)	0.9	0.8	0.06	0.05	0.2	0.2	0.001	0.001	NE	NE	NE	NE	NE	NE
A O C 9	Baseline (area-weighted)	1	1	0.06	0.06	0.3	0.2	NE	NE	NE	NE	NE	NE	NE	NE
A O C 9	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 9	Baseline Excluding Background A s (area-weighted)	0.4	0.4	0.02	0.03	0.09	0.08	NE	NE	NE	NE	NE	NE	NE	NE
A O C 10	Baseline (depth-weighted)	1	**2**	0.07	0.08	0.3	0.3	0.00008	0.00008	NE	NE	NE	NE	NE	NE
A O C 10	Baseline (depth-weighted)	NA	Arsenic (1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
A O C 10	Baseline Excluding Background A s (depth-weighted)	NE	NE	0.3	0.7	0.7	0.7	0.3	0.3	0.3	0.3	0.3	0.4
A O C 10	Baseline (area-weighted)	NE	NE	0.3	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.6	0.7
A O C 10	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	Baseline Excluding Background A s (area-weighted)	NE	NE	0.3	0.6	0.6	0.6	0.2	0.2	0.2	0.2	0.2	0.3
A O C 10	2-foot Scouring (depth-weighted)	NE	NE	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.7	0.7
A O C 10	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (depth-weighted)	NE	NE	0.5	0.5	0.4	0.4	0.2	0.2	0.2	0.2	0.3	0.3
A O C 10	2-foot Scouring (area-weighted)	NE	NE	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.7	0.7
A O C 10	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (area-weighted)	NE	NE	0.5	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.3	0.3
A O C 10	5-foot Scouring (depth-weighted)	NE	NE	0.06	0.06	0.05	NE	0.4	0.4	0.4	NE	0.6	0.6
A O C 10	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (depth-weighted)	NE	NE	0.04	0.04	0.03	NE	0.2	0.1	0.2	NE	0.2	0.2
A O C 10	5-foot Scouring (area-weighted)	NE	NE	NE	NE	NE	NE	0.4	0.4	0.4	NE	0.6	0.6

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	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
A O C 10	Baseline Excluding Background A s (depth-weighted)	0.6	0.8	0.03	0.04	0.2	0.2	0.00008	0.00008	NE	NE	NE	NE	NE	NE
A O C 10	Baseline (area-weighted)	1	1	NE	NE	0.3	0.3	NE	NE	NE	NE	NE	NE	NE	NE
A O C 10	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	Baseline Excluding Background A s (area-weighted)	0.4	0.7	NE	NE	0.1	0.1	NE	NE	NE	NE	NE	NE	NE	NE
A O C 10	2-foot Scouring (depth-weighted)	1	1	0.07	0.07	0.3	0.3	0.00008	0.00008	NE	NE	NE	NE	NE	NE
A O C 10	2-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (depth-weighted)	0.6	0.6	0.03	0.03	0.1	0.1	0.00008	0.00008	NE	NE	NE	NE	NE	NE
A O C 10	2-foot Scouring (area-weighted)	1	1	NE	NE	0.3	0.3	NE	NE	NE	NE	NE	NE	NE	NE
A O C 10	2-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	2-foot Scouring Excluding Background A s (area-weighted)	0.5	0.6	NE	NE	0.1	0.1	NE	NE	NE	NE	NE	NE	NE	NE
A O C 10	5-foot Scouring (depth-weighted)	1	1	0.06	0.06	0.3	0.3	0.0001	0.0001	NE	NE	NE	NE	NE	NE
A O C 10	5-foot Scouring (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (depth-weighted)	0.4	0.4	0.02	0.02	0.1	0.09	0.0001	0.0001	NE	NE	NE	NE	NE	NE
A O C 10	5-foot Scouring (area-weighted)	1	1	NE	NE	0.3	0.3	NE	NE	NE	NE	NE	NE	NE	NE

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	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
A O C 10	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (area-weighted)	NE	NE	NE	NE	NE	NE	0.1	0.1	0.1	NE	0.2	0.2
A O C 11	Baseline (depth-weighted)	NE	NE	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.6	0.6
A O C 11	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s (depth-weighted)	NE	NE	0.1	0.1	0.1	0.09	0.1	0.1	0.1	0.1	0.2	0.2
A O C 11	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	0.4	0.4	0.4	0.4	0.6	0.6
A O C 11	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s+B4 (area-weighted)	NE	NE	NE	NE	NE	NE	0.1	0.1	0.1	0.1	0.2	0.2
A O C 12	Baseline (depth-weighted)	NE	NE	0.002	0.002	0.001	0.001	0.001	0.0008	0.0006	0.0005	0.0007	0.0006
A O C 12	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (depth-weighted)	NE	NE	0.01	0.6	0.7	0.5	0.003	0.1	0.2	0.1	0.004	0.2
A O C 14	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	0.003	0.1	0.2	0.1	NE	NE
A O C 14	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (depth-weighted)	NE	NE	0.07	0.08	0.08	0.06	0.09	0.05	0.05	0.03	0.06	0.05

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	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
A O C 10	5-foot Scouring (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 10	5-foot Scouring Excluding Background A s (area-weighted)	0.4	0.4	NE	NE	0.08	0.08	NE	NE	NE	NE	NE	NE	NE	NE
A O C 11	Baseline (depth-weighted)	1	1	0.06	0.06	0.2	0.3	0.0006	0.0006	NE	NE	NE	NE	NE	NE
A O C 11	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s (depth-weighted)	0.3	0.3	0.02	0.02	0.08	0.08	0.0006	0.0006	NE	NE	NE	NE	NE	NE
A O C 11	Baseline (area-weighted)	1	1	NE	NE	0.2	0.2	NE	NE	NE	NE	NE	NE	NE	NE
A O C 11	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 11	Baseline Excluding Background A s+B4 (area-weighted)	0.3	0.3	NE	NE	0.07	0.07	NE	NE	NE	NE	NE	NE	NE	NE
A O C 12	Baseline (depth-weighted)	0.001	0.001	0.00008	0.00006	0.0008	0.0006	0.0000004	0.0000004	NE	NE	NE	NE	NE	NE
A O C 12	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (depth-weighted)	0.009	0.5	0.001	0.02	0.002	0.08	0.00009	0.0001	NE	NE	NE	NE	NE	NE
A O C 14	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 14	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
A O C 14	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (depth-weighted)	0.1	0.1	0.02	0.01	0.03	0.02	0.0002	0.0002	NE	NE	NE	NE	NE	NE

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	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
A O C 27	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	0.06	0.03	0.03	0.03	NE	NE
A O C 27	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 28	Baseline (depth-weighted)	NE	NE	0.03	0.03	0.03	0.04	0.004	0.004	0.004	0.004	0.005	0.005
A O C 28	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 31	Baseline (depth-weighted)	NE	NE	0.02	0.01	0.01	0.01	0.004	0.003	0.002	0.002	0.003	0.003
A O C 31	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline (depth-weighted)	NE	NE	0.5	0.5	0.5	0.5	1	1	1	1	1	**2**
UA-2	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	A s (2)
UA-2	Baseline Excluding A s (depth-weighted)	NE	NE	0.4	0.4	0.4	0.4	0.1	0.1	0.1	0.1	0.01	0.02
All AOCs Outside Compressor Station	Baseline (depth-weighted)	NE	NE	0.2	0.1	0.1	0.1	0.09	0.07	0.07	0.06	0.1	0.09
All AOCs Outside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station	Baseline (area-weighted)	NE	NE	0.2	0.1	0.1	0.1	0.1	0.07	0.06	0.05	0.2	0.1
All AOCs Outside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	NE	NE	0.2	0.2	0.2	0.1	0.06	0.07	0.07	0.06	0.07	0.09
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
A O C 27	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 27	Baseline (area-weighted)	0.05	0.04	NE	NE	0.01	0.009	NE	NE	NE	NE	NE	NE	NE	NE
A O C 27	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 28	Baseline (depth-weighted)	0.01	0.01	0.004	0.004	0.002	0.002	0.0002	0.0002	NE	NE	NE	NE	NE	NE
A O C 28	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A O C 31	Baseline (depth-weighted)	0.006	0.005	0.001	0.0009	0.003	0.002	0.00006	0.00006	NE	NE	NE	NE	NE	NE
A O C 31	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline (depth-weighted)	**3**	**4**	0.1	0.2	0.6	8	0.0003	0.0003	NE	NE	NE	NE	NE	NE
UA-2	Baseline (depth-weighted)	A s (3)	A s (4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
UA-2	Baseline Excluding A s (depth-weighted)	0.03	0.03	0.004	0.004	0.04	0.04	0.0003	0.0003	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station	Baseline (depth-weighted)	0.3	0.2	0.02	0.01	0.06	0.04	0.0003	0.0003	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station	Baseline (area-weighted)	0.4	0.2	NE	NE	0.06	0.04	NE	NE	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	0.1	0.2	0.01	0.01	0.04	0.05	0.0004	0.0004	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station excluding BCW	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2	Camper - Surface	Camper - Shallow
	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	NE	NE	0.07	0.1	0.1	0.1	0.03	0.05	0.05	0.05	0.04	0.08
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (depth-weighted)	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (depth-weighted)	NA	NA	0.2	0.1	--	0.1	0.06	0.04	--	0.04	0.1	0.07
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NA	NA	0.2	0.2	0.2	0.1	0.06	0.07	0.07	0.06	0.07	0.09
North of Railroad	Baseline (depth-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
North of Railroad	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
North of Railroad	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
North of Railroad	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inside Compressor Station	Baseline (depth-weighted)	0.6	0.4	0.5	0.4	0.4	0.4	0.2	0.1	0.1	0.1	NE	NE
Inside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	0.08	0.2	NE	NE	0.02	0.03	NE	NE	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station excluding BCW	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (depth-weighted)	0.2	0.1	0.01	0.008	0.03	0.02	0.0001	0.0001	NA	NA	NA	NA	NA	NA
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE	NE
All AOCs Outside Compressor Station excluding SWMU1-TCS4 and A 0 C10-20	Baseline (area-weighted)	0.1	0.2	0.01	0.01	0.04	0.05	0.0004	0.0004	NA	NA	NA	NA	NA	NA
North of Railroad	Baseline (depth-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	**2**	**2**	1	1	**6**	**7**
North of Railroad	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	TEQ human (1)	TEQ human (1)	NA	NA	CR-6 (1), Total PCBs (0.4), TPHd (5)	CR-6 (1), Total PCBs (0.4), TPHd (5)
North of Railroad	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	1	1	1	1	**6**	**6**
North of Railroad	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	CR-6 (1), Total PCBs (0.4), TPHd (5)	CR-6 (0.9), Total PCBs (0.4), TPHd (5)
Inside Compressor Station	Baseline (depth-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Inside Compressor Station	Baseline (depth-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Commercial Worker - Surface	Commercial Worker - Shallow	Short-Term Maintenance - Surface	Short-Term Maintenance - Shallow	Short-Term Maintenance - Subsurface 1	Short-Term Maintenance - Subsurface 2	Long-Term Maintenance - Surface	Long-Term Maintenance - Shallow	Long-Term Maintenance - Subsurface 1	Long-Term Maintenance - Subsurface 2	Camper - Surface	Camper - Shallow
	Background A s Estimated HI [a]	NE	NE	0.02	0.02	0.02	0.02	0.3	0.3	0.3	0.3	0.4	0.4
Inside Compressor Station	Baseline (area-weighted)	0.5	0.4	NE	NE	NE	NE	0.1	0.09	0.08	0.08	NE	NE
Inside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Exposure Area	Scenario	Hiker - Surface	Hiker - Shallow	Hunter - Surface	Hunter - Shallow	OHV Rider - Surface	OHV Rider - Shallow	Tribal User - Surface	Tribal User - Shallow	Hypothetical Future Resident - Surface	Hypothetical Future Resident - Shallow	Hypothetical Future Resident - Subsurface 1	Hypothetical Future Resident - Subsurface 2	Hypothetical Future Resident Consumer of Home-Produced Food - Surface	Hypothetical Future Resident Consumer of Home-Produced Food - Shallow
	Background A s Estimated HI [a]	0.8	0.8	0.04	0.04	0.2	0.2	0.0000006	0.0000006	NE	NE	NE	NE	NE	NE
Inside Compressor Station	Baseline (area-weighted)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Inside Compressor Station	Baseline (area-weighted)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-7
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Notes:
[a] Estimated HI for exposure to arsenic background concentrations in soil was calculated using the 95% UCL (95UCL) on the mean background arsenic concentration as an estimate of the exposure point concentration (EPC).

Abbreviations:
NE
- Area-weighted EPCs are evaluated only for receptors and exposure areas where depth-weighted EPCs result in estimated ILCRs and HIs above 0.000001 and 1, respectively, per the RAWP (Arcadis 2008).
- Subsurface 2 soil is not evaluated for the 5-foot scouring scenarios.
- Commercial worker receptor only evaluated for Inside Compressor Station exposure area as described in Section 5.3 of the main report.
- Hypothetical future resident receptor and hypothetical future resident consumer of home-produced food only evaluated for North of Railroad exposure area as described in Section 5.3 of the main report.
- AOC 4: subsurface 1 and subsurface 2 soil not included in the evaluation because bedrock is encountered and 3 feet bgs in AOC 4.

AOC = area of concern.
Area-weighted = results presented are for area-weighted EPCs.
As = arsenic.
BCW = bat cave wash.
bgs = below ground surface.
Cr-6 = hexavalent chromium.
Depth-weighted = results presented are for depth-weighted EPCs.
HI = hazard index.
EPC = exposure point concentration.
ILCRs = incremental lifetime cancer risks.
NA = Not applicable. ILCR and HI drivers are presented only for the scenarios included in the exposure area-specific evaluation and only for estimated ILCRs above 0.000001 and estimated HIs above 1.
RAWP = Risk Assessment Work Plan.
SWMU = solid waste management unit.
TCS = Topock Compressor Station.
TEQ human = dioxin toxicity equivalents for humans.
Total PCBs = total polychlorinate biphenyls.
TPHd = Total petroleum hydrocarbons as diesel.
UCL = upper confidence limit.

Reference:
Arcadis. 2008. Human Health and Ecological Risk Assessment Work Plan (RAWP), Topock Compressor Station, Needles, California. August.

Table 6-1
Assessment Endpoints and Measurement Endpoints

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
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Assessment Endpoint	Corresponding Measurement Endpoint[1]	Representative Receptor
Sufficient rates of survival, growth, and reproduction to sustain plant populations (e.g., creosote bush scrub)	Comparison of contaminant concentrations in soil with relevant plant toxicity data (i.e., soil screening level) obtained from the literature	Plant communities
Sufficient rates of survival, growth, and reproduction to sustain invertebrate populations	Comparison of contaminant concentrations in soil with relevant invertebrate toxicity data obtained from the literature	Invertebrates
Sufficient rates of survival, growth, and reproduction to sustain avian populations	Calculated hazard quotients (HQs) for selected indicator receptors; HQs will be based on estimated exposure doses compared with toxicity reference values	Gambel's quail (granivorous birds), Cactus wren (insectivorous birds), Red-tailed hawk (carnivorous birds)
Sufficient rates of survival, growth, and reproduction to sustain mammalian populations	Calculated HQs for selected indicator receptors; HQs will be based on estimated exposure doses compared with toxicity reference values	Desert shrew (invertivorous small mammals and special status species Yuma myotis and pallid bats), Desert kit fox (carnivorous mammals and special status species ringtail cat), Merriam's kangaroo rat (granivorous small mammals), Nelson's desert bighorn sheep (herbivorous large mammals and special-status species)

Note:

[1] Measurement endpoints such as estimates of HQs only account for a single line of evidence (L O E). A weight-of-evidence approach using multiple L O E provide a more robust approach for interpreting the risk results and evaluating assessment endpoints. L O E could include but are not limited to the following: supporting statistical and site use information (e.g,, frequency of detection [FOD]), basis of the exposure concentrations (maximum versus 95UCL), confidence in the toxicity values, the direction of uncertainty in the risk estimates, consideration of special-status species at the site, and spatial extent of elevated concentrations.

Table 6-2
Exposure Depth Intervals for Ecological Receptors for Calculating of Exposure Point Concentrations

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Ecological Receptor	Plant/Burrowing Receptor?	Food Source or Type of Prey - All Exposure Areas [c]	Exposure Depth Intervals for Calculation of EPCs[a,b] - Soil EPCs for Uptake/Incidental Ingestion of Soil - All Exposure Areas [c]	Exposure Depth Intervals for Calculation of EPCs [a,b] - Biota Tissue EPCs (modeled from soil EPCs) - All Exposure Areas [c]
Plants	Yes	NA	Highest EPCs from the three depth intervals[b]	NA
Soil Invertebrates	No	NA	EPCs from 0-0.5 feet bgs	NA
Granivorous bird (Gambel's quail)	No	Plants (with roots in all three depth intervals)	EPCs from 0-0.5 feet bgs	Highest EPCs from the three depth intervals[b]
Insectivorous bird (cactus wren)	No	Insects (from surface soil)	EPCs from 0-0.5 feet bgs	EPCs from 0-0.5 feet bgs
Carnivorous bird (red-tailed hawk)	No	Insectivorous mammals (from surface soil)	EPCs from 0-0.5 feet bgs	EPCs from 0-0.5 feet bgs
Granivorous mammal (kangaroo rat)	Yes	Plants (with roots in all three depth intervals)	Highest EPCs from the three depth intervals[b]	Highest EPCs from the three depth intervals[b]
Insectivorous mammal (desert shrew)	No	Insects (from surface soil)	EPCs from 0-0.5 feet bgs	EPCs from 0-0.5 feet bgs
Carnivorous mammal (desert kit fox)	Yes	Insectivorous mammals (from surface soil)	Highest EPCs from the three depth intervals[b]	EPCs from 0-0.5 feet bgs
Herbivorous large mammal (desert bighorn sheep)	No	Plants (with roots in all three depth intervals)	EPCs from 0-0.5 feet bgs	Highest EPCs from the three depth intervals[b]

Notes:
a. Exposure point concentrations (EPCs) for ecological receptors are represented by the maximum depth-weighted concentration, depth-weighted 95 percent upper confidence limit on the mean (95UCL), and area-weighted 95UCL.
b. Depth intervals for ecological receptors in baseline scenarios include:
Surface Soil = 0 to 0.5 feet below ground surface (bgs)
Shallow Soil = 0 to 3 feet bgs
Subsurface Soil 1 = 0 to 6 feet bgs
c. Exposure areas outside the compressor station, as defined in Section 3 of the main report.

Acronyms and Abbreviations:
NA = not applicable

Table 6-3
Exposure Parameters for Terrestrial Wildlife Receptors

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Category	Parameter	Units	Gambel's Quail	Source	Cactus Wren	Source	Red-Tailed Hawk	Source	Desert Shrew	Source	Desert Kit Fox	Source	Merriam's Kangaroo Rat	Source	Nelson's Desert Bighorn Sheep	Source
Diet Composition	Plants	fraction	1	CDFG (CalEPA 2005)	NA	NA	NA	NA	NA	NA	NA	NA	1	CDFG (CalEPA 2005)	1	CDFG (CalEPA 2005)
Diet Composition	Invertebrates	fraction	NA	NA	1	CDFG (CalEPA 2005)	NA	NA	1	CDFG (CalEPA 2005)	NA	NA	NA	NA	NA	NA
Diet Composition	Mammals	fraction	NA	NA	NA	NA	1	CDFG (CalEPA 2005)	NA	NA	1	Assumed based on information presented for the kit fox in CDFG (CalEPA 2005)	NA	NA	NA	NA
Body Weight	Body Weight	kg	0.1693	Based on average weight for M/F adults from Gorsuch (1934); cited in Gee et al. (2013)	0.0389	Based on average weight for M/F adults from Anderson and Anderson (1973); cited in Hamilton et al. (2011)	1.134	Based on average weight for M/F adults (U S E P A 1993)	0.005	Based on average weight for M/F adults for desert shrew (Silva and Downing 1995)	1.985	Based on the average weight for M/F adults; O'Farrell and Gilbertson (1986) cited in Cal/Ecotox (CalEPA 2007)	0.0343	Nagy et al., (1999); cited in Nagy (2001)	67.5	California Department of Fish and Wildlife (2015)
Media Uptake	Water ingestion rate	L/kg bw-day	0.106	WIR (L/day) = 0.059 $BW(kg)^{0.67}$ Calder and Braun (1983)	0.172	WIR (L/day) = 0.059 $BW(kg)^{0.67}$ Calder and Braun (1983)	0.057	WIR (L/day) = 0.059 $BW(kg)^{0.67}$ Calder and Braun (1983)	0.168	WIR (L/day) = 0.099 $BW(kg)^{0.90}$ Calder and Braun (1983)	0.092	WIR (L/day) = 0.099 $BW(kg)^{0.90}$ Calder and Braun (1983)	0.139	WIR (L/day) = 0.099 $BW(kg)^{0.90}$ Calder and Braun (1983)	0.065	WIR (L/day) = 0.099 $BW(kg)^{0.90}$ Calder and Braun (1983)
Media Uptake	Food ingestion rate	kg/day	0.00649	Nagy (2001); Table 1: Species-specific feeding rates.	0.00713	Nagy (2001); ingestion equation for insectivorous birds	0.0899	Nagy (2001); ingestion equation for carnivorous birds	0.001	Nagy (2001); ingestion equation for insectivores	0.0702	Nagy (2001); Table 1: Species-specific feeding rates	0.00282	Nagy (2001); Table 1: Species-specific feeding rates	0.926	Nagy (2001); ingestion equation for herbivores.
Media Uptake	Food ingestion rate units	kg/day	(dry weight)	Nagy (2001); Table 1: Species-specific feeding rates.	(dry weight)	Nagy (2001); ingestion equation for insectivorous birds	(dry weight)	Nagy (2001); ingestion equation for carnivorous birds	(dry weight)	Nagy (2001); ingestion equation for insectivores	(dry weight)	Nagy (2001); Table 1: Species-specific feeding rates	(dry weight)	Nagy (2001); Table 1: Species-specific feeding rates	(dry weight)	Nagy (2001); ingestion equation for herbivores.
Media Uptake	Percent soil in diet	%	10.4	Based on American Woodcock (Beyer et al., 1994)	9.3	Based on wild turkey (Beyer et al., 1994)	1.4	Assumed to be no greater than 1/2 soil intake of red fox (Beyer et. al. 1994)	2	Based on white-footed mouse (Beyer et al., 1994)	2.8	Based on the red fox (Beyer et al., 1994)	2.4	Based on the meadow vole (Beyer etal., 1994)	30	Thornton and Abrahams (1983)
Media Uptake	Soil ingestion rate	kg/day	0.00067496	Calculated: % soil * F I R	0.000663	Calculated: % soil * F I R	0.00126	Calculated: % soil * F I R	2.03E-05	Calculated: % soil * F I R	0.00197	Calculated: % soil * F I R	0.0000677	Calculated: % soil * F I R	0.278	Calculated: % soil * F I R
Home Range	Receptor home range[a]	acres	35.7	Gullion (1962); cited in CDFG (CalEPA 2005)	4.8	Anderson and Anderson (1973); cited in CDFG (CalEPA 2005)	2471	CDFG (CalEPA 2005)	0.1	Based on dusky shrew; Hawes (1977); cited in CDFG (CalEPA 2005)	3039	Zoellick and Smith (1992)	0.13	Based on 7.6 individuals per acre; Soholt (1973); cited in CDFG (CalEPA 2005)	1270	Oehler et.al. (2003); Based on mean core area of 514 hectares.

Table 6-3
Exposure Parameters for Terrestrial Wildlife Receptors

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Notes:
a. Home ranges were converted to acres if presented in units other than acres in respective sources.

Acronyms and Abbreviations:
NA = not applicable
% = percent
BW = body weight
CalEPA = California Environmental Protection Agency
CDFG = California Department of Fish and Game
CDFW = California Department of Fish and Wildlife
FIR = food ingestion rate
FS = fraction soil
HR = home range
kg = kilogram
L = liter
M/F = male/female
SIR = soil ingestion rate
USEPA = United States Environmental Protection Agency
WIR = water ingestion rate

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Table 6-4
Site Use Factors by AOC and Receptor

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Exposure Area	Units	Gambel's Quail	Cactus Wren	Desert Shrew	Merriam's Kangaroo Rat	Desert Kit Fox[b]	Red-Tailed Hawk[b]	Nelson's Desert Bighorn Sheep[b]
Site Use Factors	SUF - conservative	unitless	1	1	1	1	1	1	1
Site Use Factors	Receptor home range	acres	35.7	4.8	0.1	0.13	3039	2471	1270
Site Areas	Bat Cave Wash; A O C 28d	acres	18	18	18	18	NA	NA	NA
Site Areas	SWMU1 / TCS-4	acres	1.4	1.4	1.4	1.4	NA	NA	NA
Site Areas	Tamarisk Thicket	acres	5.1	5.1	5.1	5.1	NA	NA	NA
Site Areas	Bat Cave Wash Excluding SWMU1 / TCS-4	acres	17	17	17	17	NA	NA	NA
Site Areas	A O C 4	acres	2.1	2.1	2.1	2.1	NA	NA	NA
Site Areas	A O C 9, A O C 10 a	acres	1.6	1.6	1.6	1.6	NA	NA	NA
Site Areas	A O C 10 b, c, and d	acres	3.0	3.0	3.0	3.0	NA	NA	NA
Site Areas	A O C 11	acres	5.8	5.8	5.8	5.8	NA	NA	NA
Site Areas	A O C 12	acres	0.32	0.32	0.32	0.32	NA	NA	NA
Site Areas	A O C 14	acres	2.9	2.9	2.9	2.9	NA	NA	NA
Site Areas	UA-2 / Former 300B Liquids Tank Area	acres	0.096	0.096	0.096	0.096	NA	NA	NA
Site Areas	A O C 27	acres	3.8	3.8	3.8	3.8	NA	NA	NA
Site Areas	A O C 28 a, b, c	acres	0.45	0.45	0.45	0.45	NA	NA	NA
Site Areas	A O C 31 – Former Teapot Dome Oil Pit	acres	0.11	0.11	0.11	0.11	NA	NA	NA
Site Areas	Bat Cave Wash and A O C 4; A O C 28d	acres	NA	NA	NA	NA	20	20	20
Site Areas	Outside Compressor Station (A O C s combined)	acres	NA	NA	NA	NA	38	38	38
Site Areas	Outside Compressor Station (Excluding BCW and A O C 4)	acres	NA	NA	NA	NA	18	18	18
Receptor-Specific SUF[a]	Bat Cave Wash / A O C 28 d	unitless	0.5	1.0	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	SWMU1 / TCS-4	unitless	0.04	0.3	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	Tamarisk Thicket	unitless	0.1	1.0	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	Bat Cave Wash Excluding SWMU1 / TCS-4	unitless	0.5	1.0	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 4	unitless	0.06	0.4	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 9 (A O C s 9 and A O C 10 a)	unitless	0.04	0.3	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 10 (A O C s 10 b, c, and d)	unitless	0.08	0.6	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 11	unitless	0.2	1.0	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 12	unitless	0.01	0.07	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 14	unitless	0.08	0.6	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	UA-2 / Former 300B Liquids Tank Area	unitless	0.003	0.02	1.0	0.7	NA	NA	NA
Receptor-Specific SUF[a]	A O C 27	unitless	0.1	0.8	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 28	unitless	0.01	0.09	1.0	1.0	NA	NA	NA
Receptor-Specific SUF[a]	A O C 31	unitless	0.003	0.02	1.0	0.8	NA	NA	NA

Table 6-4
Site Use Factors by AOC and Receptor

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Exposure Area	Units	Gambel's Quail	Cactus Wren	Desert Shrew	Merriam's Kangaroo Rat	Desert Kit Fox[b]	Red-Tailed Hawk[b]	Nelson's Desert Bighorn Sheep[b]
Receptor-Specific SUF[a]	Bat Cave Wash / AOC 28d and AOC 4 (BCW + AOC 4)	unitless	NA	NA	NA	NA	0.007	0.008	0.02
Receptor-Specific SUF[a]	Outside Compressor Station (OCS; exposure areas combined)	unitless	NA	NA	NA	NA	0.01	0.02	0.03
Receptor-Specific SUF[a]	Outside Compressor Station Excluding BCW and AOC 4 (OCS x BCW + AOC4)	unitless	NA	NA	NA	NA	0.006	0.007	0.01

Notes:
a. Site-specific SUF were evaluated for the depth-weighted and area-weighted 95 percent upper confidence limit scenarios.
b. Large home range receptor evaluated for exposure to combined exposure areas: 1) BCW and A O C 4; 28d, 2) Outside the Compressor Station (excluding BCW and A O C 4; 28d), and 3) Outside the Compressor Station.

Acronyms and Abbreviations:
NA = not applicable
A O C = area of concern
SUF = site use factor

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Log Kow[b]	Soil-to-Biota Bioaccumulation Factors[a] BAF_{plant} (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAF_{invert} (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAFmammal (dw) (kg soil/kg tissue)	
Inorganics	Aluminum	NA	NA		NA		NA	
Inorganics	Antimony	NA	ln(C_p) = 0.938 * ln(C_s) - 3.233	c	1.00	c	Cm = 0.05 * Cd	c
Inorganics	Arsenic	NA	0.03752	c	ln(Ci) = 0.706 * ln(Cs) - 1.421	c	ln(Cm) = 0.8188 * ln(Cs) -4.8471	c
Inorganics	Barium	NA	0.156	c	0.091	c	Cm = 0.0075 * Cd	c
Inorganics	Beryllium	NA	ln(C_p) = 0.7345 * ln(C_s) - 0.5361	c	0.045	c	Cm = 0.05 * Cd	c
Inorganics	Cadmium	NA	ln(C_p) = 0.546 * ln(C_s) - 0.475	c	ln(Ci) = 0.795 * ln(Cs) + 2.114	c	ln(Cm) = 0.4723 * ln(Cs) - 1.2571	c
Inorganics	Calcium	NA	NA	EN	NA	EN	NA	EN
Inorganics	Chromium, total	NA	0.041	c	0.306	c	ln(Cm) = 0.7338 * ln(Cs) - 1.4599	c
Inorganics	Chromium, hexavalent	NA	0.041	c	0.306	c	ln(Cm) = 0.7338 * ln(Cs) - 1.4599	c
Inorganics	Cobalt	NA	0.0075	c	0.122	c	ln(Cm) = 1.307 * ln(Cs) - 4.4669	c
Inorganics	Copper	NA	ln(C_p) = 0.394 * ln(C_s) + 0.668	c	0.515	c	ln(Cm) = 0.1444 * ln(Cs) + 2.042	c
Inorganics	Cyanide	NA	0	n	0	n	0	n
Inorganics	Iron	NA	NA		NA		NA	
Inorganics	Lead	NA	ln(C_p) = 0.561 * ln(C_s) - 1.328	c	ln(Ci) = 0.807 * ln(Cs) - 0.218	c	ln(Cm) = 0.4422 * ln(Cs) + 0.0761	c
Inorganics	Magnesium	NA	NA	EN	NA	EN	NA	EN
Inorganics	Manganese	NA	0.079 (Note 1)	c	(Ci) = 0.682 * ln(Cs) - 0.809 (Note	c	0.0205 (Note 1)	c
Inorganics	Mercury	NA	ln(C_p) = 0.544 * ln(Cs) - 0.996	d	ln(Ci) = 0.3369 * ln(Cs) - 0.078	e	0.192	f
Inorganics	Molybdenum	NA	0.25	g	0.55	h	ln(Cm) = 0.006 * 50 * Cd	g
Inorganics	Nickel	NA	ln(Cp) = 0.748 * ln(Cs) - 2.223	c	1.059	c	ln(Cm) = 0.4658 * ln(Cs) - 0.2462	c
Inorganics	Potassium	NA	NA	EN	NA	EN	NA	EN
Inorganics	Selenium	NA	ln(Cp) = 1.104 * ln(Cs) - 0.677	c	ln(Ci) = 0.733 * ln(Cs) - 0.075	c	ln(Cm) = 0.3764 * ln(Cs) - 0.4158	c
Inorganics	Silver	NA	0.014	c	2.045	c	0.004	c
Inorganics	Sodium	NA	NA	EN	NA	EN	NA	EN
Inorganics	Thallium	NA	0.004	g	0.55	h	0.112	f
Inorganics	Vanadium	NA	0.00485	c	0.042	c	0.0123	c
Inorganics	Zinc	NA	ln(Cp) = 0.554 * ln(Cs) + 1.575	c	ln(Ci) = 0.328 * ln(Cs) + 4.449	c	ln(Cm) = 0.0706 * ln(Cs) + 4.3632	c
Volatile Organic Compounds	1,2,4-Trimethylbenzene (Note 2)	3.78	0	b	0	b	0	b
Volatile Organic Compounds	1,3,5-Trimethylbenzene (Note 2)	3.42	0	b	0	b	0	b
Volatile Organic Compounds	Acetone (Note 2)	-0.24	0	b	0	b	0	b
Volatile Organic Compounds	Bromomethane (Note 2)	1.19	0	b	0	b	0	b
Volatile Organic Compounds	Chloro methane (Note 2)	0.91	0	b	0	b	0	b

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Log K o wb	Soil-to-Biota Bioaccumulation Factors[a] BAF$_{plant}$ (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAF$_{invert}$ (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAFmammal (dw) (kg soil/kg tissue)	
Volatile Organic Compounds	Chloroform (Note 2)	1.97	0	b	0	b	0	b
Volatile Organic Compounds	Ethyl- benzene (Note 2)	3.15	0	b	0	b	0	b
Volatile Organic Compounds	Isopropylbenzene (Note 2)	3.66	0	b	0	b	0	b
Volatile Organic Compounds	Methyl acetate	0.18	0 (Note 1)	b	0 (Note 1)	b	0 (Note 1)	b
Volatile Organic Compounds	Methyl ethyl ketone (Note 2)	0.29	0	b	0	b	0	b
Volatile Organic Compounds	Methylene chloride (Note 2)	1.25	0	b	0	b	0	b
Volatile Organic Compounds	N-Butylbenzene (Note 2)	4.38	0	b	0	b	0	b
Volatile Organic Compounds	N-Propylbenzene (Note 2)	3.69	0	b	0	b	0	b
Volatile Organic Compounds	sec-Butylbenzene (Note 2)	4.57	0	b	0	b	0	b
Volatile Organic Compounds	Toluene (Note 2)	2.73	0	b	0	b	0	b
Volatile Organic Compounds	Xylene, m,p- (Note 2)	3.20	0	b	0	b	0	b
Volatile Organic Compounds	Xylene, o- (Note 2)	3.12	0	b	0	b	0	b
Volatile Organic Compounds	Xylenes, total (Note 2)	NA	0	b	0	b	0	b
Semi-Volatile Organic Compounds	2,4-Dimethylphenol	2.3	log(BAF) = 1.588-0.578*(log K o w) (Note 1)	k,l	2.7 (Note 1)	c,j	0 (Note 1)	b
Semi-Volatile Organic Compounds	2,4-Dinitrophenol (Note 2)	1.67	0	b	0	b	0	b
Semi-Volatile Organic Compounds	4,6-Dinitro-2-methylphenol (Note 2)	2.13	0	b	0	b	0	b
Semi-Volatile Organic Compounds	4-Methylphenol	1.94	0 (Note 1)	b	0 (Note 1)	b	0 (Note 1)	b
Semi-Volatile Organic Compounds	Benzoic acid (Note 2)	1.87	0	b	0	b	0	b

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Log K o wb	Soil-to-Biota Bioaccumulation Factors[a] BAF_{plant} (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAF_{invert} (dw) (kg soil/kg tissue)		Soil-to-Biota Bioaccumulation Factors[a] BAFmammal (dw) (kg soil/kg tissue)	
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	5.11	0	i	1.995	c,j	0	i
Semi-Volatile Organic Compounds	Butylbenzylphthalate	4.91	0 (Note 1)	i	22.3 (Note 1)	c,j	0 (Note 1)	i
Semi-Volatile Organic Compounds	Carbazole	3.72	log(BAF) = 1.588-0.578*(log K o w) (Note 1)	k,l	0.01	m	0.000012	k.l
Semi-Volatile Organic Compounds	Dibenzofuran	4.12	log(BAF) = 1.588-0.578*(log K o w) (Note 1)	k,l	3 (Note 1)	c,j	0 (Note 1)	o
Semi-Volatile Organic Compounds	Di-n-butyl phthalate	4.72	0	i	12.7	c,j	0	i
Semi-Volatile Organic Compounds	Hexachlorocyclopentadiene (Note 2)	5.04	log(BAF) = 1.588 - 0.578*(log K o w)	k,l	Log(BAF) = 0.819*(log K o w) - 1.146	k	Cm = 1.2 * Cd; based on dieldrin	c
Semi-Volatile Organic Compounds	Isophorone (Note 2)	1.70	0	b	0	b	0	b
Semi-Volatile Organic Compounds	Pentachlorophenol	5.12	5.93	c	14.63	c	Cm = 0.00452 * Cd + 0.198	c
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight		ln(Cp) = 0.4544 * ln(Cs)-1.3205	c	3.04	c	0	c
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight		ln(Cp) = 0.9469 * ln(Cs)-1.7026	c	2.6	c	0	c
Pesticides	4,4-DDT	6.36	ln(Cp)= 0.7524 * ln(Cs) - 2.5119; DDT/DDE/DDD combined (Note 1)	c	ln(Ci)= 0.8689 * ln(Cs) + 2.1247 (Note 1)	c	ln(Cm)= 0.7254 * ln(Cd) + 1.1788 (Note 1)	c
Pesticides	4,4-DDE	6.51	ln(Cp)= 0.7524 * ln(Cs) - 2.5119; DDT/DDE/DDD combined (Note 1)	c	ln(Ci)= 0.8804 * ln(Cs) + 2.4771 (Note 1)	c	ln(Cm)= 0.641* ln(Cd) + 3.6401 (Note 1)	c
Pesticides	Alpha-Chlordane	6.16	0.19	c,j	24.3	c,j	Cm = 1.2 * Cd; based on dieldrin	c
Pesticides	Dieldrin	4.55	0.41	c	14.7	c	Cm = 1.2 * Cd	c
Pesticides	Gamma-Chlordane	6.16	0.19	c,j	24.3	c,j	Cm = 1.2 * Cd; based on dieldrin	c
Polychlorinated Biphenyls	Total PCBs		0.01	k,l	ln(Ci) = 1.361 * ln(Cs) + 1.41	e	Cm = 0.025* Cd	k,l
Dioxins	TEQ Avian	6.8	0.0056; based on TCDD	k	ln(Ci) = 1.182 * ln(Cs) + 3.533	e	ln(Cm)= 1.0993 * ln(Cs) + 0.8113	f
Dioxins	TEQ Mammals	6.8	0.0056; based on TCDD	k	ln(Ci) = 1.182 * ln(Cs) + 3.533	e	ln(Cm)= 1.0993 * ln(Cs) + 0.8113	f
Miscellaneous	Asbestos (Note 2)		NA		NA		NA	
Miscellaneous	Ammonia as nitrogen		NA		NA		NA	
Miscellaneous	Chloride		NA		NA		NA	
Miscellaneous	Fluoride		NA		NA		NA	
Miscellaneous	Nitrate		NA		NA		NA	

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Log K o wb	Soil-to-Biota Bioaccumulation Factors[a] BAF_{plant} (dw) (kg soil/kg tissue)	Soil-to-Biota Bioaccumulation Factors[a] BAF_{invert} (dw) (kg soil/kg tissue)	Soil-to-Biota Bioaccumulation Factors[a] BAFmammal (dw) (kg soil/kg tissue)
Miscellaneous	Orthophosphate (Note 2)		NA	NA	NA
Miscellaneous	Phosphate (Note 2)		NA	NA	NA
Miscellaneous	Sulfate		NA	NA	NA
Miscellaneous	Sulfide		NA	NA	NA

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

Note 1	Blue Note 1 indicates new or updated values from those presented in the RAWP and Technical Memorandums.
Note 2	Green Note 2 indicates new constituent not presented in RAWP or Technical Memorandums.

a. Bioaccumulation factors
b. Log K o w values were obtained from the HSDB (2016) or SRC Chem Fate database (2016). Chemicals with low Log K o ws (less than 2.0) do not bioaccumulate (CalEPA 1996, U S E P A 2000); therefore, uptake models for these chemicals were assumed to be zero.
c. U S E P A (2007)
d. Bechtel Jacobs Company, LLC (1998)
e. Sample et al. (1998a)
f. Sample et al. (1998b)
g. Baes et al. (1984).
h. Mean of available metal BAFs (invertebrates only). This follows the approach in U S E P A (1999).
i. Staples et.al. (1997); assumption
j. Jager (1998)
k. U S E P A (1999)
l. Travis and Arms (1988)
m. Sverdrup et al. (2006)
n. Eisler (1991); assumption
o. Assumed; based on similar properties to polycyclic aromatic hydrocarbons

Acronyms and Abbreviations:

NA = not available
BAF = bioaccumulation factor
BAF_{invert} = soil-to-invertebrate uptake bioaccumulation factor (kilogram soil/kilogram tissue)
BAF_{plant} = soil-to-plant uptake bioaccumulation factor (kilogram soil/kilogram tissue)
BAF_{mammal} = soil-to-mammal uptake bioaccumulation factor (kilogram soil/kilogram tissue)
C_d = constituent concentration in diet
C_i = constituent concentration in invertebrates
C_m = constituent concentration in mammals
C_p = constituent concentration in plants
C_s = constituent concentration in soil
dw = dry weight
EN = essential nutrient; typically not assessed in ecological risk assessments
HMW = high molecular weight
kg = kilogram
K o w = octanol-water partition coefficient
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
ln = natural log
TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent

Table 6-5a
Bioaccumulation Factors for Estimating Tissue Concentrations from Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

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Table 6-5b
Congener-Specific Bioaccumulation Factors for Dioxin TEQ

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Bioaccumulation Factors - Plants	Bioaccumulation Factors - Terrestrial Invertebrates
Congener-Specific Approach (U S E P A 1999)		0.00029	0.081
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,6,7,8-hpcdf	0.000062	0.017
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8,9-hpcdf	0.0022	0.62
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8-hxcdd	0.0017	0.49
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8-hxcdf	0.00043	0.121
Congener-Specific Approach (U S E P A 1999)	1,2,3,6,7,8-hxcdd	0.00067	0.19
Congener-Specific Approach (U S E P A 1999)	1,2,3,6,7,8-hxcdf	0.0011	0.3
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8,9-hxcdd	0.00078	0.22
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8,9-hxcdf	0.0035	1
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8-pecdd	0.0052	1.46
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8-pecdf	0.0011	0.32
Congener-Specific Approach (U S E P A 1999)	2,3,4,6,7,8-hxcdf	0.0038	1.07
Congener-Specific Approach (U S E P A 1999)	2,3,4,7,8-pecdf	0.009	2.54
Congener-Specific Approach (U S E P A 1999)	2,3,7,8-tcdd	0.0056	1.59
Congener-Specific Approach (U S E P A 1999)	2,3,7,8-tcdf	0.0045	1.27
Congener-Specific Approach (U S E P A 1999)	ocdd	0.000067	0.019
Congener-Specific Approach (U S E P A 1999)	ocdf	0.00009	0.025
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,4,6,7,8-hpcdd	NA	0.20
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,4,6,7,8-hpcdf	NA	0.36
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,4,7,8,9-hpcdf	NA	0.34
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,4,7,8-hxcdd	NA	0.23
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,4,7,8-hxcdf	NA	0.48
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,6,7,8-hxcdd	NA	0.19
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,6,7,8-hxcdf	NA	0.59
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,7,8,9-hxcdd	NA	0.13
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,7,8,9-hxcdf	NA	1.22
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,7,8-pecdd	NA	0.18
Congener-Specific Approach (Fagervold et al. 2010)[a]	1,2,3,7,8-pecdf	NA	0.79
Congener-Specific Approach (Fagervold et al. 2010)[a]	2,3,4,6,7,8-hxcdf	NA	0.33
Congener-Specific Approach (Fagervold et al. 2010)[a]	2,3,4,7,8-pecdf	NA	0.56
Congener-Specific Approach (Fagervold et al. 2010)[a]	2,3,7,8-tcdd	NA	1.65
Congener-Specific Approach (Fagervold et al. 2010)[a]	2,3,7,8-tcdf	NA	1.21

Table 6-5b
Congener-Specific Bioaccumulation Factors for Dioxin TEQ

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Bioaccumulation Factors - Plants	Bioaccumulation Factors - Terrestrial Invertebrates
Congener-Specific Approach (Fagervold et al. 2010)[a]	ocdd	NA	0.25
Congener-Specific Approach (Fagervold et al. 2010)[a]	ocdf	NA	0.27

Notes:
a. Bioaccumulation Factors (BAFs) calculated using soil-to-earthworm 2,3,7,8-TCDD BAF for soil SW-20 (BAF = 1.65) and earthworm congener-specific bioaccumulation equivalency factors.

Acronyms and Abbreviations:
BAF = bioaccumulation factor
NA = not available
U S E P A = United States Environmental Protection Agency

References:

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Table 6-6
Ecological Benchmarks for Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Benchmar	Plants[a] (mg/kg)	Benchmar	Invertebrates[a] (mg/kg)
Inorganics	Aluminum	pH less than 5.5	U S E P A (2008)	pH less than 5.5	U S E P A (2008)
Inorganics	Antimony	5 *	Efroymson et al. (1997a)	78	U S E P A (2008)
Inorganics	Arsenic	18	U S E P A (2008)	60 **	Efroymson et al. (1997b)
Inorganics	Barium	500 *	Efroymson et al. (1997a)	330	U S E P A (2008)
Inorganics	Beryllium	10 *	Efroymson et al. (1997a)	40	U S E P A (2008)
Inorganics	Cadmium	32	U S E P A (2008)	140	U S E P A (2008)
Inorganics	Calcium	NA	essential nutrient	NA	essential nutrient
Inorganics	Chromium, total	NA	NA	18 (Note 1)	based on Cr-3; U S E P A (2015) (Note 1)
Inorganics	Chromium, hexavalent	1 *	Efroymson et al. (1997a)	0.4 **	Efroymson et al. (1997b)
Inorganics	Cobalt	13	U S E P A (2008)	NA	NA
Inorganics	Copper	70	U S E P A (2008)	80	U S E P A (2008)
Inorganics	Cyanide	NA	NA	0.9	U S E P A (2015)
Inorganics	Iron	NA	NA	NA	NA
Inorganics	Lead	120	U S E P A (2008)	1700	U S E P A (2008)
Inorganics	Magnesium	NA	essential nutrient	NA	essential nutrient
Inorganics	Manganese	220 (Note 1)	U S E P A (2008) (Note 1)	450 (Note 1)	U S E P A (2008) (Note 1)
Inorganics	Mercury	0.3 *	Efroymson et al. (1997a)	0.1 **	Efroymson et al. (1997b)
Inorganics	Molybdenum	2 *	Efroymson et al. (1997a)	NA	NA
Inorganics	Nickel	38	U S E P A (2008)	280	U S E P A (2008)
Inorganics	Potassium	NA	essential nutrient	NA	essential nutrient
Inorganics	Selenium	0.52	U S E P A (2008)	4.1	U S E P A (2008)
Inorganics	Silver	560	U S E P A (2008)	NA	NA
Inorganics	Sodium	NA	essential nutrient	NA	essential nutrient
Inorganics	Thallium	1 *	Efroymson et al. (1997a)	NA	NA
Inorganics	Vanadium	2 *	Efroymson et al. (1997a)	NA	NA
Inorganics	Zinc	160	U S E P A (2008)	120	U S E P A (2008)
Volatile Organic Compounds	1,2,4-Trimethylbenzene (Note 2)	NA	NA	0.09	f; U S E P A (2015)
Volatile Organic Compounds	1,3,5-Trimethylbenzene (Note 2)	NA	NA	0.16	f; U S E P A (2015)
Volatile Organic Compounds	Acetone (Note 2)	NA	NA	0.04	f; U S E P A (2015)
Volatile Organic Compounds	Bromomethane (Note 2)	NA	NA	0.002	f; U S E P A (2015)
Volatile Organic Compounds	Chloro methane (Note 2)	NA	NA	NA	NA
Volatile Organic Compounds	Chloroform (Note 2)	NA	NA	0.05	f; U S E P A (2015)
Volatile Organic Compounds	Ethyl- benzene (Note 2)	NA	NA	0.27	f; U S E P A (2015)
Volatile Organic Compounds	Isopropylbenzene (Note 2)	NA	NA	0.04	f; U S E P A (2015)
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA
Volatile Organic Compounds	Methyl ethyl ketone (Note 2)	NA	NA	1	f; U S E P A (2015)
Volatile Organic Compounds	Methylene chloride (Note 2)	1,600	U S E P A (2015)	0.21	f; U S E P A (2015)

Table 6-6
Ecological Benchmarks for Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Benchmar	Plants[a] (mg/kg)	Benchmar	Invertebrates[a] (mg/kg)
Volatile Organic Compounds	N-Butylbenzene (Note 2)	NA	NA	NA	NA
Volatile Organic Compounds	N-Propylbenzene (Note 2)	NA	NA	NA	NA
Volatile Organic Compounds	sec-Butylbenzene (Note 2)	NA	NA	NA	NA
Volatile Organic Compounds	Toluene (Note 2)	200	Efroymson et al. (1997a)	0.15	f; U S E P A (2015)
Volatile Organic Compounds	Xylene, m,p- (Note 2)	100	Total xylenes; U S E P A (2015)	0.1	(Total xylenes) f; U S E P A (2015)
Volatile Organic Compounds	Xylene, o- (Note 2)	100	Total xylenes; U S E P A (2015)	0.1	(Total xylenes) f; U S E P A (2015)
Volatile Organic Compounds	Xylenes, total (Note 2)	100	Total xylenes; U S E P A (2015)	0.1	(Total xylenes) f; U S E P A (2015)
Semi-Volatile Organic Compounds	2,4-Dimethylphenol	NA	NA	0.04 (Note 1)	f; U S E P A (2015) (Note 1)
Semi-Volatile Organic Compounds	2,4-Dinitrophenol (Note 2)	20	Efroymson et al. (1997a)	0.15	f; U S E P A (2015)
Semi-Volatile Organic Compounds	4,6-Dinitro-2-methylphenol (Note 2	NA	NA	NA	NA
Semi-Volatile Organic Compounds	4-Methylphenol	10	Adema et al. (2001)	0.08 (Note 1)	f; U S E P A (2015) (Note 1)
Semi-Volatile Organic Compounds	Benzoic acid (Note 2)	NA	NA	0.01	f; U S E P A (2015)
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	200	Efroymson et al. (1997a); (DNB)	200	Efroymson et al. (1997b); (DMP)
Semi-Volatile Organic Compounds	Butylbenzylphthalate	NA	NA	0.59 (Note 1)	f; U S E P A (2015) (Note 1)
Semi-Volatile Organic Compounds	Carbazole	NA	NA	2800	Svedrup et al. (2006)
Semi-Volatile Organic Compounds	Dibenzofuran	6.1 (Note 1)	U S E P A (2015) (Note 1)	0.15 (Note 1)	f; U S E P A (2015) (Note 1)
Semi-Volatile Organic Compounds	Di-n-butyl phthalate	200	Efroymson et al. (1997a)	200	Efroymson et al. (1997b); (DMP)
Semi-Volatile Organic Compounds	Hexachlorocyclopentadiene (Note	10	Efroymson et al. (1997a)	0.001	f; U S E P A (2015)
Semi-Volatile Organic Compounds	Isophorone (Note 2)	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Pentachlorophenol	5	U S E P A (2008)	31	U S E P A (2008)
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	10	b; Hulzebos et al. (1993)	29	U S E P A (2008)
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	1.2	c; U S E P A (1999)	18	U S E P A (2008)
Pesticides	4,4-DDT	0.9	d; Urzua (1986)	0.01	g; Van de Plassche et al. (1994)
Pesticides	4,4-DDE	0.9	d; Urzua (1986); based on DDT	0.01	g; Van de Plassche et al. (1994)
Pesticides	Alpha-Chlordane	0.224	U S E P A (2003)	0.0043	g; Van de Plassche et al. (1994)
Pesticides	Dieldrin	1.0	e; Rajanna and De la Cruz (1977)	0.05	g; Van de Plassche et al. (1994)
Pesticides	Gamma-Chlordane	0.224	U S E P A (2003)	0.0043	g; Van de Plassche et al. (1994)
Polychlorinated Biphenyls	Total PCBs	40	Efroymson et al. (1997a)	1.0	h; Beyer (1990)
Dioxins (presented in ng/kg)	2,3,7,8-TCDD	NA	NA	8800	f; U S E P A (2015) (Note 1)
Miscellaneous	Asbestos (Note 2)	NA	NA	NA	NA
Miscellaneous	Ammonia as nitrogen	NA	NA	NA	NA
Miscellaneous	Chloride	NA	NA	NA	NA
Miscellaneous	Fluoride	NA	NA	NA	NA
Miscellaneous	Nitrate	NA	NA	NA	NA
Miscellaneous	Orthophosphate (Note 2)	NA	NA	NA	NA
Miscellaneous	Phosphate (Note 2)	NA	NA	NA	NA
Miscellaneous	Sulfate	NA	NA	NA	NA
Miscellaneous	Sulfide	NA	NA	NA	NA

Table 6-6
Ecological Benchmarks for Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

**Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The tests were conducted with earthworms.

*Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The soil type and test species (typically agricultural) may also vary significantly from site-specific conditions or the toxic effects may be unspecified in the source study. There may be significant variability in the toxic responses noted.

Note 1 Blue Note 1 indicates new or updated values from those presented in the RAWP and Technical Memorandums.

