Prepared for
Nevada Environmental Response Trust

Project Number
1690029369-012

Prepared by
Ramboll Americas Engineering Solutions, Inc.
Emeryville, California

Date
November 16, 2023

HEALTH RISK ASSESSMENT FOR PARCEL E, REVISION 1

NEVADA ENVIRONMENTAL RESPONSE TRUST SITE HENDERSON, NEVADA

Health Risk Assessment for Parcel E, Revision 1

Nevada Environmental Response Trust Site
(Former Tronox LLC Site)
Henderson, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification
I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Not Individually, but Solely
as President of the Trustee

Signature: Jay A Steinberg, President

Name: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Title: Solely as President and not individually

Company: Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Date: 11/15/23

Health Risk Assessment for Parcel E, Revision 1

Nevada Environmental Response Trust Site
(Former Tronox LLC Site)
Henderson, Nevada

Responsible Certified Environmental Manager (CEM) for this project
I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

Kimberly Kuwabara, MS **Senior Managing Consultant**	**Date**

Certified Environmental Manager
Ramboll Americas
Engineering Solutions, Inc.
CEM Certificate Number: 2353
CEM Expiration Date: March 20, 2024

The following individuals provided input to this document:

Allan J. DeLorme, PE
Elizabeth Miesner, MS
Christopher M. Stubbs, PhD, PE
Kimberly Kuwabara, MS
Gregory S. Kinsall, RG
William Fuller, DE
Kun Zhao, MS
Shuo Yu, PhD
Jonathan Hunt, PhD
Yuan Zhuang, PhD
Rachel Connolly, MS
Shang Shi, MS
Katie Dally, MS
John Crowther
Jaishree Gupta

Health Risk Assessment for Parcel E, Revision 1
Nevada Environmental Response Trust
Henderson, Nevada

Date	**November 16, 2023**
Prepared by	**Ramboll Americas Engineering Solutions, Inc.**
Description	**Health Risk Assessment for Parcel E, Revision 1**

Project No. **1690029369-012**

Ramboll
2200 Powell St.
Suite 200
Emeryville, CA 94608
USA
T +1 510 655 7400
F +1 510 655 9517
www.ramboll.com

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix F

Appendix G

Appendix M

Appendix N

ACRONYMS AND ABBREVIATIONS

ALS	Australian Laboratory Services
API	American Petroleum Institute
AS	Analytical Sensitivity
atm	atmosphere
ATSDR	Agency for Toxic Substances and Disease Registry
BaP	benzo(a)pyrene
BaPEq	benzo(a)pyrene equivalent
BCA	bias-corrected accelerated
BCL	basic comparison level
bgs	below ground surface
BHRA	baseline human health risk assessment
BMI	Black Mountain Industrial
BRC	Basic Remediation Company
BTEX	benzene, toluene, ethylbenzene, and total xylenes
Cal/EPA	California Environmental Protection Agency
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeter
cm^3	cubic centimeter
COC	chain-of-custody
COPC	chemical of potential concern
CSF	cancer slope factor
CSM	conceptual site model
CTE	central tendency exposure
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DOE	Department of Energy
DQI	data quality indicator
DUE	data usability evaluation
DVSR	data validation summary report

EDA	exploratory data analysis
EDD	electronic data deliverable
EMD	EMD Acquisition LLC
ENSR	ENSR Corporation
ENVIRON	ENVIRON International Corporation
EPC	exposure point concentration
Exponent	Exponent, Inc.
°F	degrees Fahrenheit
f	fiber
ft	feet
FS	feasibility study
g	gram
GC/MS	gas chromatography/mass spectroscopy
GRAS	Generally Recognized as Safe
GWETS	groundwater extraction and treatment system
HEAST	Health Effects Assessment
HI	hazard index
HQ	hazard quotient
HRA	health risk assessment
IF_{inh}	inhalation intake factor
IQR	interquartile range
IRIS	Integrated Risk Information System
ITRC	Interstate Technology Regulatory Council
IUR	inhalation unit risk
kg	kilogram
Kleinfelder	Kleinfelder, Inc.
L	liter
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
LOU	Letter of Understanding
m^3	cubic meter
mg	milligram
mm HG	millimeter of mercury