Note 2 Green Note 2 indicates new constituent not presented in RAWP or Technical Memorandums.

a. Ecological benchmarks for plants and invertebrates are consistent with the RAWP and Technical Memorandums for the site (Arcadis 2008a, 2008b, and 2009).

b. Based on napthalene. UF of 10 applied to L O A E L to estimate N O A E L.

c. Based on benzo(a)pyrene.

d. UF of 10 applied to L O A E L to estimate N O A E L.

e. UF of 10 applied to L O A E L to estimate N O A E L.

f. Ecological Structure Activity Relationships (ECOSAR) and U S E P A Region 4 soil model.

g. Adjusted to 1 percent organic carbon.

h. "B" value

Acronyms & Abbreviations:

NA = not available
DMP = dimethylphthalate
DNB = di-n-butylphthalate
HMW = high molecular weight
LMW = low molecular weight
L O A E L = lowest observed adverse effect level
mg/kg = milligrams per kilogram
ng/kg = nanograms per kilogram
N O A E L = no observed adverse effect level
P A H = polycyclic aromatic hydrocarbons
TEQ = toxic equivalent
UF = uncertainty factor
U S E P A = United States Environmental Protection Agency

Table 6-6
Ecological Benchmarks for Soil

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

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Table 6-7
Selected Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Low TRV (N O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - High TRV (L O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Low TRV (N O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - High TRV (L O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Source
Inorganics	Aluminum	pH less than 5.5	U S E P A (2008)	pH less than 5.5	U S E P A (2008)	pH less than 5.5	U S E P A (2008)	pH less than 5.5	U S E P A (2008)
Inorganics	Antimony	NA	NA	NA	NA	0.059	U S E P A (2008)	0.59	U S E P A (2008)
Inorganics	Arsenic	2.24	U S E P A (2008)	3.55	U S E P A (2008)	1.04	U S E P A (2008)	1.66	U S E P A (2008)
Inorganics	Barium	NA	NA	NA	NA	51.8	U S E P A (2008)	82.6	U S E P A (2008)
Inorganics	Beryllium	NA	NA	NA	NA	0.532	U S E P A (2008)	0.630	U S E P A (2008)
Inorganics	Cadmium	1.47	U S E P A (2008)	6.35	U S E P A (2008)	0.770	U S E P A (2008)	7.7	U S E P A (2008)
Inorganics	Calcium	NA	essential nutrient	NA	NA	NA	essential nutrient	NA	NA
Inorganics	Chromium, total	2.66	U S E P A (2008)	15.6	U S E P A (2008)	2.40	U S E P A (2008)	9.62	U S E P A (2008)
Inorganics	Chromium, hexavalent	2.5 (Note 1)	NA	25 (Note 1)	Butkauskas and Sruoga (2004); UF of 10 was applied to the N O A E L (Note 1)	9.24	U S E P A, 2008	38.4	U S E P A (2008)
Inorganics	Cobalt	7.61	U S E P A (2008)	18.3	U S E P A (2008)	7.33	U S E P A (2008)	18.8	U S E P A (2008)
Inorganics	Copper	4.05	U S E P A (2008)	12.1	U S E P A (2008)	5.60	U S E P A (2008)	9.34	U S E P A (2008)
Inorganics	Cyanide	0.04	U S E P A (1999); chronic N O A E L estimated from LD50	0.4 (Note 1)	U S E P A (1999); UF of 10 applied to N O A E L (Note 1)	4.5	NTP (1993); cited in A T S D R (2006)	12.5 (Note 1)	NTP (1993); cited in A T S D R (2006) (Note 1)
Inorganics	Iron	NA	NA	NA	NA	NA	NA	NA	NA
Inorganics	Lead	1.63	U S E P A (2008)	3.26	U S E P A (2008)	4.70	U S E P A (2008)	8.90	U S E P A (2008)
Inorganics	Magnesium	NA	essential nutrient	NA	NA	NA	essential nutrient	NA	NA
Inorganics	Manganese	179 (Note 1)	U S E P A (2008) (Note 1)	376.5611434201 (Note 1)	U S E P A (2008) (Note 1)	51.5 (Note 1)	U S E P A (2008) (Note 1)	145.674726883238	U S E P A (2008) (Note 1)
Inorganics	Mercury	0.039	CalEPA (2009)	0.18	CalEPA (2009)	0.25	CalEPA (2002)	4	CalEPA (2002)
Inorganics	Molybdenum	3.5	Sample et al. (1996)	35.3	Sample et al. (1996)	0.26	Sample et al. (1996)	2.6	Sample et al. (1996)
Inorganics	Nickel	6.71	U S E P A (2008)	18.6	U S E P A (2008)	1.70	U S E P A (2008)	3.40	U S E P A (2008)
Inorganics	Potassium	NA	essential nutrient	NA	NA	NA	essential nutrient	NA	NA
Inorganics	Selenium	0.290	U S E P A (2008)	0.579	U S E P A (2008)	0.143	U S E P A (2008)	0.215	U S E P A (2008)
Inorganics	Silver	2.02	U S E P A (2008)	20.2	U S E P A (2008)	6.02	U S E P A (2008)	60.2	U S E P A (2008)
Inorganics	Sodium	NA	essential nutrient	NA	NA	NA	essential nutrient	NA	NA
Inorganics	Thallium	0.35 ((Note 1))	U S E P A (1999) (Note 1)	3.5 (Note 1)	U S E P A (1999) (Note 1)	0.48	CalEPA (2002)	1.43	CalEPA (2002)
Inorganics	Vanadium	0.344	U S E P A (2008)	0.688	U S E P A (2008)	4.16	U S E P A (2008)	8.31	U S E P A (2008)
Inorganics	Zinc	66.1	U S E P A (2008)	171	U S E P A (2008)	75.4	U S E P A (2008)	298	U S E P A (2008)
Volatile Organic Compounds	1,2,4-Trimethylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	1,3,5-Trimethylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Acetone (Note 2)					10	Sample et al. 1996	50	Sample et al. 1996
Volatile Organic Compounds	Bromomethane (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloro methane (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloroform (Note 2)	NA	NA	NA	NA	15	Sample et al. 1996	41	Sample et al. 1996
Volatile Organic Compounds	Ethyl- benzene (Note 2)	NA	NA	NA	NA	29.1	IRIS 2017	291	IRIS 2017
Volatile Organic Compounds	Isopropylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA	90 ((Note 1))	ethyl acetate; Sample et al. 1996 (Note 1)	360 (Note 1)	ethyl acetate; Sample et al. 1996 (Note 1)
Volatile Organic Compounds	Methyl ethyl ketone (Note 2)	NA	NA	NA	NA	1771	Sample et al. 1996	4571	Sample et al. 1996
Volatile Organic Compounds	Methylene chloride (Note 2)	NA	NA	NA	NA	5.85	Sample et al. 1996	50	Sample et al. 1996
Volatile Organic Compounds	N-Butylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	N-Propylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	sec-Butylbenzene (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Toluene (Note 2)	NA	NA	NA	NA	26	Sample et al. 1996	260	Sample et al. 1996
Volatile Organic Compounds	Xylene, m,p- (Note 2)	NA	NA	NA	NA	2.1	Sample et al. 1996	2.6	Sample et al. 1996
Volatile Organic Compounds	Xylene, o- (Note 2)	NA	NA	NA	NA	2.1	Sample et al. 1996	2.6	Sample et al. 1996
Volatile Organic Compounds	Xylenes, total (Note 2)	NA	NA	NA	NA	2.1	Sample et al. 1996	2.6	Sample et al. 1996
Semi-Volatile Organic Compounds	2,4-Dimethylphenol	NA	NA	NA	NA	NA	--	NA	NA
Semi-Volatile Organic Compounds	2,4-Dinitrophenol (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA

Table 6-7
Selected Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Low TRV (NOAEL)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - High TRV (LOAEL)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Low TRV (NOAEL)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - High TRV (LOAEL)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Source
Semi-Volatile Organic Compounds	4,6-Dinitro-2-methylphenol (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Benzoic acid (Note 2)	NA	NA	NA	NA	500	IRIS 2017	750	IRIS 2017
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	1.1	Sample et al. (1996)	11 (Note 1)	Sample et al. (1996); UF of 10 applied to chronic NOAE (Note 1)	18.3	Sample et al. (1996)	183 (Note 1)	Sample et al. (1996) (Note 1)
Semi-Volatile Organic Compounds	Butylbenzylphthalate	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Carbazole	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Dibenzofuran	NA	NA	NA	NA	3 (Note 1)	2,3-benzofuran; ATSDR 1992 (Note 1)	30 (Note 1)	2,3-benzofuran; ATSDR 1992 (Note 1)
Semi-Volatile Organic Compounds	Di-n-butyl phthalate	0.11	Sample et al. (1996)	1.1 (Note 1)	Sample et al. (1996) (Note 1)	550	Sample et al. (1996)	1833 (Note 1)	Sample et al. (1996) (Note 1)
Semi-Volatile Organic Compounds	Hexachlorocyclopentadiene (Note 2)	NA	NA	NA	NA	3.8	NA	38	USEPA (1999); UF of 10 applied to NOAEL
Semi-Volatile Organic Compounds	Isophorone (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Pentachlorophenol	6.73	USEPA (2008)	67.3 (Note 1)	USEPA (2008) (Note 1)	8.42	USEPA (2008)	22.7 (Note 1)	USEPA (2008) (Note 1)
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	22.8	Patton and Dieter (1980)	228	Patton and Dieter (1980)	65.6	USEPA (2008)	328	USEPA (2008)
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	10	Trust et al. (1994)	100	Trust et al. (1994)	0.6	USEPA (2008)	3	USEPA (2008)
Pesticides	4,4-DDT	0.227 (Note 1)	USEPA (2008) (Note 1)	2.27 (Note 1)	USEPA (2008) (Note 1)	0.147	USEPA (2008)	0.735 (Note 1)	USEPA (2008) (Note 1)
Pesticides	4,4-DDE	0.227 (Note 1)	USEPA (2008) (Note 1)	2.27 (Note 1)	USEPA (2008) (Note 1)	0.147	USEPA (2008)	0.735 (Note 1)	USEPA (2008) (Note 1)
Pesticides	Alpha-Chlordane	2.1	Sample et al. (1996); based on chlordane	10.7 (Note 1)	Sample et al. (1996); based on chlordane (Note 1)	4.6	Sample et al. (1996); based on chlordane	9.2 (Note 1)	Sample et al. (1996); based on chlordane (Note 1)
Pesticides	Dieldrin	0.0709	USEPA (2008)	3.78 (Note 1)	USEPA (2008) (Note 1)	0.015	USEPA (2008)	0.03 (Note 1)	USEPA (2008) (Note 1)
Pesticides	Gamma-Chlordane	2.1	Sample et al. (1996); based on chlordane	10.7 (Note 1)	Sample et al. (1996); based on chlordane (Note 1)	4.6	Sample et al. (1996); based on chlordane	9.2 (Note 1)	Sample et al. (1996); based on chlordane (Note 1)
Polychlorinated Biphenyls	Total PCBs	0.09	CalEPA (2009)	1.27 (Note 1)	CalEPA (2009) (Note 1)	0.36	CalEPA (2002)	1.28 (Note 1)	CalEPA (2002) (Note 1)
Dioxins (presented in ng/kg)	TEQ Avian	14	Sample et al. (1996); based on TCDD	140 (Note 1)	Sample et al. (1996); based on TCDD (Note 1)	NA	NA	NA	NA
Dioxins (presented in ng/kg)	TEQ Mammals	NA	NA	NA	NA	1	Sample et al. (1996); based on TCDD	10 (Note 1)	Sample et al. (1996); based on TCDD (Note 1)
Miscellaneous	Asbestos (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Ammonia as nitrogen	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Chloride	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Fluoride	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Nitrate	NA	NA	NA	NA	507 (Note 1)	Sample et al. 1996 (Note 1)	1130 (Note 1)	Sample et al. 1996 (Note 1)
Miscellaneous	Orthophosphate (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Phosphate (Note 2)	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Sulfate	NA	NA	NA	NA	NA	NA	NA	NA
Miscellaneous	Sulfide	NA	NA	NA	NA	NA	NA	NA	NA

Table 6-7
Selected Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

Note 1	Blue Note 1 indicates new or updated values from those presented in the RAWP and Technical Memorandums.
Note 2	Green Note 2 indicates new constituent not presented in RAWP or Technical Memorandums.

a. EcoSSLs (U S E P A 2008) were preferentially selected.
b. Some sources provide only N O A E L-based TRVs. Therefore, L O A E L-based TRVs were developed for birds and mammals as follows:
(a) If a bounded N O A E L-based TRV was recommended, the L O A E L from the same study and endpoint was selected.
(b) If the recommended N O A E L-based TRV was unbounded, the lowest reproduction, growth, and survival L O A E L greater than the N O A E L-based TRV was selected.
(c) If the recommended N O A E L-based TRV was a geometric mean of the reproduction and growth N O A E Ls, the geometric mean of the reproduction and growth L O A E Ls was selected.
(d) The mammalian N O A E L-based TRV for chromium is the geometric mean of the reproduction and growth N O A E Ls. However, no bounded N O A E Ls or L O A E Ls were contained in the dataset.
(e) If the recommended N O A E L-based TRV was derived from a L O A E L with a UF applied, the L O A E L-based TRV was selected by removing the UF. For birds and mammals, this was the case for silver. Therefore, the lowest reproduction and growth L O A E L greater than mammalian low TRV for chromium was conservatively selected as the L O A E L-base

Acronyms and Abbreviations:
NA = not available
A T S D R = Agency for Toxic Substances and Disease Registry
CalEPA = California Environmental Protection Agency
LD50 = concentration lethal to 50 percent of the test organisms
L O A E L = lowest observed adverse effects level
mg/kg-bw/day = milligrams per kilogram of body weight per day
ng/kg = nanograms per kilogram
N O A E L = no observed adverse effects level
NTP = National Toxicology Program
TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin
TRV = toxicity reference value
UF = uncertainty factor
U S E P A = United States Environmental Protection Agency

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Table 6-8
Toxicity Reference Values for Wildlife - DTSC-Recommended Values

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Low TRV (N O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - High TRV (L O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Birds - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Low TRV (N O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - Source	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals - High TRV (L O A E L)	Wildlife TRVs (mg/kg-bw/day)[a,b] Mammals -Source
Inorganics	Arsenic	5.5	CalEPA (2009)	22.0	CalEPA (2009)	0.32	CalEPA (2002)	4.7	CalEPA (2002)
Inorganics	Cadmium	0.7	CalEPA (2009)	10.4	CalEPA (2009)	0.060	CalEPA (2002)	2.64	CalEPA (2002)
Inorganics	Cobalt	NA	NA	NA	NA	1.2	CalEPA (2002)	20	CalEPA (2002)
Inorganics	Copper	2.30	CalEPA (2009)	52.3	CalEPA (2009)	2.67	CalEPA (2002)	632	CalEPA (2002)
Inorganics	Lead	0.014	CalEPA (2009)	8.75	CalEPA (2009)	1.0	CalEPA (2002)	241	CalEPA (2002)
Inorganics	Manganese	77.6 (Note 1)	CalEPA (2009) (Note 1)	776 (Note 1)	CalEPA (2009) (Note 1)	13.7 (Note 1)	CalEPA (2002) (Note 1)	159 (Note 1)	CalEPA (2002) (Note 1)
Inorganics	Mercury	0.039	CalEPA (2009)	0.18	CalEPA (2009)	0.25	CalEPA (2002)	4	CalEPA (2002)
Inorganics	Nickel	1.38	CalEPA (2009)	56.3	CalEPA (2009)	0.133	CalEPA (2002)	31.6	CalEPA (2002)
Inorganics	Selenium	0.23	CalEPA (2009)	0.93	CalEPA (2009)	0.05	CalEPA (2002)	1.21	CalEPA (2002)
Inorganics	Thallium	NA	NA	NA	NA	0.48	CalEPA (2002)	1.43	CalEPA (2002)
Inorganics	Zinc	17.2	CalEPA (2009)	172	CalEPA (2009)	9.60	CalEPA (2002)	411	CalEPA (2002)
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	22.8	Patton and Dieter (1980)	228	Patton and Dieter (1980)	50	CalEPA (2002)	150	CalEPA (2002)
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	10	Trust et al. (1994)	100	Trust et al. (1994)	1.31	CalEPA (2002)	32.8	CalEPA (2002)
Pesticides	4,4-DDT	0.009	CalEPA (2009)	1.5	CalEPA (2009)	0.8	CalEPA (2002)	16	CalEPA (2002)
Pesticides	4,4-DDE	0.009 (Note 1)	DDT surrogate (Note 1)	0.6	CalEPA (2009)	0.8	CalEPA (2002)	16	CalEPA (2002)
Polychlorinated Biphenyls	Total PCBs	0.09	CalEPA (2009)	1.27	CalEPA (2009)	0.36	CalEPA (2002)	1.28	CalEPA (2002)

Notes:

Note 1 Blue Note 1 indicates new or updated values from those presented in the RAWP and Technical Memorandums.

a. CalEPA (2002, 2009) TRVs, if available, were preferentially selected.

b. Some sources provide only N O A E L-based TRVs. Therefore, L O A E L-based TRVs were developed for birds and mammals as follows:

(a) If a bounded N O A E L-based TRV was recommended, the L O A E L from the same study and endpoint was selected.

(b) If the recommended N O A E L-based TRV was unbounded, the lowest reproduction, growth, and survival L O A E L greater than the N O A E L-based TRV was selected.

(c) If the recommended N O A E L-based TRV was a geometric mean of the reproduction and growth N O A E Ls, the geometric mean of the reproduction and growth L O A E Ls was selected.

(d) The mammalian N O A E L-based TRV for chromium is the geometric mean of the reproduction and growth N O A E Ls. However, no bounded N O A E Ls or L O A E Ls were contained in the dataset.

(e) If the recommended N O A E L-based TRV was derived from a L O A E L with a UF applied, the L O A E L-based TRV was selected by removing the UF. For birds and mammals, this was the case for silv
reproduction and growth L O A E L greater than mammalian low TRV for chromium was conservatively selected as the L O A E L-based TRV.

Table 6-8
Toxicity Reference Values for Wildlife - DTSC-Recommended Values

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Acronyms and Abbreviations:
NA = BTAG TRV not available
A T S D R = Agency for Toxic Substances and Disease Registry
CalEPA = California Environmental Protection Agency
LD50 = concentration lethal to 50 percent of the test organisms
L O A E L = lowest observed adverse effects level
mg/kg-bw/day = milligrams per kilogram of body weight per day
N O A E L = no observed adverse effects level
NTP = National Toxicology Program
TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin
TRV = toxicity reference value
UF = uncertainty factor
U S E P A = United States Environmental Protection Agency

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Table 6-9
Selected Allometrically Converted Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Inorganics	Wildlife Receptors[a] Desert Shrew - NOAEL	Wildlife Receptors[a] Desert Shrew - LOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - NOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - LOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - NOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - LOAEL	Body Weight (kg) Test Species (Mammals) - NOAEL	Body Weight (kg) Test Species (Mammals) - LOAEL	Source
Inorganics	Antimony	NA	NA	NA	NA	0.043	0.43	0.330	0.330	TRV study
Inorganics	Arsenic	1.5	2.4	1.5	2.3	NA	NA	10.100	10.100	TRV study
Inorganics	Beryllium	NA	NA	NA	NA	0.40	0.42	0.486	0.090	TRV study
Inorganics	Cadmium	NA	NA	NA	NA	0.57	5.7	0.230	0.430	TRV study
Inorganics	Copper	9.4	16	9.0	15	NA	NA	100.000	100.000	TRV study
Inorganics	Cyanide	NA	NA	NA	NA	3.3	9.1	0.350	0.350	rat; Sample et al. 1996
Inorganics	Lead	NA	NA	NA	NA	3.4	6.4	0.300	0.300	TRV study
Inorganics	Mercury	NA	NA	NA	NA	0.18	2.9	0.350	0.350	rat; Sample et al. 1996
Inorganics	Molybdenum	NA	NA	NA	NA	0.16	1.6	0.030	0.030	TRV study
Inorganics	Nickel	NA	NA	NA	NA	1.1	2.1	0.025	0.025	TRV study
Inorganics	Selenium	0.23	0.35	0.21	0.31	NA	NA	17.800	17.800	TRV study
Inorganics	Silver	8.8	88	8.4	84	NA	NA	8.860	8.860	TRV study
Inorganics	Thallium	NA	NA	NA	NA	0.35	1.0	0.350	0.350	rat; Sample et al. 1996
Inorganics	Vanadium	NA	NA	NA	NA	2.7	5.4	0.047	0.047	TRV study
Volatile Organic Compounds	Acetone	NA	NA	NA	NA	7.3	36	0.350	0.350	rat; Sample et al. 1996
Volatile Organic Compounds	Chloroform	NA	NA	NA	NA	11	30	0.350	0.350	rat; Sample et al. 1996
Volatile Organic Compounds	Ethyl- benzene	NA	NA	NA	NA	21	212	0.350	0.350	rat; Sample et al. 1996
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA	66	263	0.350	0.350	rat; Sample et al. 1996

Table 6-9
Selected Allometrically Converted Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Inorganics	Wildlife Receptors[a] Desert Shrew - NOAEL	Wildlife Receptors[a] Desert Shrew - LOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - NOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - LOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - NOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - LOAEL	Body Weight (kg) Test Species (Mammals) - NOAEL	Body Weight (kg) Test Species (Mammals) - LOAEL	Source
Volatile Organic Compounds	Methyl ethyl ketone	NA	NA	NA	NA	1292	3333	0.350	0.350	rat; Sample et al. 1996
Volatile Organic Compounds	Methylene chloride	NA	NA	NA	NA	4.3	36	0.350	0.350	rat; Sample et al. 1996
Volatile Organic Compounds	Toluene	NA	NA	NA	NA	16	164	0.030	0.030	mouse; Sample et al. 1996
Volatile Organic Compounds	Xylene, m,p-	NA	NA	NA	NA	1.3	1.6	0.030	0.030	mouse; Sample et al. 1996
Volatile Organic Compounds	Xylene, o-	NA	NA	NA	NA	1.3	1.6	0.030	0.030	mouse; Sample et al. 1996
Volatile Organic Compounds	Xylenes, total	NA	NA	NA	NA	1.3	1.6	0.030	0.030	mouse; Sample et al. 1996
Semi-Volatile Organic Compounds	Benzoic acid	NA	NA	NA	NA	365	547	0.350	0.350	rat; Sample et al. 1996
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	NA	NA	NA	NA	12	115	0.030	0.030	mouse; Sample et al. 1996
Semi-Volatile Organic Compounds	Dibenzofuran	NA	NA	NA	NA	2.2	22	0.350	0.350	rat; Sample et al. 1996
Semi-Volatile Organic Compounds	Di-n-butyl phthalate	NA	NA	NA	NA	346	1154	0.030	0.030	mouse; Sample et al. 1996
Semi-Volatile Organic Compounds	Hexachlorocyclopentadiene	NA	NA	NA	NA	2.8	28	0.350	0.350	rat; Sample et al. 1996
Pesticides	4,4-DDT	NA	NA	NA	NA	0.10	0.49	0.068	0.068	TRV study
Pesticides	4,4-DDE	NA	NA	NA	NA	0.10	0.49	0.068	0.068	TRV study
Pesticides	Dieldrin	NA	NA	NA	NA	0.010	0.021	0.156	0.156	TRV study
Pesticides	Alpha-Chlordane	NA	NA	NA	NA	2.9	5.8	0.030	0.030	mouse; Sample et al. 1996
Pesticides	Gamma-Chlordane	NA	NA	NA	NA	2.9	5.8	0.030	0.030	mouse; Sample et al. 1996

Table 6-9
Selected Allometrically Converted Toxicity Reference Values for Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Inorganics	Wildlife Receptors[a] Desert Shrew - NOAEL	Wildlife Receptors[a] Desert Shrew - LOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - NOAEL	Wildlife Receptors[a] Merriam's Kangaroo Rat - LOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - NOAEL	Wildlife Receptors[a] Nelson's Desert Bighorn Sheep - LOAEL	Body Weight (kg) Test Species (Mammals) - NOAEL	Body Weight (kg) Test Species (Mammals) - LOAEL	Source
Polychlorinated Biphenyls	Total PCBs	--	--	--	--	0.23	0.81	0.030	0.030	mouse; Sample et al. 1996
Dioxins (presented in ng/kg)	TEQ Mammals	NA	NA	NA	NA	0.73	7.29	0.350	0.350	rat; Sample et al. 1996

Notes:
a. Sample and Arenal (1999) equation used: Aw = At * (BWt/BWw)^1-b
Where:
Aw = toxicity value of wildlife species
At = toxicity value of test species (TRV)
BWt = body weight of test species
BWw = body weight of wildlife species
b = allometric scaling factor (1.2 for birds, 0.94 for mammals)
b. When a body weight was not available for a study, a surrogate body weight for the same test species was selected from another source.

Acronyms and Abbreviations:
NA = not applicable
kg = kilogram
LOAEL = lowest observed adverse effects level
ng/kg = nanogram per kilogram
NOAEL = no observed adverse effects level
PCBs = polychlorinated biphenyls
PG&E = Pacific Gas and Electric Company
TEQ = toxic equivalent
TRV = toxicity reference value

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Table 6-10
Allometrically Converted Toxicity Reference Values for Wildlife - DTSC-Recommended Values

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Constituent	Wildlife Receptors [a] Desert Shrew - NOAEL	Wildlife Receptors [a] Desert Shrew - LOAEL	Wildlife Receptors [a] Merriam's Kangaroo Rat - NOAEL	Wildlife Receptors [a] Merriam's Kangaroo Rat - LOAEL	Wildlife Receptors [a] Nelson's Desert Bighorn Sheep - NOAEL	Wildlife Receptors [a] Nelson's Desert Bighorn Sheep - LOAEL	Body Weight (kg) Test Species (Mammals) - NOAEL	Body Weight (kg) Test Species (Mammals) - LOAEL	Source
Inorganics	Arsenic	NA	NA	NA	NA	0.23	3.4	0.35	0.35	rat; Sample et al. 1996
Inorganics	Cadmium	NA	NA	NA	NA	0.038	1.7	0.03	0.03	mouse; Sample et al. 1996
Inorganics	Cobalt	NA	NA	NA	NA	0.88	15	0.35	0.35	rat; Sample et al. 1996
Inorganics	Copper	NA	NA	NA	NA	1.7	461	0.03	0.35	mouse/rat; Sample et al. 1996
Inorganics	Lead	NA	NA	NA	NA	0.73	152	0.35	0.03	rat/mouse; Sample et al. 1996
Inorganics	Manganese	NA	NA	NA	NA	8.6	100	0.03	0.03	mouse; Sample et al. 1996
Inorganics	Mercury	NA	NA	NA	NA	0.18	2.9	0.35	0.35	rat; Sample et al. 1996
Inorganics	Nickel	NA	NA	NA	NA	0.097	23	0.35	0.35	rat; Sample et al. 1996
Inorganics	Selenium	NA	NA	NA	NA	0.031	0.76	0.03	0.03	mouse; Sample et al. 1996
Inorganics	Thallium	NA	NA	NA	NA	0.35	1.0	0.35	0.35	rat; Sample et al. 1996
Inorganics	Zinc	NA	NA	NA	NA	6.0	300	0.03	0.35	mouse/rat; Sample et al. 1996
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	NA	NA	NA	NA	36	109	0.35	0.35	rat; Sample et al. 1996
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	NA	NA	NA	NA	0.82	21	0.03	0.03	mouse; Sample et al. 1996
Pesticides	4,4-DDT	NA	NA	NA	NA	0.58	11.7	0.35	0.35	rat; Sample et al. 1996
Pesticides	4,4-DDE	NA	NA	NA	NA	0.58	12	0.35	0.35	rat; Sample et al. 1996
Polychlorinated Biphenyls	Total PCBs	NA	NA	NA	NA	0.23	0.81	0.03	0.03	mouse; Sample et al. 1996

Table 6-10
Allometrically Converted Toxicity Reference Values for Wildlife - DTSC-Recommended Values

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
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Notes:

a. Sample and Arenal (1999) equation used: Aw = At * (BWt/BWw)^1-b
Where:
Aw = toxicity value of wildlife species
At = toxicity value of test species (TRV)
BWt = body weight of test species
BWw = body weight of wildlife species
b = allometric scaling factor (1.2 for birds, 0.94 for mammals)

b. When a body weight was not available for a study, a surrogate body weight for the same test species was selected from another source.

Acronyms and Abbreviations:

DTSC = Department of Toxic Substances Control
kg = kilogram
LOAEL = lowest observed adverse effect level
NA = not applicable
NOAEL = no-observed adverse effect level
PAH = polycyclic aromatic hydrocarbon
PCBs = polychlorinated biphenyls
PG&E = Pacific Gas and Electric Company
TRV = toxicity reference value

References:

Sample, B.E. and C.A. Arenal. 1999. Allometric Models for Interspecies Extrapolation of Wildlife Toxicity Data. Bull. Environ. Contam. Toxicol. (1999) 62: 653-663.
Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird N O A E L	Notes	Area-weighted HQs - Mammal/ Bird L O A E L	Notes	Additional Lines of Evidence [c] - Low FOD (Max = EPC) [b]	Additional Lines of Evidence [c] - Locations greater than BTV	Additional Lines of Evidence [c] - Locations greater than 10xBTV	Additional Lines of Evidence [c] - Background HQs [d] N O A E L	Notes
Small Home Range Receptors	BCW (Baseline)	Plants	Antimony	**4**	Note 5	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (Baseline)	Plants	Chromium, Hexavalent	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (Baseline)	Plants	Thallium	**2**	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (Baseline)	Soil Invertebrates	Chromium, Total	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (Baseline)	Soil Invertebrates	Chromium, Hexavalent	**2**	Note 3	NA	None	NA	None	No	28/161	6	**2**	Note 3
Small Home Range Receptors	BCW (Baseline)	Merriam's Kangaroo Rat	TEQ Mammals [h]	NA	None	**2**	Note 2	0.2	None	No	53/67	17	0.002	None
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	Antimony	NA	None	**63**	Note 2	**6**	Note 3	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	Chromium, Total	NA	None	**2**	Note 2	0.4	None	No	42/155	13	0.7	None
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	TEQ Mammals	NA	None	**1308**	Note 2	**131**	Note 5	No	53/67	17	0.5	None
Small Home Range Receptors	BCW (Baseline)	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	Chromium, Total	NA	None	**2**	Note 2	0.3	None	No	42/155	13	0.7	None
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	Mercury	NA	None	**2**	Note 2	0.4	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	TEQ Avian	NA	None	**62**	Note 2	**6**	Note 3	No	53/67	17	0.03	None
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Antimony	**3**	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Chromium, Hexavalent	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Thallium	**2**	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Chromium, Total	**2**	Note 3	NA	None	NA	None	No	30/131	12	0.7	None
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Chromium, Hexavalent	**2**	Note 3	NA	None	NA	None	No	21/131	6	**2**	Note 3
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Mercury	**3**	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (2-foot scouring)	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	Antimony	NA	None	**46**	Note 2	**5**	Note 3	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	Chromium, Total	NA	None	**2**	Note 2	1	None	No	30/131	12	0.7	None
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	TEQ Mammals	NA	None	**187**	Note 2	**19**	Note 4	No	23/57	7	0.5	None
Small Home Range Receptors	BCW (2-foot scouring)	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	Chromium, Total	NA	None	**2**	Note 2	0.4	None	No	30/131	12	0.7	None
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	Mercury	NA	None	**3**	Note 2	1	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	TEQ Avian	NA	None	**6**	Note 2	1	None	No	23/57	7	0.03	None
Small Home Range Receptors	BCW (5-foot scouring)	Plants	Chromium, Hexavalent	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (5-foot scouring)	Plants	Thallium	**2**	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (5-foot scouring)	Soil Invertebrates	Chromium, Total	**2**	Note 3	NA	None	NA	None	No	31/123	9	0.7	None
Small Home Range Receptors	BCW (5-foot scouring)	Soil Invertebrates	Chromium, Hexavalent	**3**	Note 3	NA	None	NA	None	No	19/123	6	**2**	Note 3
Small Home Range Receptors	BCW (5-foot scouring)	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	Antimony	NA	None	**4**	Note 2	0.4	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	Chromium, Total	NA	None	**4**	Note 2	1	None	No	31/123	9	0.7	None
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	TEQ Mammals	NA	None	**20**	Note 2	**2**	Note 3	No	16/46	4	0.5	None
Small Home Range Receptors	BCW (5-foot scouring)	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	Chromium, Total	NA	None	**4**	Note 2	1	None	No	31/123	9	0.7	None
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	Mercury	NA	None	**2**	Note 2	0.4	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	TEQ Avian	NA	None	1	None	0.07	None	No	12/46	3	0.03	None
Small Home Range Receptors	SWMU 1	Plants	Antimony	**4**	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	SWMU 1	Plants	Chromium, Hexavalent	**6**	Note 3	NA	None	NA	None	No	31 / 68	11 / 68	0.8	None
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Chromium, Total	**5**	Note 3	NA	None	NA	None	No	26 / 61	13 / 61	0.7	None
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Chromium, Hexavalent	**12**	Note 4	NA	None	NA	None	No	20 / 62	6 / 62	**2**	Note 3
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Mercury	**3**	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	SWMU 1	Merriam's Kangaroo Rat	Chromium, Total	NA	None	1	None	0.2	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	SWMU 1	Merriam's Kangaroo Rat	TEQ Mammals	NA	None	**6**	Note 2	1	None	No	12 / 16	5 / 16	0.002	None

Table 6-11
Risk Conclusions and Lines of Evidence Summary

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Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Small Home Range Receptors	BCW (Baseline)	Plants	Antimony	NC	None	NA	Low	NE	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (Baseline)	Plants	Chromium, Hexavalent	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (Baseline)	Soil Invertebrates	Chromium, Total	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (Baseline)	Merriam's Kangaroo Rat	TEQ Mammals [h]	0.0002	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	Antimony	NC	None	NE	Low	High	Yes	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	Yes	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	Yes	NA	Possible	Possible	Yes
Small Home Range Receptors	BCW (Baseline)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (Baseline)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Antimony	NC	None	NA	Low	NE	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Chromium, Hexavalent	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Chromium, Total	0.7	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Soil Invertebrates	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	Antimony	NC	None	NE	Low	High	Yes	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	Yes	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	Yes	NA	Possible	Possible	Yes
Small Home Range Receptors	BCW (2-foot scouring)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (2-foot scouring)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Plants	Chromium, Hexavalent	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (5-foot scouring)	Soil Invertebrates	Chromium, Total	0.7	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (5-foot scouring)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (5-foot scouring)	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	Antimony	NC	None	NE	Low	High	Yes	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	Yes	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	Yes	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW (5-foot scouring)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW (5-foot scouring)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Not expected	Not expected	No
Small Home Range Receptors	SWMU 1	Plants	Antimony	NC	None	NA	Low	NE	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	SWMU 1	Plants	Chromium, Hexavalent	0.8	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Chromium, Total	0.7	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	SWMU 1	Soil Invertebrates	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	SWMU 1	Merriam's Kangaroo Rat	Chromium, Total	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	SWMU 1	Merriam's Kangaroo Rat	TEQ Mammals	0.0002	None	High	Moderate	High	No	NA	Unlikely	Not expected	No

Table 6-11
Risk Conclusions and Lines of Evidence Summary

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Receptor Type	A O C	Receptor	C O P E C [a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird N O A E L	Notes	Area-weighted HQs - Mammal/ Bird L O A E L	Notes	Additional Lines of Evidence [c] - Low FOD (Max = EPC) [b]	Additional Lines of Evidence [c] - Locations greater than BTV	Additional Lines of Evidence [c] - Locations greater than 10xBTV	Additional Lines of Evidence [c] - Background HQs [d] N O A E L	Notes
Small Home Range Receptors	SWMU 1	Desert Shrew	Antimony	NA	None	**63**	Note 2	**6**	Note 3	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	SWMU 1	Desert Shrew	Chromium, Total	NA	None	**8**	Note 2	**2**	Note 3	No	26 / 61	13 / 61	0.7	None
Small Home Range Receptors	SWMU 1	Desert Shrew	TEQ Mammals	NA	None	**5732**	Note 2	**573**	Note 5	No	12 / 16	5 / 16	0.5	None
Small Home Range Receptors	SWMU 1	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	NA	NA	NA	NA	None
Small Home Range Receptors	SWMU 1	Cactus Wren	Chromium, Total	NA	None	**2**	Note 2	0.4	None	No	26 / 61	13 / 61	0.7	None
Small Home Range Receptors	SWMU 1	Cactus Wren	TEQ Avian	NA	None	**93**	Note 2	**9**	Note 3	No	8 / 16	5 / 16	0.03	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-4	Plants	Thallium	**2**	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-5	Soil Invertebrates	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-6	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-7	Desert Shrew	TEQ Mammals	NA	None	**62**	Note 2	**6**	Note 3	No	41 / 51	12	0.5	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-8	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-9	Cactus Wren	Mercury	NA	None	**2**	Note 2	0.5	None	Yes	BG NA	NE (3 detect)	NC	None
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-10	Cactus Wren	TEQ Avian	NA	None	**2**	Note 2	0.2	None	No	33 / 51	4	0.03	None
Small Home Range Receptors	A O C 4	Plants	Vanadium	**21**	Note 4	NA	None	NA	None	No	30 / 94	0	**26**	Note 4
Small Home Range Receptors	A O C 4	Plants	HMW P A H	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 4	Soil Invertebrates	Chromium, Hexavalent [h]	**3**	Note 3	NA	None	NA	None	No	19 / 90	1	**2**	Note 3
Small Home Range Receptors	A O C 4	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 4	Desert Shrew	Antimony	NA	None	**9**	Note 2	1	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	A O C 4	Desert Shrew	Nickel	NA	None	**4**	Note 2	**2**	Note 3	No	40/94	0	**2**	Note 3
Small Home Range Receptors	A O C 4	Desert Shrew	HMW P A H	NA	None	1	None	0.1	None	No	52 / 97	19	0.004	None
Small Home Range Receptors	A O C 4	Desert Shrew	Total PCBs	NA	None	1	None	0.4	None	No	BG NA	BG NA	NC	None
Small Home Range Receptors	A O C 4	Desert Shrew	TEQ Mammals	NA	None	**27**	Note 2	**3**	Note 3	No	57 / 97	10	0.5	None
Small Home Range Receptors	A O C 4	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 4	Cactus Wren	Total PCBs	NA	None	**2**	Note 2	0.1	None	No	BG NA	BG NA	NC	None
Small Home Range Receptors	A O C 9	Plants	Antimony	**3**	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	A O C 9	Plants	Chromium, Hexavalent	**295**	Note 5	NA	None	NA	None	No	19 / 46	3	0.8	None
Small Home Range Receptors	A O C 9	Plants	Copper	**4**	Note 3	NA	None	NA	None	No	18 / 50	4	0.2	None
Small Home Range Receptors	A O C 9	Plants	Mercury	**15**	Note 4	NA	None	NA	None	No	BG NA	NE (2 greater than 10xRL)	NC	None
Small Home Range Receptors	A O C 9	Plants	Thallium	**3**	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	A O C 9	Plants	Zinc	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 9	Plants	HMW P A H	**2**	Note 3	NA	None	NA	None	No	34 / 41	5	**31**	Note 4
Small Home Range Receptors	A O C 9	Soil Invertebrates	Chromium, Hexavalent	**738**	Note 5	NA	None	NA	None	No	19 / 46	3	**2**	Note 3
Small Home Range Receptors	A O C 9	Soil Invertebrates	Chromium, Total	**5**	Note 3	NA	None	NA	None	No	13 / 50	2	1	None
Small Home Range Receptors	A O C 9	Soil Invertebrates	Copper	**3**	Note 3	NA	None	NA	None	No	18 / 50	2	0.2	None
Small Home Range Receptors	A O C 9	Soil Invertebrates	Mercury	**46**	Note 4	NA	None	NA	None	No	BG NA	NE (2 greater than 10xRL)	NC	None
Small Home Range Receptors	A O C 9	Soil Invertebrates	Zinc	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 9	Merriam's Kangaroo Rat	TEQ Mammals	NA	None	1	None	0.06	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 9	Desert Shrew	Antimony	NA	None	**53**	Note 2	**5**	Note 3	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	A O C 9	Desert Shrew	Chromium, Hexavalent	NA	None	**2**	Note 2	1	None	No	19 / 46	3	0.01	None

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Risk Conclusions and Lines of Evidence Summary

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PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Small Home Range Receptors	SWMU 1	Desert Shrew	Antimony	NC	None	NE	Low	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	SWMU 1	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	SWMU 1	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	SWMU 1	Gambel's Quail	None	NA	None	NA	NA	NA	NA	Note 1	Not expected	Not expected	No
Small Home Range Receptors	SWMU 1	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Not expected	Not expected	No
Small Home Range Receptors	SWMU 1	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-4	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-5	Soil Invertebrates	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-6	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-7	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	Yes	NA	Unlikely	Unlikely	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-8	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-9	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	BCW excluding SWMU 1 and TCS-10	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 4	Plants	Vanadium	**26**	Note 4	NA	Low	NA	No	TCRA Complete	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 4	Plants	HMW P A H	Note 1	None	Note 1	Note 1	Note 1	Note 1	TCRA Complete	Not expected	Not expected	No
Small Home Range Receptors	A O C 4	Soil Invertebrates	Chromium, Hexavalent [h]	**2**	Note 3	NA	Low	NA	No	TCRA Complete	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 4	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	TCRA Complete	Not expected	Not expected	No
Small Home Range Receptors	A O C 4	Desert Shrew	Antimony	NC	None	NE	Low	High	No	TCRA Complete	Unlikely	Not expected	No
Small Home Range Receptors	A O C 4	Desert Shrew	Nickel	1	None	NE	Moderate	High	No	TCRA Complete	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 4	Desert Shrew	HMW P A H	0.001	None	NE	Moderate	High	No	TCRA Complete	Not expected	Not expected	No
Small Home Range Receptors	A O C 4	Desert Shrew	Total PCBs	NC	None	NE	Moderate	High	No	TCRA Complete	Not expected	Not expected	No
Small Home Range Receptors	A O C 4	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	TCRA Complete	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 4	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	TCRA Complete	Not expected	Not expected	No
Small Home Range Receptors	A O C 4	Cactus Wren	Total PCBs	NC	None	Uncertain	Moderate	High	No	TCRA Complete	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Plants	Antimony	NC	None	NA	Low	NE	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Plants	Chromium, Hexavalent	0.8	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Plants	Copper	0.2	None	NA	Robust	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Plants	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Plants	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 9	Plants	HMW P A H	**31**	Note 4	NA	Low	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Soil Invertebrates	Chromium, Hexavalent	**2**	Note 3	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Soil Invertebrates	Chromium, Total	1	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Soil Invertebrates	Copper	0.2	None	NA	Robust	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Soil Invertebrates	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Soil Invertebrates	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 9	Merriam's Kangaroo Rat	TEQ Mammals	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 9	Desert Shrew	Antimony	NC	None	NE	Low	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 9	Desert Shrew	Chromium, Hexavalent	0.001	None	NE	Robust	High	No	NA	Unlikely	Not expected	No

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird N O A E L	Notes	Area-weighted HQs - Mammal/ Bird L O A E L	Notes	Additional Lines of Evidence [c] - Low FOD (Max = EPC) [b]	Additional Lines of Evidence [c] - Locations greater than BTV	Additional Lines of Evidence [c] - Locations greater than 10xBTV	Additional Lines of Evidence [c] - Background HQs [d] N O A E L	Notes
Small Home Range Receptors	A O C 9	Desert Shrew	Chromium, Total	NA	None	9	Note 2	2	Note 3	No	13 / 50	2	0.7	None
Small Home Range Receptors	A O C 9	Desert Shrew	Copper	NA	None	3	Note 2	2	Note 3	No	18 / 50	2	0.1	None
Small Home Range Receptors	A O C 9	Desert Shrew	Nickel	NA	None	2	Note 2	1	None	No	3 / 50	0	2	Note 3
Small Home Range Receptors	A O C 9	Desert Shrew	HMW P A H	NA	None	2	Note 2	0.5	None	No	34 / 41	5	0.004	None
Small Home Range Receptors	A O C 9	Desert Shrew	TEQ Mammals	NA	None	396	Note 2	40	Note 4	No	15 / 17	5	0.5	None
Small Home Range Receptors	A O C 9	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 9	Cactus Wren	Chromium, Hexavalent	NA	None	3	Note 2	0.3	None	No	19 / 46	Yes (3 Locations)	0.02	None
Small Home Range Receptors	A O C 9	Cactus Wren	Chromium, Total	NA	None	3	Note 2	0.5	None	No	13 / 50	Yes (2 Locations)	0.7	None
Small Home Range Receptors	A O C 9	Cactus Wren	Copper	NA	None	2	Note 2	0.8	None	No	18 / 50	(4 Locations)	0.3	None
Small Home Range Receptors	A O C 9	Cactus Wren	Mercury	NA	None	3	Note 2	0.7	None	No	BG NA	Yes (1 Location)	NC	None
Small Home Range Receptors	A O C 9	Cactus Wren	TEQ Avian	NA	None	4	Note 2	0.4	None	No	14 / 17	(5 Locations)	0.03	None
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Chromium, Hexavalent	14	Note 4	NA	None	NA	None	No	26 / 53	10	0.8	None
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Manganese	2	Note 3	NA	None	NA	None	No	2 / 10	0	2	Note 3
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Thallium	6	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detect)	NC	None
Small Home Range Receptors	A O C 10 (Baseline)	Soil Invertebrates	Chromium, Hexavalent	12	Note 4	NA	None	NA	None	No	21 / 47	4	2	Note 3
Small Home Range Receptors	A O C 10 (Baseline)	Soil Invertebrates	Chromium, Total	2	Note 3	NA	None	NA	None	No	16 / 47	3	1	None
Small Home Range Receptors	A O C 10 (Baseline)	Merriam's Kangaroo Rat	Chromium, Total	NA	None	1	None	0.2	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (Baseline)	Desert Shrew	Chromium, Total	NA	None	4	Note 2	0.9	None	No	16 / 47	3	0.7	None
Small Home Range Receptors	A O C 10 (Baseline)	Desert Shrew	TEQ Mammals	NA	None	192	Note 2	19	Note 4	No	9 / 13	2	0.5	None
Small Home Range Receptors	A O C 10 (Baseline)	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (Baseline)	Cactus Wren	Chromium, Total	NA	None	2	Note 2	0.4	None	No	16 / 47	3	0.7	None
Small Home Range Receptors	A O C 10 (Baseline)	Cactus Wren	TEQ Avian	NA	None	4	Note 2	0.4	None	No	9 / 13	2	0.03	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Chromium, Hexavalent	15	Note 4	NA	None	NA	None	No	20 / 38	8	0.8	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Thallium	6	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detect)	NC	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Hexavalent	37	Note 4	NA	None	NA	None	No	20 / 38	8	2	Note 3
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Total	8	Note 3	NA	None	NA	None	No	22 / 38	7	0.7	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Merriam's Kangaroo Rat	Chromium, Total	NA	None	1	None	0.3	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Antimony	NA	None	12	Note 2	1	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Chromium, Total	NA	None	13	Note 2	3	Note 3	No	22 / 38	7	0.7	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Total PCBs	NA	None	2	Note 2	0.5	None	Yes	BG NA	NE (3 Detected)	NC	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	TEQ Mammals	NA	None	184	Note 2	18	Note 4	No	8 / 13	5	0.5	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Chromium, Total	NA	None	8	Note 2	1	None	No	22 / 38	7	0.7	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Copper	NA	None	1	Note 2	0.3	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Mercury	NA	None	2	Note 2	0.4	None	Yes	BG NA	NE (2 detect)	NC	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Total PCBs	NA	None	4	Note 2	0.3	None	Yes	BG NA	NE (3 detect)	NC	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	TEQ Avian	NA	None	5	Note 2	0.5	None	No	8 / 13	4	0.03	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Chromium, Hexavalent	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Hexavalent	3	Note 3	NA	None	NA	None	No	8 / 27	0	2	Note 3
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Chromium, Total	NA	None	2	Note 2	0.4	None	No	7 / 27	0	0.7	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	TEQ Mammals	NA	None	133	Note 2	13	Note 4	No	5 / 11	4	0.5	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	TEQ Avian	NA	None	4	Note 2	0.4	None	No	5 / 11	3	0.03	None
Small Home Range Receptors	A O C 11	Plants	Chromium, Hexavalent	2	Note 3	NA	None	NA	None	No	13 / 53	1	0.8	None
Small Home Range Receptors	A O C 11	Plants	HMW P A H	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Small Home Range Receptors	A O C 9	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Desert Shrew	Copper	0.08	None	NE	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Desert Shrew	Nickel	1	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Desert Shrew	HMW P A H	0.001	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 9	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 9	Cactus Wren	Chromium, Hexavalent	0.002	None	NE	Low	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Cactus Wren	Copper	0.1	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 9	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Chromium, Hexavalent	0.8	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Manganese	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 10 (Baseline)	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 10 (Baseline)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (Baseline)	Soil Invertebrates	Chromium, Total	0.7	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (Baseline)	Merriam's Kangaroo Rat	Chromium, Total	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (Baseline)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (Baseline)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (Baseline)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (Baseline)	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (Baseline)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Chromium, Hexavalent	0.8	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Total	1	None	NA	Low	NA	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Merriam's Kangaroo Rat	Chromium, Total	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Antimony	NC	None	NE	Low	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Total PCBs	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Chromium, Total	0.1	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Copper	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	Total PCBs	NC	None	Uncertain	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Plants	Chromium, Hexavalent	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	Chromium, Total	0.2	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Possible	Possible	Yes
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 10 (2-foot Scouring)	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 11	Plants	Chromium, Hexavalent	0.8	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Plants	HMW P A H	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No

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Needles, California

Receptor Type	AOC	Receptor	COPEC[a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird NOAEL	Notes	Area-weighted HQs - Mammal/ Bird LOAEL	Notes	Additional Lines of Evidence[c] - Low FOD (Max = EPC)[b]	Additional Lines of Evidence[c] - Locations greater than BTV	Additional Lines of Evidence[c] - Locations greater than 10xBTV	Additional Lines of Evidence[c] - Background HQs[d] NOAEL	Notes
Small Home Range Receptors	AOC 11	Soil Invertebrates	Chromium, Hexavalent	5	Note 3	NA	None	NA	None	No	9 / 52	1	2	Note 3
Small Home Range Receptors	AOC 11	Soil Invertebrates	Mercury	2	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	AOC 11	Soil Invertebrates	Zinc	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 11	Soil Invertebrates	Alpha-Chlordane	3	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	AOC 11	Soil Invertebrates	Gamma-Chlordane	3	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	AOC 11	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 11	Desert Shrew	HMW PAH	NA	None	1	None	0.3	None	No	43 / 52	NE	0.004	None
Small Home Range Receptors	AOC 11	Desert Shrew	TEQ Mammals	NA	None	90	Note 2	9	Note 3	No	13 / 26	4	0.5	None
Small Home Range Receptors	AOC 11	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 11	Cactus Wren	Lead[h]	NA	None	2	Note 2	1	None	No	29 / 52	2	0.4	None
Small Home Range Receptors	AOC 11	Cactus Wren	Mercury	NA	None	3	Note 2	1	None	Yes	BG NA	NE (1 Detected)	NC	None
Small Home Range Receptors	AOC 11	Cactus Wren	Total PCBs	NA	None	1	None	0.08	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 11	Cactus Wren	TEQ Avian	NA	None	3	Note 2	0.3	None	No	11 / 26	NE	0.03	None
Small Home Range Receptors	AOC 12[e]	Plants	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 12[e]	Soil Invertebrates	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 12[e]	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 12[e]	Desert Shrew	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 12[e]	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 12[e]	Cactus Wren	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 14	Plants	Antimony	4	Note 3	NA	None	NA	None	Yes	BG NA	NE (2 detects)	NC	None
Small Home Range Receptors	AOC 14	Plants	Chromium, Hexavalent[h]	2	Note 3	NA	None	NA	None	No	8 / 52	3	0.8	None
Small Home Range Receptors	AOC 14	Plants	Copper	2	Note 3	NA	None	NA	None	No	6 / 48	2	0.2	None
Small Home Range Receptors	AOC 14	Plants	Lead	2	Note 3	NA	None	NA	None	No	9 / 24	1	0.07	None
Small Home Range Receptors	AOC 14	Plants	Mercury	340	Note 5	NA	None	NA	None	Yes	BG NA	NE (3 detects) (1 greater than BL)[i]	NC	None
Small Home Range Receptors	AOC 14	Plants	Thallium	2	Note 3	NA	None	NA	None	Yes	BG NA	BG NA	NC	None
Small Home Range Receptors	AOC 14	Plants	HMW PAH	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 14	Soil Invertebrates	Mercury	4	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	AOC 14	Soil Invertebrates	4-methylphenol	5	Note 3	NA	None	NA	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	AOC 14	Merriam's Kangaroo Rat	Antimony	NA	None	2	Note 2	0.2	None	Yes	BG NA	NE (2 detects)	NC	None
Small Home Range Receptors	AOC 14	Merriam's Kangaroo Rat	Mercury	NA	None	2	Note 2	0.1	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	AOC 14	Desert Shrew	HMW PAH	NA	None	1	None	0.2	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 14	Desert Shrew	TEQ Mammals	NA	None	2	Note 2	0.2	None	No	1 / 8	0	0.5	None
Small Home Range Receptors	AOC 14	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 14	Cactus Wren	Mercury	NA	None	2	Note 2	0.4	None	Yes	BG NA	NE (1 detect)	NC	None
Small Home Range Receptors	AOC 27	Plants	Copper	2	Note 3	NA	None	NA	None	No	4 / 16	2	0.2	None
Small Home Range Receptors	AOC 27	Plants	Lead	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Plants	Zinc	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Plants	HMW PAH	4	Note 3	NA	None	NA	None	No	10 / 16	4	31	Note 4
Small Home Range Receptors	AOC 27	Soil Invertebrates	Chromium, Hexavalent	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Soil Invertebrates	Copper	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Soil Invertebrates	Mercury	1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Soil Invertebrates	Zinc	2	Note 3	NA	None	NA	None	No	5 / 16	2	0.5	None
Small Home Range Receptors	AOC 27	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	AOC 27	Desert Shrew	Cadmium	NA	None	4	Note 2	0.4	None	Yes	3 / 16	0	2	Note 3

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Small Home Range Receptors	A O C 11	Soil Invertebrates	Chromium, Hexavalent	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Soil Invertebrates	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Soil Invertebrates	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 11	Soil Invertebrates	Alpha-Chlordane	NC	None	NA	Moderate	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Soil Invertebrates	Gamma-Chlordane	NC	None	NA	Moderate	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 11	Desert Shrew	HMW P A H	0.0009	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 11	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 11	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 11	Cactus Wren	Lead [h]	0.2	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 11	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 11	Cactus Wren	Total PCBs	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 11	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Plants	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Soil Invertebrates	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Desert Shrew	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 12 [e]	Cactus Wren	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 14	Plants	Antimony	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	Chromium, Hexavalent [h]	0.8	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	Copper	0.2	None	NA	Robust	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	Lead	0.07	None	NA	Robust	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	Thallium	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Plants	HMW P A H	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 14	Soil Invertebrates	Mercury	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Soil Invertebrates	4-methylphenol	NC	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 14	Merriam's Kangaroo Rat	Antimony	NC	None	NE	Low	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 14	Merriam's Kangaroo Rat	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 14	Desert Shrew	HMW P A H	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 14	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 14	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 14	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Plants	Copper	0.2	None	NA	Robust	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 27	Plants	Lead	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Plants	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Plants	HMW P A H	31	Note 4	NA	Low	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 27	Soil Invertebrates	Chromium, Hexavalent	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Soil Invertebrates	Copper	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Soil Invertebrates	Mercury	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Soil Invertebrates	Zinc	0.5	None	NA	Robust	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 27	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Desert Shrew	Cadmium	0.2	None	NE	NE	High	No	NA	Unlikely	Not expected	No

Table 6-11
Risk Conclusions and Lines of Evidence Summary

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Receptor Type	A O C	Receptor	C O P E C [a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird N O A E L	Notes	Area-weighted HQs - Mammal/ Bird L O A E L	Notes	Additional Lines of Evidence [c] - Low FOD (Max = EPC) [b]	Additional Lines of Evidence [c] - Locations greater than BTV	Additional Lines of Evidence [c] - Locations greater than 10xBTV	Additional Lines of Evidence [c] - Background HQs [d] N O A E L	Notes
Small Home Range Receptors	A O C 27	Desert Shrew	Copper	NA	None	1	None	0.8	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 27	Desert Shrew	Lead	NA	None	**2**	Note 2	1	None	No	6 / 16	2	0.1	None
Small Home Range Receptors	A O C 27	Desert Shrew	Zinc	NA	None	1	None	0.3	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 27	Desert Shrew	HMW P A H	NA	None	**4**	Note 2	0.8	None	No	10 / 16	4	0.004	None
Small Home Range Receptors	A O C 27	Desert Shrew	TEQ Mammals	NA	None	**36**	Note 2	**4**	Note 3	No	7 / 9	2	0.5	None
Small Home Range Receptors	A O C 27	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 27	Cactus Wren	Cadmium	NA	None	**2**	Note 2	0.4	None	Yes	3 / 16	0	1	None
Small Home Range Receptors	A O C 27	Cactus Wren	Copper	NA	None	**2**	Note 2	0.8	None	No	4 / 16	2	0.3	None
Small Home Range Receptors	A O C 27	Cactus Wren	Lead	NA	None	**5**	Note 2	**2**	Note 3	No	6 / 16	2	0.4	None
Small Home Range Receptors	A O C 27	Cactus Wren	Mercury	NA	None	**2**	Note 2	0.4	None	Yes	BG NA	NE (4 detected)	NC	None
Small Home Range Receptors	A O C 27	Cactus Wren	Zinc	NA	None	1	None	0.4	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 27	Cactus Wren	TEQ Avian	NA	None	**2**	Note 2	0.2	None	No	7 / 9	2	0.03	None
Small Home Range Receptors	A O C 28 [e]	Plants	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 28 [e]	Soil Invertebrates	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 28 [e]	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 28 [e]	Desert Shrew	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 28 [e]	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 28 [e]	Cactus Wren	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Plants	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Soil Invertebrates	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Desert Shrew	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	A O C 31 [e]	Cactus Wren	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	UA-2 [e]	Plants	Manganese	**4**	Note 3	NA	None	NA	None	Yes	2/2	0	**2**	Note 3
Small Home Range Receptors	UA-2 [e]	Soil Invertebrates	Manganese	**2**	Note 3	NA	None	NA	None	Yes	2/2	0	0.9	None
Small Home Range Receptors	UA-2 [e]	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	UA-2 [e]	Desert Shrew	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	UA-2 [e]	Gambel's Quail	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	UA-2 [e]	Cactus Wren	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	Tamarisk Thicket	Plants	Manganese	**2**	Note 3	NA	None	NA	None	Yes	1/2	0	**2**	Note 3
Small Home Range Receptors	Tamarisk Thicket	Soil Invertebrates	None	HQs less than or equal to 1	None	NA	None	NA	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	Tamarisk Thicket	Merriam's Kangaroo Rat	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	Tamarisk Thicket	Desert Shrew	TEQ Mammals	NA	None	**72**	Note 2	**7**	Note 3	No	19 / 21	7	0.5	None
Small Home Range Receptors	Tamarisk Thicket	Gambel's Quail	None	NA	None	HQs less than 1	Note 2	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Small Home Range Receptors	Tamarisk Thicket	Cactus Wren	TEQ Avian	NA	None	**3**	Note 2	0.3	None	No	17 / 21	2	0.03	None
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 4	Desert kit fox	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 5	Nelson's Desert Bighorn Sheep	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 6	Red-tailed hawk	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
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Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Small Home Range Receptors	A O C 27	Desert Shrew	Copper	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Desert Shrew	Lead	0.07	None	NE	Low	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Desert Shrew	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Desert Shrew	HMW P A H	0.001	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 27	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Cactus Wren	Cadmium	0.3	None	NE	Robust	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Cactus Wren	Copper	0.1	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Cactus Wren	Lead	0.2	None	NE	Moderate	High	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	A O C 27	Cactus Wren	Mercury	NC	None	NE	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 27	Cactus Wren	Zinc	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 27	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Plants	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Soil Invertebrates	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Desert Shrew	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 28 [e]	Cactus Wren	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Plants	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Soil Invertebrates	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Desert Shrew	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	A O C 31 [e]	Cactus Wren	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	UA-2 [e]	Plants	Manganese	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	UA-2 [e]	Soil Invertebrates	Manganese	0.9	None	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	UA-2 [e]	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	UA-2 [e]	Desert Shrew	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	UA-2 [e]	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	UA-2 [e]	Cactus Wren	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	Tamarisk Thicket	Plants	Manganese	2	Note 3	NA	Low	NA	No	NA	Unlikely	Unlikely	No
Small Home Range Receptors	Tamarisk Thicket	Soil Invertebrates	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	Tamarisk Thicket	Merriam's Kangaroo Rat	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	Tamarisk Thicket	Desert Shrew	TEQ Mammals	0.05	None	High	Moderate	High	Yes	NA	Unlikely	Unlikely	No
Small Home Range Receptors	Tamarisk Thicket	Gambel's Quail	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Small Home Range Receptors	Tamarisk Thicket	Cactus Wren	TEQ Avian	0.003	None	High	Moderate	High	No	NA	Unlikely	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 4	Desert kit fox	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 5	Nelson's Desert Bighorn Sheep	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 6	Red-tailed hawk	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Receptor Type	AOC	Receptor	COPEC [a]	Area-weighted HQs - Plant and Soil Invertebrates	Notes	Area-weighted HQs - Mammal/ Bird NOAEL	Notes	Area-weighted HQs - Mammal/ Bird LOAEL	Notes	Additional Lines of Evidence [c] - Low FOD (Max = EPC) [b]	Additional Lines of Evidence [c] - Locations greater than BTV	Additional Lines of Evidence [c] - Locations greater than 10xBTV	Additional Lines of Evidence [c] - Background HQs [d] NOAEL	Notes
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + AOC 7	Desert kit fox	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + AOC 8	Nelson's Desert Bighorn Sheep	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + AOC 9	Red-tailed hawk	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+AOC 4)	Desert kit fox	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+AOC 4)	Nelson's Desert Bighorn Sheep	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+AOC 4)	Red-tailed hawk	None	NA	None	HQs less than 1	None	HQs less than 1	None	Note 1	Note 1	Note 1	Note 1	None

Table 6-11
Risk Conclusions and Lines of Evidence Summary

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PG&E Topock Compressor Station
Needles, California

Receptor Type	A O C	Receptor	C O P E C [a]	Additional Lines of Evidence [c] - Background HQs [d] L O A E L	None	Additional Lines of Evidence [c] - BAFs	Additional Lines of Evidence [c] - Quality of SL or TRV	Additional Lines of Evidence [c] - Exposure Assumptions[e]	Additional Lines of Evidence [c] - Observation of T&E species [f]	Additional Lines of Evidence [c] - Other L O E	Risk Conclusions - Individuals	Risk Conclusions - Populations	Risk Driver (L O A E L HQ greater than 1 and Supporting L O E) [g]
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 7	Desert kit fox	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 8	Nelson's Desert Bighorn Sheep	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Including BCW) BCW + A O C 9	Red-tailed hawk	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+A O C 4)	Desert kit fox	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+A O C 4)	Nelson's Desert Bighorn Sheep	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No
Large Home Range Receptors	Outside the Compressor Station (Excluding BCW+A O C 4)	Red-tailed hawk	None	Note 1	None	Note 1	Note 1	Note 1	Note 1	Note 1	Not expected	Not expected	No

Table 6-11
Risk Conclusions and Lines of Evidence Summary

Soil Human Health and Ecological Risk Assessment
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Needles, California

Notes:

[a] C O P E C s are presented for HQs greater than 1 based on the depth-weighted EPC and/or area-weighted EPC and species and site-specific SUF.

[b] The EPC is based on the maximum depth-weighted concentration due to the small dataset size.

[c] The additional lines of evidence for C O P E Cs with N O A E L and L O A E L HQs less than or equal to 1 (based on the area-weighted EPC and species and site-specific SUF) are not included in the table.

[d] For plants and soil invertebrates, the background HQ is based on the BTV. For mammals and birds, the N O A E L and L O A E L background HQs are based on the 95 percent upper confidence limit.

[e] Applicable to wildlife, unless noted.

[f] In areas where observations were noted, the T&E species observed have large home ranges and unlikely to forage in upland habitat. See text for details.

[g] For dioxin TEQ, L O A E L HQs less than 10 with supporting L O E were considered unlikely to pose an unacceptable risk to populations of wildlife receptors due to the compounded conservative assumptions included in the ecological risk assessment. See Section 6.7.6 of the main report.

[h] Depth-weighted EPC resulted in an HQ or N O A E L-based HQ less than 1, and is less than the area-weighted HQ or N O A E L-based HQ.

[i] Although a BTV is not available, concentrations were at or below the reporting limit except for the number of locations noted.

Note 1	L O A E L and N O A E L HQs less than or equal to 1 for the receptor
Note 2	N O A E L HQ greater than 1
Note 3	HQ/L O A E L HQ greater than 1
Note 4	HQ/L O A E L HQ greater than 10
Note 5	HQ/L O A E L HQ greater than 100

Abbreviations:

A O C = area of concern
BAF = bioaccumulation factor
BCW = Bat Cave Wash
BG NA = background value not available
BTV = background threshold value
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
FOD = frequency of detection
HQ = hazard quotient
L O A E L = lowest observed adverse effect limit
L O E = line of evidence
NA = not applicable
NC = not calculated
NE = line of evidence not evaluated
N O A E L = no observed adverse effect limit
P A H = polycyclic aromatic hydrocarbon
RL = reporting limit
SL = screening level
SWMU 1 = solid waste management unit 1
T&E = threatened and endangered
TCS-4= Topock Compressor Station Well #4
TEQ = toxic equivalent
TRV = toxicity reference value

Table 6-12
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
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Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Notes	Baseline HQs - Plants - Area-Weighted HQ	Notes	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - WOE Result [a]
Inorganics	Antimony	**4**	Note 2	**4**	Note 2	Unlikely	0.2	None	0.2	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	**5**	Note 2	1	None	HQ less than or equal to 1	**8**	Note 2	**2**	Note 2	Unlikely
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**4**	Note 2	1	None	HQ less than or equal to 1
Inorganics	Cobalt	0.6	None	0.6	None	HQ less than or equal to 1	No SL	None	No SL	None	NA
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	None	0.2	None	HQ less than or equal to 1
Inorganics	Lead	0.06	None	0.06	None	HQ less than or equal to 1	0.004	None	0.004	None	HQ less than or equal to 1
Inorganics	Mercury	0.2	None	0.2	None	HQ less than or equal to 1	0.6	None	0.6	None	HQ less than or equal to 1
Inorganics	Thallium	**2**	Note 2	**2**	Note 2	Unlikely	No SL	None	No SL	None	NA
Inorganics	Zinc	0.5	None	0.3	None	HQ less than or equal to 1	0.6	None	0.5	None	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	No SL	None	No SL	None	NA	ND	None	ND	None	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.01	None	0.01	None	HQ less than or equal to 1	0.01	None	0.01	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.003	None	0.001	None	HQ less than or equal to 1	0.0009	None	0.000	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.4	None	0.1	None	HQ less than or equal to 1	0.02	None	0.008	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.005	None	0.003	None	HQ less than or equal to 1	0.1	None	0.1	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.0003	None	0.0003	None	HQ less than or equal to 1
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA

Table 6-12
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.5 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.5 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.5 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.5 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - W O E Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 N O A E L
Inorganics	Antimony	NA	NA	NA	NA	NA	NA	None	NA	NA
Inorganics	Chromium, hexavalent	0.004	0.0004	0.001	0.0001	HQ less than or equal to 1	0.09	None	0.009	0.03
Inorganics	Chromium, total	0.3	0.05	0.07	0.01	HQ less than or equal to 1	**7**	Note 1	1	**2**
Inorganics	Cobalt	0.002	0.0009	0.002	0.0009	HQ less than or equal to 1	0.04	None	0.02	0.04
Inorganics	Copper	0.03	0.01	0.03	0.01	HQ less than or equal to 1	0.4	None	0.1	0.4
Inorganics	Lead	0.02	0.009	0.02	0.009	HQ less than or equal to 1	0.5	None	0.3	0.5
Inorganics	Mercury	0.04	0.009	0.04	0.009	HQ less than or equal to 1	**2**	Note 1	0.4	**2**
Inorganics	Thallium	0.01	0.001	0.01	0.001	HQ less than or equal to 1	0.8	None	0.08	0.8
Inorganics	Zinc	0.02	0.007	0.01	0.006	HQ less than or equal to 1	1	None	0.4	0.9
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA	NA	NA	None	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.004	0.0004	0.004	0.0004	HQ less than or equal to 1	0.7	None	0.1	0.7
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.00005	0.000005	0.00003	0.000003	HQ less than or equal to 1	0.0007	None	0.00007	0.0003
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.0002	0.00002	0.00009	0.000009	HQ less than or equal to 1	0.02	None	0.002	0.007
Polychlorinated Biphenyls	Total PCBs	0.003	0.0002	0.003	0.0002	HQ less than or equal to 1	0.5	None	0.04	0.4
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA	None	NA	NA
Dioxins	TEQ Avian	0.02	0.002	0.08	0.008	HQ less than or equal to 1	**9**	Note 1	0.9	**62**
Dioxins	TEQ Mammals	NA	NA	NA	NA	NA	NA	None	NA	NA

Table 6-12
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Category	C O P E C	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 L O A E L		Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 L O A E L
Inorganics	Antimony	None	NA	None	NA	**63**	Note 1	**6**	Note 2	**63**	Note 1	**6**
Inorganics	Chromium, hexavalent	None	0.003	None	HQ less than or equal to 1	0.02	None	0.005	None	0.007	None	0.002
Inorganics	Chromium, total	Note 1	0.3	None	HQ less than or equal to 1	**7**	Note 1	**2**	Note 2	**2**	Note 1	0.4
Inorganics	Cobalt	None	0.02	None	HQ less than or equal to 1	0.03	None	0.01	None	0.03	None	0.01
Inorganics	Copper	None	0.1	None	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None	0.09
Inorganics	Lead	None	0.2	None	HQ less than or equal to 1	0.2	None	0.09	None	0.2	None	0.09
Inorganics	Mercury	Note 1	0.4	None	HQ less than or equal to 1	0.3	None	0.02	None	0.3	None	0.02
Inorganics	Thallium	None	0.08	None	HQ less than or equal to 1	0.6	None	0.2	None	0.6	None	0.2
Inorganics	Zinc	None	0.3	None	HQ less than or equal to 1	1	None	0.2	None	0.9	None	0.2
Volatile Organic Compounds	Methyl acetate	None	NA	None	NA	NA	None	NA	None	NA	None	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	None	0.07	None	HQ less than or equal to 1	0.04	None	0.004	None	0.04	None	0.004
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	None	0.00003	None	HQ less than or equal to 1	0.0003	None	0.00005	None	0.00009	None	0.00002
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	None	0.0007	None	HQ less than or equal to 1	0.4	None	0.07	None	0.1	None	0.03
Polychlorinated Biphenyls	Total PCBs	None	0.03	None	HQ less than or equal to 1	0.1	None	0.04	None	0.1	None	0.03
Dioxins	2,3,7,8-TCDD	None	NA	None	NA	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	Note 1	**6**	Note 2	Unlikely	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	None	NA	None	NA	**303**	Note 1	**30**	Note 3	**1308**	Note 1	**131**

Table 6-12
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 NOAEL	Notes	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Antimony	Note 2	Unlikely	1	0.1	1	None	0.1	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	None	HQ less than or equal to 1	0.003	0.0007	0.0007	None	0.0002	HQ less than or equal to 1
Inorganics	Chromium, total	None	HQ less than or equal to 1	0.8	0.2	0.2	None	0.05	HQ less than or equal to 1
Inorganics	Cobalt	None	HQ less than or equal to 1	0.003	0.001	0.003	None	0.001	HQ less than or equal to 1
Inorganics	Copper	None	HQ less than or equal to 1	0.05	0.03	0.05	None	0.03	HQ less than or equal to 1
Inorganics	Lead	None	HQ less than or equal to 1	0.02	0.009	0.02	None	0.009	HQ less than or equal to 1
Inorganics	Mercury	None	HQ less than or equal to 1	0.03	0.002	0.03	None	0.002	HQ less than or equal to 1
Inorganics	Thallium	None	HQ less than or equal to 1	0.01	0.004	0.01	None	0.004	HQ less than or equal to 1
Inorganics	Zinc	None	HQ less than or equal to 1	0.06	0.02	0.05	None	0.01	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	None	NA	0.0000003	0.00000007	0.0000003	None	0.00000007	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	None	HQ less than or equal to 1	0.0002	0.00002	0.0002	None	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	None	HQ less than or equal to 1	0.00007	0.00001	0.00004	None	0.000008	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	None	HQ less than or equal to 1	0.01	0.002	0.004	None	0.0009	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	None	HQ less than or equal to 1	0.002	0.0004	0.0008	None	0.0002	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	None	NA	NA	NA	NA	None	NA	NA
Dioxins	TEQ Avian	None	NA	NA	NA	NA	None	NA	NA
Dioxins	TEQ Mammals	Note 4	Possible	0.8	0.08	**2**	Note 1	0.2	add text

Table 6-12
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

[a] W O E Result is risk conclusion based on 1) HQ/L O A E L HQ using area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:

A O C = area of concern
BCW = Bat Cave Wash
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-13
Ecological Risk Estimate Summary for 2-foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Needles, California

Category	C O P E C	HQs (2-foot Scouring) - Plants Depth-Weighted HQ	Notes	HQs (2-foot Scouring) - Plants Area-Weighted HQ	Notes	HQs (2-foot Scouring) - Plants W O E Result [a]	HQs (2-foot Scouring) - Soil Invertebrates - Depth-Weighted HQ	Notes	HQs (2-foot Scouring) - Soil Invertebrates - Area-Weighted HQ	Notes	HQs (2-foot Scouring) - Soil Invertebrates - W O E Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail - Depth-Weighted SUF = 0.5 N O A E L
Inorganics	Antimony	**3**	Note 2	**3**	Note 2	Unlikely	0.2	None	0.2	None	HQ less than or equal to 1	NA
Inorganics	Chromium, hexavalent	**7**	Note 2	1	None	HQ less than or equal to 1	**7**	Note 2	**2**	Note 2	Unlikely	0.004
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**4**	Note 2	**2**	Note 2	Unlikely	0.3
Inorganics	Cobalt	0.6	None	0.6	None	HQ less than or equal to 1	No SL	None	No SL	None	NA	0.002
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	None	0.1	None	HQ less than or equal to 1	0.03
Inorganics	Lead	0.06	None	0.04	None	HQ less than or equal to 1	0.004	None	0.003	None	HQ less than or equal to 1	0.02
Inorganics	Mercury	0.9	None	0.9	None	HQ less than or equal to 1	**3**	Note 2	**3**	Note 2	Unlikely	0.1
Inorganics	Thallium	**2**	Note 2	**2**	Note 2	Unlikely	ND	None	ND	None	NA	0.0004
Inorganics	Zinc	0.4	None	0.3	None	HQ less than or equal to 1	0.5	None	0.4	None	HQ less than or equal to 1	0.02
Volatile Organic Compounds	Methyl acetate	No SL	None	No SL	None	NA	No SL	None	No SL	None	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.004	None	0.004	None	HQ less than or equal to 1	0.004	None	0.004	None	HQ less than or equal to 1	0.001
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.002	None	0.0004	None	HQ less than or equal to 1	0.0004	None	0.0001	None	HQ less than or equal to 1	0.00004
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.2	None	0.06	None	HQ less than or equal to 1	0.004	None	0.003	None	HQ less than or equal to 1	0.0001
Polychlorinated Biphenyls	Total PCBs	0.001	None	0.002	None	HQ less than or equal to 1	0.05	None	0.08	None	HQ less than or equal to 1	0.001
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00006	None	0.00008	None	HQ less than or equal to 1	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.02
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA

Table 6-13
Ecological Risk Estimate Summary for 2-foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
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Category	COPEC	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail - Depth-Weighted SUF = 0.5 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail - Area-Weighted SUF = 0.5 NOAEL	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail - Area-Weighted SUF = 0.5 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail - WOE Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Depth-Weighted SUF = 1 NOAEL	Notes	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Depth-Weighted SUF = 1 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Area-Weighted SUF = 1 NOAEL	Notes
Inorganics	Antimony	NA	NA	NA	NA	NA	None	NA	NA	None
Inorganics	Chromium, hexavalent	0.0004	0.001	0.0001	HQ less than or equal to 1	0.08	None	0.008	0.02	None
Inorganics	Chromium, total	0.05	0.1	0.02	HQ less than or equal to 1	**7**	Note 1	1	**2**	Note 1
Inorganics	Cobalt	0.001	0.002	0.001	HQ less than or equal to 1	0.04	None	0.02	0.04	None
Inorganics	Copper	0.01	0.03	0.01	HQ less than or equal to 1	0.3	None	0.1	0.3	None
Inorganics	Lead	0.009	0.01	0.007	HQ less than or equal to 1	0.5	None	0.2	0.4	None
Inorganics	Mercury	0.02	0.1	0.02	HQ less than or equal to 1	**3**	Note 1	0.6	**3**	Note 1
Inorganics	Thallium	0.00004	0.0004	0.00004	HQ less than or equal to 1	NA	None	NA	NA	None
Inorganics	Zinc	0.006	0.01	0.005	HQ less than or equal to 1	0.9	None	0.3	0.9	None
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA	NA	None	NA	NA	None
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.0001	0.001	0.0001	HQ less than or equal to 1	0.3	None	0.03	0.3	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.000004	0.00002	0.000002	HQ less than or equal to 1	0.0003	None	0.00003	0.00009	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.00001	0.00004	0.000004	HQ less than or equal to 1	0.004	None	0.0004	0.003	None
Polychlorinated Biphenyls	Total PCBs	0.00008	0.002	0.0001	HQ less than or equal to 1	0.1	None	0.01	0.3	None
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	None	NA	NA	None
Dioxins	TEQ Avian	0.002	0.01	0.001	HQ less than or equal to 1	**12**	Note 1	1	**6**	Note 1
Dioxins	TEQ Mammals	NA	NA	NA	NA	NA	None	NA	NA	None

Table 6-13
Ecological Risk Estimate Summary for 2-foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Category	COPEC	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Area-Weighted SUF = 1 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - WOE Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 NOAEL	Notes	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 LOAEL	Notes	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 NOAEL	Notes	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 LOAEL	Notes
Inorganics	Antimony	NA	NA	**46**	Note 1	**5**	Note 2	**46**	Note 1	**5**	Note 2
Inorganics	Chromium, hexavalent	0.002	HQ less than or equal to 1	0.02	None	0.005	None	0.006	None	0.001	None
Inorganics	Chromium, total	0.4	HQ less than or equal to 1	**7**	Note 1	**2**	Note 2	**2**	Note 1	0.6	None
Inorganics	Cobalt	0.02	HQ less than or equal to 1	0.03	None	0.01	None	0.03	None	0.01	None
Inorganics	Copper	0.1	HQ less than or equal to 1	0.1	None	0.09	None	0.1	None	0.08	None
Inorganics	Lead	0.2	HQ less than or equal to 1	0.2	None	0.09	None	0.1	None	0.07	None
Inorganics	Mercury	0.6	HQ less than or equal to 1	0.5	None	0.03	None	0.5	None	0.03	None
Inorganics	Thallium	NA	NA	NA	None	NA	None	NA	None	NA	None
Inorganics	Zinc	0.3	HQ less than or equal to 1	0.9	None	0.2	None	0.8	None	0.2	None
Volatile Organic Compounds	Methyl acetate	NA	NA	0.0000005	None	0.0000001	None	0.0000005	None	0.0000001	None
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.03	HQ less than or equal to 1	0.02	None	0.002	None	0.02	None	0.002	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.000009	HQ less than or equal to 1	0.0001	None	0.00002	None	0.00003	None	0.000007	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.0003	HQ less than or equal to 1	0.07	None	0.01	None	0.05	None	0.009	None
Polychlorinated Biphenyls	Total PCBs	0.02	HQ less than or equal to 1	0.04	None	0.01	None	0.07	None	0.02	None
Dioxins	2,3,7,8-TCDD	NA	NA	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	0.6	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Mammals	NA	NA	**306**	Note 1	**31**	Note 3	**187**	Note 1	**19**	Note 3

Table 6-13
Ecological Risk Estimate Summary for 2-foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Category	COPEC	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - WOE Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 NOAEL	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 NOAEL	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 LOAEL	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Antimony	Unlikely	1	0.1	1	0.1	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.004	0.0009	0.0007	0.0002	HQ less than or equal to 1
Inorganics	Chromium, total	HQ less than or equal to 1	1	0.3	0.2	0.05	HQ less than or equal to 1
Inorganics	Cobalt	HQ less than or equal to 1	0.003	0.001	0.003	0.001	HQ less than or equal to 1
Inorganics	Copper	HQ less than or equal to 1	0.05	0.03	0.05	0.03	HQ less than or equal to 1
Inorganics	Lead	HQ less than or equal to 1	0.02	0.009	0.01	0.007	HQ less than or equal to 1
Inorganics	Mercury	HQ less than or equal to 1	0.06	0.004	0.06	0.004	HQ less than or equal to 1
Inorganics	Thallium	NA	0.009	0.003	0.009	0.003	HQ less than or equal to 1
Inorganics	Zinc	HQ less than or equal to 1	0.06	0.01	0.05	0.01	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	HQ less than or equal to 1	0.0000003	0.0000001	0.0000003	0.00000007	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	HQ less than or equal to 1	0.00009	0.000009	0.00009	0.000009	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	HQ less than or equal to 1	0.00005	0.00001	0.00003	0.000005	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	HQ less than or equal to 1	0.007	0.001	0.002	0.0004	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	0.0004	0.0001	0.0006	0.0002	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	Possible	0.5	0.05	0.3	0.03	HQ less than or equal to 1

Table 6-13
Ecological Risk Estimate Summary for 2-foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Needles, California

Notes:

[a] W O E Result is risk conclusion based on 1) HQ/L O A E L HQ using area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:

A O C = area of concern
BCW = Bat Cave Wash
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-14
Ecological Risk Estimate Summary for 5-Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Category	C O P E C	HQs (5-foot Scouring) - Plants Depth-Weighted HQ	Notes	HQs (5-foot Scouring) - Plants Area-Weighted HQ	Notes	HQs (5-foot Scouring) - Plants W O E Result [a]	HQs (5-foot Scouring) - Soil Invertebrates - Depth-Weighted HQ	Notes	HQs (5-foot Scouring) - Soil Invertebrates - Area-Weighted HQ	Notes	HQs (5-foot Scouring) - Soil Invertebrates - Depth-Weighted W O E Result [a]
Inorganics	Antimony	0.3	None	0.2	None	HQ less than or equal to 1	0.02	None	0.01	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	**7**	Note 2	1	None	HQ less than or equal to 1	**10**	Note 2	**3**	Note 2	Unlikely
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**7**	Note 2	**2**	Note 2	Unlikely
Inorganics	Cobalt	0.7	None	0.7	None	HQ less than or equal to 1	No SL	None	No SL	None	NA
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	None	0.1	None	HQ less than or equal to 1
Inorganics	Lead	0.07	None	0.07	None	HQ less than or equal to 1	0.01	None	0.005	None	HQ less than or equal to 1
Inorganics	Mercury	0.2	None	0.2	None	HQ less than or equal to 1	0.6	None	0.6	None	HQ less than or equal to 1
Inorganics	Thallium	**2**	Note 2	**2**	Note 2	Unlikely	No SL	None	No SL	None	NA
Inorganics	Zinc	0.5	None	0.4	None	HQ less than or equal to 1	0.7	None	0.5	None	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	No SL	None	No SL	None	NA	No SL	None	No SL	None	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.002	None	0.002	None	HQ less than or equal to 1	0.002	None	0.002	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.02	None	0.02	None	HQ less than or equal to 1	0.006	None	0.01	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.3	None	0.1	None	HQ less than or equal to 1	0.007	None	0.01	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0008	None	0.0008	None	HQ less than or equal to 1	ND	None	ND	None	NA
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00002	None	0.00005	None	HQ less than or equal to 1
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA

Table 6-14
Ecological Risk Estimate Summary for 5-Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
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Needles, California

Category	COPEC	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail Depth-Weighted SUF = 0.5 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail Depth-Weighted SUF = 0.5 LOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail Area-Weighted SUF = 0.5 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail Area-Weighted SUF = 0.5 LOAEL	HQs based on Selected TRVs (5-foot Scouring) Gambel's Quail - WOE Result [a]	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren Depth-Weighted SUF = 1 NOAEL	Notes	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Depth-Weighted SUF = 1 LOAEL	Notes
Inorganics	Antimony	NA	NA	NA	NA	NA	NA	None	NA	None
Inorganics	Chromium, hexavalent	0.01	0.0005	0.001	0.0001	HQ less than or equal to 1	0.1	None	0.01	None
Inorganics	Chromium, total	0.5	0.08	0.1	0.02	HQ less than or equal to 1	**12**	Note 1	**2**	Note 2
Inorganics	Cobalt	0.002	0.001	0.002	0.0009	HQ less than or equal to 1	0.04	None	0.02	None
Inorganics	Copper	0.03	0.01	0.03	0.01	HQ less than or equal to 1	0.3	None	0.1	None
Inorganics	Lead	0.02	0.01	0.02	0.01	HQ less than or equal to 1	0.6	None	0.3	None
Inorganics	Mercury	0.04	0.01	0.04	0.01	HQ less than or equal to 1	**2**	Note 1	0.4	None
Inorganics	Thallium	0.01	0.001	0.01	0.001	HQ less than or equal to 1	0.8	None	0.08	None
Inorganics	Zinc	0.02	0.01	0.02	0.01	HQ less than or equal to 1	1	None	0.4	None
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	NA	NA	NA	None	NA	None
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.0007	0.0001	0.0007	0.0001	HQ less than or equal to 1	0.1	None	0.01	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0001	0.00001	0.0001	0.00001	HQ less than or equal to 1	0.005	None	0.0005	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.0002	0.00002	0.00007	0.000007	HQ less than or equal to 1	0.006	None	0.001	None
Polychlorinated Biphenyls	Total PCBs	0.00007	0.000005	0.00007	0.000005	HQ less than or equal to 1	NA	None	NA	None
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA	None	NA	None
Dioxins	TEQ Avian	0.005	0.0005	0.002	0.0002	HQ less than or equal to 1	**2**	Note 1	0.2	None
Dioxins	TEQ Mammals	NA	NA	NA	NA	NA	NA	None	NA	None

Table 6-14
Ecological Risk Estimate Summary for 5-Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Area-Weighted SUF = 1 N O A E L	Notes	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Area-Weighted SUF = 1 L O A E L	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - W O E Result [a]	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Notes	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Notes	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Notes	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 L O A E L
Inorganics	Antimony	NA	None	NA	NA	**4**	Note 1	0.4	None	**4**	Note 1	0.4
Inorganics	Chromium, hexavalent	0.04	None	0.004	HQ less than or equal to 1	0.03	None	0.01	None	0.01	None	0.002
Inorganics	Chromium, total	**4**	Note 1	0.6	HQ less than or equal to 1	**12**	Note 1	**3**	Note 2	**4**	Note 1	0.9
Inorganics	Cobalt	0.04	None	0.02	HQ less than or equal to 1	0.03	None	0.01	None	0.03	None	0.01
Inorganics	Copper	0.3	None	0.1	HQ less than or equal to 1	0.1	None	0.09	None	0.1	None	0.08
Inorganics	Lead	0.6	None	0.3	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None	0.1
Inorganics	Mercury	**2**	Note 1	0.4	HQ less than or equal to 1	0.3	None	0.02	None	0.3	None	0.02
Inorganics	Thallium	0.8	None	0.08	HQ less than or equal to 1	0.6	None	0.2	None	0.6	None	0.2
Inorganics	Zinc	0.9	None	0.4	HQ less than or equal to 1	1	None	0.2	None	0.9	None	0.2
Volatile Organic Compounds	Methyl acetate	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.1	None	0.01	HQ less than or equal to 1	0.008	None	0.0008	None	0.01	None	0.0008
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.005	None	0.0005	HQ less than or equal to 1	0.002	None	0.0003	None	0.002	None	0.0003
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.01	None	0.0006	HQ less than or equal to 1	0.1	None	0.02	None	0.1	None	0.02
Polychlorinated Biphenyls	Total PCBs	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	0.7	None	0.07	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	NA	**81**	Note 1	**8**	Note 2	**20**	Note 1	**2**

Table 6-14
Ecological Risk Estimate Summary for 5-Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Category	C O P E C	Notes	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - W O E Result [a]	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Antimony	None	HQ less than or equal to 1	0.1	0.01	0.1	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	None	HQ less than or equal to 1	0.004	0.0009	0.0007	0.0002	HQ less than or equal to 1
Inorganics	Chromium, total	None	HQ less than or equal to 1	1	0.3	0.3	0.08	HQ less than or equal to 1
Inorganics	Cobalt	None	HQ less than or equal to 1	0.003	0.001	0.003	0.001	HQ less than or equal to 1
Inorganics	Copper	None	HQ less than or equal to 1	0.05	0.03	0.05	0.03	HQ less than or equal to 1
Inorganics	Lead	None	HQ less than or equal to 1	0.02	0.01	0.02	0.009	HQ less than or equal to 1
Inorganics	Mercury	None	HQ less than or equal to 1	0.03	0.002	0.03	0.002	HQ less than or equal to 1
Inorganics	Thallium	None	HQ less than or equal to 1	0.01	0.004	0.01	0.004	HQ less than or equal to 1
Inorganics	Zinc	None	HQ less than or equal to 1	0.06	0.02	0.05	0.01	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	None	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	None	HQ less than or equal to 1	0.00004	0.000004	0.00004	0.000004	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	None	HQ less than or equal to 1	0.0002	0.00003	0.0002	0.00003	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	None	HQ less than or equal to 1	0.01	0.002	0.004	0.0007	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	None	NA	0.0003	0.00007	0.0003	0.00007	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	Note 2	Unlikely	0.3	0.03	0.09	0.01	HQ less than or equal to 1

Table 6-14
Ecological Risk Estimate Summary for 5-Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW

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Needles, California

Notes:

[a] W O E Result is risk conclusion based on 1) HQ/L O A E L HQ using area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:

A O C = area of concern
BCW = Bat Cave Wash
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-15
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for SWMU1 and TCS-4

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Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Note	Baseline HQs - Plants - Area-Weighted HQ	Note	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Note	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Note	Baseline HQs - Soil Invertebrates - WOE Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.04 NOAEL
Inorganics	Antimony	**4**	Note 2	**4**	Note 2	Unlikely	0.2	None	0.2	None	HQ less than or equal to 1	NA
Inorganics	Chromium, hexavalent	**9**	Note 2	**6**	Note 2	Possible	**15**	Note 3	**12**	Note 3	Possible	0.0006
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**10**	Note 2	**5**	Note 2	Possible	0.05
Inorganics	Cobalt	0.7	None	0.7	None	HQ less than or equal to 1	No SL	None	No SL	None	--	0.0002
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	None	0.2	None	HQ less than or equal to 1	0.002
Inorganics	Lead	0.04	None	0.04	None	HQ less than or equal to	0.003	None	0.003	None	HQ less than or equal to 1	0.001
Inorganics	Mercury	0.9	None	0.9	None	HQ less than or equal to 1	**3**	Note 2	**3**	Note 2	Unlikely	0.008
Inorganics	Zinc	0.7	None	0.5	None	HQ less than or equal to 1	0.8	None	0.6	None	HQ less than or equal to 1	0.002
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.0004	None	0.0003	None	HQ less than or equal to 1	0.00007	None	0.00008	None	HQ less than or equal to 1	0.000001
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.12	None	0.08	None	HQ less than or equal to 1	0.008	None	0.005	None	HQ less than or equal to 1	0.000006
Polychlorinated Biphenyls	Total PCBs	0.001	None	0.001	None	HQ less than or equal to 1	0.04	None	0.04	None	HQ less than or equal to 1	0.00008
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.008	None	0.008	None	HQ less than or equal to 1	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.09
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA

Table 6-15
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.04 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.04 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.04 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - W O E Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.3 N O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.3 L O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.3 N O A E L	Note
Inorganics	Antimony	NA	NA	NA	NA	NA	None	NA	None	NA	None
Inorganics	Chromium, hexavalent	0.00006	0.0004	0.00004	HQ less than or equal to 1	0.05	None	0.005	None	0.04	None
Inorganics	Chromium, total	0.009	0.03	0.005	HQ less than or equal to 1	**4**	Note 1	0.8	None	**2**	Note 1
Inorganics	Cobalt	0.00008	0.0002	0.00008	HQ less than or equal to 1	0.01	None	0.00527	None	0.01	None
Inorganics	Copper	0.0008	0.002	0.0008	HQ less than or equal to 1	0.1	None	0.03	None	0.1	None
Inorganics	Lead	0.0005	0.001	0.0005	HQ less than or equal to 1	0.1	None	0.05	None	0.1	None
Inorganics	Mercury	0.002	0.008	0.002	HQ less than or equal to 1	0.8	None	0.2	None	0.8	None
Inorganics	Zinc	0.0007	0.001	0.0005	HQ less than or equal to 1	0.3	None	0.1	None	0.3	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0000001	0.000001	0.0000001	HQ less than or equal to 1	0.00001	None	0.000001	None	0.00002	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.0000006	0.000004	0.0000004	HQ less than or equal to 1	0.002	None	0.0002	None	0.001	None
Polychlorinated Biphenyls	Total PCBs	0.000006	0.00008	0.000006	HQ less than or equal to 1	0.03	None	0.002	None	0.04	None
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	0.009	0.03	0.003	HQ less than or equal to 1	**404**	Note 1	**40**	Note 3	**93**	Note 1
Dioxins	TEQ Mammals	NA	NA	NA	NA	NA	None	NA	None	NA	None

Table 6-15
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.3 L O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 L O A E L	Note
Inorganics	Antimony	NA	None	NA	**63**	Note 1	**6**	Note 2	**63**	Note 1	**6**	Note 2
Inorganics	Chromium, hexavalent	0.004	None	HQ less than or equal to 1	0.04	None	0.01	None	0.04	None	0.008	None
Inorganics	Chromium, total	0.4	None	HQ less than or equal to 1	**16**	Note 1	**4**	Note 2	**8**	Note 1	**2**	Note 2
Inorganics	Cobalt	0.005	None	HQ less than or equal to 1	0.03	None	0.01	None	0.03	None	0.01	None
Inorganics	Copper	0.03	None	HQ less than or equal to 1	0.1	None	0.09	None	0.1	None	0.09	None
Inorganics	Lead	0.05	None	HQ less than or equal to 1	0.1	None	0.07	None	0.1	None	0.07	None
Inorganics	Mercury	0.2	None	HQ less than or equal to 1	0.5	None	0.03	None	0.5	None	0.03	None
Inorganics	Zinc	0.1	None	HQ less than or equal to 1	1	None	0.3	None	0.9	None	0.2	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.000002	None	HQ less than or equal to 1	0.00002	None	0.000004	None	0.00002	None	0.000004	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.0001	None	HQ less than or equal to 1	0.1	None	0.02	None	0.08	None	0.02	None
Polychlorinated Biphenyls	Total PCBs	0.002	None	HQ less than or equal to 1	0.03	None	0.009	None	0.03	None	0.009	None
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	**9**	Note 2	Unlikely	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Mammals	NA	None	NA	**24144**	Note 1	**2414**	Note 4	**5732**	Note 1	**573**	Note 4

Table 6-15
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs based on Selected TRVs - Desert Shrew - W O E Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	Note	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Antimony	Unlikely	1	None	0.1	None	1	None	0.1	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.005	None	0.001	None	0.003	None	0.0008	HQ less than or equal to 1
Inorganics	Chromium, total	Possible	**2**	Note 1	0.5	None	1	None	0.2	HQ less than or equal to 1
Inorganics	Cobalt	HQ less than or equal to 1	0.003	None	0.001	None	0.003	None	0.001	HQ less than or equal to 1
Inorganics	Copper	HQ less than or equal to 1	0.05	None	0.03	None	0.05	None	0.03	HQ less than or equal to 1
Inorganics	Lead	HQ less than or equal to 1	0.01	None	0.01	None	0.01	None	0.007	HQ less than or equal to 1
Inorganics	Mercury	HQ less than or equal to 1	0.06	None	0.004	None	0.06	None	0.004	HQ less than or equal to 1
Inorganics	Zinc	HQ less than or equal to 1	0.07	None	0.02	None	0.06	None	0.02	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	HQ less than or equal to 1	0.00003	None	0.000006	None	0.00002	None	0.000004	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	HQ less than or equal to 1	0.004	None	0.0008	None	0.003	None	0.0006	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	0.0003	None	0.00009	None	0.0003	None	0.00009	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	None	NA	None	NA	None	NA	NA
Dioxins	TEQ Avian	NA	NA	None	NA	None	NA	None	NA	NA
Dioxins	TEQ Mammals	Possible	**20**	Note 1	**2**	Note 2	**6**	Note 1	0.6	HQ less than or equal to 1

Table 6-15
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for SWMU1 and TCS-4

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Notes:
a W O E Result is risk conclusion based on 1) HQ/L O A E L HQ using
area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:
A O C = area of concern
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SUF = site use factor
SWMU1 = Solid Waste Management Unit 1
TCDD = tetrachlorodibenzo-p-dioxin
TCS-4= Topock Compressor Station Well #4
TRV = toxicity reference value
TEQ = toxic equivalent
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either
1) not expected, 2) unlikely, or 3) possible.

Table 6-16
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for
BCW Excluding SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs - Plants - Depth-Weighted HQ	Note	Baseline HQs - Plants - Area-Weighted HQ	Note	Baseline HQs - Plants - W O E Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Baseline HQs - Soil Invertebrates - W O E Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.5 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.5 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.5 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.5 LOAEL
Inorganics	Antimony	ND	None	ND	None	NA	ND	ND	NA	NA	NA	NA	NA
Inorganics	Chromium, hexavalent	0.4	None	0.3	None	HQ less than or equal to 1	0.9	0.8	HQ less than or equal to 1	0.0004	0.00004	0.0003	0.00003
Inorganics	Chromium, total	No SL	None	No SL	None	NA	0.6	0.5	HQ less than or equal to 1	0.03	0.005	0.03	0.005
Inorganics	Cobalt	0.6	None	0.6	None	HQ less than or equal to 1	No SL	No SL	NA	0.002	0.0008	0.002	0.0008
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	0.2	HQ less than or equal to 1	0.03	0.01	0.03	0.01
Inorganics	Lead	0.07	None	0.06	None	HQ less than or equal to 1	0.005	0.004	HQ less than or equal to 1	0.02	0.01	0.02	0.008
Inorganics	Mercury	0.4	None	0.4	None	HQ less than or equal to 1	1	1	HQ less than or equal to 1	0.06	0.01	0.06	0.01
Inorganics	Thallium	**2**	Note 2	**2**	Note 2	Unlikely	No SL	No SL	NA	0.01	0.001	0.01	0.001
Inorganics	Zinc	0.4	None	0.4	None	HQ less than or equal to 1	0.5	0.5	HQ less than or equal to 1	0.01	0.006	0.01	0.005
Volatile Organic Compounds	Methyl acetate	No SL	None	No SL	None	NA	ND	ND	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.01	None	0.01	None	HQ less than or equal to 1	0.01	0.01	HQ less than or equal to 1	0.003	0.0003	0.003	0.0003
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.004	None	0.001	None	HQ less than or equal to 1	0.001	0.0004	HQ less than or equal to 1	0.00005	0.000005	0.00003	0.000003
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.5	None	0.1	None	HQ less than or equal to 1	0.02	0.01	HQ less than or equal to 1	0.0003	0.00003	0.0001	0.00001
Polychlorinated Biphenyls	Total PCBs	0.004	None	0.004	None	HQ less than or equal to 1	0.2	0.1	HQ less than or equal to 1	0.004	0.0003	0.003	0.0002
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00004	0.00007	HQ less than or equal to 1	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	NA	NA	0.005	0.0005	0.005	0.0005
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	NA	NA	NA	NA	NA	NA

Table 6-16
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for
BCW Excluding SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs based on Selected TRVs - Gambel's Quail - WOE Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 NOAEL	Note
Inorganics	Antimony	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.01	None	0.001	0.009	None	0.0009	HQ less than or equal to 1	0.002	None	0.0006	None	0.002	None
Inorganics	Chromium, total	HQ less than or equal to 1	0.9	None	0.2	0.8	None	0.1	HQ less than or equal to 1	0.9	None	0.2	None	0.8	None
Inorganics	Cobalt	HQ less than or equal to 1	0.04	None	0.02	0.04	None	0.02	HQ less than or equal to 1	0.03	None	0.01	None	0.03	None
Inorganics	Copper	HQ less than or equal to 1	0.4	None	0.1	0.4	None	0.1	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None
Inorganics	Lead	HQ less than or equal to 1	0.6	None	0.3	0.5	None	0.3	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None
Inorganics	Mercury	HQ less than or equal to 1	**2**	Note 1	0.5	**2**	Note 1	0.5	HQ less than or equal to 1	0.4	None	0.02	None	0.4	None
Inorganics	Thallium	HQ less than or equal to 1	0.8	None	0.08	0.8	None	0.08	HQ less than or equal to 1	0.6	None	0.2	None	0.6	None
Inorganics	Zinc	HQ less than or equal to 1	0.9	None	0.4	0.9	None	0.4	HQ less than or equal to 1	0.9	None	0.2	None	0.9	None
Volatile Organic Compounds	Methyl acetate	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	HQ less than or equal to 1	0.7	None	0.07	0.7	None	0.07	HQ less than or equal to 1	0.04	None	0.0045	None	0.04	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	HQ less than or equal to 1	0.001	None	0.0001	0.0003	None	0.00003	HQ less than or equal to 1	0.0004	None	0.00008	None	0.0001	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	HQ less than or equal to 1	0.01	None	0.001	0.009	None	0.0009	HQ less than or equal to 1	0.2	None	0.05	None	0.2	None
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	0.8	None	0.06	0.6	None	0.04	HQ less than or equal to 1	0.2	None	0.06	None	0.2	None
Dioxins	2,3,7,8-TCDD	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	HQ less than or equal to 1	**2**	Note 1	0.2	**2**	Note 1	0.2	HQ less than or equal to 1	NA	None	NA	None	NA	None
Dioxins	TEQ Mammals	NA	NA	None	NA	NA	None	NA	NA	**63**	Note 1	**6**	Note 2	**62**	Note 1

Table 6-16
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for
BCW Excluding SWMU1 and TCS-4

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Category	C O P E C	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 LOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew - WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Antimony	NA	None	NA	NA	NA	NA	NA	NA
Inorganics	Chromium, hexavalent	0.0005	None	HQ less than or equal to 1	0.0003	0.00006	0.0002	0.00005	HQ less than or equal to 1
Inorganics	Chromium, total	0.2	None	HQ less than or equal to 1	0.07	0.02	0.07	0.02	HQ less than or equal to 1
Inorganics	Cobalt	0.01	None	HQ less than or equal to 1	0.003	0.001	0.003	0.001	HQ less than or equal to 1
Inorganics	Copper	0.09	None	HQ less than or equal to 1	0.06	0.03	0.05	0.03	HQ less than or equal to 1
Inorganics	Lead	0.09	None	HQ less than or equal to 1	0.02	0.01	0.02	0.009	HQ less than or equal to 1
Inorganics	Mercury	0.02	None	HQ less than or equal to 1	0.04	0.003	0.04	0.003	HQ less than or equal to 1
Inorganics	Thallium	0.2	None	HQ less than or equal to 1	0.01	0.004	0.01	0.004	HQ less than or equal to 1
Inorganics	Zinc	0.2	None	HQ less than or equal to 1	0.05	0.01	0.05	0.01	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	NA	None	NA	0.0000003	0.00000007	0.0000003	0.00000007	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.004	None	HQ less than or equal to 1	0.0002	0.00002	0.0002	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.00002	None	HQ less than or equal to 1	0.00008	0.00002	0.00005	0.000009	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.03	None	HQ less than or equal to 1	0.02	0.003	0.005	0.001	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.05	None	HQ less than or equal to 1	0.001	0.0004	0.001	0.0003	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	**6**	Note 2	Unlikely	0.1	0.01	0.2	0.02	HQ less than or equal to 1

Table 6-16
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for
BCW Excluding SWMU1 and TCS-4

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Notes:
a. W O E Result is risk conclusion based on 1) HQ/L O A E L HQ
using area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:
A O C = area of concern
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either
1) not expected, 2) unlikely, or 3) possible.

Table 6-17
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs - Plants - Depth-Weighted HQ		Baseline HQs - Plants - Area-Weighted HQ	Note	Baseline HQs - Plants - W O E Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Note	Baseline HQs - Soil Invertebrates - W O E Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.1 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.1 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.1 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.1 L O A E L
Inorganics	Antimony	0.5	None	0.5	None	HQ less than or equal to 1	0.03	0.03	None	HQ less than or equal to 1	NA	NA	NA	NA
Inorganics	Barium	0.7	None	0.6	None	HQ less than or equal to 1	1	0.8	None	HQ less than or equal to 1	NA	NA	NA	NA
Inorganics	Chromium, hexavalent	0.5	None	1	None	HQ less than or equal to 1	1	**3**	Note 2	Unlikely	0.00006	0.000006	0.0001	0.00001
Inorganics	Chromium, total	No SL	None	No SL	None	NA	0.9	0.8	None	HQ less than or equal to 1	0.006	0.001	0.005	0.0009
Inorganics	Cobalt	0.8	None	0.7	None	HQ less than or equal to 1	No SL	No SL	None	NA	0.0003	0.0001	0.0003	0.0001
Inorganics	Copper	1	None	0.7	None	HQ less than or equal to 1	0.9	0.6	None	HQ less than or equal to 1	0.01	0.003	0.008	0.003
Inorganics	Lead	0.2	None	0.1	None	HQ less than or equal to 1	0.01	0.009	None	HQ less than or equal to 1	0.005	0.003	0.004	0.002
Inorganics	Mercury	0.3	None	0.3	None	HQ less than or equal to 1	0.9	1	None	HQ less than or equal to 1	0.006	0.001	0.007	0.001
Inorganics	Nickel	0.8	None	0.7	None	HQ less than or equal to 1	0.1	0.1	None	HQ less than or equal to 1	0.001	0.0005	0.001	0.0005
Inorganics	Vanadium	**24**	Note 3	**21**	Note 3	Unlikely	No SL	No SL	None	NA	0.03	0.02	0.03	0.01
Inorganics	Zinc	0.4	None	0.4	None	HQ less than or equal to 1	0.5	0.5	None	HQ less than or equal to 1	0.002	0.0007	0.002	0.0007
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.02	None	0.005	None	HQ less than or equal to 1	0.006	0.002	None	HQ less than or equal to 1	0.00001	0.000001	0.000007	0.0000007
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	**2**	Note 2	0.5	None	HQ less than or equal to 1	0.1	0.03	None	HQ less than or equal to 1	0.0001	0.00001	0.00004	0.000004
Polychlorinated Biphenyls	Total PCBs	0.02	None	0.02	None	HQ less than or equal to 1	0.8	0.6	None	HQ less than or equal to 1	0.002	0.0002	0.002	0.0001
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00003	0.0001	None	HQ less than or equal to 1	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	NA	None	NA	0.0006	0.00006	0.0004	0.00004
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	NA	None	NA	NA	NA	NA	NA

Table 6-17
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs - Gambel's Quail - W O E Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.4 N O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.4 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.4 N O A E L	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.4 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Note
Inorganics	Antimony	NA	NA	None	NA	NA	None	NA	NA	**9**	None	0.9	None	**9**	Note 1
Inorganics	Barium	NA	NA	None	NA	NA	None	NA	NA	0.2	None	0.1	None	0.1	None
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.006	None	0.0006	0.0	None	0.001	HQ less than or equal to 1	0.004	None	0.0009	None	0.008	None
Inorganics	Chromium, total	HQ less than or equal to 1	0.6	None	0.1	0.5	None	0.09	HQ less than or equal to 1	1	None	0.3	None	1	None
Inorganics	Cobalt	HQ less than or equal to 1	0.02	None	0.009	0.02	None	0.009	HQ less than or equal to 1	0.04	None	0.02	None	0.04	None
Inorganics	Copper	HQ less than or equal to 1	0.8	None	0.3	0.6	None	0.2	HQ less than or equal to 1	0.8	None	0.5	None	0.6	None
Inorganics	Lead	HQ less than or equal to 1	0.6	None	0.3	0.4	None	0.2	HQ less than or equal to 1	0.5	None	0.2	None	0.3	None
Inorganics	Mercury	HQ less than or equal to 1	0.9	None	0.2	0.9	None	0.2	HQ less than or equal to 1	0.3	None	0.02	None	0.3	None
Inorganics	Nickel	HQ less than or equal to 1	0.4	None	0.1	0.4	None	0.1	HQ less than or equal to 1	**4**	Note 1	**2**	Note 2	**4**	Note 1
Inorganics	Vanadium	HQ less than or equal to 1	1	None	0.7	1	None	0.7	HQ less than or equal to 1	0.1	None	0.07	None	0.1	None
Inorganics	Zinc	HQ less than or equal to 1	0.4	None	0.2	0.4	None	0.2	HQ less than or equal to 1	0.9	None	0.2	None	0.9	None
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	HQ less than or equal to 1	0.002	None	0.0002	0.0006	None	0.00006	HQ less than or equal to 1	0.002	None	0.0003	None	0.0005	None
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	HQ less than or equal to 1	0.05	None	0.005	0.01	None	0.001	HQ less than or equal to 1	**2**	Note 1	0.4	None	0.5	None
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	**3**	Note 1	0.2	**2**	Note 1	0.1	HQ less than or equal to 1	**2**	Note 1	0.5	None	1	None
Dioxins	2,3,7,8-TCDD	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	HQ less than or equal to 1	1	None	0.1	0.6	None	0.06	HQ less than or equal to 1	NA	None	NA	None	NA	None
Dioxins	TEQ Mammals	NA	NA	None	NA	NA	None	NA	NA	**66**	Note 1	**7**	Note 2	**27**	Note 1

Table 6-17
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 L O A E L	Note	Baseline HQs based on Selected TRVs - Desert Shrew - W O E Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Antimony	0.9	None	HQ less than or equal to 1	0.2	0.02	0.2	0.02	HQ less than or equal to 1
Inorganics	Barium	0.08	None	HQ less than or equal to 1	0.1	0.06	0.08	0.05	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.002	None	HQ less than or equal to 1	0.0003	0.00007	0.0006	0.0001	HQ less than or equal to 1
Inorganics	Chromium, total	0.3	None	HQ less than or equal to 1	0.1	0.03	0.1	0.02	HQ less than or equal to 1
Inorganics	Cobalt	0.01	None	HQ less than or equal to 1	0.004	0.001	0.003	0.001	HQ less than or equal to 1
Inorganics	Copper	0.3	None	HQ less than or equal to 1	0.1	0.07	0.09	0.06	HQ less than or equal to 1
Inorganics	Lead	0.2	None	HQ less than or equal to 1	0.04	0.02	0.03	0.01	HQ less than or equal to 1
Inorganics	Mercury	0.02	None	HQ less than or equal to 1	0.03	0.002	0.04	0.002	HQ less than or equal to 1
Inorganics	Nickel	**2**	Note 2	Unlikely	0.1	0.05	0.09	0.05	HQ less than or equal to 1
Inorganics	Vanadium	0.06	None	HQ less than or equal to 1	0.03	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Zinc	0.2	None	HQ less than or equal to 1	0.05	0.01	0.05	0.01	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0001	None	HQ less than or equal to 1	0.0002	0.00003	0.00009	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.1	None	HQ less than or equal to 1	0.06	0.0	0.02	0.003	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.4	None	HQ less than or equal to 1	0.006	0.002	0.005	0.001	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	**3**	Note 2	Unlikely	0.1	0.01	0.06	0.006	HQ less than or equal to 1

Table 6-17
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 4

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Notes:
[a] W O E Result is risk conclusion based on 1) HQ/L O A E L HQ using area-weighted EPCs, and 2) supporting L O E s.

Note 1	N O A E L HQ greater than 1
Note 2	L O A E L HQ greater than 1
Note 3	L O A E L HQ greater than 10
Note 4	L O A E L HQ greater than 100

Abbreviations:
A O C = area of concern
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
W O E = weight of evidence, considering multiple L O E s.
If HQs/L O A E L HQs are greater than 1, W O E Result is either
1) not expected, 2) unlikely, or 3) possible.