mol	mole
Montrose	Montrose Chemical Company
mph	miles per hour
MRL	minimal risk level
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tert-butyl ether
NCP	National Contingency Plan
NDEP	Nevada Division of Environmental Protection
Neptune	Neptune and Company, Inc.
NERT	Nevada Environmental Response Trust
NFA	No further action
NOAA	National Oceanic and Atmospheric Administration
Northgate	Northgate Environmental Management, Inc.
NRC	National Research Council
NSF	risk coefficient for population of non-smoking females
NSM	risk coefficient for population of non-smoking males
OCP	organochlorine pesticide
OPP	organophosphorus pesticide
OSSM	Olin Chlor-Alkali/Stauffer/Syngenta/Montrose
OSWER	Office of Solid Waste and Emergency Response
OU-1	Operable Unit 1
OU-2	Operable Unit 2
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEF	particulate emission factor
pg	picogram
PPRTV	Provisional Peer Reviewed Toxicity Values
PQL	practical quantitation limit
Q-Q	quartile to quartile
Q/C	site-specific dispersion factor
Q1	first quartile
Q3	third quartile

QA/QC	quality assurance/quality control
Qal	quaternary alluvial deposit
QAPP	Quality Assurance Project Plan
Ra	radium
Ramboll	Ramboll Americas Engineering Solutions, Inc. (formally Ramboll US Consulting, Inc.)
Ramboll Environ	Ramboll Environ US Corporation
RBTC	risk-based target concentration
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RI/FS	remedial investigation/Feasibility study
RME	reasonable maximum exposure
RPD	relative percent difference
RSL	regional screening level
RZ-A	Remediation Zone A
SF	risk coefficient for population of smoking females
SIM	selective ion monitoring
Site	Nevada Environmental Response Trust Site
SM	risk coefficient for population of smoking males
SMP	Site Management Plan
SOP	standard operating procedure
SQL	sample quantitation limit
SRC	site-related chemical
Stauffer	Stauffer Chemical Company
SVOC	semi-volatile organic compound
TDS	total dissolved solids
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
Th	thorium
TIMET	Titanium Metals Corporation
TPH	total petroleum hydrocarbon
TRECO	TRECO, LLC

Tronox	Tronox, LLC
Trust	Nevada Environmental Response Trust
U	uranium
UCL	upper confidence limit
µg	microgram
µm	micron or micrometer
UMCf	Upper Muddy Creek Formation
US	United States
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
WHO	World Health Organization

EXECUTIVE SUMMARY

This report presents the Health Risk Assessment (HRA) for Parcel E at the Nevada Environmental Response Trust ("NERT" or "the Trust") site in Henderson, Nevada (the "NERT Site" or "the Site"). The HRA was conducted to evaluate potential health risks to on-Site workers in Parcel E from exposures to residual levels of chemicals, radionuclides, and asbestos in soils and volatile organic compounds (VOCs) released from soil gas and shallow groundwater to indoor, outdoor, and trench air.

Operable Unit 1 (OU-1), designated for the Remedial Investigation and Feasibility Study (RI/FS) currently in progress, comprises approximately 346 acres and is located within a portion of the Black Mountain Industrial (BMI) Complex in unincorporated Clark County, Nevada; it is surrounded by the City of Henderson (Figure ES-1). As shown in Figure ES-2, OU-1 consists of property owned by NERT (the NERT Site, approximately 257 contiguous acres and approximately 8 acres of the non-contiguous Sale Parcel E) as well as five former sale parcels (former Sale Parcels C, D, F, G, and H, comprising 81 acres) which have been transferred from NERT to TRECO, LLC (TRECO) and are no longer owned by NERT. Within the Site, the Operations Area is used by the Trust for groundwater treatment operations and its tenant EMD Acquisition LLC (EMD) for the operation of its chemical manufacturing business. Outside the Operations Area is one sale parcel (Sale Parcel E, comprising 8 acres) that is not currently used by the Trust or its tenant. However unlike the other Sale Parcels, Parcel E is unique in that the entire parcel is encumbered with an easement and is not contemplated for sale or development in the foreseeable future.

Parcel E is located in the northwest corner of the Site and is not contiguous with the Operations Area. Former activities within Parcel E were not expected to have resulted in significant chemical impacts and the Nevada Division of Environmental Protection (NDEP) did not identify any Letter of Understanding areas (LOUs) for investigation within Parcel E. Environmental investigations at Parcel E have generally been conducted separately from investigations in the Operations Area of the Site because there were no reported industrial activities in this area and an extraction well field and the recharge trench for a groundwater extraction and treatment system (GWETS) jointly operated by Olin, Stauffer Chemical Company (Stauffer), Syngenta, and Montrose Chemical Company (Montrose) (collectively referred to as OSSM) is present on Parcel E. The terms of the easement and the presence and configuration of OSSM's GWETS prevent development of this parcel in the foreseeable future. Prior to the Trust receiving ownership of the Site, Tronox identified Parcel E as a parcel suitable for potential future sale. However, OSSM has not expressed any interest in purchasing this parcel. Field investigation work for soils at Parcel E was conducted in 2018 and 2019. Soil gas samples were collected within Parcel E in 2008 and 2019. Groundwater monitoring has been ongoing since the late 1990's.