Table 6-18
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 9

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Notes	Baseline HQs - Plants - Area-Weighted HQ	Notes	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - WOE Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.04 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.04 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.04 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.04 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - WOE Result [a]
Inorganics	Antimony	**3**	Note 2	**3**	Note 2	Unlikely	0.2	None	0.2	None	HQ less than or equal to 1	NA	NA	NA	NA	NA
Inorganics	Arsenic	0.3	None	0.2	None	HQ less than or equal to 1	0.09	None	0.07	None	HQ less than or equal to 1	0.001	0.0004	0.0005	0.0003	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	**321**	Note 4	**295**	Note 4	Possible	**803**	Note 4	**738**	Note 4	Possible	0.03	0.003	0.03	0.003	HQ less than or equal to 1
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**6**	Note 2	**5**	Note 2	Possible	0.03	0.005	0.03	0.005	HQ less than or equal to 1
Inorganics	Copper	**5**	Note 2	**4**	Note 2	Possible	**4**	Note 2	**3**	Note 2	Possible	0.02	0.008	0.02	0.006	HQ less than or equal to 1
Inorganics	Lead	0.3	None	0.7	None	HQ less than or equal to 1	0.02	None	0.05	None	HQ less than or equal to 1	0.006	0.003	0.01	0.006	HQ less than or equal to 1
Inorganics	Mercury	**16**	Note 3	**15**	Note 3	Unlikely	**47**	Note 3	**46**	Note 3	Unlikely	0.06	0.01	0.06	0.01	HQ less than or equal to 1
Inorganics	Nickel	0.4	None	0.4	None	HQ less than or equal to 1	0.06	None	0.06	None	HQ less than or equal to 1	0.001	0.0002	0.0007	0.0002	HQ less than or equal to 1
Inorganics	Thallium	**3**	Note 2	**3**	Note 2	Unlikely	ND	None	ND	None	NA	0.00005	0.000005	0.00005	0.000005	HQ less than or equal to 1
Inorganics	Zinc	**2**	Note 2	0.8	None	HQ less than or equal to 1	**2**	Note 2	1	None	HQ less than or equal to 1	0.003	0.001	0.002	0.0008	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Isophorone	No SL	None	No SL	None	NA	No SL	None	No SL	None	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.04	None	0.01	None	HQ less than or equal to 1	0.01	None	0.004	None	HQ less than or equal to 1	0.00002	0.000002	0.00001	0.000001	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	**9**	Note 2	**2**	Note 2	Unlikely	0.6	None	0.2	None	HQ less than or equal to 1	0.0005	0.00005	0.0001	0.00001	HQ less than or equal to 1
Pesticides	4,4-DDE	0.004	None	0.004	None	HQ less than or equal to 1	0.3	None	0.3	None	HQ less than or equal to 1	0.00001	0.000001	0.00001	0.000001	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.006	None	0.009	None	HQ less than or equal to 1	0.3	None	0.3	None	HQ less than or equal to 1	0.001	0.00004	0.0006	0.00005	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.0004	None	0.0004	None	HQ less than or equal to 1	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.004	0.0004	0.002	0.0002	HQ less than or equal to 1
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA	NA	NA	NA	NA

Table 6-18
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 9

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PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.3 N O A E L	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.3 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.3 N O A E L	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 0.3 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 L O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - W O E Result [a]
Inorganics	Antimony	NA	None	NA	NA	None	NA	NA	**53**	Note 1	**5**	Note 2	**53**	Note 1	**5**	Note 2	Unlikely
Inorganics	Arsenic	0.03	None	0.02	0.03	None	0.02	HQ less than or equal to 1	0.1	None	0.08	None	0.1	None	0.07	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	**3**	Note 1	0.3	**3**	Note 1	0.3	HQ less than or equal to 1	**2**	Note 1	0.6	None	**2**	Note 1	0.5	None	HQ less than or equal to 1
Inorganics	Chromium, total	**3**	Note 1	0.5	**3**	Note 1	0.5	HQ less than or equal to 1	**10**	Note 1	**2**	Note 2	**9**	Note 1	**2**	Note 2	Possible
Inorganics	Copper	**3**	Note 1	1	**2**	Note 1	0.8	HQ less than or equal to 1	**4**	Note 1	**2**	Note 2	**3**	Note 1	**2**	Note 2	Possible
Inorganics	Lead	0.7	None	0.3	1	None	0.7	HQ less than or equal to 1	0.7	None	0.4	None	1	None	0.7	None	HQ less than or equal to 1
Inorganics	Mercury	**3**	Note 1	0.7	**3**	Note 1	0.7	HQ less than or equal to 1	1	None	0.08	None	1	None	0.08	None	HQ less than or equal to 1
Inorganics	Nickel	0.2	None	0.06	0.2	None	0.06	HQ less than or equal to 1	**2**	Note 1	1	None	**2**	Note 1	1	None	HQ less than or equal to 1
Inorganics	Thallium	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Inorganics	Zinc	0.5	None	0.2	0.4	None	0.1	HQ less than or equal to 1	1	None	0.4	None	1	None	0.3	None	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Isophorone	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.003	None	0.0003	0.001	None	0.0001	HQ less than or equal to 1	0.004	None	0.0007	None	0.001	None	0.0002	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.2	None	0.02	0.05	None	0.005	HQ less than or equal to 1	**10**	Note 1	**2**	Note 2	**2**	Note 1	0.5	None	HQ less than or equal to 1
Pesticides	4,4-DDE	0.02	None	0.002	0.02	None	0.002	HQ less than or equal to 1	0.1	None	0.02	None	0.1	None	0.02	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.4	None	0.03	0.5	None	0.04	HQ less than or equal to 1	0.4	None	0.1	None	0.4	None	0.1	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	**12**	Note 1	1	**4**	Note 1	0.4	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	NA	None	NA	NA	**1119**	Note 1	**112**	Note 4	**396**	Note 1	**40**	Note 3	Possible

Table 6-18
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 9

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Antimony	1	None	0.1	1	0.1	HQ less than or equal to 1
Inorganics	Arsenic	0.02	None	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.2	None	0.04	0.2	0.04	HQ less than or equal to 1
Inorganics	Chromium, total	0.8	None	0.2	0.7	0.2	HQ less than or equal to 1
Inorganics	Copper	0.3	None	0.2	0.2	0.1	HQ less than or equal to 1
Inorganics	Lead	0.05	None	0.03	0.09	0.05	HQ less than or equal to 1
Inorganics	Mercury	0.3	None	0.02	0.3	0.02	HQ less than or equal to 1
Inorganics	Nickel	0.06	None	0.03	0.06	0.03	HQ less than or equal to 1
Inorganics	Thallium	0.01	None	0.004	0.01	0.004	HQ less than or equal to 1
Inorganics	Zinc	0.1	None	0.03	0.08	0.02	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Isophorone	NA	None	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0002	None	0.00005	0.0001	0.00003	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.3	None	0.06	0.07	0.01	HQ less than or equal to 1
Pesticides	4,4-DDE	0.001	None	0.0001	0.001	0.0001	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.002	None	0.001	0.003	0.001	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	NA	NA	NA
Dioxins	TEQ Mammals	**2**	Note 1	0.2	0.6	0.06	HQ less than or equal to 1

Table 6-18
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 9

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
DDE = dichlorodiphenyldichloroethylene
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence.
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-19
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants Depth-Weighted HQ	Note	Baseline HQs - Plants Area-Weighted HQ	Note	Baseline HQs - Plants WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted - HQ	Note	Baseline HQs - Soil Invertebrates - Area-Weighted - HQ	Note	Baseline HQs - Soil Invertebrates - WOE Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted - SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted - SUF = 0.1 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted - SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted - SUF = 0.1 LOAEL
Inorganics	Antimony	0.7	None	0.7	None	HQ less than or equal to 1	ND	None	ND	None	NA	NA	NA	NA	NA
Inorganics	Arsenic	0.3	None	0.3	None	HQ less than or equal to 1	0.1	None	0.1	None	HQ less than or equal to 1	0.001	0.0008	0.001	0.0007
Inorganics	Chromium, hexavalent	**26**	Note 3	**14**	Note 3	Possible	**12**	Note 3	**12**	Note 3	Possible	0.002	0.0002	0.001	0.0001
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**3**	Note 2	**2**	Note 2	Possible	0.06	0.01	0.04	0.006
Inorganics	Copper	1	None	0.7	None	HQ less than or equal to 1	0.4	None	0.4	None	HQ less than or equal to 1	0.01	0.004	0.01	0.003
Inorganics	Lead	0.2	None	0.2	None	HQ less than or equal to 1	0.01	None	0.01	None	HQ less than or equal to 1	0.007	0.003	0.007	0.003
Inorganics	Manganese	**3**	Note 2	**2**	Note 2	Unlikely	1	None	1	None	HQ less than or equal to 1	0.002	0.001	0.002	0.0009
Inorganics	Mercury	1	None	1	None	HQ less than or equal to 1	ND	None	ND	None	NA	0.02	0.004	0.02	0.004
Inorganics	Thallium	**6**	Note 2	**6**	Note 2	Unlikely	ND	None	ND	None	NA	0.0002	0.00002	0.0002	0.00002
Inorganics	Zinc	0.7	None	0.6	None	HQ less than or equal to 1	0.7	None	0.7	None	HQ less than or equal to 1	0.004	0.001	0.003	0.001
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.005	None	0.004	None	HQ less than or equal to 1	0.002	None	0.001	None	HQ less than or equal to 1	0.00001	0.000001	0.000009	0.0000009
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.4	None	0.3	None	HQ less than or equal to 1	0.03	None	0.02	None	HQ less than or equal to 1	0.00004	0.000004	0.00003	0.000003
Polychlorinated Biphenyls	Total PCBs	0.009	None	0.005	None	HQ less than or equal to 1	0.4	None	0.2	None	HQ less than or equal to 1	0.002	0.0001	0.0009	0.00006
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.0005	None	0.0005	None	HQ less than or equal to 1	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.006	0.0006	0.002	0.0002
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA	NA	NA	NA

Table 6-19
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs - Gambel's Quail WOE Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted - SUF = 0.6 NOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted - SUF = 0.6 LOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted - SUF = 0.6 NOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted - SUF = 0.6 LOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - WOE Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted - SUF = 1 NOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted - SUF = 1 LOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted - SUF = 1 NOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted - SUF = 1 LOAEL
Inorganics	Antimony	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Inorganics	Arsenic	HQ less than or equal to 1	0.07	None	0.05	0.07	None	0.04	HQ less than or equal to 1	0.1	None	0.08	None	0.1	None	0.08
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.08	None	0.008	0.09	None	0.009	HQ less than or equal to 1	0.03	None	0.008	None	0.03	None	0.008
Inorganics	Chromium, total	HQ less than or equal to 1	**3**	Note 1	0.6	**2**	Note 1	0.4	HQ less than or equal to 1	**5**	Note 1	1	None	**4**	Note 1	0.9
Inorganics	Copper	HQ less than or equal to 1	0.5	None	0.2	0.5	None	0.2	HQ less than or equal to 1	0.3	None	0.2	None	0.3	None	0.2
Inorganics	Lead	HQ less than or equal to 1	0.7	None	0.4	0.7	None	0.4	HQ less than or equal to 1	0.4	None	0.2	None	0.4	None	0.2
Inorganics	Manganese	HQ less than or equal to 1	0.06	None	0.03	0.05	None	0.03	HQ less than or equal to 1	0.2	None	0.07	None	0.2	None	0.06
Inorganics	Mercury	HQ less than or equal to 1	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Inorganics	Thallium	HQ less than or equal to 1	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Inorganics	Zinc	HQ less than or equal to 1	0.7	None	0.3	0.6	None	0.2	HQ less than or equal to 1	1	None	0.3	None	1	None	0.2
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	HQ less than or equal to 1	0.0008	None	0.00008	0.0006	None	0.00006	HQ less than or equal to 1	0.0005	None	0.0001	None	0.0004	None	0.00007
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	HQ less than or equal to 1	0.01	None	0.001	0.01	None	0.001	HQ less than or equal to 1	0.4	None	0.08	None	0.3	None	0.06
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	1	None	0.1	0.7	None	0.05	HQ less than or equal to 1	0.6	None	0.2	None	0.3	None	0.08
Dioxins	2,3,7,8-TCDD	NA	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	HQ less than or equal to 1	**13**	Note 1	1	**4**	Note 1	0.4	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	NA	None	NA	NA	None	NA	NA	**592**	Note 1	**59**	Note 3	**192**	Note 1	**19**

Table 6-19
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Note	Baseline HQs based on Selected TRVs - Desert Shrew - WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted - SUF = 1 NOAEL	Note	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted - SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted - SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted - SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Antimony	None	NA	0.3	None	0.03	0.3	0.03	HQ less than or equal to 1
Inorganics	Arsenic	None	HQ less than or equal to 1	0.02	None	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	None	HQ less than or equal to 1	0.01	None	0.004	0.008	0.002	HQ less than or equal to 1
Inorganics	Chromium, total	None	HQ less than or equal to 1	**2**	Note 1	0.4	0.9	0.2	HQ less than or equal to 1
Inorganics	Copper	None	HQ less than or equal to 1	0.1	None	0.07	0.09	0.06	HQ less than or equal to 1
Inorganics	Lead	None	HQ less than or equal to 1	0.04	None	0.02	0.04	0.02	HQ less than or equal to 1
Inorganics	Manganese	None	HQ less than or equal to 1	0.1	None	0.04	0.09	0.03	HQ less than or equal to 1
Inorganics	Mercury	None	NA	0.07	None	0.004	0.07	0.004	HQ less than or equal to 1
Inorganics	Thallium	None	NA	0.03	None	0.01	0.03	0.01	HQ less than or equal to 1
Inorganics	Zinc	None	HQ less than or equal to 1	0.07	None	0.02	0.07	0.02	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	None	HQ less than or equal to 1	0.00009	None	0.00002	0.00008	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	None	HQ less than or equal to 1	0.01	None	0.003	0.01	0.002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	None	HQ less than or equal to 1	0.003	None	0.0008	0.002	0.0005	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	None	NA	NA	None	NA	NA	NA	NA
Dioxins	TEQ Avian	None	NA	NA	None	NA	NA	NA	NA
Dioxins	TEQ Mammals	Note 3	Possible	0.9	None	0.09	0.3	0.03	HQ less than or equal to 1

Table 6-19
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a.] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-20
Ecological Risk Estimate Summary for 2 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs (2-foot Scouring) - Plants - Depth-Weighted - HQ	Note	HQs (2-foot Scouring) - Plants - Area-Weighted - HQ	Note	HQs (2-foot Scouring) - Plants - W O E Result [a]	HQs (2-foot Scouring) - Soil Invertebrates - Depth-Weighted - HQ	Note	HQs (2-foot Scouring) - Soil Invertebrates - Area-Weighted - HQ	Note	HQs (2-foot Scouring) - Soil Invertebrates - W O E Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail Depth-Weighted SUF = 0.1 N O A E L	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail Depth-Weighted SUF = 0.1 L O A E L	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail Area-Weighted SUF = 0.1 N O A E L	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail Area-Weighted SUF = 0.1 L O A E L	HQs based on Selected TRVs (2-foot Scouring) - Gambel's Quail W O E Result [a]
Inorganics	Antimony	0.7	None	0.7	None	HQ less than or equal to1	0.04	None	0.04	None	HQ less than or equal to1	NA	NA	NA	NA	NA
Inorganics	Arsenic	0.3	None	0.3	None	HQ less than or equal to1	0.08	None	0.08	None	HQ less than or equal to1	0.001	0.0006	0.001	0.0006	HQ less than or equal to1
Inorganics	Chromium, hexavalent	**31**	Note 3	**15**	Note 3	Possible	**78**	Note 3	**37**	Note 3	Possible	0.006	0.0006	0.003	0.0003	HQ less than or equal to1
Inorganics	Chromium, total	No SL	None	No SL	None	NA	**19**	Note 3	**8**	Note 2	Possible	0.2	0.03	0.08	0.01	HQ less than or equal to1
Inorganics	Copper	1	None	0.7	None	HQ less than or equal to1	1	None	0.6	None	HQ less than or equal to1	0.02	0.006	0.01	0.004	HQ less than or equal to1
Inorganics	Lead	0.2	None	0.2	None	HQ less than or equal to1	0.02	None	0.01	None	HQ less than or equal to1	0.01	0.005	0.007	0.003	HQ less than or equal to1
Inorganics	Mercury	1	None	1	None	HQ less than or equal to1	**3**	Note 2	**3**	Note 2	Unlikely	0.02	0.004	0.02	0.004	HQ less than or equal to1
Inorganics	Thallium	**6**	Note 2	**6**	Note 2	Unlikely	No SL	None	No SL	None	NA	0.006	0.0006	0.006	0.0006	HQ less than or equal to1
Inorganics	Zinc	0.9	None	0.6	None	HQ less than or equal to1	1	None	0.8	None	HQ less than or equal to1	0.004	0.002	0.003	0.001	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.003	None	0.003	None	HQ less than or equal to1	0.001	None	0.001	None	HQ less than or equal to1	0.000009	0.0000009	0.000008	0.0000008	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.6	None	0.4	None	HQ less than or equal to1	0.04	None	0.03	None	HQ less than or equal to1	0.00007	0.000007	0.00005	0.000005	HQ less than or equal to1
Polychlorinated Biphenyls	Total PCBs	0.02	None	0.02	None	HQ less than or equal to1	0.8	None	0.8	None	HQ less than or equal to1	0.003	0.0002	0.003	0.0002	HQ less than or equal to1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00003	None	0.00003	None	HQ less than or equal to1	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.003	0.0003	0.002	0.0002	HQ less than or equal to1
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA	NA	NA	NA	NA

Table 6-20
Ecological Risk Estimate Summary for 2 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Depth-Weighted - SUF = 0.6 N O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Depth-Weighted SUF = 0.6 L O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Area-Weighted SUF = 0.6 N O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren - Area-Weighted SUF = 0.6 L O A E L	HQs based on Selected TRVs (2-foot Scouring) - Cactus Wren W O E Result [a]	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew - Area-Weighted SUF = 1 L O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Desert Shrew W O E Result [a]
Inorganics	Antimony	NA	None	NA	None	NA	None	NA	NA	**12**	Note 1	1	None	**12**	Note 1	1	None	HQ less than or equal to1
Inorganics	Arsenic	0.06	None	0.04	None	0.06	None	0.04	HQ less than or equal to1	0.1	None	0.07	None	0.1	None	0.07	None	HQ less than or equal to1
Inorganics	Chromium, hexavalent	0.6	None	0.06	None	0.3	None	0.03	HQ less than or equal to1	0.2	None	0.05	None	0.1	None	0.03	None	HQ less than or equal to1
Inorganics	Chromium, total	**19**	Note 1	**3**	Note 2	**8**	Note 1	1	HQ less than or equal to1	**30**	Note 1	**8**	Note 2	**13**	Note 1	**3**	Note 2	Possible
Inorganics	Copper	**2**	Note 1	0.6	None	0.9	None	0.3	HQ less than or equal to1	1	None	0.7	None	0.6	None	0.4	None	HQ less than or equal to1
Inorganics	Lead	1	None	0.5	None	0.7	None	0.4	HQ less than or equal to1	0.6	None	0.3	None	0.4	None	0.2	None	HQ less than or equal to1
Inorganics	Mercury	**2**	Note 1	0.4	None	**2**	Note 1	0.4	HQ less than or equal to1	0.5	None	0.03	None	0.5	None	0.03	None	HQ less than or equal to1
Inorganics	Thallium	1	None	0.1	None	1	None	0.1	HQ less than or equal to1	1	None	0.5	None	1	None	0.5	None	HQ less than or equal to1
Inorganics	Zinc	0.8	None	0.3	None	0.7	None	0.3	HQ less than or equal to1	1	None	0.3	None	1	None	0.3	None	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0005	None	0.00005	None	0.0005	None	0.00005	HQ less than or equal to1	0.0003	None	0.00006	None	0.0003	None	0.00006	None	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.02	None	0.002	None	0.02	None	0.002	HQ less than or equal to1	0.6	None	0.1	None	0.4	None	0.09	None	HQ less than or equal to1
Polychlorinated Biphenyls	Total PCBs	**4**	Note 1	0.3	None	**4**	Note 1	0.3	HQ less than or equal to1	**2**	Note 1	0.5	None	**2**	Note 1	0.5	None	HQ less than or equal to1
Dioxins	2,3,7,8-TCDD	NA	None	NA	None	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	**6**	Note 1	0.6	None	**5**	Note 1	0.5	HQ less than or equal to1	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	None	NA	None	NA	NA	**201**	Note 1	**20**	Note 3	**184**	Note 1	**18**	Note 3	Possible

Table 6-20
Ecological Risk Estimate Summary for 2 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat Depth-Weighted SUF = 1 N O A E L	Note	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat Depth-Weighted SUF = 1 L O A E L	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat Area-Weighted SUF = 1 N O A E L	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat Area-Weighted SUF = 1 L O A E L	HQs based on Selected TRVs (2-foot Scouring) - Merriam's Kangaroo Rat W O E Result [a]
Inorganics	Antimony	0.3	None	0.03	0.3	0.03	HQ less than or equal to1
Inorganics	Arsenic	0.02	None	0.01	0.02	0.01	HQ less than or equal to1
Inorganics	Chromium, hexavalent	0.02	None	0.004	0.009	0.002	HQ less than or equal to1
Inorganics	Chromium, total	**2**	Note 1	0.6	1	0.3	HQ less than or equal to1
Inorganics	Copper	0.1	None	0.08	0.1	0.06	HQ less than or equal to1
Inorganics	Lead	0.04	None	0.02	0.03	0.02	HQ less than or equal to1
Inorganics	Mercury	0.07	None	0.004	0.07	0.004	HQ less than or equal to1
Inorganics	Thallium	0.03	None	0.01	0.03	0.01	HQ less than or equal to1
Inorganics	Zinc	0.08	None	0.02	0.07	0.02	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.00007	None	0.00001	0.00007	0.00001	HQ less than or equal to1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.02	None	0.004	0.01	0.003	HQ less than or equal to1
Polychlorinated Biphenyls	Total PCBs	0.006	None	0.002	0.006	0.002	HQ less than or equal to1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	NA	NA	NA
Dioxins	TEQ Mammals	0.4	None	0.04	0.3	0.03	HQ less than or equal to1

Table 6-20
Ecological Risk Estimate Summary for 2 Foot Scouring Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a.] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-21
Ecological Risk Estimate Summary for 5 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	HQs (5-foot Scouring) - Plants - Depth-Weighted - HQ	Note	HQs (5-foot Scouring) - Plants - Area-Weighted - HQ	HQs (5-foot Scouring) - Plants - WOE Result [a]	HQs (5-foot Scouring) - Soil Invertebrates - Depth-Weighted - HQ	Note	HQs (5-foot Scouring) - Soil Invertebrates - Area-Weighted - HQ	Note	HQs (5-foot Scouring) - Soil Invertebrates - WOE Result [a]	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail - Depth-Weighted - SUF = 0.1 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail - Depth-Weighted - SUF = 0.1 LOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail - Area-Weighted - SUF = 0.1 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail - Area-Weighted - SUF = 0.1 LOAEL	HQs based on Selected TRVs (5-foot Scouring) - Gambel's Quail - WOE Result [a]
Inorganics	Antimony	ND	None	ND	NA	ND	None	ND	None	NA	NA	NA	NA	NA	NA
Inorganics	Arsenic	0.4	None	0.3	HQ less than or equal to 1	0.1	None	0.1	None	HQ less than or equal to 1	0.001	0.0008	0.001	0.0008	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	2	Note 2	1	HQ less than or equal to 1	4	Note 2	3	Note 2	Unlikely	0.0003	0.00003	0.0002	0.00002	HQ less than or equal to 1
Inorganics	Chromium, total	No SL	None	No SL	NA	1	None	1	None	HQ less than or equal to 1	0.01	0.003	0.01	0.002	HQ less than or equal to 1
Inorganics	Copper	0.3	None	0.3	HQ less than or equal to 1	0.2	None	0.2	None	HQ less than or equal to 1	0.006	0.002	0.007	0.002	HQ less than or equal to 1
Inorganics	Lead	0.05	None	0.05	HQ less than or equal to 1	0.003	None	0.004	None	HQ less than or equal to 1	0.003	0.001	0.003	0.001	HQ less than or equal to 1
Inorganics	Mercury	ND	None	ND	NA	ND	None	ND	None	NA	NA	NA	NA	NA	NA
Inorganics	Thallium	ND	None	ND	NA	ND	None	ND	None	NA	NA	NA	NA	NA	NA
Inorganics	Zinc	0.4	None	0.4	HQ less than or equal to 1	0.5	None	0.5	None	HQ less than or equal to 1	0.003	0.001	0.002	0.001	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.005	None	0.005	HQ less than or equal to 1	0.002	None	0.002	None	HQ less than or equal to 1	0.00001	0.000001	0.00001	0.000001	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.04	None	0.03	HQ less than or equal to 1	0.003	None	0.002	None	HQ less than or equal to 1	0.000005	0.0000005	0.000004	0.0000004	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.006	None	0.006	HQ less than or equal to 1	0.2	None	0.2	None	HQ less than or equal to 1	0.001	0.00007	0.001	0.00007	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	ND	None	ND	NA	ND	None	ND	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	NA	NA	None	NA	None	NA	0.004	0.0004	0.002	0.0002	HQ less than or equal to 1
Dioxins	TEQ Mammals	NA	None	NA	NA	NA	None	NA	None	NA	NA	NA	NA	NA	NA

Table 6-21
Ecological Risk Estimate Summary for 5 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Depth-Weighted - SUF = 0.6 N O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Depth-Weighted - SUF = 0.6 L O A E L	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Depth-Weighted - SUF = 0.6 N O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - Depth-Weighted - SUF = 0.6 L O A E L	HQs based on Selected TRVs (5-foot Scouring) - Cactus Wren - W O E Result [a]	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Depth-Weighted - SUF = 1 N O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Depth-Weighted - SUF = 1 L O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Area-Weighted - SUF = 1 N O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - Area-Weighted - SUF = 1 L O A E L	Note	HQs based on Selected TRVs (5-foot Scouring) - Desert Shrew - W O E Result [a]
Inorganics	Antimony	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Inorganics	Arsenic	0.07	None	0.04	0.07	None	0.05	HQ less than or equal to 1	0.1	None	0.08	None	0.1	None	0.08	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.03	None	0.003	0.02	None	0.002	HQ less than or equal to 1	0.01	None	0.003	None	0.009	None	0.002	None	HQ less than or equal to 1
Inorganics	Chromium, total	1	None	0.2	1	None	0.2	HQ less than or equal to 1	**2**	Note 1	0.6	None	**2**	Note 1	0.4	None	HQ less than or equal to 1
Inorganics	Copper	0.3	None	0.1	0.3	None	0.1	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None	0.1	None	HQ less than or equal to 1
Inorganics	Lead	0.3	None	0.1	0.3	None	0.1	HQ less than or equal to 1	0.1	None	0.08	None	0.2	None	0.08	None	HQ less than or equal to 1
Inorganics	Mercury	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Inorganics	Thallium	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Inorganics	Zinc	0.6	None	0.2	0.6	None	0.2	HQ less than or equal to 1	0.9	None	0.2	None	0.9	None	0.2	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0007	None	0.00007	0.0007	None	0.00007	HQ less than or equal to 1	0.0004	None	0.00009	None	0.0004	None	0.00009	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.002	None	0.0002	0.001	None	0.0001	HQ less than or equal to 1	0.04	None	0.009	None	0.03	None	0.007	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.8	None	0.05	0.8	None	0.05	HQ less than or equal to 1	0.3	None	0.09	None	0.3	None	0.09	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	**8**	Note 1	0.8	**4**	Note 1	0.4	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	NA	None	NA	NA	**292**	Note 1	**29**	Note 3	**133**	Note 1	**13**	Note 3	Possible

Table 6-21
Ecological Risk Estimate Summary for 5 Foot Scouring Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

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PG&E Topock Compressor Station
Needles, California

Category	COPEC	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted - SUF = 1 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Depth-Weighted - SUF = 1 LOAEL	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted - SUF = 1 NOAEL	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - Area-Weighted - SUF = 1 LOAEL	HQs based on Selected TRVs (5-foot Scouring) - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Antimony	NA	NA	NA	NA	NA
Inorganics	Arsenic	0.02	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.0009	0.0002	0.0007	0.0002	HQ less than or equal to 1
Inorganics	Chromium, total	0.2	0.05	0.1	0.03	HQ less than or equal to 1
Inorganics	Copper	0.06	0.04	0.06	0.04	HQ less than or equal to 1
Inorganics	Lead	0.01	0.008	0.02	0.008	HQ less than or equal to 1
Inorganics	Mercury	NA	NA	NA	NA	NA
Inorganics	Thallium	NA	NA	NA	NA	NA
Inorganics	Zinc	0.05	0.01	0.05	0.01	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.00008	0.00002	0.00008	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.002	0.0003	0.001	0.0002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.002	0.0005	0.002	0.0005	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	0.5	0.05	0.2	0.02	HQ less than or equal to 1

Table 6-21
Ecological Risk Estimate Summary for 5 Foot Scouring Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 10

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a.] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-22
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	C O P E C	Baseline HQs - Plants - Depth-Weighted HQ	Notes	Baseline HQs - Plants - Area-Weighted HQ	Notes	Baseline HQs - Plants - W O E Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - Area-Weighted HQ	Notes	Baseline HQs - Soil Invertebrates - W O E Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.2 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.2 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.2 N O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.2 L O A E L	Baseline HQs based on Selected TRVs - Gambel's Quail - W O E Result [a]
Inorganics	Arsenic	0.3	None	0.3	None	HQ less than or equal to 1	0.09	None	0.1	None	HQ less than or equal to 1	0.002	0.001	0.002	0.001	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	**2**	Note 2	**2**	Note 2	Unlikely	**2**	Note 2	**5**	Note 2	Unlikely	0.0004	0.00004	0.0007	0.00007	HQ less than or equal to 1
Inorganics	Chromium, total	No SL	None	No SL	None	NA	0.6	None	0.9	None	HQ less than or equal to 1	0.01	0.002	0.02	0.003	HQ less than or equal to 1
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	None	0.2	None	HQ less than or equal to 1	0.01	0.004	0.01	0.003	HQ less than or equal to 1
Inorganics	Lead	0.2	None	0.3	None	HQ less than or equal to 1	0.01	None	0.02	None	HQ less than or equal to 1	0.02	0.008	0.02	0.01	HQ less than or equal to 1
Inorganics	Mercury	0.9	None	0.9	None	HQ less than or equal to 1	**2**	Note 2	**2**	Note 2	Unlikely	0.03	0.007	0.03	0.007	HQ less than or equal to 1
Inorganics	Zinc	1	None	0.7	None	HQ less than or equal to 1	**2**	Note 2	0.9	None	HQ less than or equal to 1	0.01	0.004	0.007	0.003	HQ less than or equal to 1
Inorganics	Methyl acetate	No SL	None	No SL	None	NA	No SL	None	No SL	None	NA	NA	NA	NA	NA	add text
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.04	None	0.01	None	HQ less than or equal to 1	0.01	None	0.004	None	HQ less than or equal to 1	0.00006	0.000006	0.00003	0.000003	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	**4**	Note 2	1	None	HQ less than or equal to 1	0.3	None	0.09	None	HQ less than or equal to 1	0.0008	0.00008	0.0003	0.00003	HQ less than or equal to 1
Pesticides	4,4-DDE	0.007	None	0.007	None	HQ less than or equal to 1	0.6	None	0.6	None	HQ less than or equal to 1	0.00007	0.000007	0.00007	0.000007	HQ less than or equal to 1
Pesticides	Alpha-Chlordane	0.05	None	0.05	None	HQ less than or equal to 1	**3**	Note 2	**3**	Note 2	Unlikely	0.00001	0.000002	0.00001	0.000002	HQ less than or equal to 1
Pesticides	Dieldrin	0.007	None	0.007	None	HQ less than or equal to 1	0.1	None	0.1	None	HQ less than or equal to 1	0.0003	0.000006	0.0003	0.000006	HQ less than or equal to 1
Pesticides	Gamma-Chlordane	0.06	None	0.06	None	HQ less than or equal to 1	**3**	Note 2	**3**	Note 2	Unlikely	0.00001	0.000002	0.00001	0.000002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.01	None	0.006	None	HQ less than or equal to 1	0.4	None	0.2	None	HQ less than or equal to 1	0.004	0.0002	0.002	0.0001	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.0001	None	0.0001	None	HQ less than or equal to 1	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.004	0.0004	0.002	0.0002	HQ less than or equal to 1
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA	NA	NA	NA	NA

Table 6-22
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A O C 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	C O P E C	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Cactus Wren - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Cactus Wren - W O E Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 L O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 N O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 L O A E L	Notes	Baseline HQs based on Selected TRVs - Desert Shrew - W O E Result [a]
Inorganics	Arsenic	0.1	None	0.07	0.1	None	0.07	HQ less than or equal to 1	0.1	None	0.07	None	0.1	None	0.08	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.02	None	0.002	0.05	None	0.005	HQ less than or equal to 1	0.006	None	0.001	None	0.01	None	0.003	None	HQ less than or equal to 1
Inorganics	Chromium, total	0.9	None	0.2	1	None	0.2	HQ less than or equal to 1	0.9	None	0.2	None	1	None	0.3	None	HQ less than or equal to 1
Inorganics	Copper	0.4	None	0.1	0.3	None	0.115	HQ less than or equal to 1	0.2	None	0.09	None	0.1	None	0.09	None	HQ less than or equal to 1
Inorganics	Lead	1	None	0.7	**2**	Note 1	1	HQ less than or equal to 1	0.5	None	0.2	None	0.7	None	0.4	None	HQ less than or equal to 1
Inorganics	Mercury	**3**	Note 1	0.5	**3**	Note 1	0.5	HQ less than or equal to 1	0.4	None	0.03	None	0.4	None	0.03	None	HQ less than or equal to 1
Inorganics	Zinc	1	None	0.5	1	None	0.4	HQ less than or equal to 1	1	None	0.3	None	1	None	0.3	None	HQ less than or equal to 1
Inorganics	Methyl acetate	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.009	None	0.0009	0.003	None	0.0003	HQ less than or equal to 1	0.003	None	0.0007	None	0.001	None	0.0002	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.2	None	0.02	0.08	None	0.008	HQ less than or equal to 1	**4**	Note 1	0.8	None	1	None	0.3	None	HQ less than or equal to 1
Pesticides	4,4-DDE	0.1	None	0.01	0.1	None	0.01	HQ less than or equal to 1	0.2	None	0.04	None	0.2	None	0.04	None	HQ less than or equal to 1
Pesticides	Alpha-Chlordane	0.03	None	0.005	0.03	None	0.005	HQ less than or equal to 1	0.01	None	0.006	None	0.01	None	0.006	None	HQ less than or equal to 1
Pesticides	Dieldrin	0.3	None	0.005	0.3	None	0.005	HQ less than or equal to 1	1	None	0.7	None	1	None	0.7	None	HQ less than or equal to 1
Pesticides	Gamma-Chlordane	0.03	None	0.005	0.03	None	0.005	HQ less than or equal to 1	0.01	None	0.007	None	0.01	None	0.007	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	**3**	Note 1	0.2	1	None	0.08	HQ less than or equal to 1	0.8	None	0.2	None	0.3	None	0.09	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	**6**	Note 1	0.6	**3**	Note 1	0.3	HQ less than or equal to 1	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	NA	None	NA	NA	**247**	Note 1	**25**	Note 3	**90**	Note 1	**9**	Note 2	Unlikely

Table 6-22
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for A 0 C 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent Category	C O P E C	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - W O E Result [a]
Inorganics	Arsenic	0.02	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.001	0.0003	0.001	0.0003	HQ less than or equal to 1
Inorganics	Chromium, total	0.1	0.03	0.1	0.03	HQ less than or equal to 1
Inorganics	Copper	0.05	0.03	0.05	0.03	HQ less than or equal to 1
Inorganics	Lead	0.04	0.02	0.05	0.03	HQ less than or equal to 1
Inorganics	Mercury	0.06	0.004	0.06	0.004	HQ less than or equal to 1
Inorganics	Zinc	0.10	0.02	0.07	0.02	HQ less than or equal to 1
Inorganics	Methyl acetate	0.0000004	0.0000001	0.0000004	0.0000001	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0002	0.00004	0.0001	0.00003	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.1	0.02	0.04	0.008	HQ less than or equal to 1
Pesticides	4,4-DDE	0.001	0.0002	0.001	0.0002	HQ less than or equal to 1
Pesticides	Alpha-Chlordane	0.00005	0.00002	0.00005	0.00002	HQ less than or equal to 1
Pesticides	Dieldrin	0.02	0.008	0.02	0.008	HQ less than or equal to 1
Pesticides	Gamma-Chlordane	0.00005	0.00002	0.00005	0.00002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.003	0.001	0.002	0.0005	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	0.6	0.1	0.3	0.03	HQ less than or equal to 1

Table 6-22
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 11

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
DDE = dichlorodiphenyldichloroethylene
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence.
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-23
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 12

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Baseline HQs - Soil Invertebrates - WOE Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.01 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.01 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - WOE Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.1 LOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - WOE Result [a]
Inorganics	Zinc	0.5	HQ less than or equal to 1	0.6	HQ less than or equal to 1	0.0003	0.0001	HQ less than or equal to 1	0.07	0.03	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.2	HQ less than or equal to 1	0.009	HQ less than or equal to 1	0.000002	0.0000002	HQ less than or equal to 1	0.0005	0.00005	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0008	HQ less than or equal to 1	0.03	HQ less than or equal to 1	0.00001	0.0000009	HQ less than or equal to 1	0.005	0.0004	HQ less than or equal to 1

Table 6-23
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 12

Soil Human Health and Ecological Risk Assessment
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Category	COPEC	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Desert Shrew - WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Zinc	1	0.2	HQ less than or equal to 1	0.06	0.02	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.1	0.03	HQ less than or equal to 1	0.008	0.002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.02	0.006	HQ less than or equal to 1	0.0002	0.00007	HQ less than or equal to 1

Table 6-23
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 12

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Note:
[a.] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using depth-weighted EPCs, and 2.) supporting LOE. Area-weighted EPCs not evaluated for this exposure area.

Abbreviations:
AOC = area of concern
COPEC = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NOAEL = no-observed adverse effect level
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-24
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants Depth-Weighted HQ	Note	Baseline HQs - Plants Area-Weighted HQ	Note	Baseline HQs - Plants WOE Result [a]	Baseline HQs - Soil Invertebrates Depth-Weighted HQ	Note	Baseline HQs - Soil Invertebrates Area-Weighted HQ	Note	Baseline HQs - Soil Invertebrates WOE Result [a]	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.1 LOAEL
Inorganics	Antimony	**4**	Note 2	**4**	Note 2	Unlikely	ND	None	ND	None	NA	NA	NA
Inorganics	Chromium, hexavalent	1	None	**2**	Note 2	Unlikely	1	None	1	None	HQ less than or equal to 1	0.0001	0.00001
Inorganics	Copper	**3**	Note 2	**2**	Note 2	Unlikely	0.2	None	0.1	None	HQ less than or equal to 1	0.01	0.005
Inorganics	Lead	**3**	Note 2	**2**	Note 2	Unlikely	0.006	None	0.01	None	HQ less than or equal to 1	0.02	0.008
Inorganics	Mercury	**340**	Note 4	**340**	Note 4	Unlikely	**4**	Note 2	**4**	Note 2	Unlikely	0.4	0.08
Inorganics	Thallium	**2**	Note 2	**2**	Note 2	Unlikely	ND	None	ND	None	NA	0.00007	0.000007
Semi-Volatile Organic Compounds	4-Methylphenol	0.04	None	0.04	None	HQ less than or equal to 1	**5**	Note 2	**5**	Note 2	Unlikely	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.003	None	0.003	None	HQ less than or equal to 1	0.003	None	0	None	HQ less than or equal to 1	0.0002	0.00002
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.04	None	0.04	None	HQ less than or equal to 1	0.01	None	0	None	HQ less than or equal to 1	0.00003	0.000003
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	**4**	Note 2	1	None	HQ less than or equal to 1	0.2	None	0	None	HQ less than or equal to 1	0.0004	0.00004
Pesticides	4,4-DDT	0.003	None	0.003	None	HQ less than or equal to 1	0.30	None	0	None	HQ less than or equal to 1	0.00002	0.000002
Pesticides	4,4-DDE	0.005	None	0.005	None	HQ less than or equal to 1	0.3	None	0	None	HQ less than or equal to 1	0.00002	0.000002
Polychlorinated Biphenyls	Total PCBs	0.0009	None	0.0009	None	HQ less than or equal to 1	ND	None	ND	None	NA	0.00001	0.0000009
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00002	None	0.00002	None	HQ less than or equal to 1	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA	0.0003	0.00003
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA	NA	NA

Table 6-24
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs Gambel's Quail Area-Weighted SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs Gambel's Quail Area-Weighted SUF = 0.1 LOAEL	Baseline HQs based on Selected TRVs Gambel's Quail WOE Result [a]	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 0.6 NOAEL	Note	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 0.6 LOAEL	Baseline HQs based on Selected TRVs Cactus Wren Area-Weighted SUF = 0.6 NOAEL	Note	Baseline HQs based on Selected TRVs Cactus Wren Area-Weighted SUF = 0.6 LOAEL	Baseline HQs based on Selected TRVs Cactus Wren WOE Result [a]	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 NOAEL	Note
Inorganics	Antimony	NA	NA	NA	NA	None	NA	NA	None	NA	NA	NA	None
Inorganics	Chromium, hexavalent	0.0002	0.00002	HQ less than or equal to 1	0.009	None	0.0009	0.01	None	0.001	HQ less than or equal to 1	0.004	None
Inorganics	Copper	0.01	0.004	HQ less than or equal to 1	0.2	None	0.07	0.2	None	0.06	HQ less than or equal to 1	0.1	None
Inorganics	Lead	0.01	0.006	HQ less than or equal to 1	0.4	None	0.2	0.4	None	0.2	HQ less than or equal to 1	0.2	None
Inorganics	Mercury	0.4	0.08	HQ less than or equal to 1	**2**	None	0.4	**2**	Note 1	0.4	HQ less than or equal to 1	0.6	None
Inorganics	Thallium	0.00007	0.000007	HQ less than or equal to 1	NA	None	NA	NA	None	NA	NA	NA	None
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	NA	NA	None	NA	NA	None	NA	NA	NA	None
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.0002	0.00002	HQ less than or equal to 1	0.1	None	0.01	0.1	None	0.01	HQ less than or equal to 1	0.01	None
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.00003	0.000003	HQ less than or equal to 1	0.006	None	0.0006	0.006	None	0.0006	HQ less than or equal to 1	0.004	None
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.0001	0.00001	HQ less than or equal to 1	0.1	None	0.01	0.03	None	0.003	HQ less than or equal to 1	**4**	Note 1
Pesticides	4,4-DDT	0.00002	0.000002	HQ less than or equal to 1	0.03	None	0.003	0.03	None	0.003	HQ less than or equal to 1	0.07	None
Pesticides	4,4-DDE	0.00002	0.000002	HQ less than or equal to 1	0.03	None	0.003	0.03	None	0.003	HQ less than or equal to 1	0.1	None
Polychlorinated Biphenyls	Total PCBs	0.00001	0.0000009	HQ less than or equal to 1	NA	None	NA	NA	None	NA	NA	NA	None
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	None	NA	NA	None	NA	NA	NA	None
Dioxins	TEQ Avian	0.0001	0.00001	HQ less than or equal to 1	0.08	None	0.008	0.04	None	0.004	HQ less than or equal to 1	NA	None
Dioxins	TEQ Mammals	NA	NA	NA	NA	None	NA	NA	None	NA	NA	**3**	Note 1

Table 6-24
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for A O C 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Desert Shrew Area-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs Desert Shrew Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Desert Shrew W O E Result [a]	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Area-Weighted SUF = 1 N O A E L	Note	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Area-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat W O E Result [a]
Inorganics	Antimony	NA	NA	None	NA	NA	2	Note 1	0.2	2	Note 1	0.2	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.0009	0.004	None	0.001	HQ less than or equal to 1	0.0007	None	0.0002	0	None	0.0002	HQ less than or equal to 1
Inorganics	Copper	0.09	0.1	None	0.08	HQ less than or equal to 1	0.2	None	0.1	0.2	None	0.09	HQ less than or equal to 1
Inorganics	Lead	0.1	0.2	None	0.1	HQ less than or equal to 1	0.3	None	0.1	0.2	None	0.1	HQ less than or equal to 1
Inorganics	Mercury	0.04	0.6	None	0.04	HQ less than or equal to 1	2	Note 1	0.1	2	Note 1	0.1	HQ less than or equal to 1
Inorganics	Thallium	NA	NA	None	NA	NA	0.009	None	0.003	0.009	None	0.003	HQ less than or equal to 1
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	None	NA	NA	NA	None	NA	NA	None	NA	add text
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.001	0.01	None	0.001	HQ less than or equal to 1	0.00007	None	0.000007	0.00007	None	0.000007	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0007	0.004	None	0.0007	HQ less than or equal to 1	0.0002	None	0.00005	0.0002	None	0.00005	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.8	1	None	0.2	HQ less than or equal to 1	0.1	None	0.02	0.03	None	0.006	HQ less than or equal to 1
Pesticides	4,4-DDT	0.01	0.07	None	0.01	HQ less than or equal to 1	0.0006	None	0.0001	0.0006	None	0.0001	HQ less than or equal to 1
Pesticides	4,4-DDE	0.02	0.1	None	0.02	HQ less than or equal to 1	0.0008	None	0.0002	0.0008	None	0.0002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	NA	NA	None	NA	NA	0.0003	None	0.00008	0.0003	None	0.00008	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	None	NA	NA	NA	None	NA	NA	None	NA	NA
Dioxins	TEQ Avian	NA	NA	None	NA	NA	NA	None	NA	NA	None	NA	NA
Dioxins	TEQ Mammals	0.3	2	Note 1	0.2	HQ less than or equal to 1	0.3	None	0.03	0.1	None	0.01	HQ less than or equal to 1

Table 6-24
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 14

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	HQ or LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:

AOC = area of concern
COPEC = constituent of potential ecological concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-25
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Note	Baseline HQs - Plants - Area-Weighted HQ	Note	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates Depth-Weighted HQ	Note	Baseline HQs - Soil Invertebrates Area-Weighted HQ	Note	Baseline HQs - Soil Invertebrates WOE Result [a]
Inorganics	Antimony	0.5	None	0.5	None	HQ less than or equal to 1	ND	None	ND	None	NA
Inorganics	Cadmium	0.07	None	0.07	None	HQ less than or equal to 1	0.02	None	0.02	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	1	None	0.5	None	HQ less than or equal to 1	**3**	Note 2	1	None	HQ less than or equal to 1
Inorganics	Copper	**4**	Note 2	**2**	Note 2	Unlikely	**3**	Note 2	1	None	HQ less than or equal to 1
Inorganics	Lead	**2**	Note 2	1	None	HQ less than or equal to 1	0.1	None	0.07	None	HQ less than or equal to 1
Inorganics	Mercury	0.6	None	0.4	None	HQ less than or equal to 1	**2**	Note 2	1	None	HQ less than or equal to 1
Inorganics	Zinc	**3**	Note 2	1	None	HQ less than or equal to 1	**5**	Note 2	**2**	Note 2	Unlikely
Volatile Organic Compounds	Bromomethane	No SL	None	No SL	None	NA	ND	None	ND	None	NA
Volatile Organic Compounds	Chloro methane	No SL	None	No SL	None	NA	ND	None	ND	None	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.2	None	0.08	None	HQ less than or equal to 1	0.07	None	0.03	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	**19**	Note 3	**4**	Note 2	Unlikely	1	None	0.3	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0006	None	0.0009	None	HQ less than or equal to 1	0.02	None	0.04	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.002	None	0.002	None	HQ less than or equal to 1
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	None	NA	None	NA
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	None	NA	None	NA

Table 6-25
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.1 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.1 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Area-Weighted SUF = 0.1 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail WOE Result [a]	Baseline HQs based on Selected TRVs - Cactus Wren Depth-Weighted SUF = 0.8 NOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren Depth-Weighted SUF = 0.8 LOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren Area-Weighted SUF = 0.8 NOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren Area-Weighted SUF = 0.8 LOAEL	Note	Baseline HQs based on Selected TRVs - Cactus Wren WOE Result [a]
Inorganics	Antimony	NA	NA	NA	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Inorganics	Cadmium	0.003	0.0008	0.003	0.0008	HQ less than or equal to 1	**2**	Note 1	0.4	None	**2**	Note 1	0.4	None	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.0003	0.00003	0.0001	0.00001	HQ less than or equal to 1	0.03	None	0.003	None	0.009	None	0.0009	None	HQ less than or equal to 1
Inorganics	Copper	0.05	0.02	0.02	0.008	HQ less than or equal to 1	**6**	Note 1	**2**	Note 2	**2**	Note 1	0.8	None	HQ less than or equal to 1
Inorganics	Lead	0.07	0.04	0.04	0.02	HQ less than or equal to 1	**8**	Note 1	**4**	Note 2	**5**	Note 1	**2**	Note 2	Unlikely
Inorganics	Mercury	0.02	0.004	0.01	0.003	HQ less than or equal to 1	**2**	Note 1	0.4	None	**2**	Note 1	0.4	None	HQ less than or equal to 1
Inorganics	Zinc	0.01	0.005	0.007	0.003	HQ less than or equal to 1	**2**	Note 1	0.6	None	1	None	0.4	None	HQ less than or equal to 1
Volatile Organic Compounds	Bromomethane	NA	NA	NA	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Volatile Organic Compounds	Chloro methane	NA	NA	NA	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.0001	0.00001	0.00006	0.000006	HQ less than or equal to 1	0.04	None	0.004	None	0.02	None	0.002	None	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.002	0.0002	0.0005	0.00005	HQ less than or equal to 1	0.9	None	0.09	None	0.2	None	0.02	None	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0001	0.000009	0.0002	0.00001	HQ less than or equal to 1	0.05	None	0.003	None	0.07	None	0.005	None	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA	None	NA	None	NA	None	NA	None	NA
Dioxins	TEQ Avian	0.004	0.0004	0.001	0.0001	HQ less than or equal to 1	**8**	Note 1	0.8	None	**2**	Note 1	0.2	None	HQ less than or equal to 1
Dioxins	TEQ Mammals	NA	NA	NA	NA	NA	NA	None	NA	None	NA	None	NA	None	NA

Table 6-25
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs-Desert Shrew - Depth-Weighted SUF = 1 NOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew Depth-Weighted SUF = 1 LOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew Area-Weighted SUF = 1 NOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew - Area-Weighted SUF = 1 LOAEL	Note	Baseline HQs based on Selected TRVs - Desert Shrew WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Area-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Antimony	NA	None	NA	None	NA	None	NA	None	NA	0.2	0.02	0.2	0.02	HQ less than or equal to 1
Inorganics	Cadmium	**4**	Note 1	0.4	None	**4**	None	0.4	None	HQ less than or equal to 1	0.1	0.01	0.1	0.01	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.008	None	0.002	None	0.003	None	0.0007	None	HQ less than or equal to 1	0.0008	0.0002	0.0003	0.00006	HQ less than or equal to 1
Inorganics	Copper	**3**	Note 1	**2**	Note 2	1	None	0.8	None	HQ less than or equal to 1	0.2	0.1	0.1	0.08	HQ less than or equal to 1
Inorganics	Lead	**3**	Note 1	**2**	Note 2	**2**	Note 1	1	None	HQ less than or equal to 1	0.2	0.1	0.1	0.06	HQ less than or equal to 1
Inorganics	Mercury	0.4	None	0.03	None	0.4	None	0.02	None	HQ less than or equal to 1	0.05	0.003	0.04	0.002	HQ less than or equal to 1
Inorganics	Zinc	**2**	Note 1	0.5	None	1	None	0.3	None	HQ less than or equal to 1	0.2	0.05	0.1	0.03	HQ less than or equal to 1
Volatile Organic Compounds	Bromomethane	NA	None	NA	None	NA	None	NA	None	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloro methane	NA	None	NA	None	NA	None	NA	None	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.02	None	0.004	None	0.007	None	0.001	None	HQ less than or equal to 1	0.0005	0.0001	0.0003	0.00006	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	**19**	Note 1	**4**	Note 2	**4**	Note 1	0.8	None	HQ less than or equal to 1	0.5	0.1	0.1	0.02	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.02	None	0.004	None	0.02	None	0.007	None	HQ less than or equal to 1	0.0002	0.00005	0.0003	0.00008	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	None	NA	None	NA	None	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	None	NA	None	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	**147**	Note 1	**15**	Note 3	**36**	Note 1	**4**	Note 2	Unlikely	0.3	0.03	0.08	0.008	HQ less than or equal to 1

Table 6-25
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for AOC 27

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
a W O E Result is risk conclusion based on 1.) HQ/L O A E L HQ using area-weighted EPCs, and 2.) supporting L O E.

Note 1	N O A E L HQ greater than 1
Note 2	HQ or L O A E L HQ greater than 1
Note 3	HQ or L O A E L HQ greater than 10
Note 4	HQ or L O A E L HQ greater than 100

Abbreviations:
A O C = area of concern
C O P E C = constituent of potential ecological concern
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
No SL = no screening level available
P A H = polycyclic aromatic hydrocarbon
PCBs = polychlorinated biphenyls
SUF = site use factor
TEQ = toxic equivalent
W O E = weight of evidence, considering multiple L O E. If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-26
Ecological Risk Estimate Summary for Baseline Scenario
Using Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 28

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs Plants Depth-Weighted HQ	Baseline HQs Plants W O E Result [a]	Baseline HQs Soil Invertebrates Depth-Weighted HQ	Baseline HQs Soil Invertebrates W O E Result [a]	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.01 N O A E L	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.01 L O A E L	Baseline HQs based on Selected TRVs Gambel's Quail W O E Result [a]	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 0.1 N O A E L	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 0.1 L O A E L	Baseline HQs based on Selected TRVs Cactus Wren W O E Result [a]	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Desert Shrew W O E Result [a]	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 N O A E L	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 L O A E L	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat W O E Result [a]
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight [b]	0.0008	HQ less than or equal to 1	0.0003	HQ less than or equal to 1	0.0000006	0.00000006	HQ less than or equal to 1	0.00002	0.000002	HQ less than or equal to 1	0.00007	0.00001	HQ less than or equal to 1	0.00004	0.000007	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight [b]	0.1	HQ less than or equal to 1	0.009	HQ less than or equal to 1	0.000002	0.0000002	HQ less than or equal to 1	0.0008	0.00008	HQ less than or equal to 1	0.1	0.03	HQ less than or equal to 1	0.005	0.001	HQ less than or equal to 1

Notes:
[a] W O E Result is risk conclusion based on 1.) HQ/L O A E L HQ using depth-weighted EPCs, and 2.) supporting L O E. Area-weighted EPCs not evaluated for this exposure area.
[b] Indicator compounds evaluated to estimate TPH risk. Additionally, benzene, ethylbenzene, toluene, and xylenes were not detected at A O C 28.

Abbreviations:
AOC = area of concern
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
N O A E L = no-observed adverse effect level
P A H = polycyclic aromatic hydrocarbon
SUF = site use factor
TPH = total petroleum hydrocarbon
TRV = toxicity reference value
W O E = weight of evidence, considering multiple L O E s. If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-27
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 31

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs - Plants - Depth-Weighted HQ	Baseline HQs - Plants - WOE Result [a]	Baseline HQs - Soil Invertebrates - Depth-Weighted HQ	Baseline HQs - Soil Invertebrates - WOE Result [a]	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.003 NOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - Depth-Weighted SUF = 0.003 LOAEL	Baseline HQs based on Selected TRVs - Gambel's Quail - WOE Result [a]
Inorganics	Copper	0.9	HQ less than or equal to 1	0.8	HQ less than or equal to 1	0.0005	0.0002	HQ less than or equal to 1
Inorganics	Lead	0.2	HQ less than or equal to 1	0.01	HQ less than or equal to 1	0.0003	0.0001	HQ less than or equal to 1
Inorganics	Zinc	0.6	HQ less than or equal to 1	0.8	HQ less than or equal to 1	0.0001	0.00005	HQ less than or equal to 1
Volatile Organic Compounds	Chloroform	No SL	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.01	HQ less than or equal to 1	0.002	HQ less than or equal to 1	0.0000004	0.00000004	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.7	HQ less than or equal to 1	0.05	HQ less than or equal to 1	0.000003	0.0000003	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.002	HQ less than or equal to 1	0.07	HQ less than or equal to 1	0.00001	0.000001	HQ less than or equal to 1

Table 6-27
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 31

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.02 NOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - Depth-Weighted SUF = 0.02 LOAEL	Baseline HQs based on Selected TRVs - Cactus Wren - WOE Result [a]	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 NOAEL	Baseline HQs based on Selected TRVs - Desert Shrew - Depth-Weighted SUF = 1 LOAEL	Baseline HQs based on Selected TRVs - Desert Shrew - WOE Result [a]	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 0.9 NOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - Depth-Weighted SUF = 0.9 LOAEL	Baseline HQs based on Selected TRVs - Merriam's Kangaroo Rat - WOE Result [a]
Inorganics	Copper	0.04	0.01	HQ less than or equal to 1	0.7	0.4	HQ less than or equal to 1	0.09	0.05	HQ less than or equal to 1
Inorganics	Lead	0.03	0.01	HQ less than or equal to 1	0.4	0.2	HQ less than or equal to 1	0.03	0.01	HQ less than or equal to 1
Inorganics	Zinc	0.03	0.01	HQ less than or equal to 1	1	0.3	HQ less than or equal to 1	0.06	0.01	HQ less than or equal to 1
Volatile Organic Compounds	Chloroform	NA	NA	NA	NA	NA	NA	0.000001	0.0000005	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.00003	0.000003	HQ less than or equal to 1	0.001	0.0001	HQ less than or equal to 1	0.0001	0.00002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.001	0.0001	HQ less than or equal to 1	0.7	0.1	HQ less than or equal to 1	0.02	0.004	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.01	0.0004	HQ less than or equal to 1	0.06	0.02	HQ less than or equal to 1	0.0004	0.0001	HQ less than or equal to 1

Table 6-27
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for AOC 31

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a] W O E Result is risk conclusion based on 1.) HQ/L O A E L HQ using depth-weighted EPCs, and 2.) supporting L O E. Area-weighted EPCs not evaluated for this exposure area.

Abbreviations:
A O C = area of concern
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
PAH = polycyclic aromatic hydrocarbon
PCBs = polychlorinated biphenyls
W O E = weight of evidence, considering multiple L O Es. If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-28
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for UA-2

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs [a] Plants Depth-Weighted HQ	Note	Baseline HQs[a] Plants W O E Result [b]	Baseline HQs [a] Soil Invertebrates Depth-Weighted HQ	Note	Baseline Hqs[a] Soil Invertebrates W O E Result [b]	Baseline HQs based on Selected TRVsa Gambel's Quail Depth-Weighted SUF = 0.003 N O A E L	Baseline HQs based on Selected TRVsa Gambel's Quail Depth-Weighted SUF = 0.003 L O A E L	Baseline HQs based on Selected TRVs[a] Gambel's Quail W O E Result[b]
Inorganics	Arsenic	1	None	HQ less than or equal to 1	0.2	None	HQ less than or equal to 1	0.0001	0.00006	HQ less than or equal to 1
Inorganics	Barium	0.8	None	HQ less than or equal to 1	0.9	None	HQ less than or equal to 1	NA	NA	NA
Inorganics	Lead	0.1	None	HQ less than or equal 1	0.008	None	HQ less than or equal to 1	0.0002	0.00008	HQ less than or equal to 1
Inorganics	Manganese	**4**	Note 2	Unlikely	**2**	Note 2	Unlikely	0.00009	0.00004	HQ less than or equal to 1
Inorganics	Zinc	0.4	None	HQ less than or equal to 1	0.5	None	HQ less than or equal to 1	0.00008	0.00003	HQ less than or equal to 1
Semi-Volatile Organic Compounds	4-Methylphenol	0.03	None	HQ less than or equal to 1	ND	None	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.004	None	HQ less than or equal to 1	ND	None	NA	NA	NA	NA

Table 6-28
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for UA-2

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs[a] Cactus Wren Depth-Weighted SUF = 0.02 NOAEL	Baseline HQs based on Selected TRVs[a] Cactus Wren Depth-Weighted SUF = 0.02 LOAEL	Baseline HQs based on Selected TRVs[a] Cactus Wren WOE Result[b]	Baseline HQs based on Selected TRVs[a] Desert Shrew Depth-Weighted SUF = 0.96 NOAEL	Baseline HQs based on Selected TRVs[a] Desert Shrew Depth-Weighted SUF = 0.96 LOAEL	Baseline HQs based on Selected TRVs[a] Desert Shrew Depth-Weighted WOE Result[b]	Baseline HQs based on Selected TRVs[a] Merriam's Kangaroo Rat Depth-Weighted SUF = 0.7 NOAEL	Baseline HQs based on Selected TRVs[a] Merriam's Kangaroo Rat Depth-Weighted SUF = 0.7 LOAEL	Baseline HQs based on Selected TRVs[a] Merriam's Kangaroo Rat WOE Result[b]
Inorganics	Arsenic	0.005	0.003	HQ less than or equal to 1	0.2	0.1	HQ less than or equal to 1	0.05	0.03	HQ less than or equal to 1
Inorganics	Barium	NA	NA	NA	0.1	0.08	HQ less than or equal to 1	0.08	0.05	HQ less than or equal to 1
Inorganics	Lead	0.02	0.008	HQ less than or equal to 1	0.3	0.1	HQ less than or equal to 1	0.02	0.01	HQ less than or equal to 1
Inorganics	Manganese	0.002	0.001	HQ less than or equal to 1	0.2	0.08	HQ less than or equal to 1	0.1	0.04	HQ less than or equal to 1
Inorganics	Zinc	0.02	0.007	HQ less than or equal to 1	0.9	0.2	HQ less than or equal to 1	0.04	0.01	HQ less than or equal to 1
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	NA	NA	NA	NA	NA	NA	0.00006	0.000006	HQ less than or equal to 1

Table 6-28
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for UA-2

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a] For UA-2, due to the small dataset (i.e., sample size of 2 or 5), area-weighted HQs are not estimated.
[b] W O E Result is risk conclusion based on 1.) HQ/L O A E L HQ using depth-weighted EPCs, and 2.) supporting L O E.

Note 1	N O A E L HQ greater than 1
Note 2	HQ or L O A E L HQ greater than 1
Note 3	HQ or L O A E L HQ greater than 10
Note 4	HQ or L O A E L HQ greater than 100

Abbreviations:
A O C = area of concern
C O P E C = constituent of potential ecological concern
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
UA-2 = Undesignated Area-2
W O E = weight of evidence, considering multiple L O Es. If HQs/L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-29
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	Baseline HQs Plants Depth-Weighted-HQ	Note	Baseline HQs Plants Area-Weighted - HQ	Note	Baseline HQs Plants W O E Result [a]	Baseline HQs Soil Inverebrates Depth-Weighted HQ	Baseline HQs Soil Invertebrates Area-Weighted HQ	Baseline HQs Soil Invertebrates W O E Result [a]	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.1 - N O A E L	Baseline HQs based on Selected TRVs Gambel's Quail Depth-Weighted SUF = 0.1 - L O A E L	Baseline HQs based on Selected TRVs Gambel's Quail Area-Weighted SUF = 0.1 - N O A E L	Baseline HQs based on Selected TRVs Gambel's Quail Area-Weighted SUF = 0.1 - L O A E L	Baseline HQs based on Selected TRVs Gambel's Quail W O E Result [a]
Inorganics	Chromium, hexavalent	0.6	None	0.4	None	HQ less than or equal to 1	1	1	HQ less than or equal to 1	0.0002	0.00002	0.0001	0.00001	HQ less than or equal to 1
Inorganics	Chromium, total	No SL	None	No SL	None	--	0.7	0.6	HQ less than or equal to 1	0.01	0.002	0.01	0.002	HQ less than or equal to 1
Inorganics	Copper	0.2	None	0.2	None	HQ less than or equal to 1	0.2	0.2	HQ less than or equal to 1	0.01	0.003	0.01	0.003	HQ less than or equal to 1
Inorganics	Lead	0.09	None	0.09	None	HQ less than or equal to 1	0.007	0.006	HQ less than or equal to 1	0.007	0.004	0.007	0.004	HQ less than or equal to 1
Inorganics	Manganese	**2**	Note 2	**2**	Note 2	Unlikely	0.9	0.9	HQ less than or equal to 1	0.002	0.001	0.002	0.001	HQ less than or equal to 1
Inorganics	Zinc	0.4	None	0.4	None	HQ less than or equal to 1	0.5	0.5	HQ less than or equal to 1	0.004	0.002	0.004	0.002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.009	None	0.009	None	HQ less than or equal to 1	0.06	0.06	HQ less than or equal to 1	0.0006	0.00004	0.0006	0.00004	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	No SL	None	No SL	None	NA	0.00006	0.00006	HQ less than or equal to 1	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	None	NA	None	NA	NA	NA	NA	0.002	0.0002	0.002	0.0002	HQ less than or equal to 1
Dioxins	TEQ Mammals	NA	None	NA	None	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 6-29
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted and Area-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 1 - NOAEL	Note	Baseline HQs based on Selected TRVs Cactus Wren Depth-Weighted SUF = 1 - LOAEL	Baseline HQs based on Selected TRVs Cactus Wren Area-Weighted SUF = 1 - NOAEL	Note	Baseline HQs based on Selected TRVs Cactus Wren Area-Weighted SUF = 1 - LOAEL	Baseline HQs based on Selected TRVs Cactus Wren WOE Result [a]	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 - NOAEL	Note	Baseline HQs based on Selected TRVs Desert Shrew Depth-Weighted SUF = 1 - LOAEL	Note	Baseline HQs based on Selected TRVs Desert Shrew Area-Weighted SUF = 1 - NOAEL	Note	Baseline HQs based on Selected TRVs Desert Shrew Area-Weighted SUF = 1 - LOAEL	Note
Inorganics	Chromium, hexavalent	0.01	None	0.001	0.01	None	0.001	HQ less than or equal to 1	0.003	None	0.0008	None	0.003	None	0.0007	None
Inorganics	Chromium, total	1	None	0.2	1	None	0.2	HQ less than or equal to 1	1.05	None	0.26	None	1.00	None	0.2	None
Inorganics	Copper	0.4	None	0.1	0.4	None	0.1	HQ less than or equal to 1	0.2	None	0.1	None	0.2	None	0.1	None
Inorganics	Lead	0.8	None	0.4	0.7	None	0.4	HQ less than or equal to 1	0.3	None	0.1	None	0.3	None	0.1	None
Inorganics	Manganese	0.07	None	0.03	0.07	None	0.03	HQ less than or equal to 1	0.1	None	0.05	None	0.1	None	0.05	None
Inorganics	Zinc	0.9	None	0.4	0.9	None	0.4	HQ less than or equal to 1	0.9	None	0.2	None	0.9	None	0.2	None
Polychlorinated Biphenyls	Total PCBs	0.2	None	0.01	0.2	None	0.01	HQ less than or equal to 1	0.05	None	0.01	None	0.05	None	0.01	None
Dioxins	2,3,7,8-TCDD	NA	None	NA	NA	None	NA	NA	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Avian	**3.54**	Note 1	0.4	**2.65**	Note 1	0.3	Unlikely	NA	None	NA	None	NA	None	NA	None
Dioxins	TEQ Mammals	NA	None	NA	NA	None	NA	NA	**98.84**	Note 1	**9.88**	Note 2	**72.01**	Note 1	**7.20**	Note 2

Table 6-29
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Baseline HQs based on Selected TRVs Desert Shrew WOE Result [a]	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 - NOAEL	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Depth-Weighted SUF = 1 - LOAEL	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Area-Weighted SUF = 1 - NOAEL	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat Area-Weighted SUF = 1 - LOAEL	Baseline HQs based on Selected TRVs Merriam's Kangaroo Rat WOE Result [a]
Inorganics	Chromium, hexavalent	HQ less than or equal to 1	0.0003	0.00008	0.0002	0.00006	HQ less than or equal to 1
Inorganics	Chromium, total	HQ less than or equal to 1	0.08	0.02	0.08	0.02	HQ less than or equal to 1
Inorganics	Copper	HQ less than or equal to 1	0.06	0.03	0.06	0.03	HQ less than or equal to 1
Inorganics	Lead	HQ less than or equal to 1	0.02	0.01	0.02	0.01	HQ less than or equal to 1
Inorganics	Manganese	HQ less than or equal to 1	0.07	0.02	0.07	0.02	HQ less than or equal to 1
Inorganics	Zinc	HQ less than or equal to 1	0.05	0.01	0.05	0.01	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	HQ less than or equal to 1	0.003	0.0008	0.003	0.0008	HQ less than or equal to 1
Dioxins	2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Avian	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	Unlikely	0.2	0.02	0.1	0.01	HQ less than or equal to 1

Table 6-29
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted and Area-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for Tamarisk Thicket

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:

[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using area-weighted EPCs, and 2.) supporting LOE.

Note 1	NOAEL HQ greater than 1
Note 2	LOAEL HQ greater than 1
Note 3	HQ or LOAEL HQ greater than 10
Note 4	HQ or LOAEL HQ greater than 100

Abbreviations:

COPEC = constituent of potential ecological concern
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
NOAEL = no-observed adverse effect level
No SL = no screening level available
PCB = polychlorinated biphenyl
SUF = site use factor
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-30
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for OCS

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	HQs based on Selected TRVs Red-Tailed Hawk Depth-Weighted SUF = 0.02 - NOAEL	HQs based on Selected TRVs Red-Tailed Hawk Depth-Weighted SUF = 0.02 - LOAEL	HQs based on Selected TRVs Red-Tailed Hawk WOE Result [a]	HQs based on Selected TRVs Desert Kit Fox Depth-Weighted SUF = 0.01 - NOAEL	HQs based on Selected TRVs Desert Kit Fox Depth-Weighted SUF = 0.01 - LOAEL	HQs based on Selected TRVs Desert Kit Fox - WOE Result [a]	HQs based on Selected TRVs Nelson's Desert Bighorn Sheep Depth-Weighted SUF = 0.03 - NOAEL	HQs based on Selected TRVs Nelson's Desert Bighorn Sheep Depth-Weighted SUF = 0.03 - LOAEL	HQs based on Selected TRVs Nelson's Desert Bighorn Sheep WOE Result [a]
Inorganics	Antimony	NA	NA	NA	0.0007	0.00007	HQ less than or equal to 1	0.004	0.0004	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.002	0.0002	HQ less than or equal to 1	0.0002	0.00005	HQ less than or equal to 1	0.0005	0.0001	HQ less than or equal to 1
Inorganics	Chromium, total	0.005	0.0008	HQ less than or equal to 1	0.003	0.0006	HQ 15:27 1	0.01	0.003	HQ less than or equal to 1
Inorganics	Copper	0.004	0.001	HQ less than or equal to 1	0.001	0.0007	HQ less than or equal to 1	0.002	0.001	HQ less than or equal to 1
Inorganics	Cyanide	0.00009	0.000009	HQ less than or equal to 1	0.0000006	0.0000002	HQ less than or equal to 1	0.000008	0.000003	HQ less than or equal to 1
Inorganics	Lead	0.004	0.002	HQ less than or equal to 1	0.0006	0.0003	HQ less than or equal to 1	0.002	0.0009	HQ less than or equal to 1
Inorganics	Mercury	0.003	0.0007	HQ less than or equal to 1	0.0002	0.00001	HQ less than or equal to 1	0.002	0.0001	HQ less than or equal to 1
Inorganics	Thallium	0.001	0.0001	HQ less than or equal to 1	0.0003	0.0001	HQ less than or equal to 1	0.0009	0.0003	HQ less than or equal to 1
Inorganics	Zinc	0.002	0.0008	HQ less than or equal to 1	0.0007	0.0002	HQ less than or equal to 1	0.0005	0.0001	HQ less than or equal to 1
Volatile Organic Compounds	Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloro methane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloroform	NA	NA	NA	0.000000009	0.000000003	HQ less than or equal to 1	0.0000001	0.00000005	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	0.000000002	0.0000000006	HQ less than or equal to 1	0.00000003	0.000000008	HQ less than or equal to 1
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.00003	0.000003	HQ less than or equal to 1	0.000001	0.0000001	HQ less than or equal to 1	0.00002	0.000002	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Isophorone	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.0000001	0.00000001	HQ less than or equal to 1	0.00000003	0.000000006	HQ less than or equal to 1	0.000001	0.0000002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.000004	0.0000004	HQ less than or equal to 1	0.00005	0.000009	HQ less than or equal to 1	0.0007	0.0001	HQ less than or equal to 1
Pesticides	4,4-DDT	0.002	0.0002	HQ less than or equal to 1	0.001	0.0002	HQ less than or equal to 1	0.000008	0.000002	HQ less than or equal to 1
Pesticides	4,4-DDE	0.06	0.006	HQ less than or equal to 1	0.03	0.006	HQ less than or equal to 1	0.00002	0.000003	HQ less than or equal to 1
Pesticides	Alpha-Chlordane	0.0002	0.00004	HQ less than or equal to 1	0.00003	0.00002	HQ less than or equal to 1	0.0000008	0.0000004	HQ less than or equal to 1
Pesticides	Dieldrin	0.002	0.00004	HQ less than or equal to 1	0.004	0.002	HQ less than or equal to 1	0.0002	0.00009	HQ less than or equal to 1
Pesticides	Gamma-Chlordane	0.0002	0.00004	HQ less than or equal to 1	0.00004	0.00002	HQ less than or equal to 1	0.0000009	0.0000005	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0006	0.00005	HQ less than or equal to 1	0.00007	0.00002	HQ less than or equal to 1	0.0003	0.00008	HQ less than or equal to 1
Dioxins	TEQ Avian	0.005	0.0005	HQ less than or equal to 1	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	NA	NA	NA	0.04	0.004	HQ less than or equal to 1	0.02	0.002	HQ less than or equal to 1

Table 6-30
Ecological Risk Estimate Summary for Baseline Scenario Using
Depth-Weighted Exposure Point Concentrations
(Wildlife Species-Specific SUF, Selected TRVs) for OCS

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Note:
[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using depth-weighted EPCs, and 2.) supporting LOE. Area-weighted EPCs were not evaluated for this exposure area.

Abbreviations:
COPEC = constituent of potential ecological concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
NOAEL = no-observed adverse effect level
OCS = outside the compressor station
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If HQs/LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-31
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW and AOC4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 NOAEL	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 LOAEL	HQs based on Selected TRVs - Red-Tailed Hawk - WOE Result [a]	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 NOAEL	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 LOAEL	HQs based on Selected TRVs - Desert Kit Fox - WOE Result [a]	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.02 NOAEL	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.02 LOAEL	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - WOE Result [a]
Inorganics	Antimony	NA	NA	NA	0.0005	0.00005	HQ less than or equal to 1	0.003	0.0003	HQ less than or equal to 1
Inorganics	Barium	NA	NA	NA	0.00003	0.00002	HQ less than or equal to 1	0.0004	0.0003	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.0001	0.00001	HQ less than or equal to 1	0.00001	0.000003	HQ less than or equal to 1	0.00003	0.000007	HQ less than or equal to 1
Inorganics	Chromium, total	0.003	0.0005	HQ less than or equal to 1	0.0017	0.0004	HQ less than or equal to 1	0.008	0.002	HQ less than or equal to 1
Inorganics	Cobalt	0.00003	0.00001	HQ less than or equal to 1	0.0000	0.000006	HQ less than or equal to 1	0.00008	0.00003	HQ less than or equal to 1
Inorganics	Copper	0.002	0.0007	HQ less than or equal to 1	0.0006	0.0003	HQ less than or equal to 1	0.0007	0.0004	HQ less than or equal to 1
Inorganics	Lead	0.001	0.0007	HQ less than or equal to 1	0.0002	0.0001	HQ less than or equal to 1	0.0003	0.0002	HQ less than or equal to 1
Inorganics	Mercury	0.0002	0.00005	HQ less than or equal to 1	0.00001	0.0000009	HQ less than or equal to 1	0.0001	0.000008	HQ less than or equal to 1
Inorganics	Nickel	0.0003	0.0001	HQ less than or equal to 1	0.0005	0.0003	HQ less than or equal to 1	0.002	0.0008	HQ less than or equal to 1
Inorganics	Thallium	0.0006	0.00006	HQ less than or equal to 1	0.0002	0.00006	HQ less than or equal to 1	0.0005	0.0002	HQ less than or equal to 1
Inorganics	Vanadium	0.002	0.001	HQ less than or equal to 1	0.00009	0.00004	HQ less than or equal to 1	0.001	0.0005	HQ less than or equal to 1
Inorganics	Zinc	0.001	0.0004	HQ less than or equal to 1	0.0003	0.00008	HQ less than or equal to 1	0.0002	0.00005	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	0.0000000009	0.0000000002	HQ less than or equal to 1	0.00000001	0.000000003	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.00002	0.000002	HQ less than or equal to 1	0.0000007	0.00000007	HQ less than or equal to 1	0.00001	0.000001	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH Low molecular weight	0.00000004	0.000000004	HQ less than or equal to 1	0.000000009	0.000000002	HQ less than or equal to 1	0.0000004	0.00000008	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	PAH High molecular weight	0.000001	0.0000001	HQ less than or equal to 1	0.00001	0.000003	HQ less than or equal to 1	0.0002	0.00004	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0006	0.00004	HQ less than or equal to 1	0.00006	0.00002	HQ less than or equal to 1	0.0002	0.00006	HQ less than or equal to 1
Dioxins	TEQ Avian	0.002	0.0002	HQ less than or equal to 1	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	NA	NA	NA	0.02	0.002	HQ less than or equal to 1	0.009	0.0009	HQ less than or equal to 1

Table 6-31
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for BCW and AOC4

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
[a] W O E Result is risk conclusion based on 1.) HQ/L O A E L HQ using depth-weighted EPCs, and 2.) supporting L O E. Area-weighted EPCs were not evaluated for this exposure area.

Abbreviations:
A O C = area of concern
BCW = Bat Cave Wash
HQ = hazard quotient
L O E = line of evidence
L O A E L = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
N O A E L = no-observed adverse effect level
P A H = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TEQ = toxic equivalent
W O E = weight of evidence, considering multiple L O E s. If L O A E L HQs are greater than 1, W O E Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-32
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for the OCS (Excluding BCW and A O C 4)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 N O A E L	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 L O A E L	HQs based on Selected TRVs - Red-Tailed Hawk - W O E Result [a]	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 N O A E L	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 L O A E L	HQs based on Selected TRVs - Desert Kit Fox - W O E Result [a]	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.01 N O A E L	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.01 L O A E L	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - W O E Result [a]
Inorganics	Antimony	NA	NA	NA	0.004	0.0004	HQ less than or equal to 1	0.02	0.002	HQ less than or equal to 1
Inorganics	Chromium, hexavalent	0.001	0.0001	HQ less than or equal to 1	0.0002	0.00004	HQ less than or equal to 1	0.0005	0.0001	HQ less than or equal to 1
Inorganics	Chromium, total	0.002	0.0004	HQ less than or equal to 1	0.001	0.0003	HQ less than or equal to 1	0.006	0.001	HQ less than or equal to 1
Inorganics	Copper	0.002	0.001	HQ less than or equal to 1	0.0007	0.0004	HQ less than or equal to 1	0.002	0.0009	HQ less than or equal to 1
Inorganics	Cyanide	0.00004	0.000004	HQ less than or equal to 1	0.0000003	0.0000001	HQ less than or equal to 1	0.000004	0.000001	HQ less than or equal to 1
Inorganics	Lead	0.002	0.001	HQ less than or equal to 1	0.0004	0.0002	HQ less than or equal to 1	0.001	0.0007	HQ less than or equal to 1
Inorganics	Mercury	0.003	0.0007	HQ less than or equal to 1	0.0002	0.00002	HQ less than or equal to 1	0.002	0.0001	HQ less than or equal to 1
Inorganics	Thallium	NA	NA	NA	0.00001	0.000003	HQ less than or equal to 1	0.0001	0.00004	HQ less than or equal to 1
Inorganics	Zinc	0.001	0.0004	HQ less than or equal to 1	0.0003	0.00008	HQ less than or equal to 1	0.0003	0.00008	HQ less than or equal to 1
Volatile Organic Compounds	Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloro methane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds	Chloroform	NA	NA	NA	0.000000004	0.000000002	HQ less than or equal to 1	0.00000006	0.00000002	HQ less than or equal to 1
Volatile Organic Compounds	Methyl acetate	NA	NA	NA	0.000000001	0.0000000003	HQ less than or equal to 1	0.00000002	0.000000004	HQ less than or equal to 1
Semi-Volatile Organic Compounds	4-Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semi-Volatile Organic Compounds	Bis (2-ethylhexyl) phthalate	0.000005	0.0000005	HQ less than or equal to 1	0.0000002	0.00000002	HQ less than or equal to 1	0.000004	0.0000004	HQ less than or equal to 1
Semi-Volatile Organic Compounds	Isophorone	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons	P A H Low molecular weight	0.0000001	0.00000001	HQ less than or equal to 1	0.00000003	0.000000006	HQ less than or equal to 1	0.0000008	0.0000002	HQ less than or equal to 1
Polycyclic Aromatic Hydrocarbons	P A H High molecular weight	0.000003	0.0000003	HQ less than or equal to 1	0.00004	0.000008	HQ less than or equal to 1	0.0006	0.0001	HQ less than or equal to 1
Pesticides	4,4-DDT	0.001	0.0001	HQ less than or equal to 1	0.001	0.0001	HQ less than or equal to 1	0.000004	0.0000008	HQ less than or equal to 1
Pesticides	4,4-DDE	0.03	0.003	HQ less than or equal to 1	0.01	0.003	HQ less than or equal to 1	0.000007	0.000001	HQ less than or equal to 1
Pesticides	Alpha-Chlordane	0.0001	0.00002	HQ less than or equal to 1	0.00002	0.000008	HQ less than or equal to 1	0.0000004	0.0000002	HQ less than or equal to 1
Pesticides	Dieldrin	0.001	0.00002	HQ less than or equal to 1	0.002	0.0008	HQ less than or equal to 1	0.00009	0.00004	HQ less than or equal to 1
Pesticides	Gamma-Chlordane	0.0001	0.00002	HQ less than or equal to 1	0.00002	0.00001	HQ less than or equal to 1	0.0000004	0.0000002	HQ less than or equal to 1
Polychlorinated Biphenyls	Total PCBs	0.0002	0.00001	HQ less than or equal to 1	0.00002	0.00001	HQ less than or equal to 1	0.0001	0.00003	HQ less than or equal to 1

Table 6-32
Ecological Risk Estimate Summary for Baseline Scenario Using Depth-Weighted Exposure Point Concentrations (Wildlife Species-Specific SUF, Selected TRVs) for the OCS (Excluding BCW and AOC 4)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 NOAEL	HQs based on Selected TRVs - Red-Tailed Hawk - Depth-Weighted SUF = 0.01 LOAEL	HQs based on Selected TRVs - Red-Tailed Hawk - WOE Result [a]	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 NOAEL	HQs based on Selected TRVs - Desert Kit Fox - Depth-Weighted SUF = 0.01 LOAEL	HQs based on Selected TRVs - Desert Kit Fox - WOE Result [a]	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.01 NOAEL	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - Depth-Weighted SUF = 0.01 LOAEL	HQs based on Selected TRVs - Nelson's Desert Bighorn Sheep - WOE Result [a]
Dioxins	TEQ Avian	0.01	0.001	HQ less than or equal to 1	NA	NA	NA	NA	NA	NA
Dioxins	TEQ Mammals	NA	NA	NA	0.07	0.007	HQ less than or equal to 1	0.03	0.003	HQ less than or equal to 1

Notes:
[a] WOE Result is risk conclusion based on 1.) HQ/LOAEL HQ using depth-weighted EPCs, and 2.) supporting LOE. Area-weighted EPCs were not evaluated for this exposure area.

Abbreviations:
AOC = area of concern
BCW = Bat Cave Wash
COPEC = constituent of potential ecological concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HQ = hazard quotient
LOE = line of evidence
LOAEL = lowest observed adverse effect level
NA = no toxicity value available, HQs could not be estimated
ND = not detected
NOAEL = no-observed adverse effect level
No SL = no screening level available
OCS = outside the compressor station
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SUF = site use factor
TEQ = toxic equivalent
TRV = toxicity reference value
WOE = weight of evidence, considering multiple LOEs. If LOAEL HQs are greater than 1, WOE Result is either 1) not expected, 2) unlikely, or 3) possible.

Table 6-33
Comparison of Tissue Exposure Point Concentrations for Dioxin TEQ in the Baseline (No Scouring) Scenario
Bat Cave Wash (0 to 0.5 foot bgs)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Approach	Constituent	Units	Soil EPCs [a] - 95% UCL	Soil EPCs [a] - 95% UCL Method	BAFs - Plants	BAFs - Terrestrial Invertebrates	Tissue EPCs - Plants	Tissue EPCs - Terrestrial Invertebrates	TEFs [b] - Mammal	TEFs [b] - Avian	Tissue EPCs (Mammal TEF Applied) - Plants	Tissue EPCs (Mammal TEF Applied) - Terrestrial Invertebrates	Tissue EPCs (Avian TEF Applied) - Plants	Tissue EPCs (Avian TEF Applied) - Terrestrial Invertebrates
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,6,7,8-hpcdd	ng/kg	7414	KM H-UCL	0.00029	0.081	2.15	601	0.01	0.001	0.022	6.01	0.00	0.60
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,6,7,8-hpcdf	ng/kg	1417	KM H-UCL	0.000062	0.017	0.088	24	0.01	0.01	0.00088	0.24	0.00	0.24
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8,9-hpcdf	ng/kg	7.876	95% KM Approximate Gamma UCL	0.0022	0.62	0.017	4.88	0.01	0.01	0.00017	0.049	0.00017	0.049
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8-hxcdd	ng/kg	37.15	KM H-UCL	0.0017	0.49	0.063	18	0.1	0.05	0.0063	1.8	0.0032	0.91
Congener-Specific Approach (U S E P A 1999)	1,2,3,4,7,8-hxcdf	ng/kg	12.64	95% KM Approximate Gamma UCL	0.00043	0.121	0.005	1.53	0.1	0.1	0.00054	0.15	0.00054	0.15
Congener-Specific Approach (U S E P A 1999)	1,2,3,6,7,8-hxcdd	ng/kg	702	KM H-UCL	0.00067	0.19	0.470	133	0.1	0.01	0.047	13	0.0047	1.3
Congener-Specific Approach (U S E P A 1999)	1,2,3,6,7,8-hxcdf	ng/kg	19.97	KM H-UCL	0.0011	0.3	0.022	5.99	0.1	0.1	0.0022	0.60	0.0022	0.60
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8,9-hxcdd	ng/kg	258.1	KM H-UCL	0.00078	0.22	0.201	57	0.1	0.1	0.020	5.7	0.020	5.7
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8,9-hxcdf	ng/kg	0.935	95% KM (t) UCL	0.0035	1	0.003	0.94	0.1	0.1	0.00033	0.094	0.00033	0.094
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8-pecdd	ng/kg	9.44	KM H-UCL	0.0052	1.46	0.049	14	1	1	0.049	14	0.049	14
Congener-Specific Approach (U S E P A 1999)	1,2,3,7,8-pecdf	ng/kg	1.233	95% KM (t) UCL	0.0011	0.32	0.001	0.39	0.03	0.1	0.000041	0.012	0.00014	0.039
Congener-Specific Approach (U S E P A 1999)	2,3,4,6,7,8-hxcdf	ng/kg	5.219	95% KM (t) UCL	0.0038	1.07	0.020	5.58	0.1	0.1	0.0020	0.56	0.0020	0.56
Congener-Specific Approach (U S E P A 1999)	2,3,4,7,8-pecdf	ng/kg	131.7	95% KM (Chebyshev) UCL	0.009	2.54	1.19	335	0.3	1	0.36	100	1.2	335
Congener-Specific Approach (U S E P A 1999)	2,3,7,8-tcdd	ng/kg	6.176	95% KM Approximate Gamma UCL	0.0056	1.59	0.035	9.82	1	1	0.035	9.8	0.035	9.8
Congener-Specific Approach (U S E P A 1999)	2,3,7,8-tcdf	ng/kg	2.106	KM H-UCL	0.0045	1.27	0.009	2.67462	0.1	1	0.00095	0.27	0.0095	2.7

Table 6-33
Comparison of Tissue Exposure Point Concentrations for Dioxin TEQ in the Baseline (No Scouring) Scenario
Bat Cave Wash (0 to 0.5 foot bgs)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Approach	Constituent	Units	Soil EPCs [a] - 95% UCL	Soil EPCs [a] - 95% UCL Method	BAFs - Plants	BAFs - Terrestrial Invertebrates	Tissue EPCs - Plants	Tissue EPCs - Terrestrial Invertebrates	TEFs [b] - Mammal	TEFs [b] - Avian	Tissue EPCs (Mammal TEF Applied) - Plants	Tissue EPCs (Mammal TEF Applied) - Terrestrial Invertebrates	Tissue EPCs (Avian TEF Applied) - Plants	Tissue EPCs (Avian TEF Applied) - Terrestrial Invertebrates
Congener-Specific Approach (U S E P A 1999)	ocdd	ng/kg	68608	95% H-UCL	0.000067	0.019	4.60	1304	0.0003	0.0001	0.0014	0.39	0.00046	0.13
Congener-Specific Approach (U S E P A 1999)	ocdf	ng/kg	13371	95% KM (Chebyshev) UCL	0.00009	0.025	1.20	334	0.0003	0.0001	0.00036	0.10	0.00012	0.033
Congener-Specific Approach (U S E P A 1999)	Dioxin TEQ	ng/kg									**0.5**	**153**	**1.3**	**371**
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,4,6,7,8-hpcdd	ng/kg	7414	KM H-UCL	Not available	0.20	'Not available	1467	0.01	0.001	'Not available	14.67	'Not available	1.47
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,4,6,7,8-hpcdf	ng/kg	1417	KM H-UCL	'Not available	0.36	'Not available	504	0.01	0.01	'Not available	5.04	'Not available	5.04
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,4,7,8,9-hpcdf	ng/kg	7.876	95% KM Approximate Gamma UCL	'Not available	0.34	'Not available	2.66	0.01	0.01	'Not available	0.027	'Not available	0.027
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,4,7,8-hxcdd	ng/kg	37.15	KM H-UCL	'Not available	0.23	'Not available	8.51	0.1	0.05	'Not available	0.9	'Not available	0.43
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,4,7,8-hxcdf	ng/kg	12.64	95% KM Approximate Gamma UCL	'Not available	0.48	'Not available	6.01	0.1	0.1	'Not available	0.60	'Not available	0.60
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,6,7,8-hxcdd	ng/kg	702	KM H-UCL	'Not available	0.19	'Not available	135	0.1	0.01	'Not available	14	Not available	1.4
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,6,7,8-hxcdf	ng/kg	19.97	KM H-UCL	'Not available	0.59	'Not available	11.7	0.1	0.1	'Not available	1.17	'Not available	1.17
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,7,8,9-hxcdd	ng/kg	258.1	KM H-UCL	'Not available	0.13	'Not available	33	0.1	0.1	'Not available	3.3	'Not available	3.3
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,7,8,9-hxcdf	ng/kg	0.935	95% KM (t) UCL	'Not available	1.22	'Not available	1.14	0.1	0.1	'Not available	0.114	'Not available	0.114

Table 6-33
Comparison of Tissue Exposure Point Concentrations for Dioxin TEQ in the Baseline (No Scouring) Scenario
Bat Cave Wash (0 to 0.5 foot bgs)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Approach	Constituent	Units	Soil EPCs [a] - 95% UCL	Soil EPCs [a] - 95% UCL Method	BAFs - Plants	BAFs - Terrestrial Invertebrates	Tissue EPCs - Plants	Tissue EPCs - Terrestrial Invertebrates	TEFs [b] - Mammal	TEFs [b] - Avian	Tissue EPCs (Mammal TEF Applied) - Plants	Tissue EPCs (Mammal TEF Applied) - Terrestrial Invertebrates	Tissue EPCs (Avian TEF Applied) - Plants	Tissue EPCs (Avian TEF Applied) - Terrestrial Invertebrates
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,7,8-pecdd	ng/kg	9.44	KM H-UCL	'Not available	0.18	'Not available	1.73	1	1	'Not available	2	'Not available	2
Congener-Specific Approach (Fagervold et al. 2010)[c]	1,2,3,7,8-pecdf	ng/kg	1.233	95% KM (t) UCL	'Not available	0.79	'Not available	0.97	0.03	0.1	'Not available	0.029	'Not available	0.097
Congener-Specific Approach (Fagervold et al. 2010)[c]	2,3,4,6,7,8-hxcdf	ng/kg	5.219	95% KM (t) UCL	'Not available	0.33	'Not available	1.74	0.1	0.1	'Not available	0.17	'Not available	0.17
Congener-Specific Approach (Fagervold et al. 2010)[c]	2,3,4,7,8-pecdf	ng/kg	131.7	95% KM (Chebyshev) UCL	'Not available	0.56	'Not available	74	0.3	1	'Not available	22	'Not available	74
Congener-Specific Approach (Fagervold et al. 2010)[c]	2,3,7,8-tcdd	ng/kg	6.176	95% KM Approximate Gamma UCL	'Not available	1.65	'Not available	10.2	1	1	'Not available	10.2	'Not available	10.2
Congener-Specific Approach (Fagervold et al. 2010)[c]	2,3,7,8-tcdf	ng/kg	2.106	KM H-UCL	'Not available	1.21	'Not available	2.54	0.1	1	'Not available	0.25	'Not available	2.5
Congener-Specific Approach (Fagervold et al. 2010)[c]	ocdd	ng/kg	68608	95% H-UCL	'Not available	0.25	'Not available	17318	0.0003	0.0001	'Not available	5.20	'Not available	1.73
Congener-Specific Approach (Fagervold et al. 2010)[c]	ocdf	ng/kg	13371	95% KM (Chebyshev) UCL	'Not available	0.27	'Not available	3665	0.0003	0.0001	'Not available	1.10	'Not available	0.366
Congener-Specific Approach (Fagervold et al. 2010)[c]	Dioxin TEQ	ng/kg									**'Not available**	**80**	**'Not available**	**105**

Table 6-33
Comparison of Tissue Exposure Point Concentrations for Dioxin TEQ in the Baseline (No Scouring) Scenario
Bat Cave Wash (0 to 0.5 foot bgs)

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Approach	Constituent	Units	Soil EPCs [a] - 95% UCL	Soil EPCs [a] - 95% UCL Method	BAFs - Plants	BAFs - Terrestrial Invertebrates	Tissue EPCs - Plants	Tissue EPCs - Terrestrial Invertebrates	TEFs [b] - Mammal	TEFs [b] - Avian	Tissue EPCs (Mammal TEF Applied) - Plants	Tissue EPCs (Mammal TEF Applied) - Terrestrial Invertebrates	Tissue EPCs (Avian TEF Applied) - Plants	Tissue EPCs (Avian TEF Applied) - Terrestrial Invertebrates
E R A Approach	TEQ avian	ng/kg	108.2	95% H-UCL	0.0056	ln(Ci) = 1.182 * ln(Cs) + 3.533	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	**0.61**	**703**
E R A Approach	TEQ mammals	ng/kg	204.4	95% H-UCL	0.0056	ln(Ci) = 1.182 * ln(Cs) + 3.533	Not applicable	Not applicable	Not applicable	Not applicable	**1.1**	**1491**	Not applicable	Not applicable

Notes:
[a] Soil EPCs calculated for BCW surface soil (0 to 0.5 foot bgs) using ProUCL 5.1; ProUCL-recommended UCLs and UCL methods are presented.
[b] Toxic Equivalentcy Factors (TEFs) from Van den Berg (2006) for mammals and Van den Berg (1998) for birds.
[c] Bioaccumulation Factors calculated using soil-to-earthworm 2,3,7,8-TCDD BAF for soil SW-20 (BAF = 1.65) and congner-specific earthworm bioaccumulation equivalency factors. See Table 6-34.

Acronyms and Abbreviations:
BAF = bioaccumulation factor
BCW = Bat Cave Wash
EPC = exposure point concentration
H-UCL = upper confidence limit based upon Land's H-statistic
hpcdd = heptachlorodibenzo-p-dioxin
hpcdf = heptachlorodibenzofuran
hxcdd = hexachlorodibenzo-p-dioxin
hxcdf = hexachlorodibenzofuran
In(Ci) = natural log of the invertebrate prey concentration
In(Cs) = natural log of the soil concentration
KM = Kaplan Meier
ng/kg = nanograms per kilogram
ocdd = octachlorodibenzo-p-dioxin
ocdf = octachlorodibenzofuran
pecdd = pentachlorodibenzo-P-dioxin
pecdf = pentachlorodibenzofuran
tcdd = tetrachlorodibenzo-p-dioxin
tcdf = tetrachlorodibenzofuran
TEF = toxic equivalency factor
TEQ = toxicity equivalent
UCL = upper confidence limit
U S E P A = U.S. Environmental Protection Agency

References:
Fagervold, SK, Y Chai, JW Davis, M Wilken, G Cornelissen, and U Ghosh. 2010. Bioaccumulation of polychlorinated dibenzo-p-dioxins/dibenzofurans in E. fetida from floodplain soils and the effect of activated carbon amendment. Environ Sci Technol. 44(14):5546-52.
Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1998a. Development and Validation of Bioaccumulation Models for Earthworms. ES/ER/TM-220. Oak Ridge National Laboratory, Oak Ridge, TN. 93 pp.47.
U S E P A. 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. Environmental Protection Agency Peer Review Draft. August.
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Table 6-34
Development of Soil-to-Invertebrate BAFs Using Fagervold et al. (2010) Data

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent	Units	Calculation of Soil-to-Invertebrate BEFs - SW-20 [c] BAF (foc = 0.38%)	Calculation of Soil-to-Invertebrate BEFs - SW-20 BEF [a]	Calculation of Soil-to-Invertebrate BEFs - Note	Calculation of Soil-to-Invertebrate BEFs - SW-265 BAF (foc = 5.6%)	Calculation of Soil-to-Invertebrate BEFs - SW-265 BEF [a]	Calculation of Soil-to-Invertebrate BEFs - Note	Calculation of Soil-to-Invertebrate BEFs - Average BEF	Terrestrial Invertebrate BAFs [b]
1,2,3,4,6,7,8-hpcdd	ng/kg	0.185	0.11		0.023	0.13		0.12	0.20
1,2,3,4,6,7,8-hpcdf	ng/kg	0.399	0.24		0.034	0.19		0.22	0.36
1,2,3,4,7,8,9-hpcdf	ng/kg	0.338	0.20		NC	NA	ND in soil	0.20	0.34
1,2,3,4,7,8-hxcdd	ng/kg	NC	NA	ND in soil	0.025	0.14	based on DL in tissue	0.14	0.23
1,2,3,4,7,8-hxcdf	ng/kg	0.584	0.35		0.04	0.22		0.29	0.48
1,2,3,6,7,8-hxcdd	ng/kg	NC	NA	ND in soil	0.021	0.12		0.12	0.19
1,2,3,6,7,8-hxcdf	ng/kg	0.777	0.47		0.043	0.24		0.35	0.59
1,2,3,7,8,9-hxcdd	ng/kg	NC	NA	ND in soil	0.014	0.08	based on DL in tissue	0.078	0.13
1,2,3,7,8,9-hxcdf	ng/kg	1.22	0.74		0.025	0.14	based on DL in tissue	0.74	1.22
1,2,3,7,8-pecdd	ng/kg	NC	NA	ND in soil	0.02	0.11	based on DL in tissue	0.11	0.18
1,2,3,7,8-pecdf	ng/kg	0.931	0.56		0.07	0.39		0.48	0.79
2,3,4,6,7,8-hxcdf	ng/kg	0.372	0.23		0.032	0.18		0.20	0.33
2,3,4,7,8-pecdf	ng/kg	0.725	0.44		0.044	0.24		0.34	0.56
2,3,7,8-tcdd	ng/kg	1.65	1.00		0.18	1.00		1.00	1.65
2,3,7,8-tcdf	ng/kg	1.28	0.78		0.124	0.69		0.73	1.21

Table 6-34
Development of Soil-to-Invertebrate BAFs Using Fagervold et al. (2010) Data

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Constituent	Units	Calculation of Soil-to-Invertebrate BEFs - SW-20 [c] BAF (foc = 0.38%)	Calculation of Soil-to-Invertebrate BEFs - SW-20 BEF [a]	Calculation of Soil-to-Invertebrate BEFs - Note	Calculation of Soil-to-Invertebrate BEFs - SW-265 BAF (foc = 5.6%)	Calculation of Soil-to-Invertebrate BEFs - SW-265 BEF [a]	Calculation of Soil-to-Invertebrate BEFs - Note	Calculation of Soil-to-Invertebrate BEFs - Average BEF	Terrestrial Invertebrate BAFs [b]
ocdd	ng/kg	0.294	0.18		0.023	0.13		0.15	0.25
ocdf	ng/kg	0.319	0.19		0.025	0.14		0.17	0.27

Notes:
Soil BAFs and BEFs from Fagervold et al. (2010).
[a] BEFs calculated as congener-specific BAF / 2,3,7,8-TCDD BAF. When congener was not detected in soil BAF was calculated.
When congener was not detected in tissue, BAF based on reporting limit in tissue.
[b] Terrestrial Invertebrate BAF = 2,3,7,8-TCDD BAF for soil SW-20 x congener-specific BEF.
[c] Soil SW-20 considered most similar to Topock soils based on low organic carbon content (foc).
2,3,7,8-TCDD BAF for SW-20 used to calculate Terrestrial Invertebrate BAFs as described in note b.

Acronyms and Abbreviations:
BAF = bioaccumulation factor
BEF = bioaccumulation equivalency factor
DL = laboratory detection limit
foc = fraction organic carbon
hpcdd = heptachlorodibenzo-p-dioxin
hpcdf = heptachlorodibenzofuran
hxcdd = hexachlorodibenzo-p-dioxin
hxcdf = hexachlorodibenzofuran
NA = not available
NC = not calculated
ND = not detected
ocdd = octachlorodibenzo-p-dioxin
ocdf = octachlorodibenzofuran
pecdd = pentachlorodibenzo-P-dioxin
pecdf = pentachlorodibenzofuran
tcdd = tetrachlorodibenzo-p-dioxin
tcdf = tetrachlorodibenzofuran

References
Fagervold, SK, Y Chai, JW Davis, M Wilken, G Cornelissen, and U Ghosh. 2010. Bioaccumulation of polychlorinated dibenzo-p-dioxins/dibenzofurans in E. fetida from floodplain soils and the effect of activated carbon amendment. Environ Sci Technol. 44(14):5546-52

Table 6-35
Terrestrial Wildlife Risk Estimate Comparison for Dioxin TEQ (SUF = 1, Selected TRVs) Using Different Bioaccumulation Approaches

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Terrestrial Receptors	Soil EPC [a,b] (ng/kg)	Diet Composition (fraction) - Diet	Diet Composition (fraction) - Soil	Tissue EPCs (ng/kg dw) - Terrestrial Plants	Tissue EPCs (ng/kg dw) - Terrestrial Insects	Body Weight (kg)	Intake Estimates (kg dw/kg-day) - Food Ingestion Rate	Intake Estimates (kg dw/kg-day) - Soil Ingestion Rate	Site Use Factor (unitless)	Dose From Dietary Components (ng/kg-day)[b] - Terrestrial Plants	Dose From Dietary Components (ng/kg-day)[b] - Terrestrial Insects	Dose From Dietary Components (ng/kg-day)[b] - Soil	Total Dose (mg/kg-day)	TRV (ng/kg-day) - NOAEL	TRV (ng/kg-day) - LOAEL	HQ (unitless)[c] - NOAEL	HQ (unitless)[c] - LOAEL	Note	Risk-Based Remediation Goal (mg/kg)[d] - NOAEL	Risk-Based Remediation Goal (mg/kg)[d] - LOAEL
Dioxins (presented in ng/kg) - Calculations Based on TCDD Bioaccumulation (Sample et al. 1998)	TEQ Avian	Gambel's Quail	108	100% Plants	0.1	0.6	703	0.2	0.04	0.004	1	0.02	NA	0.4	0.5	14	140	0.03	0.003	None	3332	33322
Dioxins (presented in ng/kg) - Calculations Based on TCDD Bioaccumulation (Sample et al. 1998)	TEQ Avian	Cactus Wren	108	100% Insects	0.09	0.6	703	0.04	0.2	0.02	1	NA	129	2	131	14	140	9	0.9	None	16	115
Dioxins (presented in ng/kg) - Calculations Based on TCDD Bioaccumulation (Sample et al. 1998)	TEQ Mammals	Desert Shrew	204	100% Insects	0.02	1	1491	0.005	0.2	0.004	1	NA	303	0.8	303	1	10	303	**30**	Note 1	2	11
Dioxins (presented in ng/kg) - Calculations Based on TCDD Bioaccumulation (Sample et al. 1998)	TEQ Mammals	Merriam's Kangaroo Rat	204	100% Plants	0.02	1	1491	0.03	0.08	0.002	1	0.09	NA	0.4	0.5	1	10	0.5	0.05	None	411	4109
Dioxins (presented in ng/kg) - Calculations Based on USEPA (1999) Congener Bioaccumulation	TEQ Avian	Gambel's Quail	108	100% Plants	0.1	1	371	0.2	0.04	0.004	1	0.05	NA	0.4	0.5	14	140	0.03	0.003	None	3144	31441
Dioxins (presented in ng/kg) - Calculations Based on USEPA (1999) Congener Bioaccumulation	TEQ Avian	Cactus Wren	108	100% Insects	0.09	1	371	0.04	0.2	0.02	1	NA	68	2	70	14	140	5	0.5	None	22	217
Dioxins (presented in ng/kg) - Calculations Based on USEPA (1999) Congener Bioaccumulation	TEQ Mammals	Desert Shrew	204	100% Insects	0.02	0.5	153	0.005	0.2	0.004	1	NA	31	0.8	32	1	10	32	**3**	Note 1	6	64
Dioxins (presented in ng/kg) - Calculations Based on USEPA (1999) Congener Bioaccumulation	TEQ Mammals	Merriam's Kangaroo Rat	204	100% Plants	0.02	0.5	153	0.03	0.08	0.002	1	0.04	NA	0.4	0.4	1	10	0.4	0.04	None	456	4563
Dioxins (presented in ng/kg) - Calculations Based on Fagervold et al. (2010) Congener Bioaccumulation	TEQ Avian	Cactus Wren	108	100% Insects	0.09	NA	105	0.04	0.2	0.02	1	NA	19	2	21	14	140	2	0.2	None	72	721

Table 6-35
Terrestrial Wildlife Risk Estimate Comparison for Dioxin TEQ (SUF = 1, Selected TRVs) Using Different Bioaccumulation Approaches

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC	Terrestrial Receptors	Soil EPC [a,b] (ng/kg)	Diet Composition (fraction) - Diet	Diet Composition (fraction) - Soil	Tissue EPCs (ng/kg dw) - Terrestrial Plants	Tissue EPCs (ng/kg dw) - Terrestrial Insects	Body Weight (kg)	Intake Estimates (kg dw/kg-day) - Food Ingestion Rate	Intake Estimates (kg dw/kg-day) - Soil Ingestion Rate	Site Use Factor (unitless)	Dose From Dietary Components (ng/kg-day)[b] - Terrestrial Plants	Dose From Dietary Components (ng/kg-day)[b] - Terrestrial Insects	Dose From Dietary Components (ng/kg-day)[b] - Soil	Total Dose (mg/kg-day)	TRV (ng/kg-day) - NOAEL	TRV (ng/kg-day) - LOAEL	HQ (unitless)[c] NOAEL	HQ (unitless)[c] - LOAEL	Note	Risk-Based Remediation Goal (mg/kg)[d] - NOAEL	Risk-Based Remediation Goal (mg/kg)[d] - LOAEL
Dioxins (presented in ng/kg) - Calculations Based on Fagervold et al. (2010) Congener Bioaccumulation	TEQ Mammals	Desert Shrew	204	100% Insects	0.02	NA	80	0.005	0.2	0.004	1	NA	16	0.8	17.1	1	10	17	**2**	Note 1	12	119

Notes:
[a] Receptors assumed to be exposed to surface soil (0 to 0.5 foot bgs) only.
[b] Soil EPCs calculated for Bat Cave Wash exposure area. See Table 6-33.
[c] Total dose equation is presented below:
Total Dose (mg/kg-day) = $[(EPC_{soil} \times SIR) + (EPC_{plants} \times FIR \times F_{plants}) + (EPC_{insects} \times FIR \times F_{insects}) + (EPC_{mammals} \times FIR \times F_{mammals})] \times SUF$
[d] HQ = Total Dose / TRV

Note 1 — LOAEL HQ greater than 1

Abbreviations:
COPEC = constituent of potential ecological concern
dw = dry weight
dw/kg-day = dry weight per kilogram per day
EPC = exposure point concentration
EPC_{soil} = exposure point concentration in soil (ng/kg dw)
EPC_{plants} = exposure point concentration in plants (ng/kg dw)
$EPC_{insects}$ = exposure point concentration in insects (ng/kg dw)
$EPC_{mammals}$ = exposure point concentration in mammals (ng/kg dw)
F_{plants} = fraction of plants in diet
$F_{insects}$ = fraction of insects in diet
$F_{mammals}$ = fraction of mammals in diet
FIR = food ingestion rate (kg dw/kg bw-day)
HQ = hazard quotient (unitless)
kg = kilogram
kg dw/kg bw-day = kilograms per kilogram of body weight per day
LOAEL = lowest observed adverse effect level (mg/kg-day)
mg/kg = milligrams per kilogram
mg/kg-day = milligrams per kilogram per day
ng/kg = nanograms per kilogram
ng/kg-day = nanograms per kilogram per day
NA = not applicable
NOAEL = no observed adverse effect level (mg/kg-day)
SIR = soil ingestion rate (kg dw/kg bw-day)
SUF = site use factor (fraction)
TCDD = tetrachlorodibenzo-p-dioxin
TEQ = toxicity equivalent
TRV = toxicity reference value (mg/kg-day)

References:
Fagervold, SK, Y Chai, JW Davis, M Wilken, G Cornelissen, and U Ghosh. 2010. Bioaccumulation of polychlorinated dibenzo-p-dioxins/dibenzofurans in E. fetida from floodplain soils and the effect of activated carbon amendment. Environ Sci Technol. 44(14):5546-52.
Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1998a. Development and Validation of Bioaccumulation Models for Earthworms. ES/ER/TM-220. Oak Ridge National Laboratory, Oak Ridge TN. 93 pp.47
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Table 6-36
Confidence in Soil Screening Levels for Plants

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC c	Plant Soil Screening Level [a]	Reference	Basis	Soil BTV	SL < BTV?	Confidence in SL
Inorganics	Antimony	5	Efroymson et al. (1997a)	"unspecified toxicity in plants" reported in a secondary reference	NA	NA	low[b]
Inorganics	Chromium, total	None	None	None	39.8	NA	None
Inorganics	Chromium, hexavalent	1	Efroymson et al. (1997a)	"The EC for lettuce in a 50 humic sand soil (pH 5.1, % organic matter 3.7) was greater than 11 ppm, while in a loam soil (pH 7.4, % organic matter 1.4) it was 1.8 ppm Cr."	0.83	no	low
Inorganics	Copper	70	USEPA (2008)	geomean MATC & EC10 for 4 test species (crops), mulitple test conditions	16.8	no	robust
Inorganics	Lead	120	USEPA (2008)	geomean MATC for 4 test species (crops, trees), multiple test conditions	8.39	no	robust
Inorganics	Manganese	220	USEPA (2008)	geomean MATC for 3 species (crops), multiple test conditions	402	yes	low
Inorganics	Mercury	0.3	Efroymson et al. (1997a)	"unspecified toxicity in plants" reported in a secondary reference	NA	NA	low[b]
Inorganics	Thallium	1	Efroymson et al. (1997a)	"unspecified toxicity in plants" reported in a secondary reference	NA	NA	low[b]
Inorganics	Vanadium	2	Efroymson et al. (1997a)	"unspecified toxicity in plants" reported in a secondary reference	52.2	yes	low[b]
Inorganics	Zinc	160	USEPA (2008)	geomean MATC for 3 species (crops), multiple test conditions	58	no	moderate

Table 6-36
Confidence in Soil Screening Levels for Plants

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC c	Plant Soil Screening Level [a]	Reference	Basis	Soil BTV	SL < BTV?	Confidence in SL
Polycyclic Aromatic Hydrocarbons	H M W P A H	1.2	c; USEPA (1999)	chronic N O A E L for wheat	0.0376	no	low

Notes:
All units in milligrams per kilogram (mg/kg), except where noted.
[a] Plant screening levels, as selected in the RAWP (Arcadis 2008), Efroymson et al. 1997, and U S E P A Region 4 Ecological Screening Values (U S E P A 2015).
[b] Confidence in the screening level, as determined by the authors (Efroymson et al. 1997)
[c] Based on data for benzo(a)pyrene and benzo(b)fluoranthene.
d Only C O P E C s with at least one HQ greater than 1 in the E R A are presented.

Acronyms:
BTV = background threshold value (CH2MHILL 2009, 2013, 2017)
C O P E C = constituent of potential ecological concern
EC10 = 10th percentile effective concentration
E R A = ecological risk assessment
H M W P A H = high molecular weight polycyclic aromatic hydrocarbon
L O A E L = lowest observable adverse effects level N O A E L = no observable adverse effects level
N O A E L = no observable adverse effects level
MATC = maximum acceptable tolerable concentration (based on geometric mean of N O A E L and L O A E L values)
NA = not available
RAWP = Remedial Action Work Plan
SL = screening level
U S E P A = United States Environmental Protection Agency

References:
CH2M Hill. 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, CA. May 15.

Table 6-36
Confidence in Soil Screening Levels for Plants

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC c	Plant Soil Screening Level [a]	Reference	Basis	Soil BTV	SL < BTV?	Confidence in SL

CH2M HILL, Inc. (CH2M). 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, CA. January.

CH2M Engineers, Inc. (CH2M). 2017. Technical Memorandum. Ambient/Background Study of Dioxins and Furans at the Pacific Gas and Electric Company Topock Compressor Station, Needles, CA. July 20.

Efroymson et al. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants. ES/ER/TM-85/R3.

U S E P A. 2008. Guidance for Developing Ecological Soil Screening Levels, Interim Final Documents. Available at: https://rais.ornl.gov/guidance/epa_eco.html.

Table 6-37
Confidence in Soil Screening Levels for Soil Invertebrates

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC [c]	Invertebrate Soil SL [a]	Reference	Basis	Soil BTV	SL < BTV?	Confidence in SL
Inorganics	Chromium, total	57	Van Gestel et al. (1992,1993)	Maximum acceptable toxicant concentration (i.e., geometric mean of the NOAEL and LOAEL) for earthworm	39.8	no	low
Inorganics	Chromium, hexavalent	0.4	Efroymson et al. (1997b)	"Survival was the most sensitive measure with a 75% decrease resulting from 2 ppm Cr, the lowest concentration tested... The 0.4 ppm benchmark for Cr is based on the work of Abbasi and Soni (1983). A safety factor of 5 was applied to the 2 ppm LOEC because it caused a 75% reduction in earthworm survival." "The relative toxicity of Cr(III) and Cr(VI) is not clear from these studies."	0.83	yes	low
Inorganics	Copper	80	USEPA (2008)	geomean MATC & EC10 for 6 test species, mulitple test conditions	16.8	no	moderate
Inorganics	Manganese	450	USEPA (2008)	geomean EC20 for 3 species, multiple test conditions;	402	no	low
Inorganics	Mercury	0.1	Efroymson et al. (1997b)	EC50 for earthworm; UF of 5	NA	NA	lowb
Inorganics	Zinc	120	USEPA (2008)	geomean MATC & EC10 for 3 test species, mulitple test conditions	58	no	moderate
Pesticides	Alpha-Chlordane	0.0043	Van de Plassche et al. (1994)	Dutch maximum permissible concentration; based on data from sensitive taxonomic groups	NA	NA	moderate
Pesticides	Gamma-Chlordane	0.0043	Van de Plassche et al. (1994)	Dutch maximum permissible concentration; based on data from sensitive taxonomic groups	NA	NA	moderate
Semi-Volatile Organic Compounds	4-Methylphenol	0.08	USEPA (2015)	ECOSAR + EqP	NA	NA	low

Table 6-37
Confidence in Soil Screening Levels for Soil Invertebrates

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
All units in milligrams per kilogram (mg/kg), except where noted.
[a] Soil Invertebrate screening levels, as selected in the RAWP (Arcadis 2008) and additional sources.
(U S E P A 2008, Efroymson et al. 1997, U S E P A 2015, published literature as noted).
[b] Confidence in the screening level, as determined by the authors (Efroymson et al. 1997)
c Only C O P E C s with at least one HQ greater than 1 in the E R A are presented.

Acronyms:
BTV = background threshold value (CH2MHILL 2009, 2013, 2017)
BTV = background threshold value (CH2MHILL 2009, 2013, 2017)
Cr = chromium
EC10 = 10th percentile effective concentration
EC20 = 20th percentile effective concentration
EC50 = 50th percentile effective concentration
ECOSAR = Ecological Structure Activity Relationship model (as cited in U S E P A 2015)
EqP = equilibrium partitioning approach (as cited in U S E P A 2015)
E R A = ecological risk assessment
L O A E L = lowest observable adverse effects level
MATC = maximum acceptable tolerable concentration (based on geometric mean of N O A E L and L O A E L values)
NA = not available
N O A E L = no observable adverse effects level
RAWP = Remedial Action Work Plan
SL = screening level
UF = uncertainty factor
U S E P A = United States Environmental Protection Agency

Table 6-37
Confidence in Soil Screening Levels for Soil Invertebrates

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

References:

CH2M Hill. 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.

CH2M HILL, Inc. (CH2M). 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.

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Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997b. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.

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U S E P A. 2015. Supplemental Guidance to E R AGS: Region 4, Ecological Risk Assessment, Originally published November 1995.

Van Gestel, CAM, EM Dirven-Van Breemen, R Baerselman, HJB Emans, JAM Janssen, R Postuma, and PJM Van Vliet. 1992. Comparison of Sublethal and Lethal Criteria for Nine Different Chemicals in Standardized Toxicity Tests Using the Earthworm Eisenia Andrei. Ecotoxicology and Environmental Safety Volume 23, p. 206-220.

Van Gestel, CAM, EM Dirven-van Breemen, and R Baerselman. 1993. Accumulation and elimination of cadmium, chromium and zinc and effects on growth and reproduction in Eisenia andrei (Oligochaeta, Annelida). The Science of the Total Environment, Supplement 1993.