In addition to the risks related to Parcel E being evaluated under this HRA, the risks for all other properties within OU-1 were/are being evaluated and/or managed pursuant to separate actions. Specifically, separate post-remediation HRAs for Parcels C, D, F, G and H were completed in late 2017 and early 2018, all of which have been granted No Further Action (NFA) determinations by NDEP. A baseline health risk assessment (BHRA) report for soil in the Operations Area of OU-1 (the "OU-1 Soil BHRA") was first submitted to NDEP in January 2020 (Ramboll 2020a). Revision 1 of the OU-1 Soil BHRA report was submitted to

NDEP on October 14, 2021 (Ramboll 2021a), to address NDEP comments received in June 2020. Revision 2 of the OU-1 Soil BHRA report was submitted on May 6, 2022 (Ramboll 2022a) to address the NDEP comments received in December 2021, and was approved by NDEP on June 2, 2022. A BHRA report for soil gas and groundwater in the Operations Area of OU-1 (the "OU-1 Soil Gas and Groundwater BHRA") was submitted to NDEP on September 29, 2021 (Ramboll 2021b); annotated response to comment letter was submitted on June 24, 2022 to respond to NDEP comments received on March 9, 2022; NDEP's responses on the annotated response to comment letter were received on November 3, 2022, and the revised report and annotated response to the NDEP comment letter was submitted to NDEP on November 3, 2023 (Ramboll 2023a).

The findings of this Parcel E HRA report, as well as the two BHRA reports for the Operations Area, will be used in the forthcoming Feasibility Study (FS) for OU-1 and Operable Unit 2 (OU-2) to determine which areas, if any, may require remediation to address potential risks to on-Site worker populations within Parcel E.

This HRA for Parcel E follows the procedures outlined in the United States Environmental Protection Agency (USEPA) risk assessment guidance and applicable NDEP guidance. The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is the basis for the target cancer risk management range established by NDEP (2023a). According to the NCP and NDEP (2023a), lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}). According to the NCP and NDEP (2023a), noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a hazard index [HI] greater than one). It should be noted that the cancer risk and noncancer hazard estimated in this HRA are upper-bound estimates and do not represent actual health risks that may occur for the on-Site receptors in Parcel E, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks. Therefore, the actual health risks associated with exposures for the on-Site workers within Parcel E are expected to be lower than the risk estimates reported in this HRA.

Analytical results of soil samples collected at depths beginning at 1 and 10 feet (ft) below ground surface (bgs) in Parcel E were assessed through the data processing and data usability evaluation (DUE) steps (see Section 4.1.1) and data representative of current conditions were selected for purposes of the HRA. The results of the soil evaluation are summarized as follows:

- Potential exposure to soil was evaluated for on-Site indoor and outdoor commercial/industrial workers and construction workers in Parcel E via direct contact with soil (i.e., incidental ingestion and dermal contact) and inhalation of airborne particulates and vapors. Soil chemicals of potential concern (COPCs) were selected according to a multi-step process, including a concentration/toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. Based on this process, asbestos (long amphibole and chrysotile fibers) was identified as the only soil COPC. Asbestos was selected as a COPC even though no asbestos fibers were detected in any soil samples. Asbestos remained identified as a COPC because exposure and risk assessments for asbestos are highly dependent on sample size. Even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than 1 × 10^{-6}, depending on sample size. Therefore, although no long amphibole or chrysotile fibers were observed in any soil samples collected in Parcel E, asbestos was still retained as a COPC per NDEP guidance (Neptune 2015).

- A best estimate and an upper-bound estimate of potential cancer risk via inhalation of long amphibole and chrysotile fibers in airborne particulates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers were calculated for Parcel E. No asbestos fibers were detected in any soil sample, and the estimated combined risks for death from lung cancer and mesothelioma associated with asbestos exposures were all less than 1 × 10^{-6}, except for the upper-bound risk estimate for exposure to amphibole fibers by construction workers, which was 4 × 10^{-6} (Table ES-1). However, the upper-bound estimate was based on an observed count of zero long amphibole fibers[1] in the soil samples, considered representative of current conditions within Parcel E.
- As Parcel E is a relatively small parcel and is bordered to the south, east, and north by former Parcels C and D, the results of the asbestos evaluation conducted for former Parcels C and D reported in Ramboll Environ (2017a) are considered representative of Parcel E and have been included in this evaluation.[2] The best estimates and upper-bound estimates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers from potential inhalation exposure to chrysotile long fibers were all less than 1 × 10^{-6} for former Parcels C and D, which were below the lower end of the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. For amphibole long fibers, the best estimate was zero for both parcels. The upper-bound estimates for indoor and outdoor commercial/industrial workers were less than 1 × 10^{-6} for both parcels; the upper-bound estimates for construction workers were 2 × 10^{-6} and 4 × 10^{-6} for former Parcels C and D, respectively. All risk results for asbestos exposure in former Parcels C and D were below or within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}.