Table 6-38a.
Confidence in Selected TRVs for Avian Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC [b]	Avian Selected TRVs a N O A E L TRV (mg/kg bw-day)	Avian Selected TRVs [a] - Basis	Avian Selected TRVs [a] - Source	Avian Selected TRVs a - L O A E L TRV (mg/kg bw-day)	Avian Selected TRVs [a] - Basis	Avian Selected TRVs [a] - Source	Comparison to Background - Soil BTV (mg/kg)	Comparison to Background - Highest N O A E L HQ at Background 95UCL	Comparison to Background - Highest L O A E L HQ at Background 95UCL	Comparison to Background - Highest N O A E L HQ at BTV	Comparison to Background - Highest L O A E L HQ at BTV	Additional TRV Info	Confidence in Selected TRVs
Inorganics	Cadmium	1.47	geometric mean of N O A E L values for reproduction and growth	U S E P A (2008)	6.35	geometric mean of L O A E L values for reproduction and growth	U S E P A (2008)	1.1	1	0.3	1	0.3	NA	Robust
Inorganics	Chromium, total	2.66	geometric mean of growth and reproduction N O A E Ls	U S E P A (2008)	15.6	geometric mean of growth and reproduction L O A E Ls	U S E P A (2008)	39.8	0.7	0.1	1	0.2	NA	Robust
Inorganics	Chromium, hexavalent	2.5	N O A E L for hatching success	Butkauskas and Sruoga (2004)	25	UF of 10 was applied to the N O A E L	Butkauskas and Sruoga (2004)	0.83	0.02	0.002	0.02	0.002	NA	Low
Inorganics	Copper	4.05	highest bounded N O A E L lower than the lowest bounded L O A E L for reproduction, growth or survival	U S E P A (2008)	12.1	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	16.8	0.3	0.1	0.5	0.2	NA	Moderate
Inorganics	Lead	1.63	highest bounded N O A E L, lower than the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	3.26	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	8.39	0.4	0.2	0.6	0.3	Based on lead acetate data; likely overestimates bioavailability	Moderate
Inorganics	Mercury	0.039	lowest N O A E L	CalEPA (2009)	0.18	mid-range effects level	CalEPA (2009)	NA	NC	NC	NC	NC	Based on methylmercury data; likely overestimates toxicity	Moderate
Inorganics	Zinc	66.1	geometric mean of N O A E L values within the reproduction and growth effect groups	U S E P A (2008)	171	geometric mean of L O A E L values within the reproduction and growth effect groups	U S E P A (2008)	58	0.8	0.3	0.9	0.4	NA	Robust
Polychlorinated Biphenyls	Total P C B s	0.09	lowest N O A E L	CalEPA (2009)	1.27	mid-range effects level	CalEPA (2009)	NA	NC	NC	NC	NC	based on AHR Type 1 species (chicken); likely overestimates toxicity	Moderate
Dioxins (presented in ng/kg)	TEQ Avian	14	N O A E L for reduced egg production and hatchability	Sample et al. (1996)	140	L O A E L for reduced egg production and hatchability	Sample et al. (1996)	5.98	0.03	0.003	0.3	0.03	low end of published range; likely overestimates toxicity	Moderate

Notes:

a Avian TRVs, as selected in the RAWP (Arcadis 2008) and additional sources. (U S E P A 2008, Sample et al. 1996, CalEPA 2009, published literature as noted).

[b] Only COPECs with at least one HQ greater than 1 in the ERA are presented.

Table 6-38a.
Confidence in Selected TRVs for Avian Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Acronyms:
95UCL = 95% upper confidence limit on the mean
BTV = background threshold value (CH2MHILL 2009, 2013, 2017)
bw = body weight
CalEPA = California Environmental Protection Agency
COPEC = constituent of potential ecological concern
ERA = ecological risk assessment
HQ = hazard quotient
LOAEL = lowest observable adverse effects level
mg/kg = milligram per kilogram
NA = not available
NC = not calculated
ng/kg = nanogram per kilogram
NOAEL = no observable adverse effects level
PCBs = polychlorinated biphenyls
RAWP = Remedial Action Work Plan
TEQ = 2,3,7,8-TCDD toxicity equivalent
TRV = toxicity reference value
UF = uncertainty factor
USEPA = United States Environmental Protection Agency

References:
Butkauskas, D. and Sruoga, A., 2004. Effect of lead and chromium on reproductive success of Japanese quail. Environmental toxicology, 19(4), pp.412-415.
CalEPA. 2009. U.S. EPA Region 9 BTAG Recommended Toxicity Reference Values for Birds (Revision Date 02/24/09). Department of Toxic Substances Control: Human andEcological Risk Division.
CH2M Hill. 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
CH2M HILL, Inc. (CH2M). 2013. Revised Final Soil RCRA Facility Investigation/Remedial Investigation Work Plan, PG&E Topock Compressor Station, Needles, California. January.
CH2M Engineers, Inc. (CH2M). 2017. Technical Memorandum. Ambient/Background Study of Dioxins and Furans at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. July 20.
Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.
USEPA. 2008. Guidance for Developing Ecological Soil Screening Levels, Interim Final Documents. Available at: https://rais.ornl.gov/guidance/epa_eco.html.

Table 6-38b
Confidence in Selected TRVs for Mammalian Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	C O P E C b	N O A E L TRV (mg/kg bw-day)	Basis	Source	L O A E L TRV (mg/kg bw-day)	Basis	Source	Soil BTV (mg/kg)	Highest N O A E L HQ at Background 95UCL	Highest L O A E L HQ at Background 95UCL	Highest N O A E L HQ at BTV	Highest L O A E L HQ at BTV	Additional TRV Info	Confidence in Selected TRVs
Inorganics	Antimony	0.059	highest bounded N O A E L below the lowest bounded L O A E L	U S E P A (2008)	0.59	L O A E L for reproduction, growth, or survival from same study as N O A E L basis	U S E P A (2008)	NA	NC	NC	NC	NC	low end of published range; likely overestimates toxicity	Low
Inorganics	Cadmium	0.770	highest bounded N O A E L below the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	7.7	L O A E L for reproduction, growth, or survival from same study as N O A E L basis	U S E P A (2008)	1.1	**2**	0.2	**2**	0.2	NA	Moderate
Inorganics	Chromium, total	2.40	geometric mean of N O A E L values for reproduction and growth	U S E P A (2008)	9.62	geometric mean of L O A E L values for reproduction and growth	U S E P A (2008)	39.8	0.7	0.2	1	0.3	NA	Robust
Inorganics	Chromium, hexavalent	9.24	geometric mean of the N O A E L values for reproduction and growth	U S E P A (2008)	38.4	geometric mean of the L O A E L values for reproduction and growth	U S E P A (2008)	0.83	0.006	0.001	0.006	0.001	NA	Robust
Inorganics	Copper	5.60	highest bounded N O A E L below the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	9.34	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	16.8	0.1	0.08	0.2	0.1	NA	Moderate
Inorganics	Lead	4.70	highest bounded N O A E L below the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	8.90	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	8.39	0.1	0.07	0.2	0.1	Based on lead acetate data; likely overestimates bioavailability	Low
Inorganics	Mercury	0.25	lowest rodent N O A E L	CalEPA (2002)	4	lowest rodent L O A E L	CalEPA (2002)	NA	NC	NC	NC	NC	Based on methylmercury data; likely overestimates toxicity	Moderate
Inorganics	Nickel	1.70	highest bounded N O A E L below the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	3.40	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	27.3	**2**	1	**4**	**2**	NA	Moderate
Inorganics	Zinc	75.4	geometric mean of the N O A E L values for reproduction and growth	U S E P A (2008)	298	geometric mean of the L O A E L values for reproduction and growth	U S E P A (2008)	58	0.8	0.2	0.9	0.2	NA	Robust
Polycyclic Aromatic Hydrocarbons	HMW P A H	0.615	highest bounded N O A E L lower than the lowest bounded L O A E L for reproduction, growth, or survival	U S E P A (2008)	3.07	L O A E L from the same study and endpoint as the N O A E L was selected	U S E P A (2008)	0.0376	0.004	0.0009	**30**	**7**	NA	Moderate

Table 6-38b
Confidence in Selected TRVs for Mammalian Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	COPEC b	NOAEL TRV (mg/kg bw-day)	Basis	Source	LOAEL TRV (mg/kg bw-day)	Basis	Source	Soil BTV (mg/kg)	Highest NOAEL HQ at Background 95UCL	Highest LOAEL HQ at Background 95UCL	Highest NOAEL HQ at BTV	Highest LOAEL HQ at BTV	Additional TRV Info	Confidence in Selected TRVs
Polychlorinated Biphenyls	Total PCBs	0.36	lowest NOAEL	CalEPA (2002)	1.28	mid-range effects level	CalEPA (2002)	NA	NC	NC	NC	NC	NA	Moderate
Dioxins (presented in ng/kg)	TEQ Mammals	1	NOAEL for reduced fecundity	Sample et al. (1996)	10	LOAEL for reduced fecundity	Sample et al. (1996)	5.58	0.5	0.05	**4**	0.4	low end of published range; likely overestimates toxicity	Moderate

Notes:
[a] Mammalian TRVs, as selected in the RAWP (Arcadis 2008) and additional sources.
(USEPA 2008, Sample et al. 1996, CalEPA 2002).
b Only COPECs with at least one HQ greater than 1 in the ERA are presented.

Acronyms:
95UCL = 95% upper confidence limit on the mean
BTV = background threshold value (CH2MHILL 2009, 2013, 2017)
bw = body weight
CalEPA = California Environmental Protection Agency
COPEC = constituent of potential ecological concern
ERA = ecological risk assessment
HQ = hazard quotient
LOAEL = lowest observable adverse effects level
mg/kg = milligram per kilogram
NA = not available
NC = not calculated
ng/kg = nanogram per kilogram
NOAEL = no observable adverse effects level
PCBs = polychlorinated biphenyls
RAWP = Remedial Action Work Plan
TEQ = 2,3,7,8-TCDD toxicity equivalent
TRV = toxicity reference value
UF = uncertainty factor
USEPA = United States Environmental Protection Agency

References:
CalEPA. 2002. U.S. EPA Region 9 BTAG Recommended Toxicity Reference Values for Mammals (Revision Date 11/21/2002). Department of Toxic Substances Control: Humanand Ecological Risk Division.
CH2M Hill. 2009. Soil Background Investigation at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. May 15.
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CH2M Engineers, Inc. (CH2M). 2017. Technical Memorandum. Ambient/Background Study of Dioxins and Furans at the Pacific Gas and Electric Company Topock Compressor Station, Needles, California. July 20.
Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.
USEPA. 2008. Guidance for Developing Ecological Soil Screening Levels, Interim Final Documents. Available at: https://rais.ornl.gov/guidance/epa_eco.html.

Table 6-39
Alternate Dioxin Toxicity Reference Values for Small Mammals

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Dioxin Congener	Study Type	Test Organism	Study Duration	Endpoints	Exposure Route	Dietary Concentration(s)	Reported Toxicity Value(s)	Test Species NOAEL	Test Species LOAEL	TRV NOAEL - (ng/kg-day)	TRV LOAEL - (ng/kg-day)	Source/Comments
2,3,7,8-TCDD	Lab	Sprague Dawley Rats	13 weeks (91 days)	Growth	Gavage	Control and four daily doses: 0.71, 7.1, 71.4, and 714 ng/kg_{bw}-day.	NOAEL, LOAEL	7.1 ng/kg_{bw}-day	71.4 ng/kg_{bw}-day	7.10	71.40	Kociba et al. (1976)
2,3,7,8-TCDD	Lab	Sprague Dawley Rats	2 years	Growth	Gavage	Control and three daily doses: 0.001, 0.01, and 0.1 µg/kg_{bw}-day	NOAEL, LOAEL	0.001 µg/kg_{bw}-day	0.01 µg/kg_{bw}-day	1	10	Kociba et al. (1978)
2,3,7,8-TCDD	Lab	Rats	Three generations	Reproduction	Diet	Control and three daily doses: 0.001, 0.01, and 0.1 µg/kg_{bw}-day	NOAEL, LOAEL	0.001 µg/kg_{bw}-day	0.01 µg/kg_{bw}-day	1	10	Murray et al. (1979)
2,3,7,8-TCDD	Lab	Sprague Dawley Rats (Female)	128 days	Growth	Gavage	Control and five daily doses: 0.85, 3.4, 13.6, 54.3, and 217 ng/kg_{bw}-day	NOAEL, LOAEL	54.3 ng/kg_{bw}-day	217 ng/kg_{bw}-day	54.30	217	Croutch et al. (2005). Average daily doses reported by USEPA (2012) in summary of this study. Dosing scheme was initial loading of 0, 0.0125, 0.05, 0.2, 0.8, or 3.2 µg/kg_{bw} at time zero followed by a "maintenance dose" dose rate about one-tenth of the loading dose every 3 days.
2,3,7,8-TCDD	Lab	Sprague Dawley Rats (Female)	2 years	Survival	Gavage	Control and five doses; 3, 10, 22, 46, and 100 ng/kg_{bw} 5 days per week	NOAEL	100 ng/kg_{bw}	--	71.40	NA	Walker et al. (2006). Dose concentrations were converted to averaged daily doses (i.e., TRV units) by the authors.
2,3,7,8-TCDD	Lab	Sprague Dawley Rats (Female)	2 years	Growth	Gavage	Control and five doses; 3, 10, 22, 46, and 100 ng/kg_{bw} 5 days per week	NOAEL, LOAEL	10 ng/kg_{bw}	22 ng/kg_{bw}	7.10	15.70	Walker et al. (2006). Dose concentrations were converted to averaged daily doses (i.e., TRV units) by the authors.
NA	NA	NA	NA	NA	NA	NA	NA	All Studies	Average	23.65	64.82	
NA	NA	NA	NA	NA	NA	NA	NA	All Studies	Geomean	7.62	30.01	
NA	NA	NA	NA	NA	NA	NA	NA	All Studies	N	6	5	
NA	NA	NA	NA	NA	NA	NA	NA	Bounded Studies (Reproduction & Growth)	Average	14.10	64.82	
NA	NA	NA	NA	NA	NA	NA	NA	Bounded Studies (Reproduction & Growth)	Geomean	4.87	**30.01**	Selected Alternate LOAEL-based TRV
NA	NA	NA	NA	NA	NA	NA	NA	Bounded Studies (Reproduction & Growth)	N	5	5	

Acronyms and Abbreviations:
LOAEL = lowest observed adverse effect level
µg/kg_{bw}-day = micrograms per kilogram body weight per day
NA = not applicable
ng/kg_{bw}-day = nanograms per kilogram body weight per day
NOAEL = no observed adverse effect level
TRV = toxicity reference value
USEPA = United States Environmental Protection Agency

Sources:

Croutch, C.R., M. Lebofsky, K.W. Schramm, P.F. Terranova, and K.K. Rozman. 2005. 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and 1,2,3,4,7,8-hexachlorodibenzo-*p*-dioxin (HxCDD) alter body weight by decreasing insulin-like growth factor I (IGF-I) signaling. Toxicol. Sci. 85(1):560–571.
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Walker, N.J., M.E. Wyde, L.J. Fischer, A. Nyska, and J.R. Bucher. 2006. Comparison of chronic toxicity and carcinogenicity of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) in two-year bioassays in female Sprague-Dawley rats. *Mol. Nutr. Food Res*. 50(10): 934–944.

Table 6-40
Summary of Avian Species with their Aryl Hydrocarbon Receptor Genetically Sequenced

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

AHR Type 1 (high sensitivity)	AHR Type 2 (moderate sensitivity)	AHR Type 3 (lowest sensitivity)
domestic chicken (*Gallus gallus domesticus*)	ruffed grouse (*Bonasa umbellus*)	great blue heron (*Ardea herodias*)
red jungle fowl (*Gallus gallus*)	wild turkey (*Meleagris gallopavo*)	Japanese quail (*Coturnix japonica*)
European starling (*Sturnus vulgaris*)	willow ptarmigan (*Lagopus lagopus*)	American kestrel (*Falco sparverius*)
ruby-throated hummingbird (*Archilochus colubris*)	American redstart (*Setophaga ruticilla*)	Arctic tern (Sterna paradisaea)
gray catbird (*Dumetella carolinensis*)	Baltimore oriole (*Icterus galbula*)	bald eagle (*Haliaeetus leucocephalus*)
	black-and-white warbler (*Mniotilta varia*)	barred owl (*Strix varia*)
	black-capped chickadee (*Poecile atricapilla*)	belted kingfisher (*Megaceryle alcyon*)
	brown-headed cowbird (*Molothrus ater*)	common flicker (*Colaptes auratus*)
	cedar waxwing (*Bombycilla cedrorum*)	common loon (*Gavia immer*)
	chipping sparrow (*Spizella passerina*)	common tern (*Sterna hirundo*)
	common grackle (*Quiscalus quiscula*)	Cooper's hawk (*Accipiter cooperii*)
	common yellowthroat (*Geothlypis trichas*)	double-crested cormorant (*Phalacrocorax auritus*)
	indigo bunting (*Passerina cyanea*)	downy woodpecker (*Picoides pubescens*)
	Northern cardinal (*Cardinalis cardinalis*)	Eastern kingbird (*Tyrannus tyrannus*)
	ovenbird (*Seiurus aurocapilla*)	great cormorant (*Phalacrocorax carbo*)
	red-winged blackbird (*Agelaius phoeniceus*)	great horned owl (*Bubo virginianus*)
	rose-breasted grosbeak (*Pheucticus ludovicianus*)	herring gull (*Larus argentatus*)
	swamp sparrow (*Melospiza georgiana*)	ivory gull (*Pagophila eburnea*)
	tufted titmouse (*Baeolophus bicolor*)	killdeer (*Charadrius vociferus*)
	white-throated sparrow (*Zonotrichia albicollis*)	osprey (*Pandion haliaetus*)
	rock ptarmigan (*Lagopus muta*)	red-tailed hawk (*Buteo jamaicensis*)
	American woodcock (*Scolopax minor*)	ring-billed gull (*Larus delawarensis*)
	spotted sandpiper (*Actitis macularius*)	sandhill crane (*Grus canadensis*)
	American crow (*Corvus brachyrhynchos*)	screech owl (*Megascops asio*)
	American goldfinch (*Carduelis tristis*)	thick-billed murre (*Uria lomvia*)
	American robin (*Turdus migratorius*)	turkey vulture (*Cathartes aura*)
	bank swallow (*Riparia riparia*)	brant (*Branta bernicla*)
	barn swallow (*Hirundo rustica*)	Canada goose (*Branta canadensis*)
	blue jay (*Cyanocitta cristata*)	common eider (*Somateria mollissima)*
	cliff swallow (*Petrochelidon pyrrhonota*)	greater scaup (*Aythya marila*)

Table 6-40

Summary of Avian Species with their Aryl Hydrocarbon Receptor Genetically Sequenced

Soil Human Health and Ecological Risk Assessment

PG&E Topock Compressor Station

Needles, California

AHR Type 1 (high sensitivity)	AHR Type 2 (moderate sensitivity)	AHR Type 3 (lowest sensitivity)
	Eastern bluebird (*Sialia sialis*)	mallard (*Anas platyrhynchos*)
	hermit thrush (*Catharus guttatus*)	wood duck (*Aix sponsa*)
	house finch (*Carpodacus mexicanus*)	wood thrush (*Hylocichla mustelina*)
	house sparrow (*Passer domesticus*)	
	house wren (*Troglodytes aedon*)	
	red-eyed vireo (*Vireo olivaceus*)	
	tree swallow (*Tachycineta bicolor*)	
	veery (*Catharus fuscescens*)	
	white-breasted nuthatch (*Sitta carolinensis*)	
	black-footed albatross (*Phoebastria nigripes*)	
	brown thrasher (*Toxostoma rufum*)	
	emu (*Dromaius novaehollandiae*)	
	mourning dove (*Zenaida macroura*)	
	bobwhite quail (*Colinus virginianus*)	
	ring-necked pheasant (*Phasianus colchicus*)	

Notes:

Data from Farmahin et al. 2012 and Eng et al. (2014)

AHR: aryl hydrocarbon receptor

References:

Eng ML, JE Elliott, SP Jones, TD Williams, KG Drouillard, SW Kennedy. 2014. Amino acid sequence of the AhR1 ligand-binding domain predicts avian sensitivity to dioxin like compounds: in vivo verification in European starlings. Environ Toxicol Chem. 33(12):2753-8

Farmahin R., GE Manning, D Crump, D Wu, LJ Mundy, SP Jones, ME Hahn, SI Karchner, JP Giesy, SJ Bursian, MJ Zwiernik, TB Fredricks, and SW Kennedy. 2012. Amino acid sequence of the ligand-binding domain of the aryl hydrocarbon receptor 1 predicts sensitivity of wild birds to effects of dioxin-like compounds. Toxicol. Sci. 131(1):139-52.

Table 6-41
Summary of Non-Chicken Toxicity Studies for Polychlorinated Biphenyls

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Chemical	Study Type	Test Organism	Study Duration	Endpoints	Exposure Route	Dosage	Reported Toxicity Value(s)	Test Species NOAEL	Test Species LOAEL	Food Intake (kg_{ww}/day)	Body Weight (kg)	TRVNOAEL (mg/kg-day)	TRVLOAEL (mg/kg-day)	Include for TRV calculation?	Source/Comments
Aroclor 1254	Lab	Ringed turtle dove	6 months (180 days)	Reproduction	Oral in diet	10 ppm in diet	NOAEL	10 ppm	NA	0.017	0.155	1.10	NA	Yes	Peakall (1971)
Aroclor 1254	Lab	Ring-necked pheasant	17 weeks (119 days)	Reproduction	Oral by gelatin capsule	Two dose levels: 12.5 and 50 mg/bird/week.	NOAEL, LOAEL	12.5 mg/week	50 mg/week	Used study values	NA	1.80	7.10	Yes	Dahlgren et al. (1972)
Aroclor 1254	Lab	Northern bobwhite	2 years (730 days)	Reproduction	Oral in diet	50 ppm in diet	NOAEL	50 ppm	NA	Used study values	NA	4.70	NA	Yes	Heath et al. (1972)
Aroclor 1254	Lab	Mallard duck	2 years (730 days)	Reproduction	Oral in diet	25 ppm in diet	NOAEL, LOAEL	25 ppm in diet	50 ppm	Used study values	NA	7.00	14.00	Yes	Heath et al. (1972)
Aroclor 1254	Lab	Chickens	39 weeks (273 days)	Reproduction	Oral in diet	Two dose levels: 5 and 50 ppm in diet	LOAEL	NA	5 ppm	0.106	1.5	NA	0.35	Yes	Platonow and Reinhart (1973)
Aroclor 1254	Lab	Ringed turtle dove	NR	Reproduction	Oral in diet	10 ppm in diet	LOAEL	NA	10 ppm	0.017	0.155	NA	1.10	Yes	Peakall and Peakall (1973). Data was from F1 generation of Peakall (1971) study.
Aroclor 1254	Lab	Chickens	9 weeks (63 days)	Reproduction	Oral in diet	Two dose levels: 2 and 20 ppm in diet	NOAEL, LOAEL	2 ppm	20 ppm	0.106	1.5	0.14	1.41	Yes	Cecil et al. (1974)
Aroclor 1254	Lab	Chickens	9 weeks (63 days)	Reproduction	Oral in diet	Two dose levels: 2 and 20 ppm in diet	NOAEL, LOAEL	2 ppm	20 ppm	0.1214	1.953	0.12	1.24	Yes	Lillie et al. (1974)
Aroclor 1254	Lab	Chickens	8 weeks (56 days)	Reproduction	Oral in diet	Three dose levels: 5, 10 and 20 ppm in diet	NOAEL, LOAEL	20 ppm	NA	0.1214	1.953	1.24	NA	Yes	Lillie et al. (1975). The authors evaluated other Aroclor PCB mixtures as well. Values shown here are for Aroclor 1254 only.
Aroclor 1254	Lab	Duck	4 months (120 days)	Reproduction	Oral in diet	40 ppm in diet	NOAEL	40 ppm	NA	0.1	1	4.00	NA	Yes	Riseborough and Anderson (1975)
Delor 105 (54% by weight chlorine)	Lab	Chickens	6 weeks (42 days)	Reproduction	Oral in diet	5 ppm	NOAEL	5 ppm	NA	0.106	1.5	0.35	NA	Yes	Kosutsky et al. (1979)
Aroclor 1254	Lab	Ring-necked pheasant	NR	Reproduction	Oral in diet	50 ppm in diet	LOAEL	NA	50 ppm	USEPA (2000)	NA	NA	2.90	Yes	Roberts et al. (1978); as reported in USEPA (2000).
Aroclor 1254	Lab	Duck	1 month (30 days)	Reproduction	Oral in diet	NA	NOAEL	25 ppm in diet	NA	NA	NA	7.00	NA	No	Custer and Heinz (1980)
Environmental PCBs	Lab	Chickens	10 weeks (70 days)	Growth, Reproduction	Oral in diet	0.3, 0.8, and 6.6 ppm in diet	NOAEL	0.8 ppm	NA	0.09119	1.593	0.05	NA	Yes	Summer et al. (1996). TRV calculated using average body weight and feed consumption rate of intermediate dose group.
Environmental PCBs	Field	Tree swallows	Field	Reproduction	Oral in diet	Up to 0.61 mg/kg in diet	NOAEL	0.61 ppm	NA	NA	NA	0.55	NA	Yes	Custer et al. (1998). Populations in Fox River and Green Bay, Michigan. DDE also reported in samples. TRV shown is value reported by USEPA (2000).

Notes:
Only those studies with a minimum exposure period of 2 months were considered for the TRV derivation.
Study durations shown were as reported by the authors and were also adjusted to days to facilitate comparisons between studies.

Table 6-41
Summary of Non-Chicken Toxicity Studies for Polychlorinated Biphenyls

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Acronyms and Abbreviations:
DDE = dichloro-diphenyl-dichloroethene
kg = kilogram
kg_{bw}/day = kilograms body weight per day
LOAEL = lowest observed adverse effect level
mg = milligram
mg/kg-day = milligram per kilogram per day
NA = not applicable
NOAEL = no observed adverse effect level
PCB = polychlorinated biphenyl
PG&E = Pacific Gas and Electric Company
ppm = parts per million
TRV = toxicity reference value
USEPA = United States Environmental Protection Agency

References:

Cecil, H.C., J. Bitman, R.J. Lillie. G.F. Fries, and J. Verrett. 1974. Embryotoxic and teratogenic effects in unhatched fertile eggs from hens fed polychlorinated biphenyls (PCBs). *Bull. Environ. Contam. Toxicol* . 11(6):489–455.
Custer, T.W., and G.H. Heinz. 1980. Reproductive success and nest attentiveness of mallard ducks fed Aroclor 1254. *Environ. Poll. (Ser A).* 21:313–318.
Custer, C.M., T.W. Custer, P.D. Allen, K.L. Stromborg, and M.J. Melancon. 1998. Reproduction and environmental contamination in tree swallows nesting in the Fox River drainage and Green Bay, Wisconsin, USA. *Environ. Toxicol. Chem* . 17(9):1786–1798.
Dahlgren, R.B., R.L. Linder, and C.W. Carlson. 1972. Polychlorinated biphenyls: Their effects on penned pheasants. *Environ. Health. Perspect* . 1:89–101.
Heath, R.G., J.W. Spann, J.F. Kreitzer, and C. Vance. 1972. Effects of polychlorinated biphenyls on birds. In: Symposium on Chemical Pollution. XV Cong. of Int. Ornithol. Den Haag. 475-485. (from EcoTox database)
Kosutzky, J., O. Adamec, and E. Bobáková. 1979. Effects of polychlorinated biphenyls on poultry reproduction. *Bull. Environ. Contam. Toxicol* . 21:737–742.
Lillie, R.J., H.C. Cecil, J. Bitman, G.G. Fries, and J. Verrett. 1974. Differences in response of caged white leghorn layers to various polychlorinated biphenyls (PCBs) in the diet. *Poul. Sci* . 53:726–732.
Lillie, R.J., H.C. Cecil, J. Bitman, and G.F. Fries. 1975. Toxicity of certain polychlorinated and polybrominated biphenyls on reproductive efficiency of caged chickens. *Poul. Sci.* 54:1550–1555.
Peakall, D.B. 1971. Effect of polychlorinated biphenyls (PCBs) on the eggshells of ring doves. *Bull. Environ. Contam. Toxicol* . 6(2):100–101.
Peakall, D.B., and M.L. Peakall. 1973. Effects of a polychlorinated biphenyl on the reproduction of artificially and naturally incubated dove eggs. *J. Appl. Ecol* . 10(3):863–868.
Platonow, N.S., and B.S. Reinhart. 1973. The effect of polychlorinated biphenyls Aroclor 1254 on chicken egg production, fertility, and hatchability. *Can. J. Comp. Med* . 37:341–346.
Riseborough, R.W., and R.W. Anderson. 1975. Some effects of DDE and PCB on mallards and their eggs. *J. Wild. Manage* . 39:508–513.
Roberts, J.R., D.W. Rodgers, J.R. Bailey, and M.A. Rorke. 1978. Polychlorinated biphenyls: Biological criteria for an assessment of their effects on environmental quality. National Research Council of Canada. Report No. 16077. 172 pp. As cited in USEPA 2000.
Summer C.L., J.P. Giesy, S.J. Bursian, J.A. Render, T.J. Kubiak, P.D. Jones, D.A. Verbrugge, and R.J. Aulerich. 1996. Effects induced by feeding organochlorine-contaminated carp from Saginaw Bay, Lake Huron, to laying White Leghorn hens. I. Effects on health of adult hens, egg production, and fertility. *J. Toxicol. Environ. Health.* 49(4):389–407.
USEPA. 2000. Phase 2 report, further site characterization and analysis, Volume 2e - Revised baseline ecological risk assessment, Hudson River PCBs reassessment. Available at: www.epa.gov/hudson/reports.htm. Prepared by TAMS Consultants, Inc. and Menzie-Cura & Associates, Inc.

Table 7-1a
Summary of Risk Drivers by A 0 C and Receptor - Terrestrial Communities and Small Home Range Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Area of Concern	Risk Driver [a]	Ecological Communities - Plants	Ecological Communities - Soil Invertebrates	Terrestrial Small Home Range Receptor: Invertivorous Mammal - Desert Shrew	Terrestrial Small Home Range Receptor: Granivorous Mammal - Merriam's Kangaroo Rat	Terrestrial Small Home Range Receptors Insectivorous Bird - Cactus Wren	Terrestrial Small Home Range Receptor: Granivorous Bird - Gambel's Quail
BCW	Dioxin TEQ	NA	NA	X	NA	NA	NA
BCW (2-Foot Scour)	Dioxin TEQ	NA	NA	X	NA	NA	NA
BCW (5-Foot Scour)	None	NA	NA	NA	NA	NA	NA
SWMU1 / TCS-4	Chromium, Hexavalent	X	X	NA	NA	NA	NA
SWMU1 / TCS-4	Chromium, Total	NA	X	X	NA	NA	NA
SWMU1 / TCS-4	Dioxin TEQ	NA	NA	X	NA	NA	NA
BCW excluding SWMU1 / TCS-4	None	NA	NA	NA	NA	NA	NA
A 0 C 4	None	NA	NA	NA	NA	NA	NA
A 0 C 9	Chromium, Hexavalent	X	X	NA	NA	NA	NA
A 0 C 9	Chromium, Total	NA	X	X	NA	NA	NA
A 0 C 9	Copper	X	X	X	NA	NA	NA
A 0 C 9	Dioxin TEQ	NA	NA	X	NA	NA	NA
A 0 C 10	Chromium, Hexavalent	X	X	NA	NA	NA	NA
A 0 C 10	Chromium, Total	NA	X	NA	NA	NA	NA
A 0 C 10	Dioxin TEQ	NA	NA	X	NA	NA	NA
A 0 C 10 (2-Foot Scour)	Chromium, Hexavalent	X	X	NA	NA	NA	NA
A 0 C 10 (2-Foot Scour)	Chromium, Total	NA	X	X	NA	NA	NA
A 0 C 10 (2-Foot Scour)	Dioxin TEQ	NA	NA	X	NA	NA	NA
A 0 C 10 (5-Foot Scour)	Chromium, Hexavalent	NA	NA	NA	NA	NA	NA
A 0 C 10 (5-Foot Scour)	Chromium Total	NA	NA	NA	NA	NA	NA
A 0 C 10 (5-Foot Scour)	Dioxin TEQ	NA	NA	X	NA	NA	NA
A 0 C 11	None	NA	NA	NA	NA	NA	NA
A 0 C 12	None	NA	NA	NA	NA	NA	NA
A 0 C 14	None	NA	NA	NA	NA	NA	NA
A 0 C 27	None	NA	NA	NA	NA	NA	NA
A 0 C 28	None	NA	NA	NA	NA	NA	NA
A 0 C 31	None	NA	NA	NA	NA	NA	NA
UA-2	None	NA	NA	NA	NA	NA	NA
Tamarisk Thicket	None	NA	NA	NA	NA	NA	NA

Table 7-1a
Summary of Risk Drivers by AOC and Receptor - Terrestrial Communities and Small Home Range Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Notes:
AOC = area of concern
BCW = bat cave wash
HQ = hazard quotient
LOAEL = lowest observed adverse effect limit
NA = not applicable
OCS = outside the Topock Compressor Station
SWMU = solid waste management unit
TCS = Topock Compressor Station
TEQ = toxic equivalent
X = risk driver for this receptor and AOC

[a] Risk drivers are identified by an HQ (plants/invertebrates) or LOAEL-based HQ (birds/mammals) greater than 1 and weight of evidence evaluation that indicates potential unacceptable risk.

Table 7-1b
Summary of Risk Drivers by AOC and Receptor - Terrestrial Large Home Range Wildlife

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Area of Concern	Risk Driver [a]	Terrestrial Large Home Range Receptor: Herbivorous Mammal - Nelson's Desert Bighorn Sheep	Terrestrial Large Home Range Receptor: Carnivorous Mammal - Desert Kit Fox	Terrestrial Large Home Range Receptor: Carnivorous Bird - Red-Tailed Hawk
OCS	None	NA	NA	NA
OCS excluding BCW and A O C 4	None	NA	NA	NA
BCW and A O C 4	None	NA	NA	NA

Notes:
A O C = area of concern
BCW = Bat Cave Wash
HQ = hazard quotient
L O A E L = lowest observed adverse effect limit
NA = not applicable
OCS = outside the Topock Compressor Station

[a] Risk drivers are identified by a L O A E L-based HQ (birds/mammals) greater than 1 and weight of evidence evaluation that indicates potential unacceptable risk.

Table 8-1
Soil Risk-Based Remediation Goals

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

C O P C Category	C O P C	Camper Cancer Risk-Based Remediation Goals (mg/kg) [a]	Camper Noncancer Hazard Risk-Based Remediation Goals (mg/kg) [b]	Hiker Cancer Risk-Based Remediation Goals (mg/kg) [a]	Hiker Noncancer Hazard Risk-Based Remediation Goals (mg/kg) [b]	O H V Rider Cancer Risk-Based Remediation Goals (mg/kg) [a]	O H V Rider Noncancer Hazard Risk-Based Remediation Goals (mg/kg) [b]
Inorganics	Chromium, Hexavalent	13	10,000	6.5	5,100	3.1	22,000
Dioxins/Furans	Toxic Equivalent Human	0.00021	0.0022	0.0001	0.0011	0.0002	0.0052

Notes:
a = Cancer Risk-Based Remediation Goals correspond to a target incremental lifetime cancer risk of 1×10^{-6}. Risk-Based Remediation Goals corresponding to target incremental lifetime cancer risks of 10^{-5} and 10^{-4} would be 10 times and 100 times higher, respectively, than the Risk-Based Remediation Goals presented in this table.
b = Noncancer hazard Risk-Based Remediation Goals correspond to a target chemical-specific hazard quotient of 1 for either the child or adult receptor as applicable for each exposure scenario. For recreational user exposure scenarios where a child receptor is evaluated (i.e., camper, hiker, and off-highway vehicle rider scenarios) the chemical-specific Risk-Based Remediation Goals calculated for the child receptor are lower than the chemical-specific Risk-Based Remediation Goals for the adult receptor; therefore, the lower Risk-Based Remediation Goals calculated for the child receptor are presented here as the most conservative Risk-Based Remediation Goals for each scenario.

Abbreviations:
C O P C = Constituent of Potential Concern
mg/kg = milligrams per kilogram
O H V = off-highway vehicle

References:
United States Environmental Protection Agency. 2018. User's Guide to Regional Screening Levels for Chemical Contaminants. May. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide.

Table 8-2
Soil Locations Associated with Unacceptable Risk to Human Receptors

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Location	Receptor	COPEC	Units	Depth Interval (feet bgs)	Risk-based Remediation Goal [a] - Value	Risk-based Remediation Goal [a] - Basis	Depth-weighted EPC [b] - Baseline	Depth-weighted EPC [b] - Method	Depth-weighted EPC [b] - Residual	Depth-weighted EPC [b] - Method	Samples Removed
Outside the Compressor Station	Human Health	Hexavalent chromium	mg/kg	0 to 0.5 foot bgs	3.1	RBRG	33.24	95% KM (Chebyshev) UCL	2.877	95% KM (Chebyshev) UCL	1 location: A O C 9 (A O C10-20)
Outside the Compressor Station	Human Health	Dioxin TEQ (10^{-6} scenario)	ng/kg	0 to 0.5 foot bgs	100	RBRG	103	KM H-UCL	89.17	KM H-UCL	1 location: SWMU1 (SWMU1-25)
Outside the Compressor Station	Human Health	Dioxin TEQ (10^{-5} scenario)	ng/kg	0 to 0.5 foot bgs	1000	RBRG	103	KM H-UCL	NA	NA	None
Outside the Compressor Station	Human Health	Hexavalent chromium	mg/kg	0 to 3 feet bgs	3.1	RBRG	22.43	95% KM (Chebyshev) UCL	2.841	95% KM (Chebyshev) UCL	3 locations: A O C 9 (A O C10-20, #10); and A O C 10 (MW-58BR_S)
Outside the Compressor Station	Human Health	Dioxin TEQ (10^{-6} scenario)	ng/kg	0 to 3 feet bgs	100	RBRG	113.8	KM H-UCL	100.5	KM H-UCL	1 location: SWMU1 (SWMU1-25)
Outside the Compressor Station	Human Health	Dioxin TEQ (10^{-5} scenario)	ng/kg	0 to 3 feet bgs	1000	RBRG	113.8	KM H-UCL	NA	NA	None

Notes:

[a] The lower of the RBRG or BTV is presented.

[b] Depth-weighted EPCs used for simplicity. Locations could be refined based on consideration of area-weighting factors or individual results at each depth interval. See Section 8 text for details.

Abbreviations:

A O C = area of concern
bgs = below ground surface
BTV = background threshold value
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
KM = Kaplan-Meier
L O A E L = lowest observed adverse effect level
mg/kg = milligram per kilogram
NA = not applicable
ng/kg = nanogram per kilogram
RBRG = risk-based remediation goal
SWMU = solid waste management unit
TEQ = toxic equivalent
TRV = toxicity reference value
UCL = upper confidence limit

Table 8-3
Ecological Risk-based Remediation Goals Summary

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Category	Risk Driver	Units	Risk-Based Remediation Goals [a] - Desert Shrew - Selected BAF/ Selected L O A E L TRV SUF = 1 L O A E L	Risk-Based Remediation Goals [a] - Desert Shrew - U S E P A (1999) BAFs/Geomean L O A E L TRV SUF = 1 L O A E L	Risk-Based Remediation Goals [a] - Desert Shrew - Fagervold et al. (2010) BAFs/Geomean L O A E L TRV SUF = 1 L O A E L
Inorganics	Chromium, total	mg/kg	145	NA	NA
Inorganics	Copper	mg/kg	145	NA	NA
Dioxins	TEQ Mammals	ng/kg	[b]	190	360

Notes:
[a] For wildlife, RBRGs were derived using the dietary dose model used to estimate HQs in the predictive E R As, calculated using an Excel solver that determines the soil concentration at which the LOAEL HQ equals 1.
[b] Soil concentration of 11 ng/kg results in an HQ of 1; this value is not recommended as a soil RBRG for shrew. See Section 8 for details.

Abbreviations:
A O C = area of concern
BAF = bioaccumulation factor
E R A = ecological risk assessment
HQ = hazard quotient
LOAEL = lowest observed adverse effect level
mg/kg = milligram per kilogram
NA = not applicable
ng/kg = nanogram per kilgram
RBRG = risk-based remediation goal
SUF = site use factor
U S E P A = United States Environmental Protection Agency
TRV = toxicity reference value

Table 8-4
Soil Locations Associated with Unacceptable Risk to Ecological Receptors

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Location	Receptor	COPEC	Units	Depth Interval (feet bgs)	Risk-based Remediation Goal [a] - Value	Risk-based Remediation Goal [a] - Basis	Depth-weighted EPC[d] - Baseline	Depth-weighted EPC[d] - Method	Depth-weighted EPC[d] - Residual	Depth-weighted EPC[d] - Method	Samples Removed
Bat Cave Wash	Desert shrew	Dioxin TEQ [b]	ng/kg	0 to 0.5 foot bgs	190	RBRG [b]	204.4	95% H-UCL	125.3	95% H-UCL	1 location: SWMU1-25
Bat Cave Wash	Desert shrew	Dioxin TEQ [c]	ng/kg	0 to 0.5 foot bgs	360	RBRG [c]	204.4	95% H-UCL	NA	NA	None
A O C 9	Desert shrew	Total chromium	mg/kg	0 to 0.5 foot bgs	145	RBRG	348.2	95% Chebyshev (Mean, Sd) UCL	93.22	95% Chebyshev (Mean, Sd) UCL	1 location: A O C 10-20
A O C 9	Desert shrew	Copper	mg/kg	0 to 0.5 foot bgs	145	RBRG	357.8	95% Chebyshev (Mean, Sd) UCL	55.49	95% Chebyshev (Mean, Sd) UCL	1 location: A O C 10-21
A O C 9	Desert shrew	Dioxin TEQ [b]	ng/kg	0 to 0.5 foot bgs	190	RBRG [b]	617.2	95% Adjusted Gamma UCL	184.5	95% Adjusted Gamma UCL	3 locations: PA-20, A O C 10-23, PA-21
A O C 9	Desert shrew	Dioxin TEQ [c]	ng/kg	0 to 0.5 foot bgs	360	RBRG [c]	617.2	95% Adjusted Gamma UCL	262.3	95% Adjusted Gamma UCL	2 locations: PA-20, A O C 10-23
A O C 10	Desert shrew	Dioxin TEQ [b]	ng/kg	0 to 0.5 foot bgs	190	RBRG [b]	360	Maximum Detect	138.6	95% Chebyshev (Mean, Sd) UCL	1 location: A O C 10c-4
A O C 10	Desert shrew	Dioxin TEQ [c]	ng/kg	0 to 0.5 foot bgs	360	RBRG [c]	360	Maximum Detect	NA	NA	None

Notes:

[a] The lower of the RBRG or BTV is presented.

b Based on U S E P A (1999) congener-specific bioaccumulation factors and geometric mean L O A E L TRV.

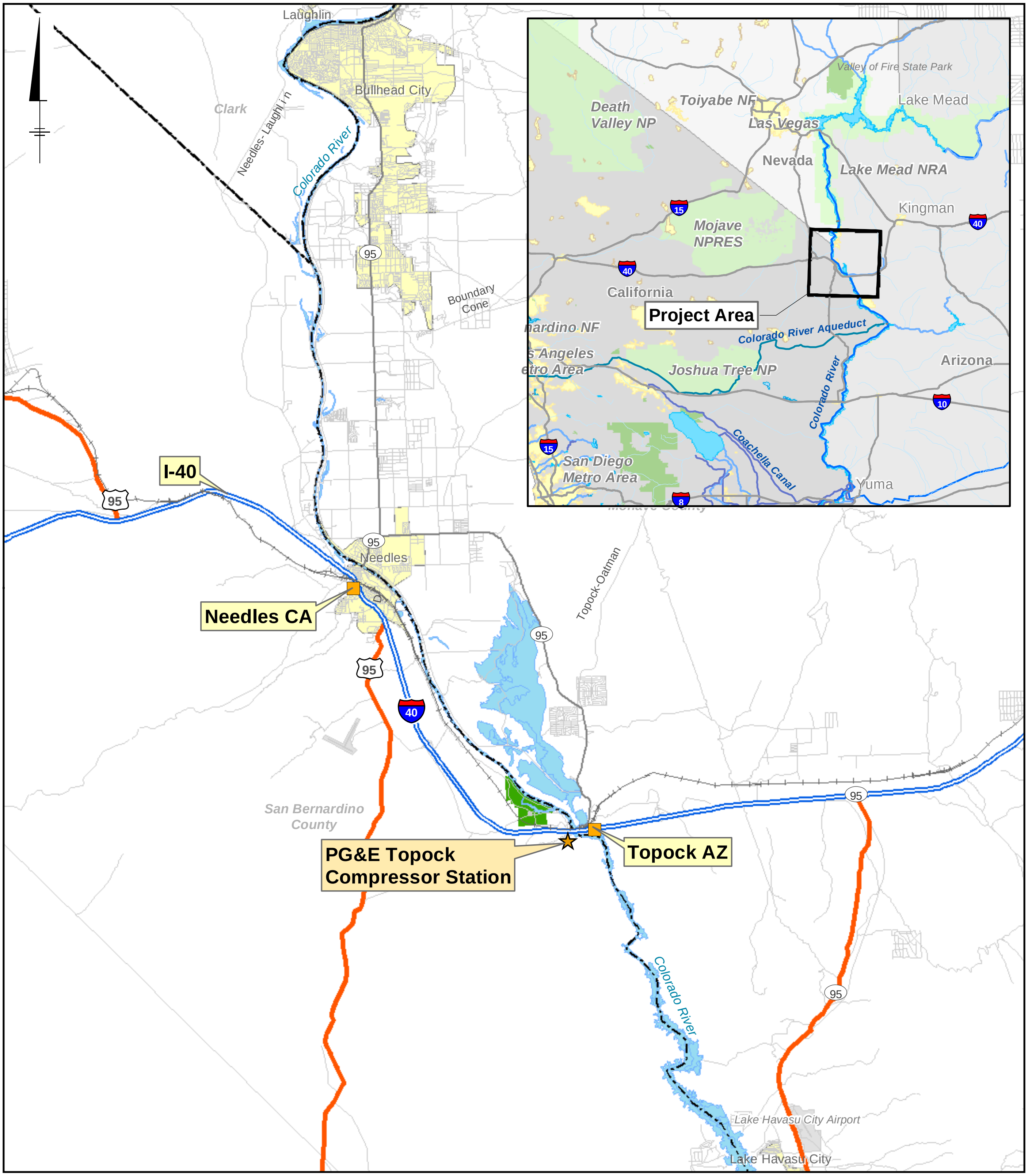
c Based on the Fagervold et al. (2010) congener-specific bioaccumulation factors and geometric mean L O A E L TRV.

[d] Depth-weighted EPCs used for simplicity. Locations could be refined based on consideration of area-weighting factors or individual results at each depth interval. See Section 8 text for details.

Abbreviations:

A O C = area of concern
bgs = below ground surface
BTV = background threshold value
C O P E C = constituent of potential ecological concern
EPC = exposure point concentration
L O A E L = lowest observed adverse effect level
mg/kg = milligram per kilogram
NA = not applicable
ng/kg = nanogram per kilogram
RBRG = risk-based remediation goal
SWMU = solid waste management unit
TEQ = toxic equivalent
TRV = toxicity reference value
UCL = upper confidence limit
U S E P A = United States Environmental Protection Agency

FIGURES



0 5 10 Miles

GRAPHIC SCALE

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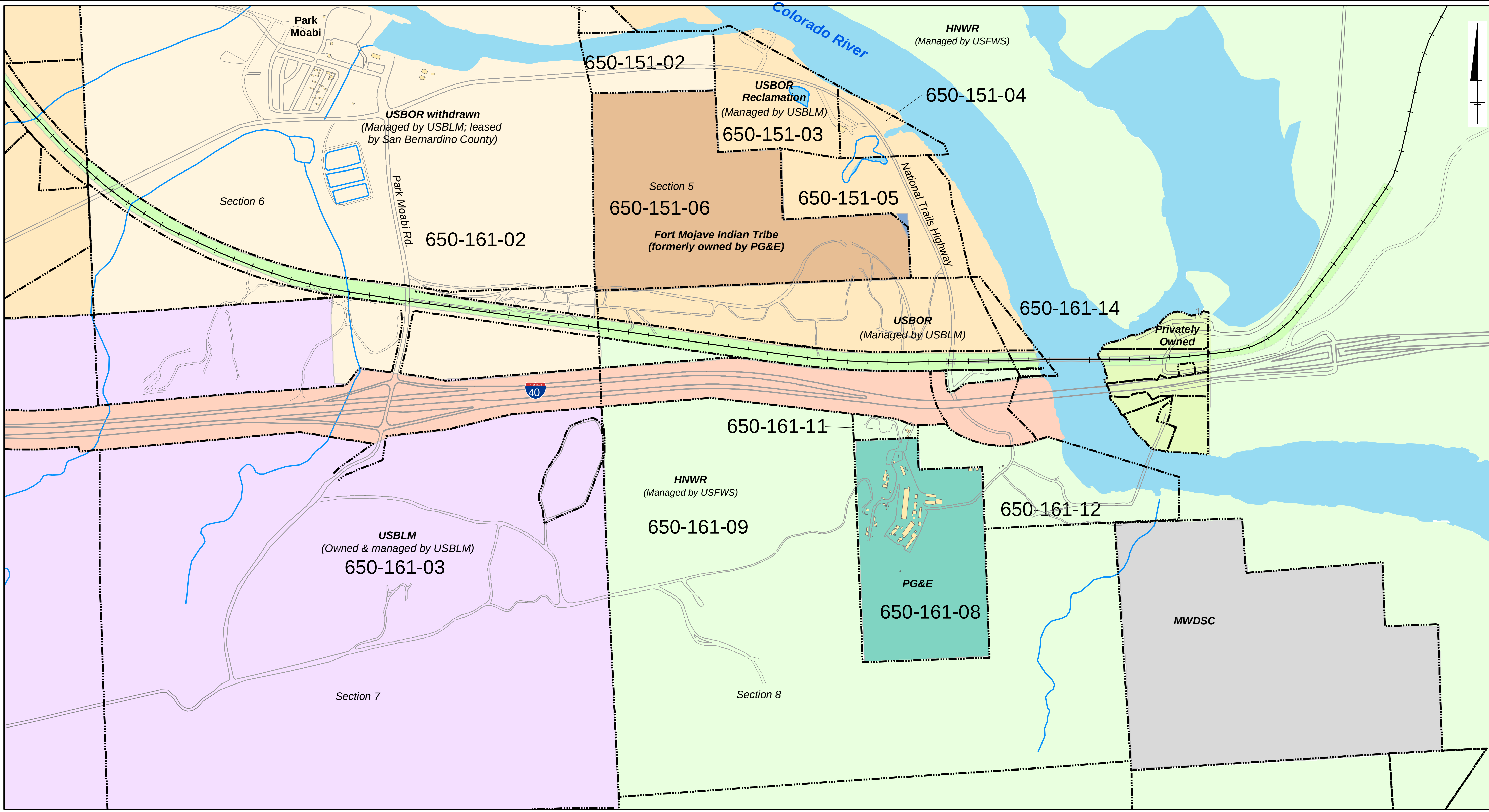
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-1



LEGEND:

- Burlington Northern Santa Fe Railroad (BNSF)
- Owned and Managed by U.S. Bureau of Land Management (USBLM)
- U.S. Bureau of Reclamation (USBLM)
- Caltrans Leased From Underlying Federal Owner
- Havasu National Wildlife Refuge (HNWR)
- Metropolitan Water District of Southern California (MWDSC)
- Pacific Gas and Electric Company (PG&E)
- Privately Owned
- Fort Mojave Indian Tribe
- San Bernardino County (SBC)
- State of California
- Property Boundary
- Highway
- Paved Road
- Dirt or Gravel Road
- Stream
- Building

0 1,000 2,000 Feet

GRAPHIC SCALE

NOTES:

1. The boundary lines shown are approximate and for reference only.

2. Source: San Bernadino County Assessor, Parcel quest, State Board of Equalization, Pacific Gas and Electric Company, Ecology and Environment and Plat maps provided by USBLM.

3. Map Source: CH2M HILL (2005-2008)

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SURROUNDING PROPERTIES

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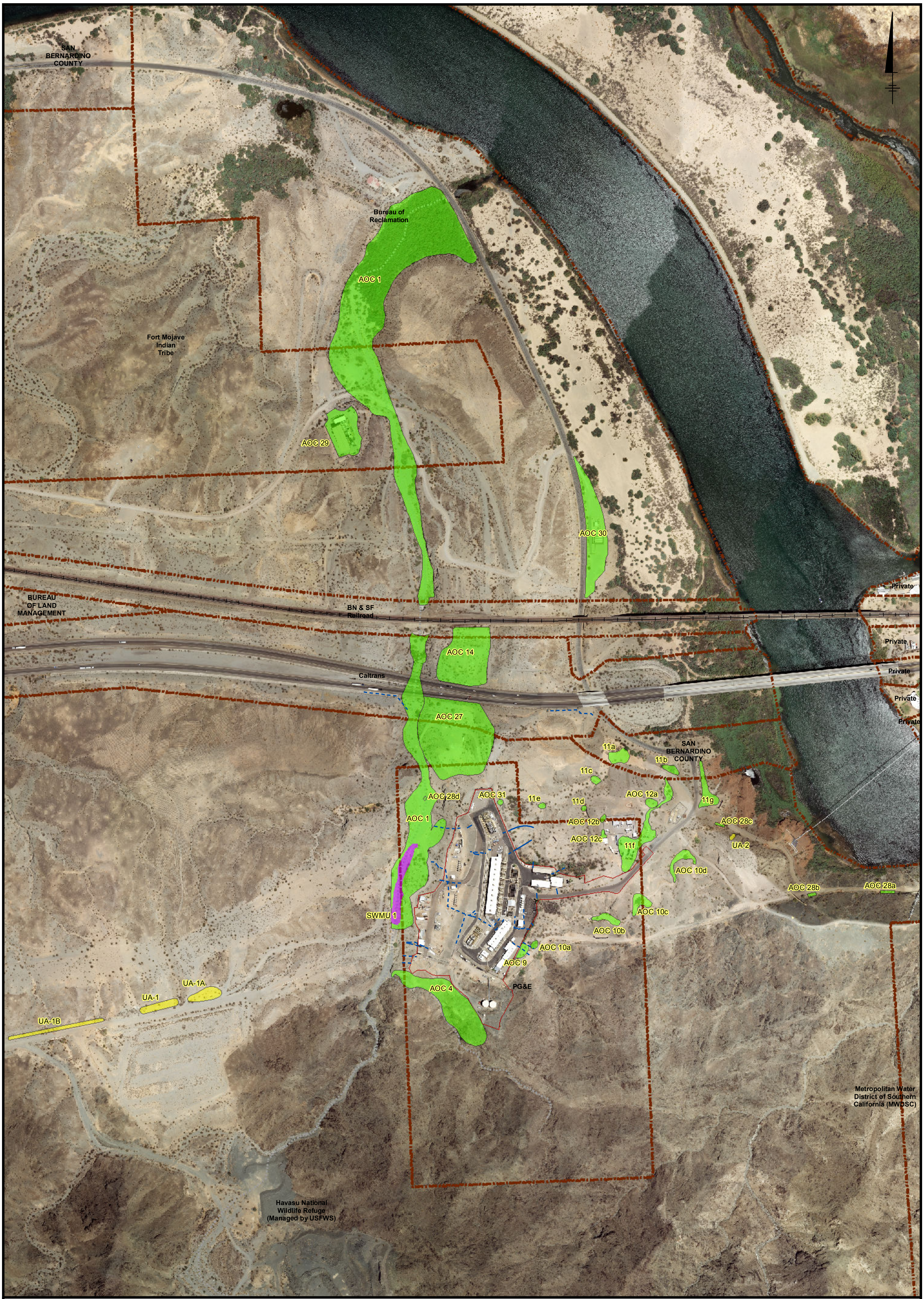
FIGURE **1-2**

PATH: Z:\GISProjects_ENV\PGE_Topock\GIS\ArcMap_MXD\SHHERA_rev\Fig_1-2_Surrounding_Properties.mxd 6/7/2018 11:10:47 AM

C:\Users\JDLoving\OneDrive - ARCADIS\BIM 360 Docs\PACIFIC GAS & ELECTRIC\TOPOCK-SWMU RAWP\Fig 2-1A.pdf CREATED: 06/08/2018 MODIFIED:06/11/2018 BY: JDLOVING



LEGEND

- Area of Concern (AOC)
- Solid Waste Management Unit (SWMU)
- Other Area
- Stormwater Piping Below Ground
- Stormwater Piping Above Ground
- Topock Compressor Station Fence Line
- Property Owner Area

0 390 780 Feet

Map Source: CH2M HILL (2018)

PG&E TOPOCK COMPRESSOR STATION NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SWMUs AND AOCs (OUTSIDE THE COMPRESSOR STATION)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2-1a

LEGEND

- Area of Concern (AOC)
- Solid Waste Management Unit (SWMU)
- Stormwater Piping Above Ground (Approximate Location)
- Stormwater Piping Below Ground (Approximate Location)
- Topock Compressor Station Fence Line
- Property Owner Area

0 100 200 Feet

Notes:
1) AOC 13 is not depicted on this figure. It consists of the unpaved areas within the compressor station.
2) AOC 20 is not depicted on this figure. It consists of industrial floor drains within the compressor station.
3) Boundaries of all SWMUs, AOCs, and Other Areas are approximate.

Map Source: CH2M HILL (2018)

PG&E TOPOCK COMPRESSOR STATION NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SWMUs AND AOCs (INSIDE THE COMPRESSOR STATION)

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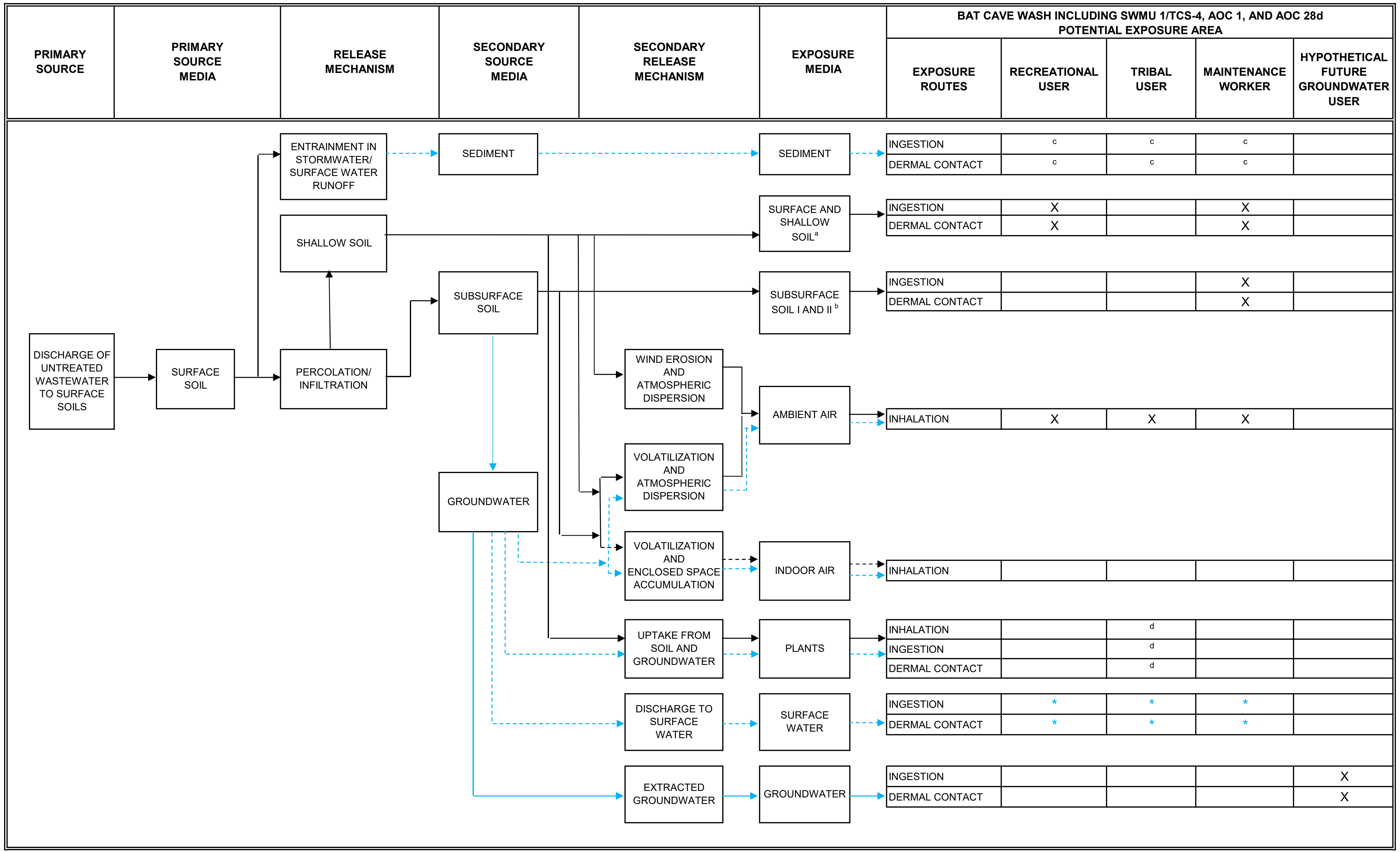
FIGURE **2-1b**

Figure 2-2
Updated[1] Human Health Conceptual Site Model for Bat Cave Wash: Recreational, Tribal, and Worker Users

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



EXPOSURE MEDIA	EXPOSURE ROUTES	RECREATIONAL USER	TRIBAL USER	MAINTENANCE WORKER	HYPOTHETICAL FUTURE GROUNDWATER USER
SEDIMENT	INGESTION	c	c	c	
	DERMAL CONTACT	c	c	c	
SURFACE AND SHALLOW SOIL[a]	INGESTION	X		X	
	DERMAL CONTACT	X		X	
SUBSURFACE SOIL I AND II [b]	INGESTION			X	
	DERMAL CONTACT			X	
AMBIENT AIR	INHALATION	X	X	X	
INDOOR AIR	INHALATION				
PLANTS	INHALATION		d		
	INGESTION		d		
	DERMAL CONTACT		d		
SURFACE WATER	INGESTION	*	*	*	
	DERMAL CONTACT	*	*	*	
GROUNDWATER	INGESTION				X
	DERMAL CONTACT				X

NOTES:

[1] Conceptual site model (CSM) from the Topock Final Human Health and Ecological Risk Assessment Work Plan (RAWP; Arcadis 2008a), updated with information based on the Topock Groundwater Risk Assessment (GWRA; Arcadis 2009b), the Topock Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015) and recent soil investigations.

a Surface soils defined as soils collected at depths between 0 and 0.5 feet below ground surface (bgs); shallow soil defined as soil collected bewteen 0 and 3 feet bgs.

b Subsurface soil I defined as soil collected between depths of 0 an 6 feet bgs; subsurface soil II defined as soil collected between 0 and 10 feet bgs.

c Insignificant exposure route as evaluated in Section 2.5.2.5 of the main report.

d In accordance with the request by the Tribes, the pathway for plant contact for the tribal user is shown as incomplete as discussed in Section 4.4.1 of the RAWP Addendum 2 (Arcadis 2015).

→ (solid black arrow) Potentially complete transport pathway to be included in the quantitative soil risk assessment.

⇢ (dashed black arrow) Insignificant transport pathway.

→ (solid blue arrow) Quantitative evaluation of the groundwater pathway completed in the GWRA (Arcadis 2009b).

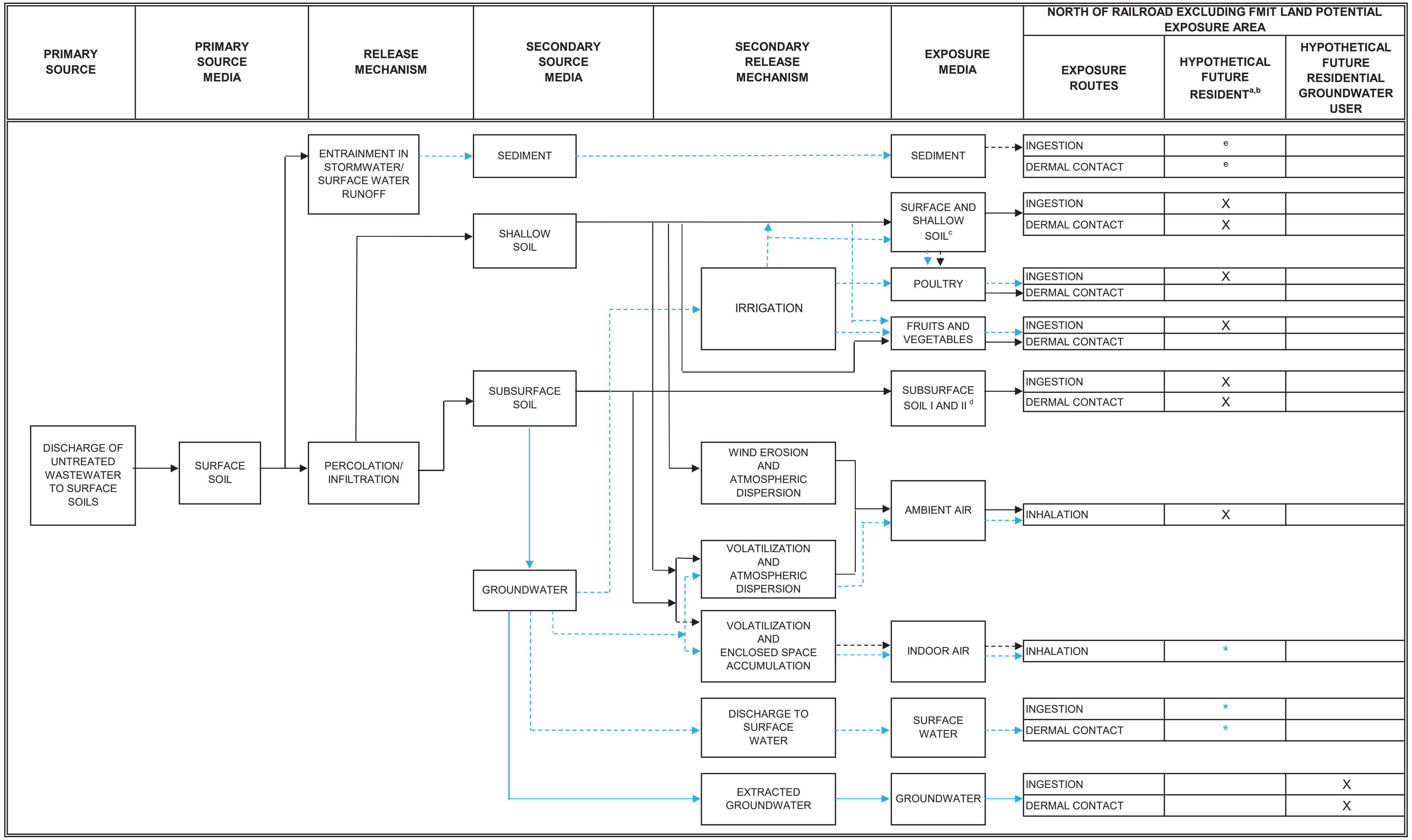
⇢ (dashed blue arrow) Insignificant transport pathway as evaluated in the GWRA (Arcadis 2009b) for groundwater and Section 2.5 of the main report (Surface Soil Transport Assessment [SSTA]) for sediment.

X Potentially complete exposure route to be included in the quantitative soil risk assessment; quantitative evaluation of groundwater exposure route completed in the GWRA (ARCADIS, 2009b).

* Insignificant exposure route as evaluated in the GWRA (Arcadis 2009b).

Figure 2-3
Updated[1] Human Health Conceptual Site Model for Bat Cave Wash: Hypothetical Future Residential Use North of Railroad

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



NOTES:

[1] Conceptual site model (CSM) from the Topock Final Human Health and Ecological Risk Assessment Work Plan (RAWP; Arcadis 2008a), updated with information based on the Topock Groundwater Risk Assessment (GWRA; Arcadis 2009b), the Topock Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015) and recent soil investigations.

a As described in the text, the U.S. Bureau of Land Management (USBLM) has requested that the risk assessment assume future unrestricted use of their property. Accordingly, a future hypothetical residential scenario for contact with soils will be evaluated for property owned by USBLM.

b The hypothetical future resident scenarios are based on land use identified by the Federal government as owners and managers of the land.

c Surface soils defined as soils collected at depths between 0 and 0.5 feet below ground surface (bgs); shallow soil defined as soil collected bewteen 0 and 3 feet bgs.

d Subsurface soil I defined as soil collected between depths of 0 an 6 feet bgs; subsurface soil II defined as soil collected between 0 and 10 feet bgs.

e Insignificant exposure route as evaluated in Section 2.5.2.5 of the main report.

——▶ Potentially complete transport pathway to be included in the quantitative soil risk assessment.

- - -▶ Insignificant transport pathway.

——▶ (blue) Quantitative evaluation of the groundwater pathway completed in the GWRA (Arcadis 2009b).

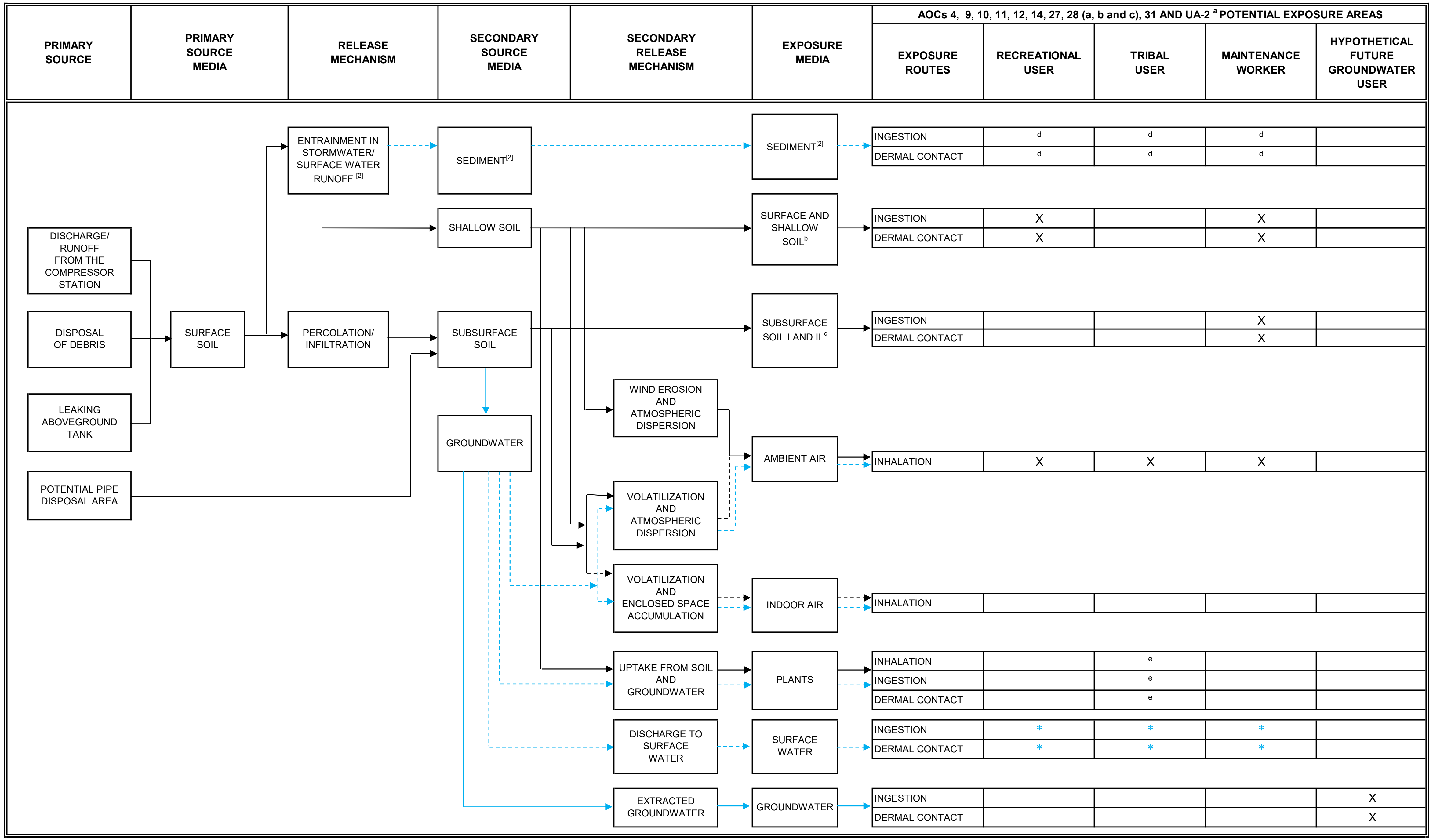
- - -▶ (blue) Insignificant transport pathway as evaluated in the GWRA (Arcadis 2009b) for groundwater and Section 2.5 of the main report (Surface Soil Transport Assessment [SSTA]) for sediment.

X Potentially complete exposure route to be included in the quantitative soil risk assessment; quantitative evaluation of the groundwater pathway completed in the GWRA (Arcadis 2009b).

* Insignificant exposure route as evaluated in the GWRA (Arcadis 2009b).

Figure 2-4
Updated[1] Human Health Conceptual Site Model for AOCs 4, 9, 10, 11, 12, 14, 27, 28 (a, b, and c), 31, and UA-2 (Outside the Compressor Station) [a]: Recreational, Tribal, and Worker Users

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

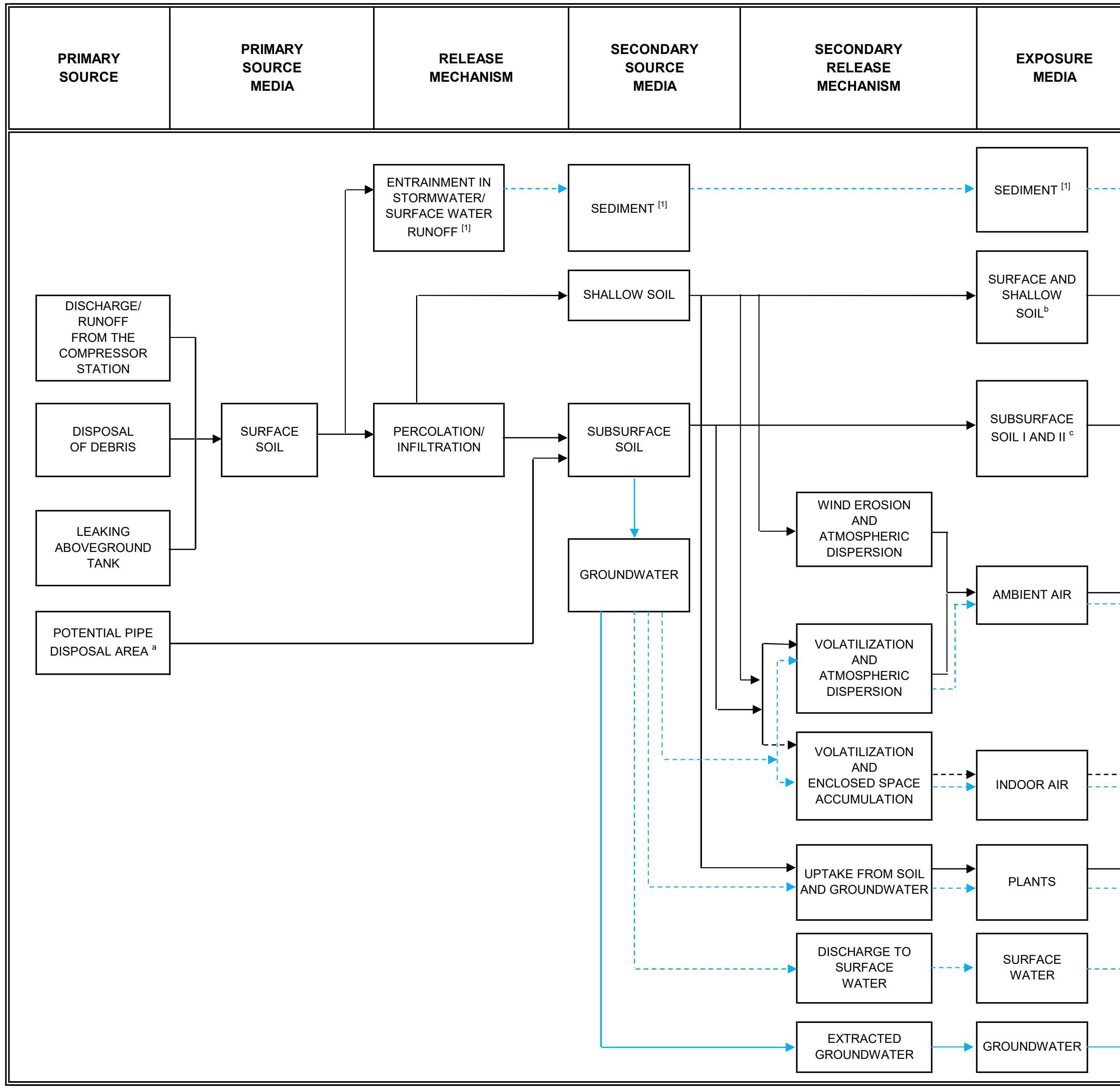


NOTES:

[1] Conceptual site model (CSM) from the Topock Final Human Health and Ecological Risk Assessment Work Plan (RAWP; Arcadis 2008a) updated with information based on the Topock Groundwater Risk Assessment (GWRA; Arcadis 2009b), the Topock Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (Arcadis 2015) and recent soil investigations.
[2] Applicable to AOC 10 only.
a The Former 300B Pipeline Liquids Tank Area (UA-2) outside the compressor station has already been closed (CH2M 2007d), but DTSC has requested additional investigation (DTSC 2007a). Based on the results of the RFI/RI investigation, UA-2 is included in the Human Health Risk Assessment (HHRA).
b Surface soils defined as soils collected at depths between 0 and 0.5 feet below ground surface (bgs); shallow soil defined as soil collected bewteen 0 and 3 feet bgs.
c Subsurface soil I defined as soil collected between depths of 0 an 6 feet bgs; subsurface soil II defined as soil collected between 0 and 10 feet bgs.
d Insignificant exposure route as evaluated in Section 2.5.2.5 of the main report.
e In accordance with the request by the Tribes, the pathway for plant contact for the tribal user is shown as incomplete as discussed in Section 4.4.1 of the RAWP Addendum 2 (Arcadis 2015).
Solid black arrow: Potentially complete transport pathway to be included in the quantitative risk assessment.
Dashed black arrow: Insignificant transport pathway.
Solid blue arrow: Quantitative evaluation of the groundwater pathway completed in the GWRA (Arcadis 2009b).
Dashed blue arrow: Insignificant transport pathway as evaluated in the GWRA (Arcadis 2009b) for groundwater and Section 2.5 of the main report (Surface Soil Transport Assessment [SSTA]) for sediment.
X Potentially complete exposure route to be included in the quantitative soil risk assessment; quantitative evaluation of groundwater exposure route completed in the GWRA (Arcadis 2009b).
* Insignificant exposure route as evaluated in the GWRA (Arcadis 2009b).

Figure 2-5
Human Health Conceptual Site Model for the Outside the Compressor Station Fenceline (Including Bat Cave Wash) Exposure Area [a]: Recreational, Tribal, and Worker Users

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



OUTSIDE THE COMPRESSOR STATION FENCELINE (INCLUDING BAT CAVE WASH) POTENTIAL EXPOSURE AREA

EXPOSURE MEDIA	EXPOSURE ROUTES	RECREATIONAL USER	TRIBAL USER	MAINTENANCE WORKER	HYPOTHETICAL FUTURE GROUNDWATER USER
SEDIMENT [1]	INGESTION	d	d	d	
	DERMAL CONTACT	d	d	d	
SURFACE AND SHALLOW SOIL b	INGESTION	X		X	
	DERMAL CONTACT	X		X	
SUBSURFACE SOIL I AND II c	INGESTION			X	
	DERMAL CONTACT			X	
AMBIENT AIR	INHALATION	X	X	X	
INDOOR AIR	INHALATION				
PLANTS	INHALATION		e		
	INGESTION		e		
	DERMAL CONTACT		e		
SURFACE WATER	INGESTION	*	*	*	
	DERMAL CONTACT	*	*	*	
GROUNDWATER	INGESTION				X
	DERMAL CONTACT				X

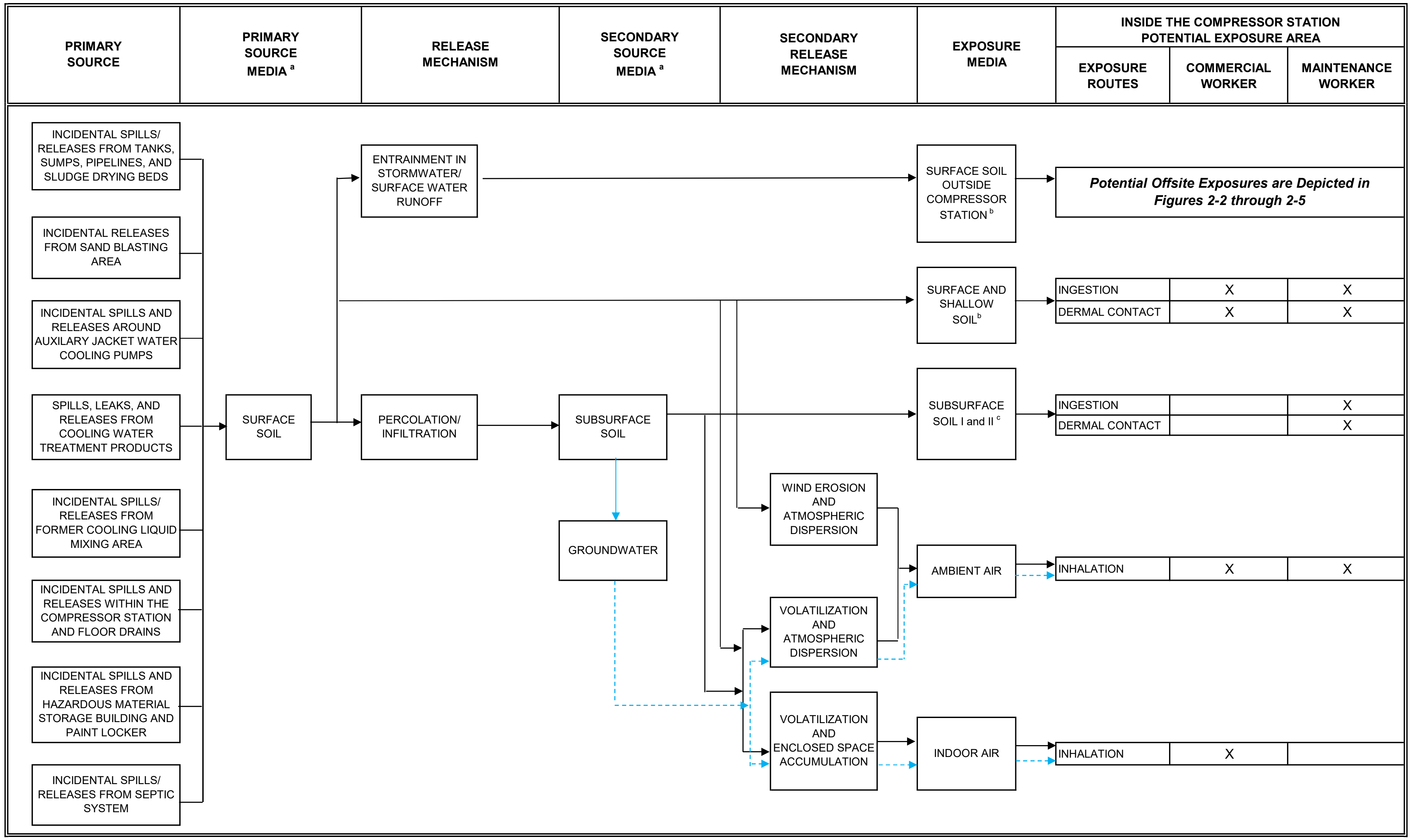
NOTES:

[1] Applicable to AOC 10 and AOC 1 only.
a The Former 300B Pipeline Liquids Tank Area (UA-2) outside the compressor station has already been closed (CH2M 2007d), but DTSC has requested additional investigation (DTSC 2007a). Based on the results of the RI/RFI Investigation, the Former 300B UA-2 is included in the Human Health Risk Assessment (HHRA).
b Surface soils defined as soils collected at depths between 0 and 0.5 feet below ground surface (bgs); shallow soil defined as soil collected bewteen 0 and 3 feet bgs.
c Subsurface soil I defined as soil collected between depths of 0 an 6 feet bgs; subsurface soil II defined as soil collected between 0 and 10 feet bgs.
d Insignificant exposure route as evaluated in Section 2.5.2.5 of the main report.
e In accordance with the request by the Tribes, the pathway for plant contact for the tribal user is shown as incomplete as discussed in Section 4.4.1 of the RAWP Addendum 2 (Arcadis 2015).
(solid black arrow) Potentially complete transport pathway to be included in the quantitative risk assessment.
(dashed black arrow) Insignificant transport pathway.
(solid blue arrow) Quantitative evaluation of the groundwater pathway completed in the Groundwater Risk Assessment (GWRA; Arcadis 2009b).
(dashed blue arrow) Insignificant transport pathway as evaluated in the GWRA (Arcadis 2009b) for groundwater and Section 2.5 of the main report (Surface Soil Transport Assessment [SSTA]) for sediment.
X Potentially complete exposure route to be included in the quantitative soil risk assessment; quantitative evaluation of groundwater exposure route completed in the GWRA (Arcadis 2009b).
* Insignificant exposure route as evaluated in the GWRA (Arcadis 2009b).

Figure 2-6

Human Health Conceptual Site Model for Inside the Compressor Station: Worker Users

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



NOTES:

[a] Potentially complete transport pathway from primary and secondary source media within the compressor station to exposure media outside of the compressor station and potentially complete exposure pathways are further evaluated in the risk assessment in the context of areas outside of the compressor station, see Figures 2-2 through 2-5.

[b] Surface soils defined as soils collected at depths between 0 and 0.5 feet below ground surface (bgs); shallow soil defined as soil collected bewteen 0 and 3 feet bgs.

[c] Subsurface soil I defined as soil collected between depths of 0 an 6 feet bgs; subsurface soil II defined as soil collected between 0 and 10 feet bgs.

Potentially complete transport pathway to be included in the quantitative risk assessment.

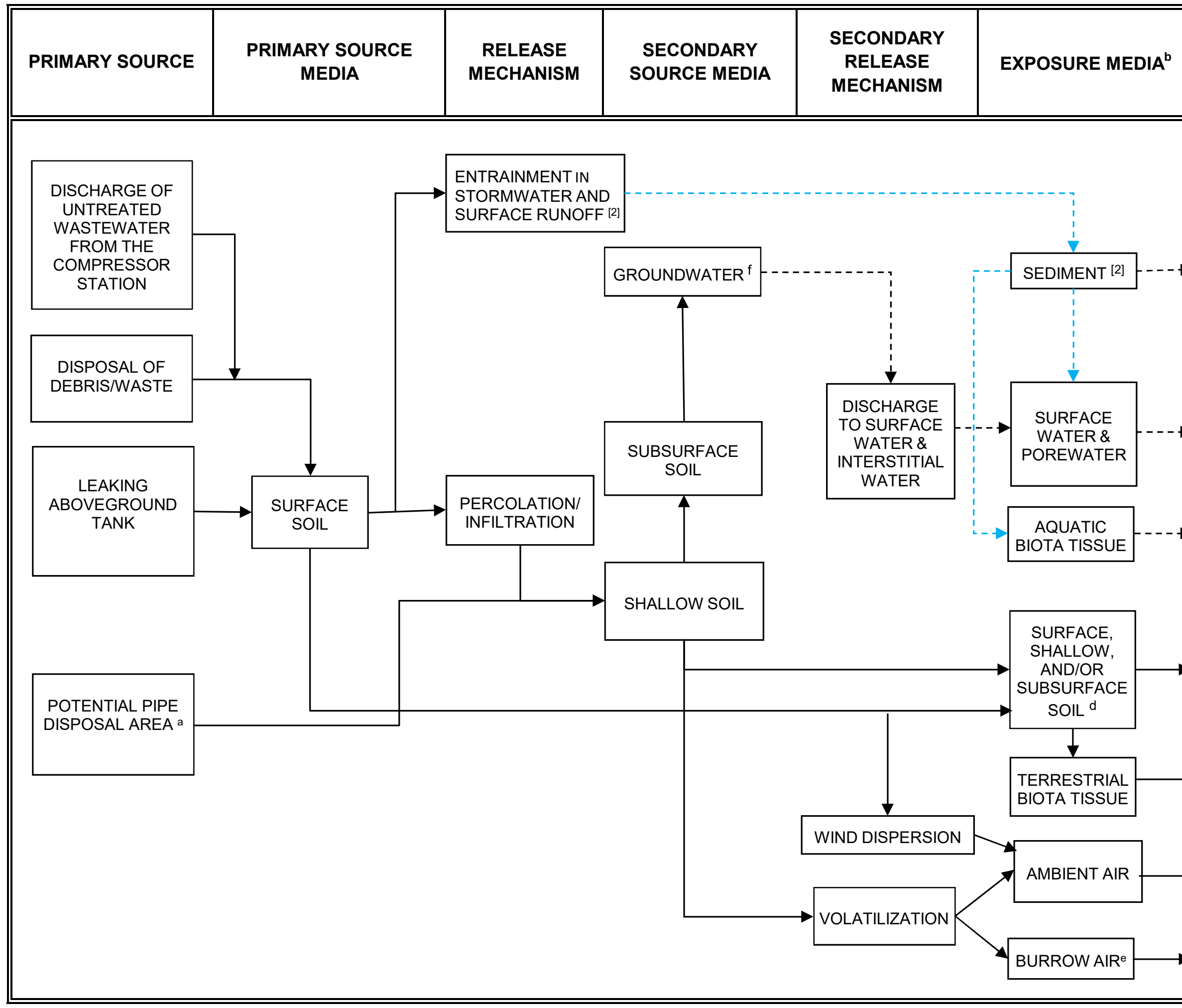
Potentially complete transport pathway. Quantitative evaluation of the groundwater pathway completed in the GWRA (Arcadis 2009b).

Insignificant transport pathway as evaluated in the GWRA (Arcadis 2009b).

X Potentially complete exposure route to be included in the quantitative risk assessment.

FIGURE 2-7
Updated[1] Ecological Conceptual Site Model

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



EXPOSURE MEDIA	EXPOSURE ROUTES	PLANTS	SOIL INVERTEBRATES	AQUATIC LIFE/FISH	REPTILES/ AMPHIBIANS	TERRESTRIAL BIRDS	TERRESTRIAL MAMMALS
SEDIMENT [2]	DERMAL ABSORPTION, DIRECT CONTACT, ROOT UPTAKE	O	O	O	O	O	O
	INGESTION		O	O	O	O	O
SURFACE WATER & POREWATER	DERMAL ABSORPTION, DIRECT CONTACT, ROOT UPTAKE	O*	O*	O*	O*	O*	O*
	INGESTION		O*	O*	O*	O*	O*
AQUATIC BIOTA TISSUE	INGESTION			O	O	O	O
SURFACE, SHALLOW, AND/OR SUBSURFACE SOIL [d]	DERMAL ABSORPTION, DIRECT CONTACT, ROOT UPTAKE	X	X		O	O	O
	INGESTION		X		O	X	X
TERRESTRIAL BIOTA TISSUE	INGESTION				O	X	X
AMBIENT AIR	INHALATION				O[c]	O[c]	O[c]
BURROW AIR[e]	INHALATION				O[c]		O[c]

NOTES:

[1]	Conceptual site model (CSM) from the Topock Final Human Health and Ecological Risk Assessment Work Plan Addendum 2 (RAWP; ARCADIS, 2015) updated with information based the complete risk assessment dataset.
[2]	Applicable to AOC 1 and AOC 10 only. Ephemeral flooding is due to infrequent high flows in the wash.
——▶	Potentially complete exposure pathway
- - - -▶ (blue)	Insignificant transport pathway as evaluated in Section 2.5 (Surface Soil Transport Assessment [SSTA])
- - - -▶	Insignificant transport pathway as evaluated in the Topcock Groundwater Risk Assessment (GWRA; ARCADIS, 2009a) and confirmed in the draft RFI/RI Volume 3 report (being prepared by Jacobs).
*	Insignificant exposure route as evaluated in the GWRA (ARCADIS, 2009a).
X	Potentially complete exposure route, assumed significant and directly assessed
O	Potentially complete exposure route, assumed insignificant and not directly assessed
AOC	Area of concern
a	The Former 300B Pipeline Liquids Tank area has already been closed (CH2M HILL, 2007), but DTSC has requested additional investigation (CalEPA, 2007). This area was included as part of the UA-2 exposure area.
b	For large home range ecological receptors, three exposure areas were evaluated: 1) OCS (all areas outside the compressor station), 2) BCW+AOC4 (Bat Cave Wash and AOC 4, and 3) OCSxBCW+AOC4 (all other remaining areas outside the compressor station excluding BCW and AOC 4. For plants, soil invertebrates, and small home range ecological receptors, 14 individual exposure areas were evaluated: BCW, SMWU1, BCWxSWMU1, AOC4, AOC9, AOC10, AOC11, AOC12, AOC14, AOC 27, AOC28, AOC31, UA-2 (including the former 300B Pipeline Liquids Tank area), Tamarisk Thicket. All exposure pathways inside the compressor station are considered incomplete and will not be evaluated for ecological receptors.
c	Potential inhalation exposure in burrows was considered an insignificant pathway based on infrequent and low concentration detections of volatile organic compounds (VOCs) in soil.
d	For applicable soil exposure depth, please see Fig 6-1.
e	Applicable soil depth is 0-6 feet below ground surface (bgs) for volatilization to burrow air.
f	As requested by California's Department of Toxic Substances Control (DTSC), the groundwater-to-phreatophytes pathway and consumption of phreatophytes by herbivores were evaluated in the GWRA (ARCADIS, 2009a) and exposure and risk were found to be insignificant.

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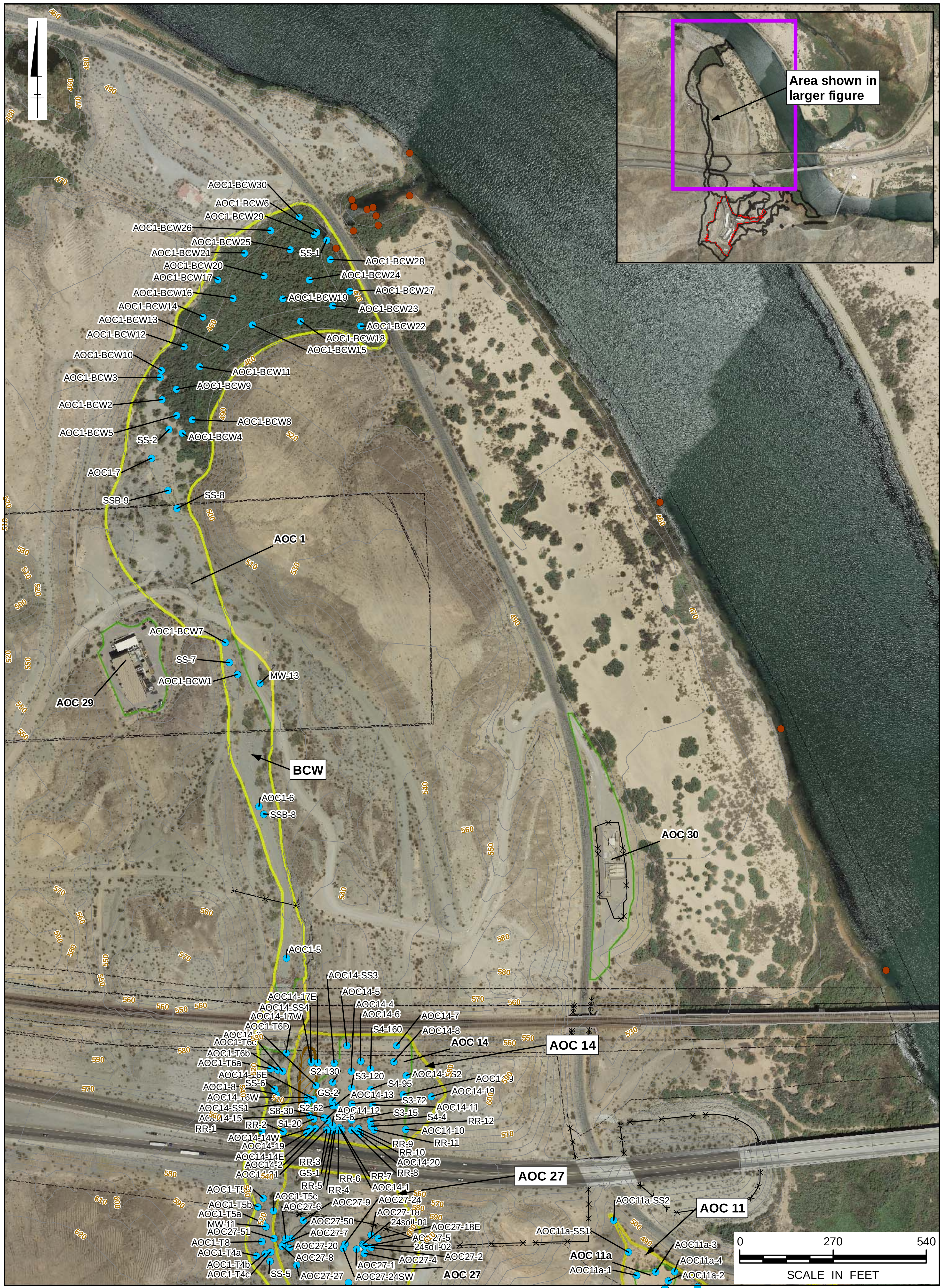

Legend:

- Soil Sampling Location
- Sediment Sampling Location
- Area of Concern
- OCS Exposure Area
- Exposure Area
- Potential Burning Related Location
- Fencing
- Property Boundaries
- Contour Line (10 feet interval)
- Inside the Topock Compressor Station boundary, as defined by current fenceline
- AOC 14 — Label for Exposure Area
- AOC 14 — Label for Area of Concern

Notes:
1. All sample locations with a labeled location ID are included in Outside the Compressor Station (OCS) exposure areas.

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SOIL SAMPLING LOCATIONS EXPOSURE AREAS OUTSIDE COMPRESSOR STATION - NORTH

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FIGURE
3-1a

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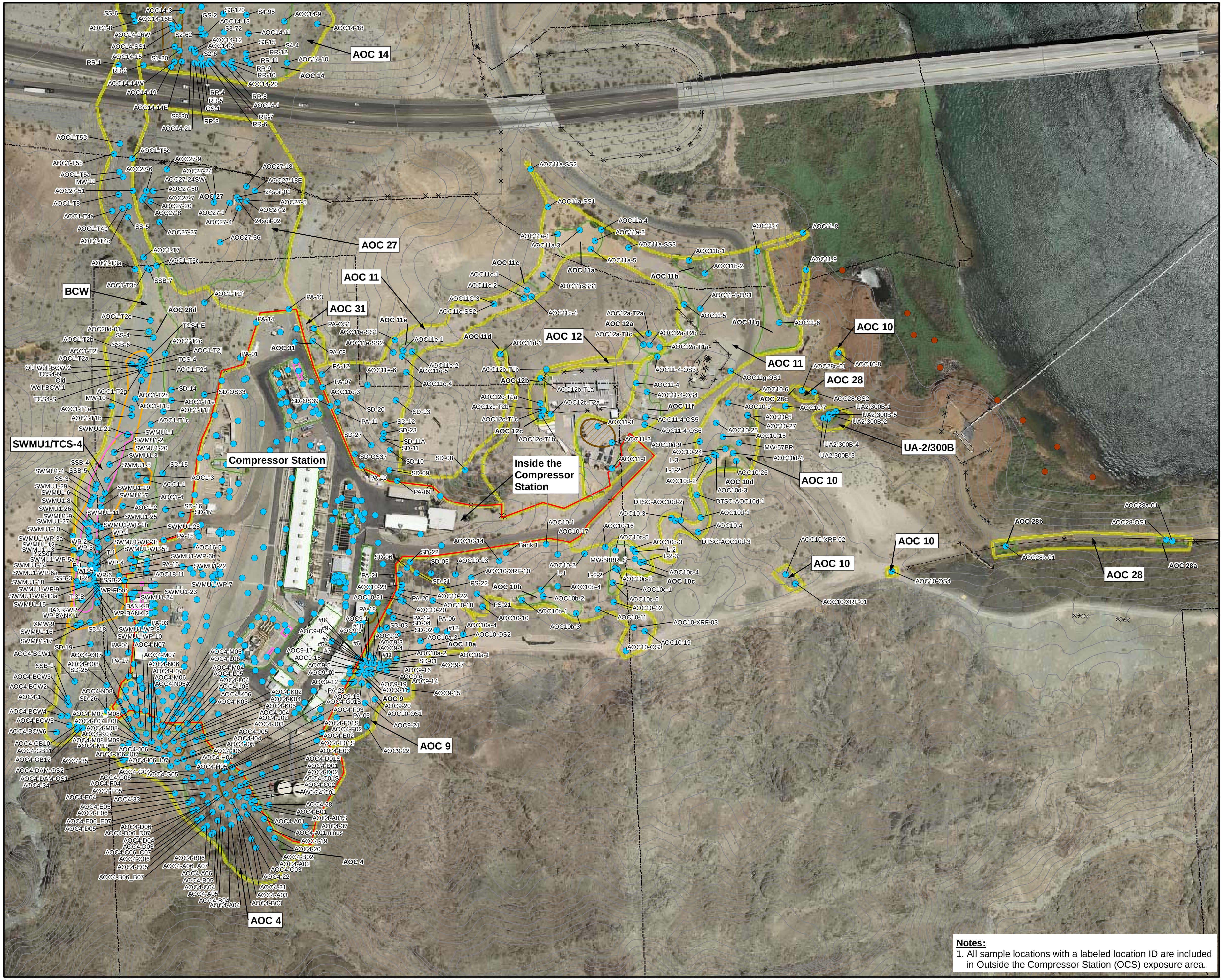

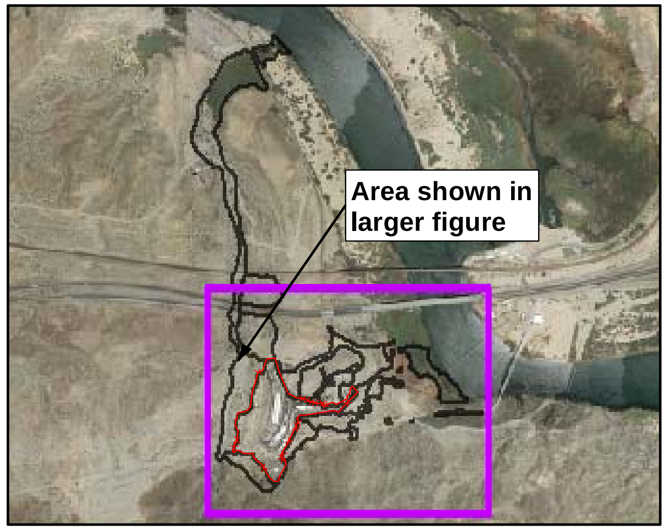

Legend:

- Soil Sampling Location
- Sediment Sampling Location
- Area of Concern
- Solid Waste Management Unit
- Potential Burning Related Location
- OCS Exposure Area
- SWMU1 Exposure Area
- Exposure Area
- Property Boundaries
- Contour Line (10 feet interval)
- Fencing
- Inside the Topock Compressor Station boundary, as defined by current fenceline

AOC 28 — Label for Exposure Area

AOC 28a — Label for Area of Concern

0 240 480

SCALE IN FEET

Notes:
1. All sample locations with a labeled location ID are included in Outside the Compressor Station (OCS) exposure area.

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SOIL SAMPLING LOCATIONS EXPOSURE AREAS OUTSIDE COMPRESSOR STATION - SOUTH

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FIGURE
3-1b

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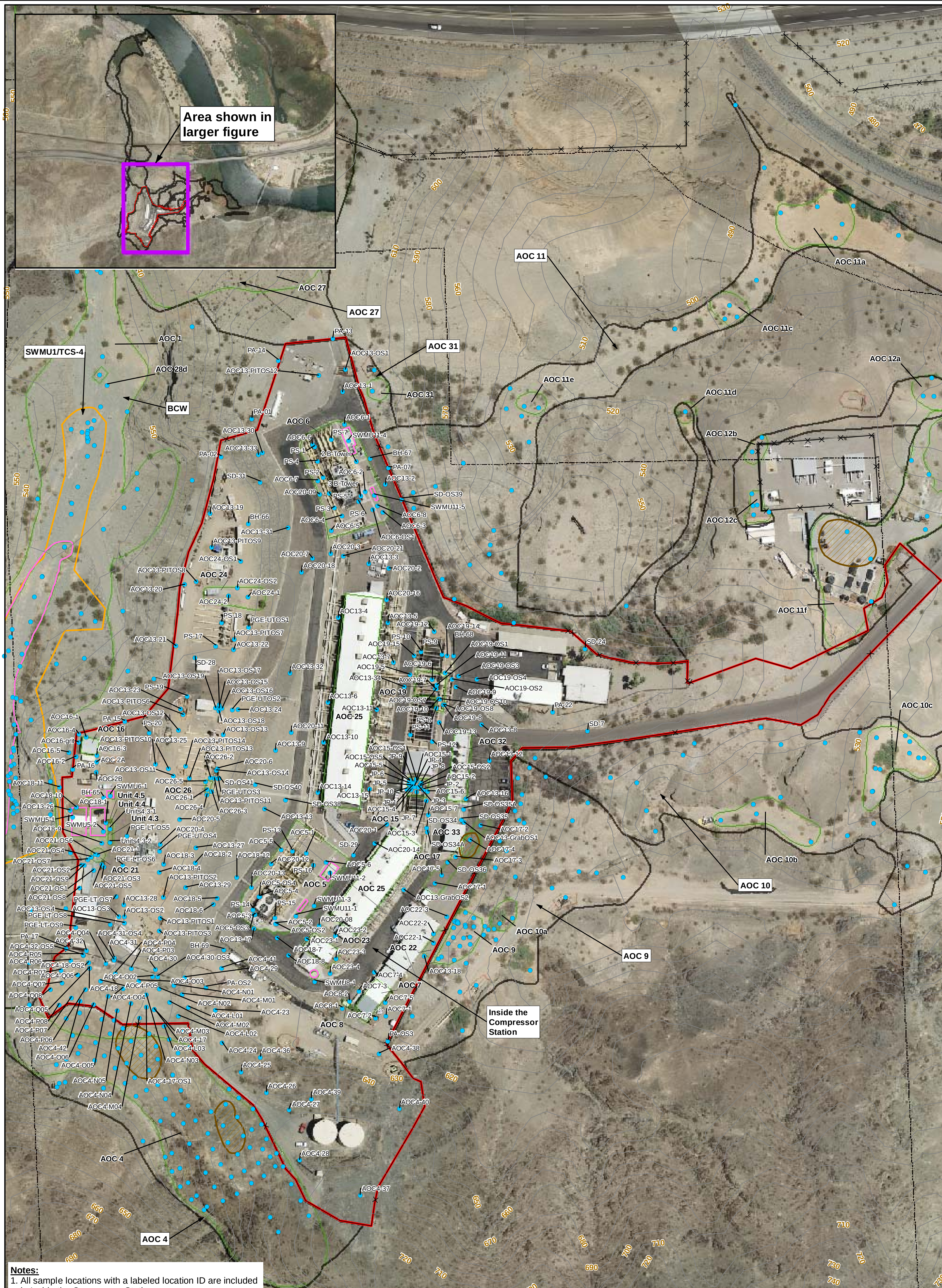

Notes:
1. All sample locations with a labeled location ID are included in Inside the Compressor Station exposure area.

Legend:

- Soil Sampling Location
- Area of Concern
- Exposure Area
- Solid Waste Management Unit
- SWMU1 Exposure Area
- Potential Burning Related Location
- Fencing
- Property Boundaries
- Contour Line (10 feet interval)
- Inside the Topock Compressor Station boundary, as defined by current fenceline
- AOC 4 Label for Exposure Area
- AOC 4 Label for Area of Concern

0 140 280

SCALE IN FEET

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

SOIL SAMPLING LOCATIONS INSIDE THE COMPRESSOR STATION EXPOSURE AREA

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FIGURE

3-2

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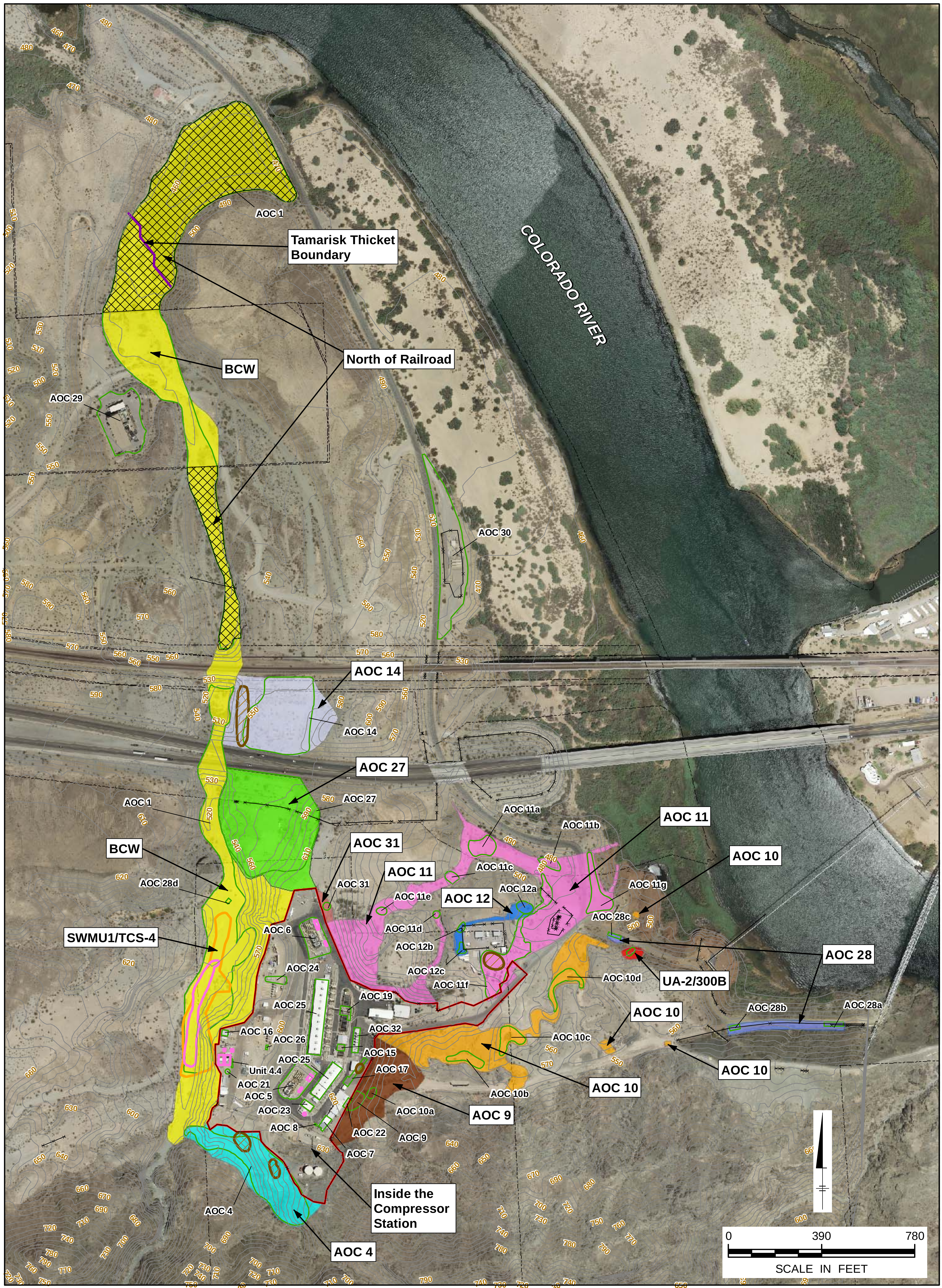

Legend:

- Area of Concern
- Solid Waste Management Unit
- Potential Burning Related Location
- Property Boundaries
- Contour Line (10 feet interval)
- Fence Line
- BCW — Label for Exposure Area
- AOC 1 — Label for Area of Concern

Exposure Areas

- Inside the Topock Compressor Station boundary, as defined by current fenceline
- North of Railroad
- SWMU1/TCS-4 Exposure Area
- BCW
- AOC 10
- AOC 11
- AOC 12
- AOC 14
- AOC 27
- AOC 28
- AOC 31
- AOC 4
- AOC 9
- UA-2/300B

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

EXPOSURE AREAS BASED ON INDIVIDUAL AOCS/INVESTIGATION AREAS

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FIGURE

3-3

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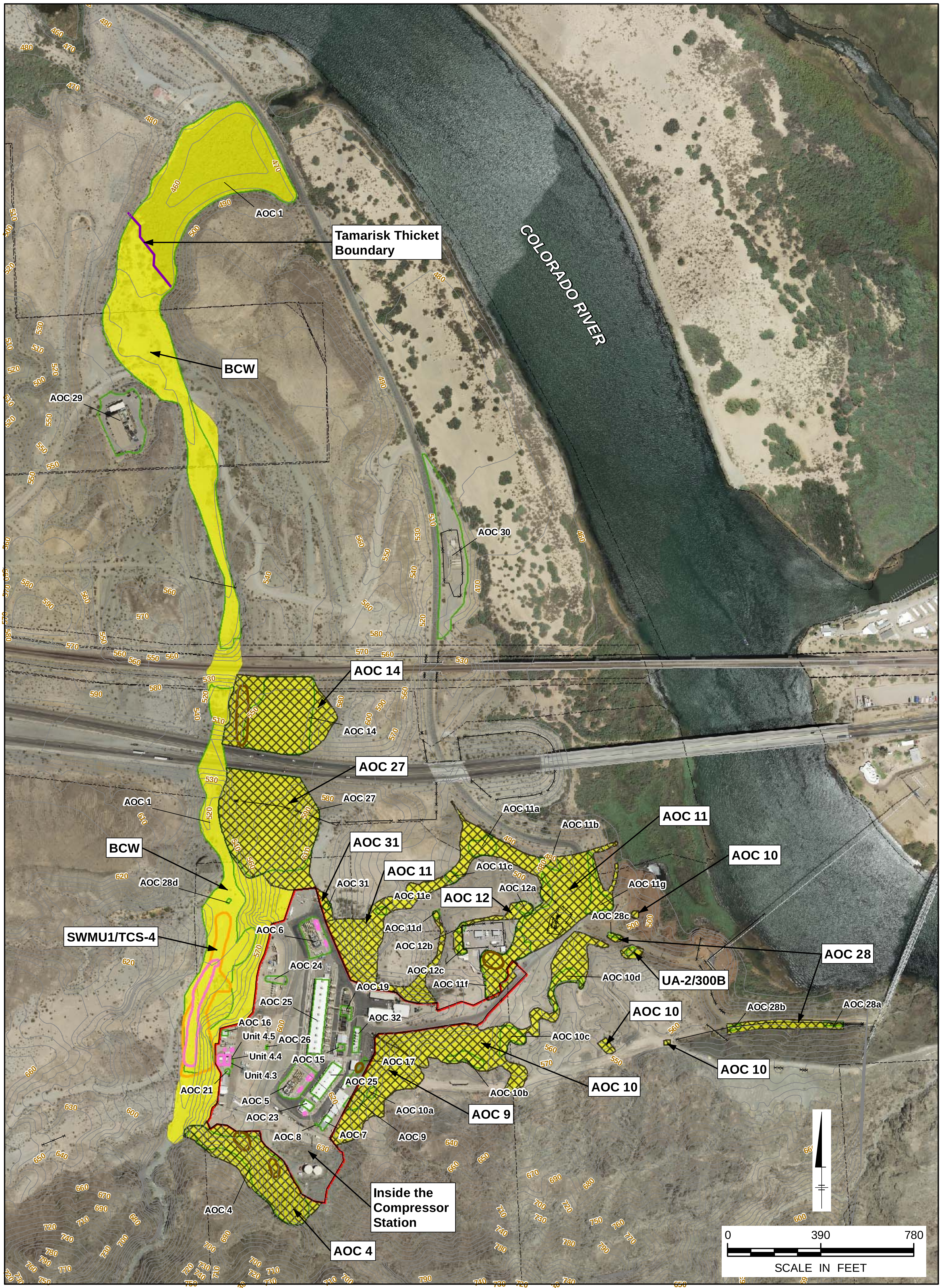

Legend:

- Area of Concern
- Solid Waste Management Unit
- Potential Burning Related Location
- Property Boundaries
- Contour Line (10 feet interval)
- Fence Line
- BCW Label for Exposure Area
- AOC 1 Label for Area of Concern

Exposure Areas

- Inside the Topock Compressor Station boundary, as defined by current fenceline
- SWMU1 Exposure Area
- Outside the Compressor Station Exposure area
- Outside Compressor Station excluding BCW Exposure Area

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

COMBINED EXPOSURE AREAS FOR HUMAN HEALTH RECEPTORS

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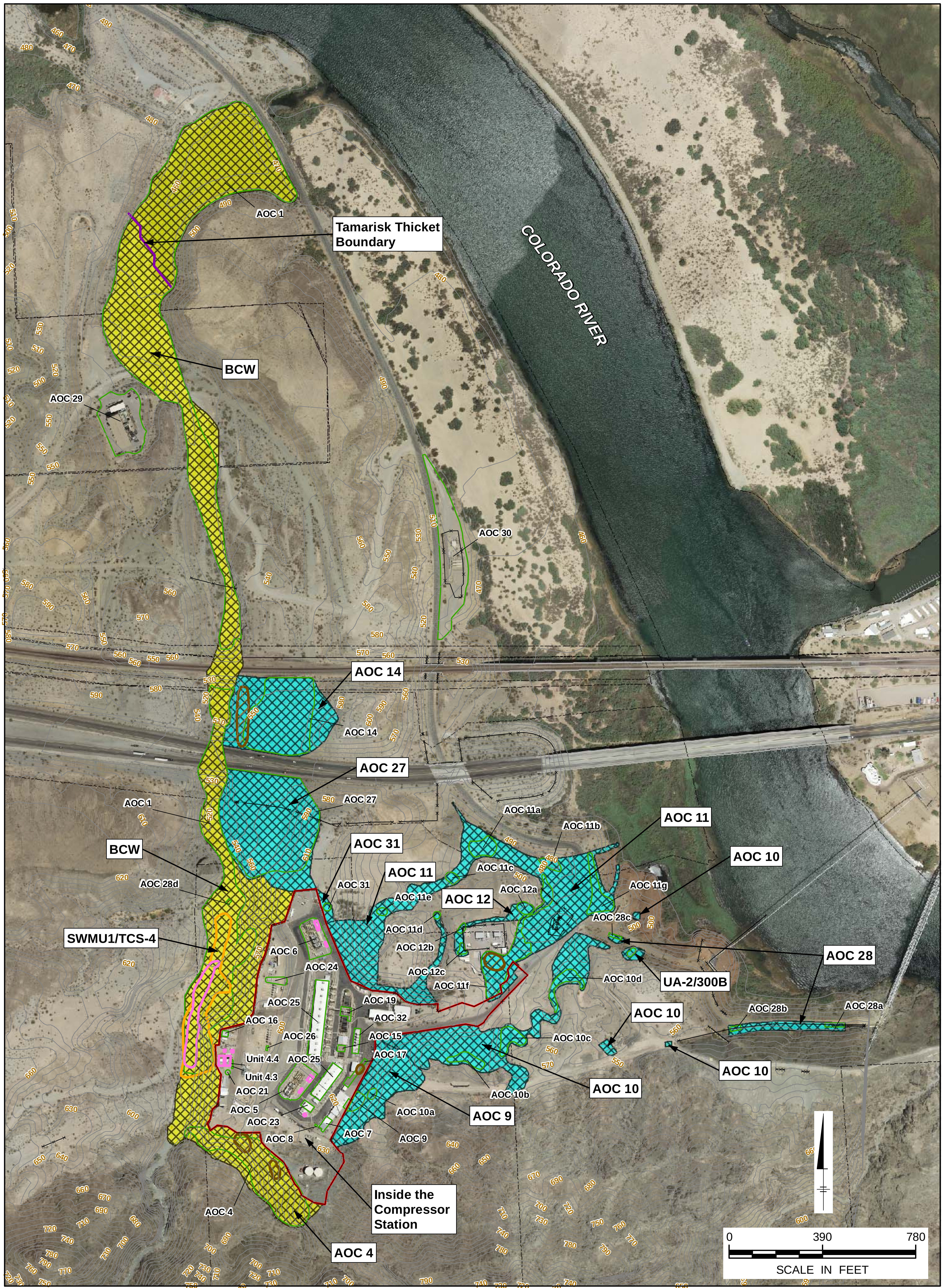
FIGURE
3-4a

PATH: Z:\GISProjects_ENV\PGE_Topock\GIS\ArcMap_MXD\SHHERA_rev\Fig3-4b_Large HomeRangeEcologicalReceptors_CombinedEAs.mxd 8/29/2018 1:33:20 PM



Legend:

- Area of Concern
- Solid Waste Management Unit
- Potential Burning Related Location
- Property Boundaries
- Contour Line (10 feet interval)
- Fence Line
- BCW — Label for Exposure Area
- AOC 1 — Label for Area of Concern

Exposure Areas

- Inside the Topock Compressor Station boundary, as defined by current fenceline
- SWMU1 Exposure Area
- Bat Cave Wash (BCW) + AOC 4 Exposure Area
- Outside Compressor Station excluding BCW+AOC 4 Exposure Area
- Outside the Compressor Station Exposure Area

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

COMBINED EXPOSURE AREAS FOR LARGE HOME RANGE ECOLOGICAL RECEPTORS

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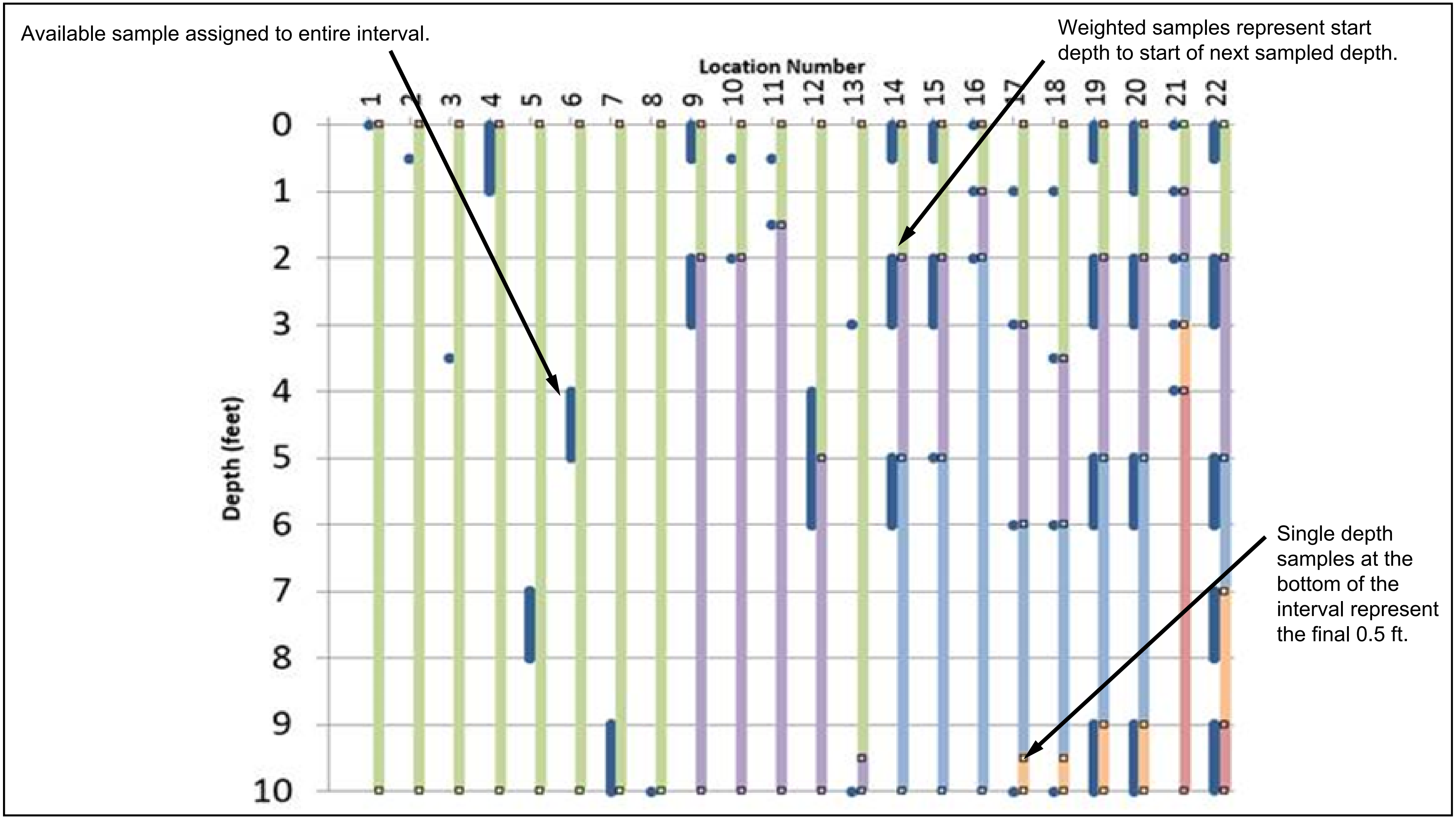
FIGURE
3-4b



LEGEND:

- Actual Sampled Depth
- 1st Weighted Interval Applied
- 2nd Weighted Interval Applied
- 3rd Weighted Interval Applied
- 4th Weighted Interval Applied
- 5th Weighted Interval Applied

NOTES:
Non-detected values are replaced with ½ Reporting Limits. For COPCs that are calculated totals, the full calculated total value is used.

PG&E TOPOCK COMPRESSOR STATION NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

DEPTH-WEIGHTING APPROACH (EXAMPLES FOR THE 0 to 10 FOOT INTERVAL)

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FIGURE
4-1

Figure 5-1
Sampling and Exposure Depth Intervals for Soil - Human Receptors

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

feet bgs	Assumed Sampling Depth Interval - Site	Assumed Sampling Depth Interval - Background	Soil Exposure Intervals			
			surface	shallow	subsurface I	subsurface II
Ground Surface (0 feet)						
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
Applicable Receptor Group	Human Receptors-outside the compressor station		Residents (USBLM land); recreational users; maintenance workers; tribal users	Residents (USBLM land); recreational users; maintenance workers; tribal users	Residents (USBLM land); maintenance workers	Residents (USBLM land); maintenance workers
	Human Receptors-inside the compressor station		commercial workers; maintenance workers	commercial workers; maintenance workers	maintenance workers	maintenance workers

Abbreviations:
AOC = includes areas of concern and undesignated areas
bgs = below ground surface
BCW = Bat Cave Wash
NA = not applicable
USBLM = U.S. Bureau of Land Management

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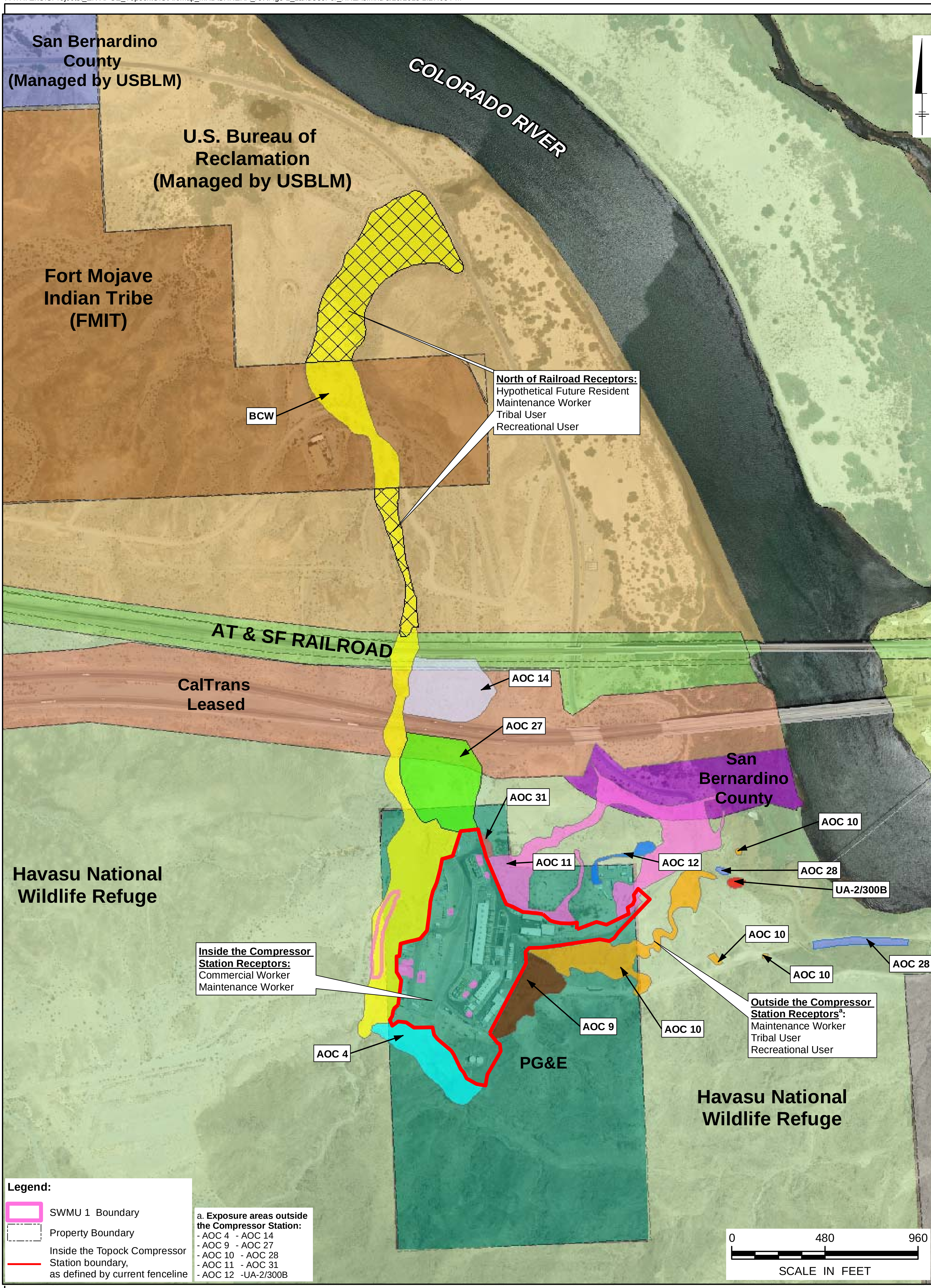

Exposure Areas

- North of Railroad
- BCW
- AOC 10
- AOC 11
- AOC 12
- AOC 14
- AOC 27
- AOC 28
- AOC 31
- AOC 4
- AOC 9
- UA-2/300B

Property Owners

- AT & SF Railroad
- Bureau of Reclamation (Managed by USBLM)
- Caltrans Leased
- Fort Mojave Indian Tribe
- Havasu National Wildlife Refuge (HNWR)
- PG&E
- San Bernardino County
- San Bernardino County (Managed by USBLM)

AOC 1 Label for Exposure Area

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

LAND USE FOR HUMAN HEALTH EXPOSURE AREAS

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FIGURE
5-2

Figure 6-1
Sampling and Exposure Depth Intervals for Soil - Ecological Receptors

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

Depth for Current Conditions (feet bgs)	Assumed Sampling Depth Interval - Site	Assumed Sampling Depth Interval - Background	Soil Exposure Intervals			
			surface	shallow	subsurface I	subsurface II
Ground Surface (0 feet)						
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						

	surface	shallow	subsurface I	subsurface II
Ecological Receptors-outside the compressor station[a,b]	**1. Plant Uptake** = highest EPC from the three exposure depth intervals[c] for all AOCs			NA
	2. Soil Invertebrate Uptake = 0-0.5 foot bgs for all AOCs	NA	NA	NA
	3. Granivorous Bird (Gambel's quail): (i) incidental ingestion of soil = 0-0.5 feet bgs for all AOCs (ii) plant (food) concentration (soil-to-plants) = highest EPC from the three exposure depth intervals[c] for all AOCs			NA
	4. Insectivorous Bird (cactus wren): (i) incidental ingestion of soil = 0-0.5 feet bgs for all AOCs (ii) prey concentration (soil-to-prey) = 0-0.5 feet bgs for all AOCs	NA	NA	NA
	5. Carnivorous Bird (red-tailed hawk): (i) incidental soil ingestion = 0-0.5 feet bgs for all AOCs (ii) prey concentration (soil-to-prey) = 0-0.5 feet bgs for all AOCs	NA	NA	NA
Ecological Receptors-outside the compressor station[a,b]	**6. Granivorous Mammal (kangaroo rat):** (i) incidental soil ingestion = highest EPC from the three depth intervals[c] for all AOCs (ii) prey (food) concentration (soil-to-plants) = highest EPC from the three exposure depth intervals[c] for all AOCs			NA
	7. Invertivorous Mammal (desert shrew): (i) incidental soil ingestion = 0-0.5 feet bgs for all AOCs (ii) prey concentration (soil-to-prey) = 0-0.5 feet bgs for all AOCs	NA	NA	NA
	8. Carnivorous Mammal (desert kit fox): (i) incidental soil ingestion = highest concentration from the three exposure depth intervals[c] for all AOCs (ii) prey concentration (soil-to-prey) = 0-0.5 feet bgs for all AOCs.			NA
	9. Herbivorous Large Mammal (desert bighorn sheep): (i) incidental soil ingestion = highest concentration from the three exposure depth intervals[c] for all AOCs (ii) plant concentration (soil-to-plant) = highest EPC from the three exposure depth intervals[c] for all AOCs			NA
Ecological Receptors-inside the compressor	NA	NA	NA	NA

Notes:
a. See Table 6-3 for details.
b. Exposure point concentrations for ecological receptors will be represented by both the maximum detected concentation and the 95 percent upper confidence limit on the mean (depth-weighted and depth- and area-weighted).
c. The 3 exposure depth intervals for ecological receptors for the current conditions (baseline scenario) include:
Surface Soil = 0 to 0.5 feet below ground surface (bgs).
Shallow Soil = 0 to 3 feet bgs.
Subsurface Soil I = 0 to 6 feet bgs.

Abbreviations:
AOC = includes areas of concern and undesignated areas
BCW = Bat Cave Wash
bgs = below ground surface
NA = not applicable

Figure 7-1
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Short-Term Maintenance Worker

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

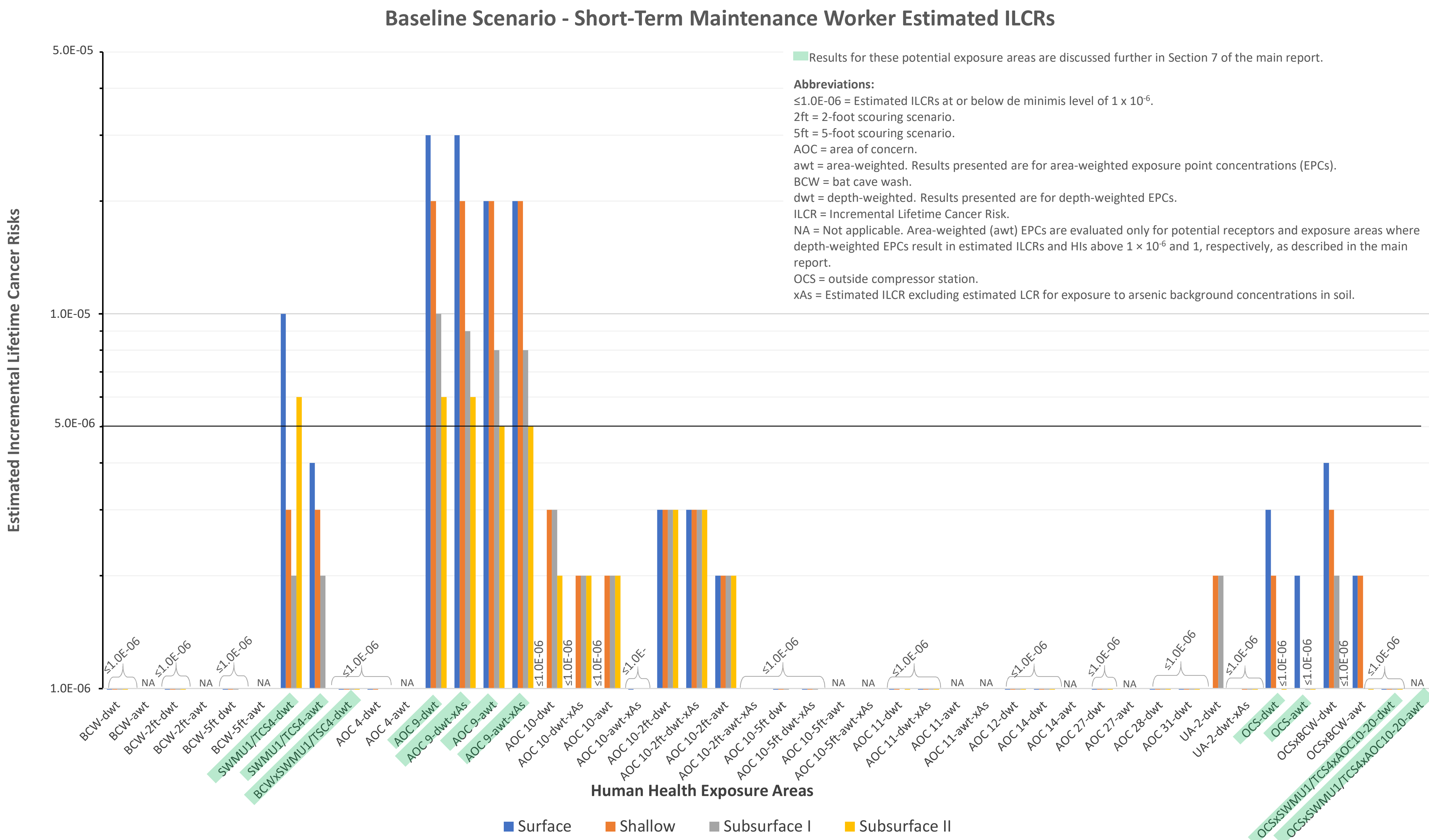


Figure 7-2
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Long-Term Maintenance Worker

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

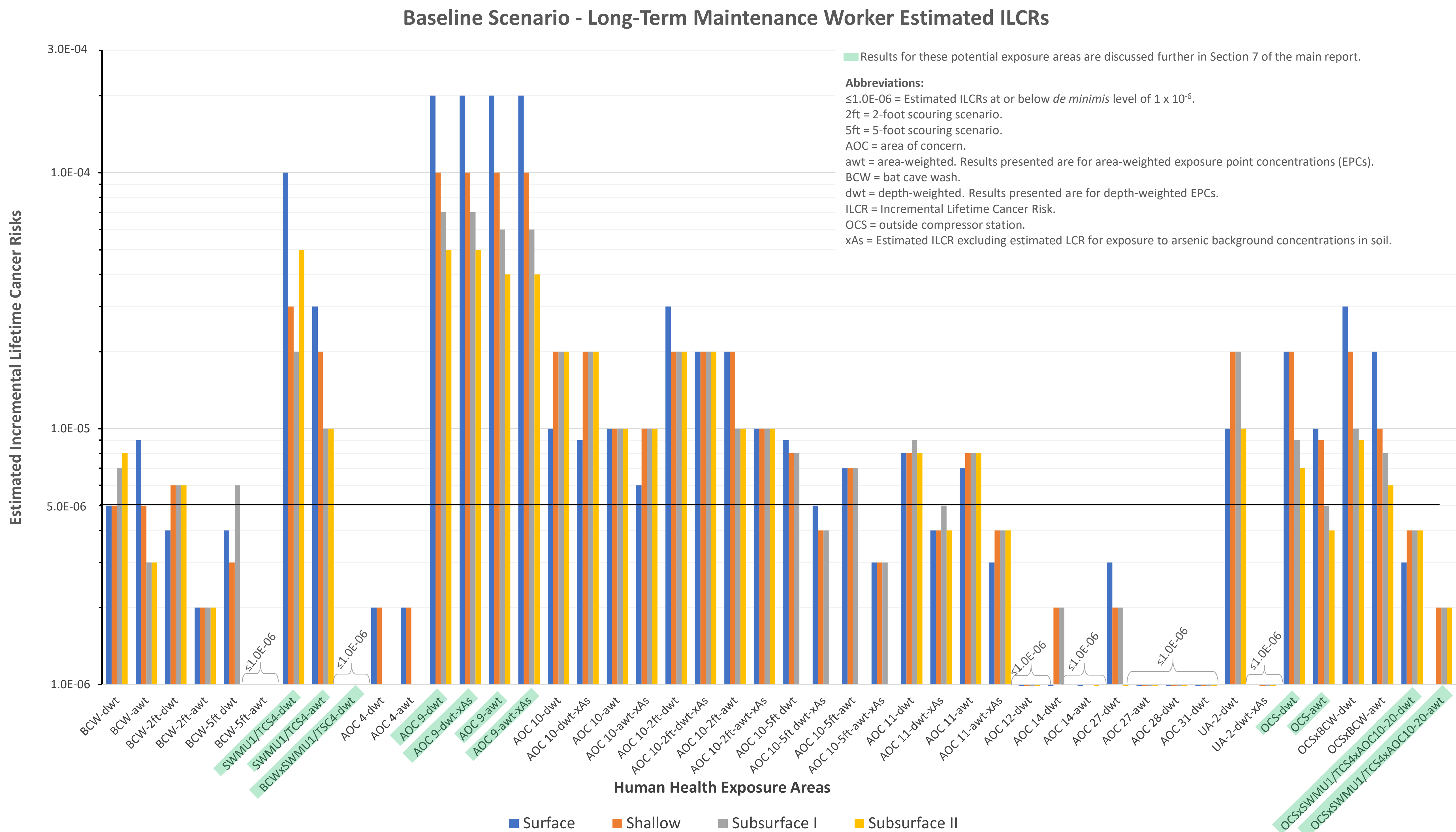


Figure 7-3
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Recreational User - Camper

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

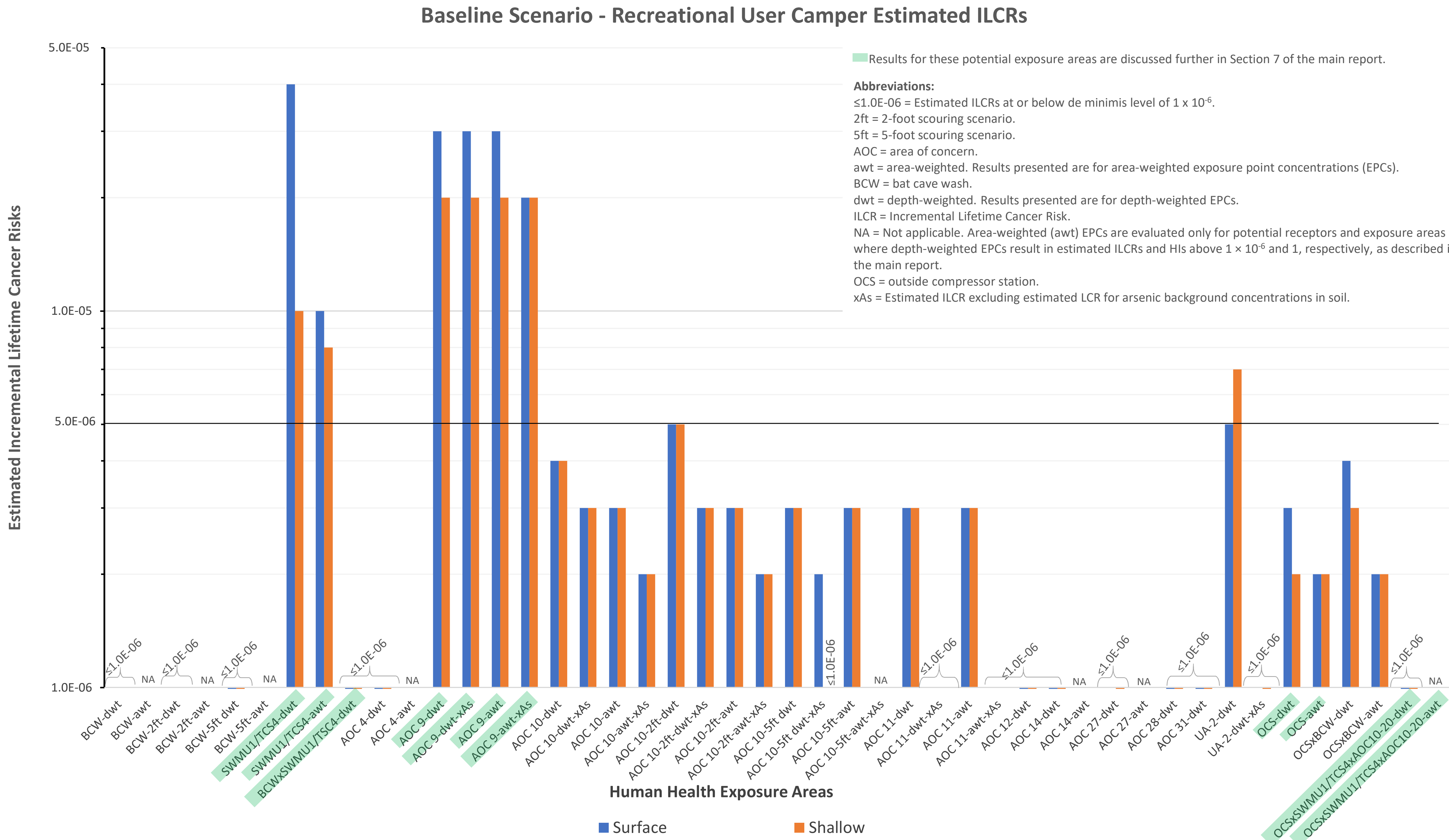


Figure 7-4
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Recreational User - Hiker

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

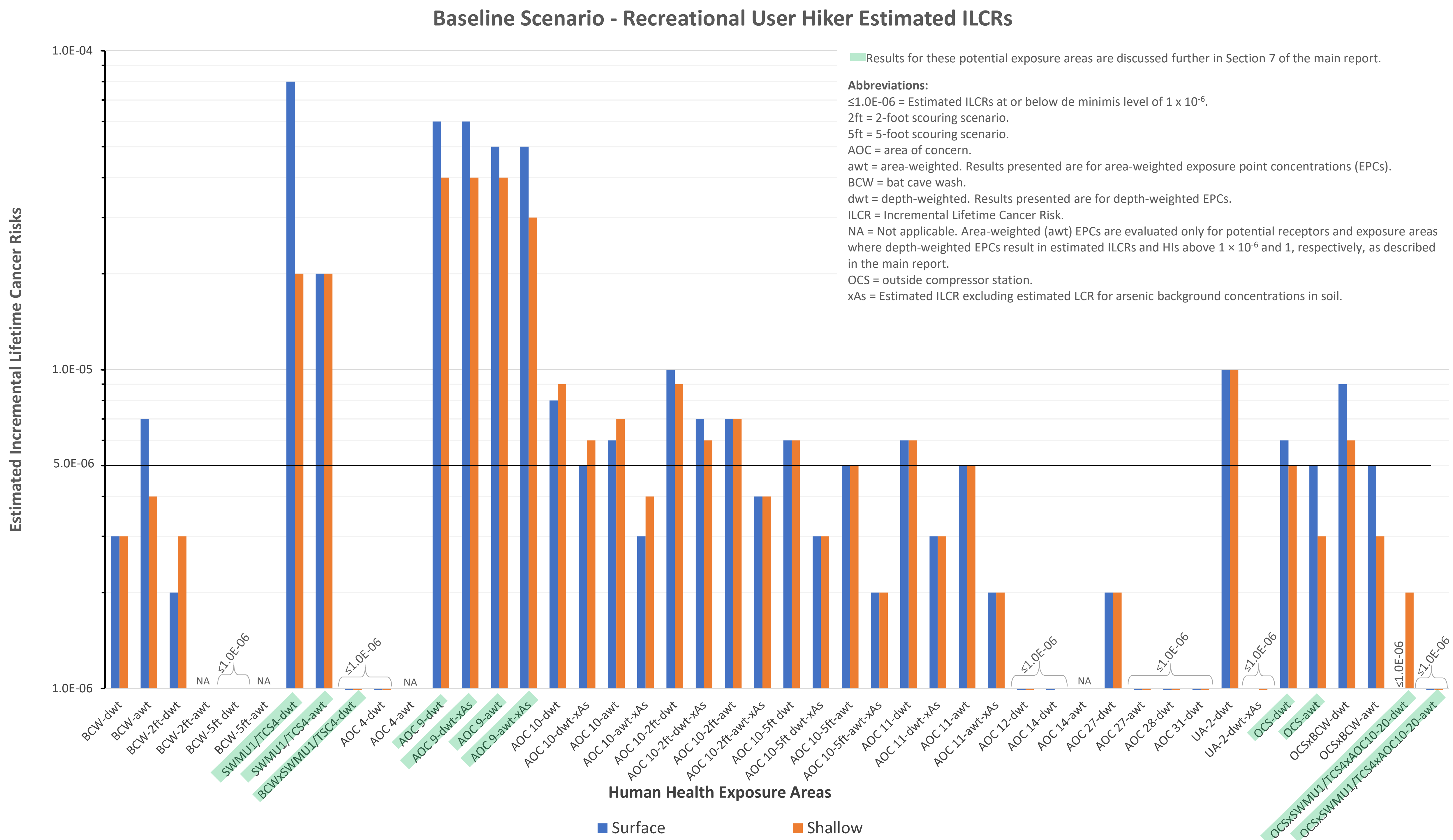


Figure 7-5
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Recreational User - Hunter

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

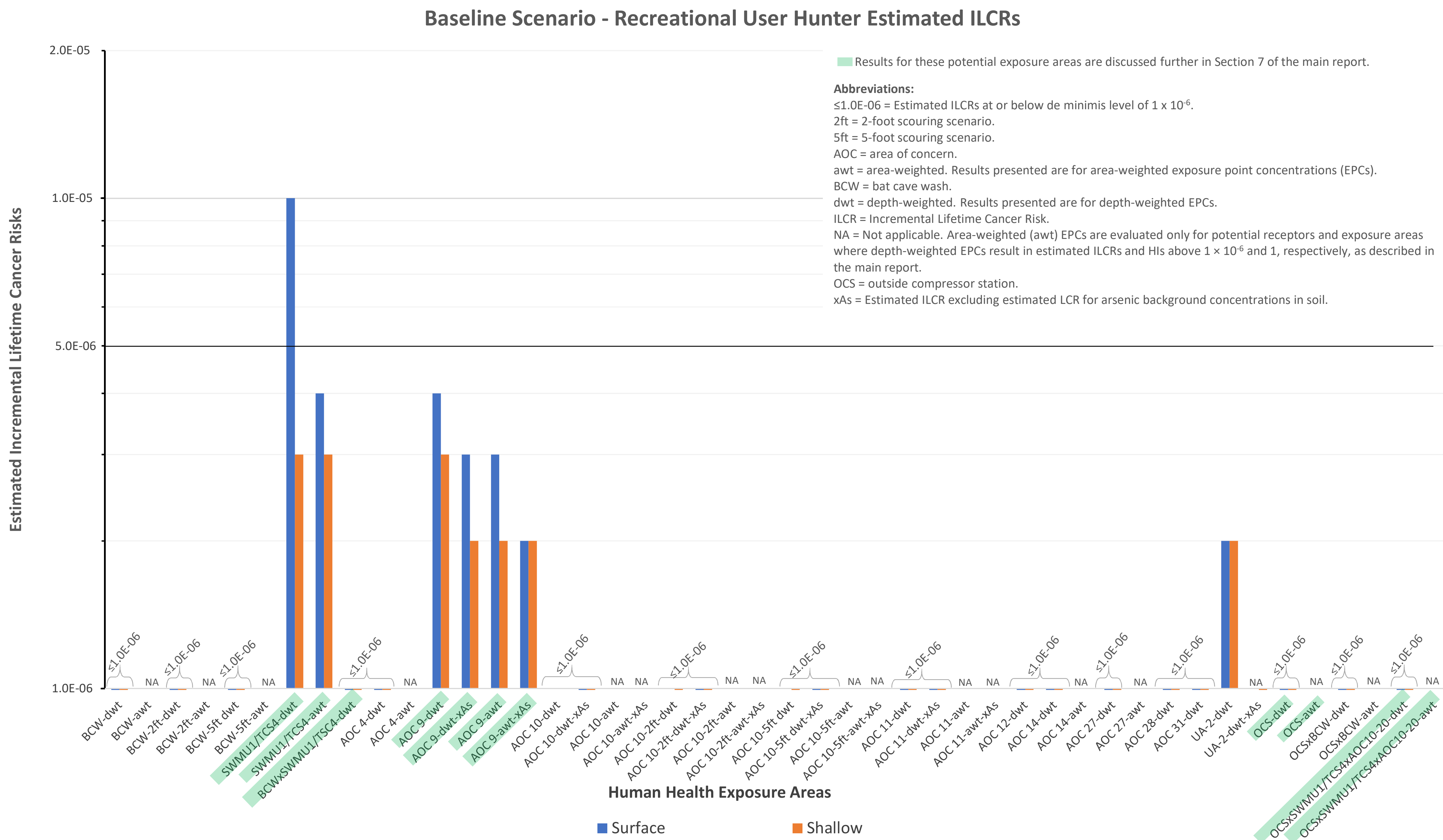


Figure 7-6
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Recreational User - OHV Rider

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California

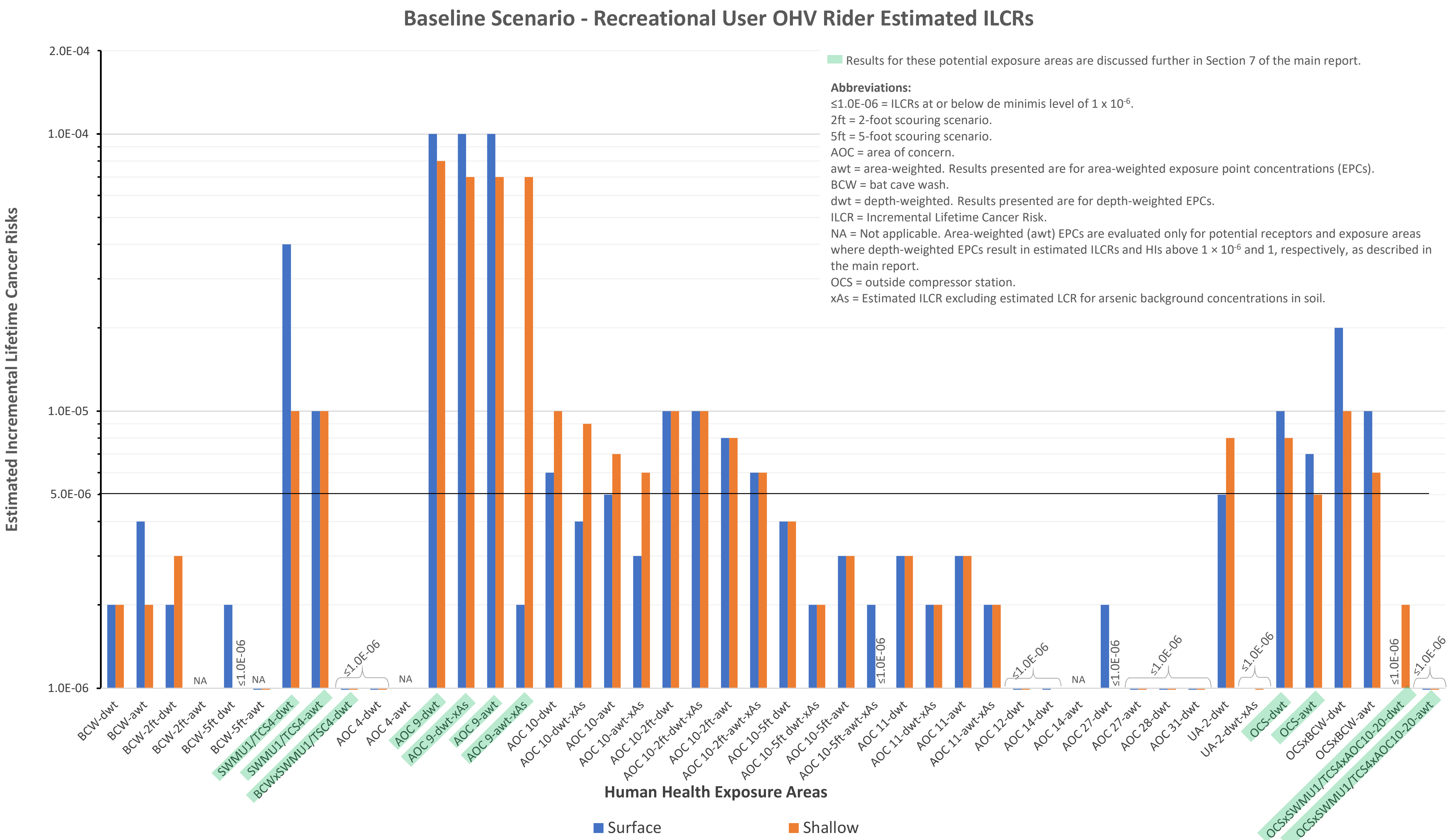
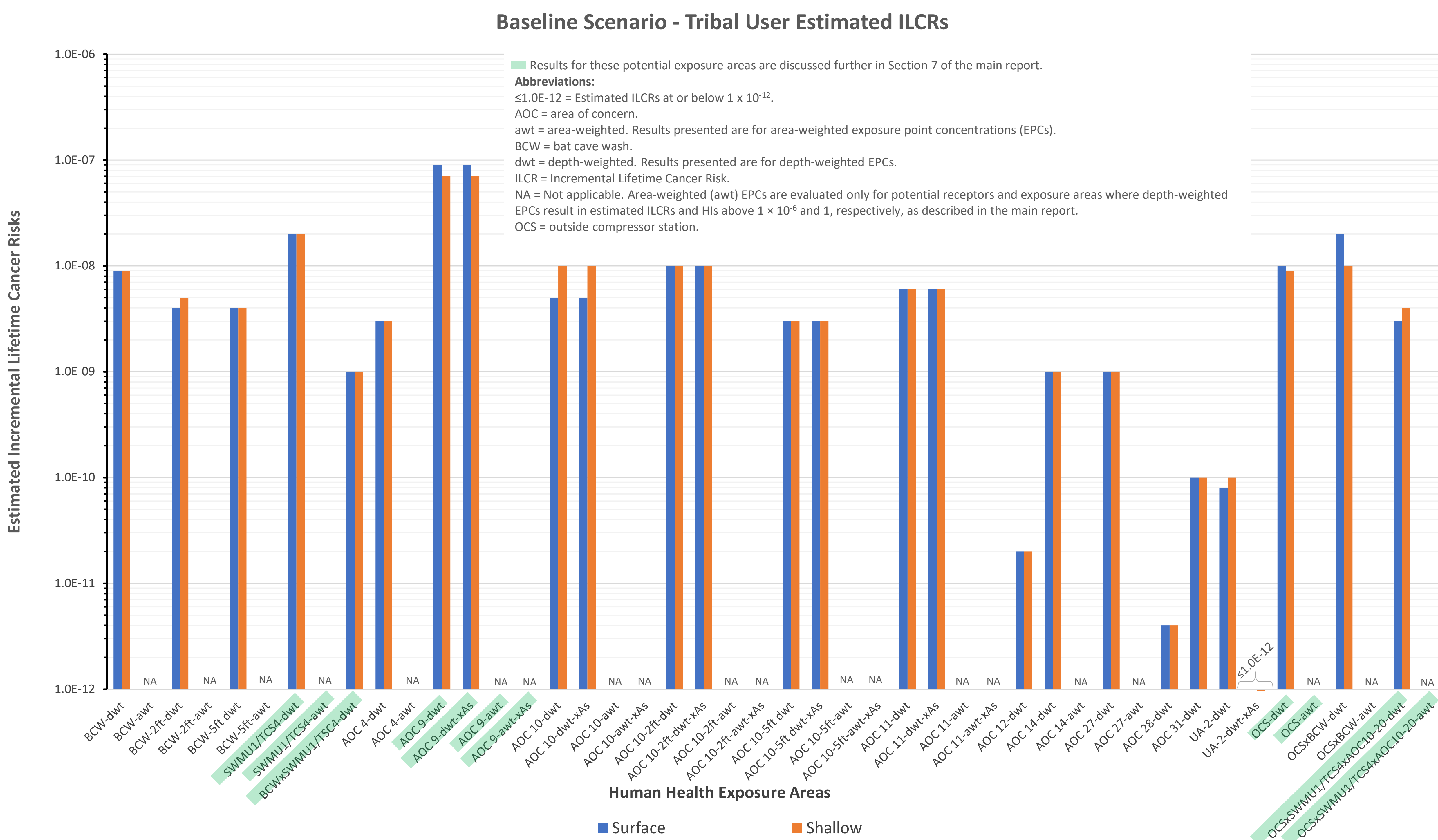


Figure 7-7
Summary of Estimated Cumulative ILCRs for Potential Exposure Areas Outside Compressor Station: Tribal User

Soil Human Health and Ecological Risk Assessment
PG&E Topock Compressor Station
Needles, California



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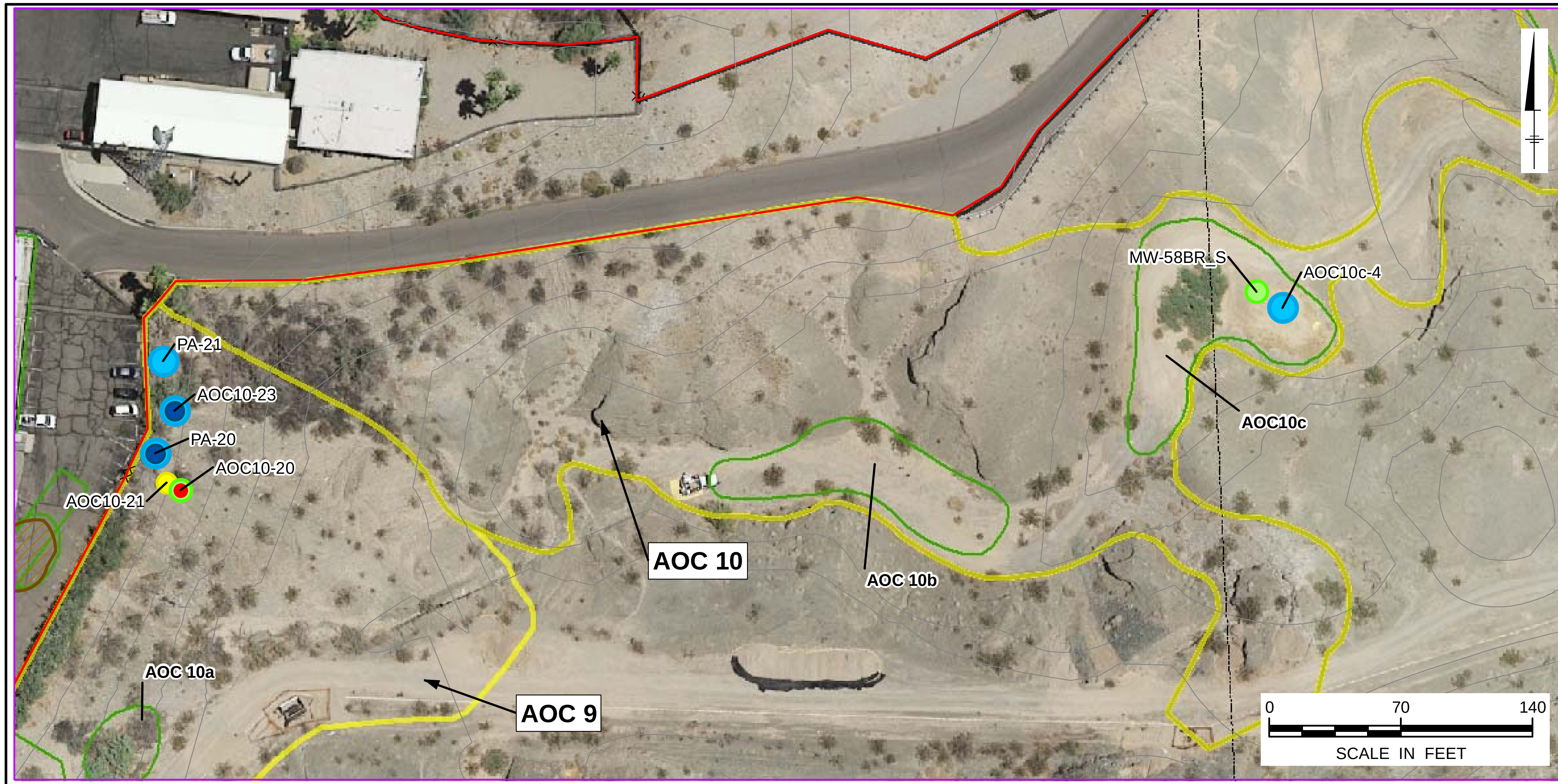

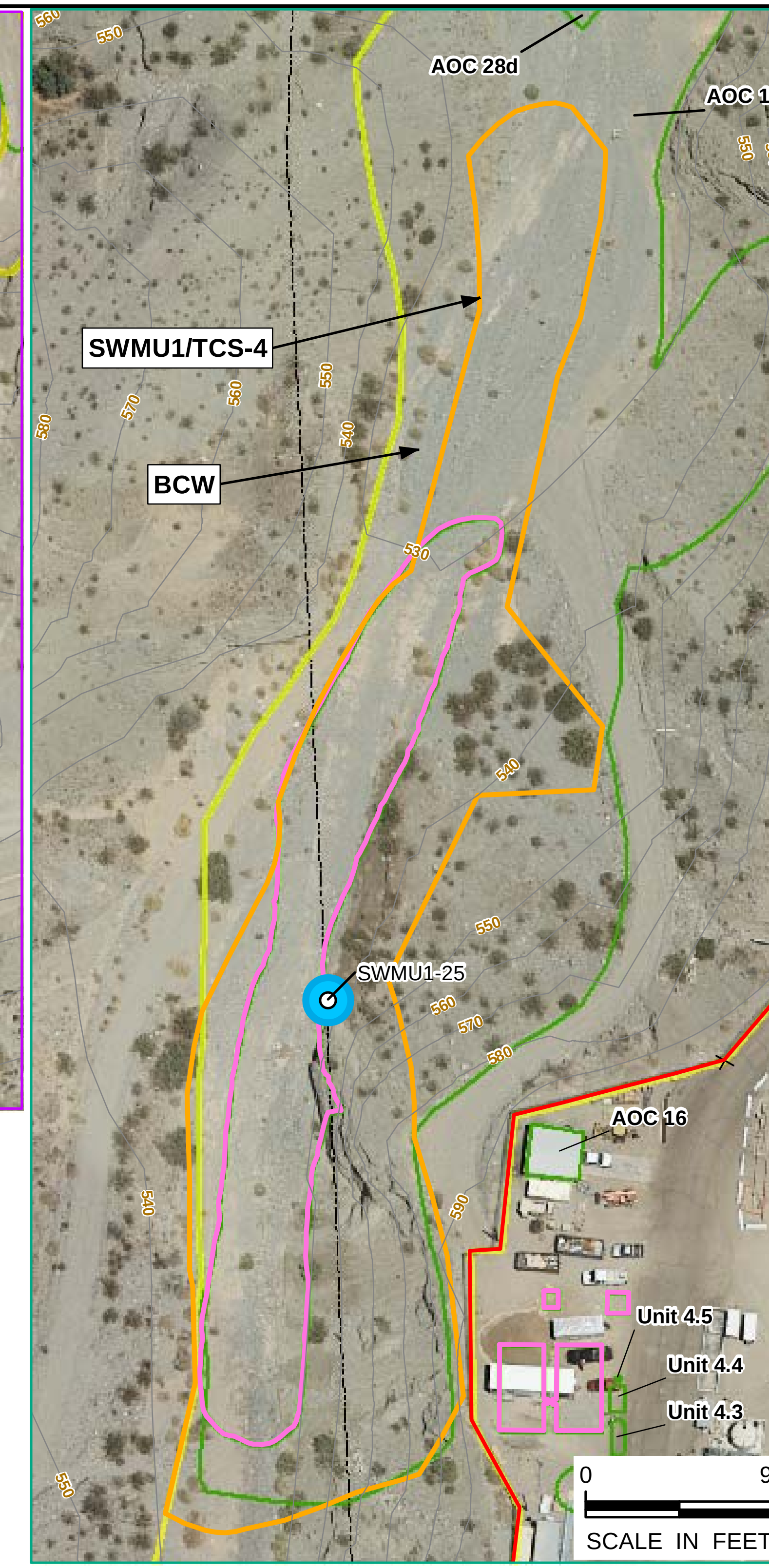

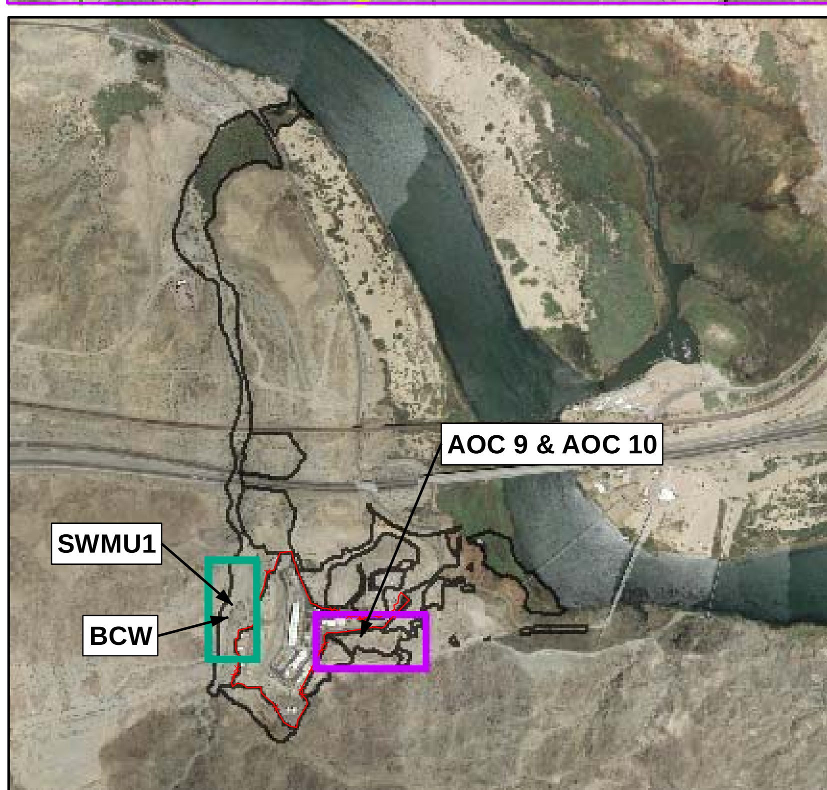

Legend:

- Area of Concern
- Solid Waste Management Unit
- Potential Burning Related Location
- Exposure Area
- Exposure Area
- Property Boundaries
- Contour Line (10 feet interval)
- Fencing
- Inside the Topock Compressor Station boundary, as defined by current fenceline
- AOC 10 — Label for Exposure Area
- AOC 10 — Label for Area of Concern

Shrew (0-0.5 ft bgs)

- Total Cr
- Copper
- Dioxin TEQ (190 ng/kg)
- Dioxin TEQ (360 ng/kg)

Recreational User (0-3 ft bgs)

- Dioxin TEQ (10^{-6})
- Hexavalent Cr
- Dioxin TEQ (10^{-5}) (no location)

Notes:
1. All sample locations with a labeled location ID are included in the AOC 9 exposure area.

PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
SOIL HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

COMBINED RISK DRIVING LOCATIONS FOR THE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

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FIGURE
9-1

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