Overall, potential exposure to asbestos in Parcel E soil is expected to be below or within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}.

Consistent with agency guidance from USEPA (2015), multiple lines of evidence were utilized in the HRA to evaluate migration of vapors from the subsurface. There are no buildings on Parcel E and no buildings are anticipated as long as the OSSM GWETS continues to operate; accordingly, no indoor workers are foreseeable on Parcel E. Soil gas data collected within Parcel E in 2008 and 2019 was used to evaluate potential exposure for future on-Site indoor and outdoor commercial/industrial workers and construction workers via inhalation of vapors migrating from the subsurface to indoor air, outdoor air, and trench air. Soil gas data is generally the preferred primary line of evidence for assessing vapor intrusion risks as opposed to groundwater or soil data primarily due to higher uncertainties associated with vapor intrusion modeling based on groundwater or soil data (i.e.,

---

[1] Although amphibole fiber counts were zero (0), upper-bound fiber concentrations in soil are estimated assuming a Poisson distribution, which yields an upper-bound risk estimate that is greater than 0.

[2] As agreed upon by NDEP during the meeting on April 6, 2023 to discuss the NDEP comments received on February 8, 2023, on the Parcel E HRA Report, Revision 0.

uncertainty in predicting contaminant partitioning from groundwater or soil moisture to soil gas and in predicting transport through the capillary fringe). Therefore, this HRA considers the soil gas data as the primary line of evidence for the vapor intrusion pathway; the groundwater data were evaluated to provide a secondary line of evidence to check consistency between soil gas and groundwater results.

VOCs detected in at least one soil gas sample were selected as soil gas COPCs. A total of 52 VOCs were identified as soil gas COPCs for Parcel E. Noncancer HIs and excess lifetime cancer risks associated with inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air were calculated. The results are summarized as follows:

- The estimated HIs were well below the NDEP significant threshold of greater than one for noncancer effects for future on-Site indoor and outdoor commercial/industrial workers and construction workers in Parcel E under the conditions evaluated. The maximum estimated HI was 0.003 for the indoor commercial/industrial worker.
- The estimated excess lifetime cancer risks were below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4} for future on-Site indoor and outdoor commercial/industrial workers and construction workers in Parcel E under the conditions evaluated. The maximum estimated excess lifetime cancer risk was 4×10^{-7} for the indoor commercial/industrial worker. Chloroform is the primary contributor to the total estimated cancer risk for soil gas; however, such contribution is not expected to pose an unacceptable health risk for future commercial/industrial development in Parcel E.

Groundwater results for volatile compounds[3] from shallow monitoring wells (with top of well screens less than 60 ft bgs) collected from 2015 to 2019 within Parcel E were included in this analysis. Similar to soil gas, the estimated excess lifetime cancer risks for vapor intrusion from groundwater were estimated within the lower end of the NDEP and USEPA cancer risk management range 1×10^{-6} to 1×10^{-4}, and all estimated HIs were below one. Chloroform was the major chemical contributor to the estimated cancer risk for both media; however, such contribution is not expected to pose an unacceptable health risk for future commercial/industrial development in Parcel E. Overall, the potential exposure to COPCs in shallow groundwater in Parcel E is not expected to pose an unacceptable cancer risk or adverse noncancer health effects under the conditions evaluated.

Consistent with the risk assessments completed for Parcels C, D, F, G, and H, exposure via domestic use of groundwater was not evaluated because on-Site groundwater is not and will not be used as a domestic water supply given the high concentrations of total dissolved solids (TDS) in the area.[4] Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities were not considered complete

---

[3] Volatile compounds are identified using the following criteria consistent with USEPA (2023a): 1) vapor pressure greater than 1 millimeter of mercury (mm Hg) or 2) Henry's Law constant greater than 0.00001 atmosphere-cubic meter per mole (atm-m^3/mol). Therefore, in addition to VOCs, any chemicals labelled as semivolatile organic compounds (SVOCs) that meet the USEPA definition of volatile compounds are also included in the vapor intrusion analysis.

[4] High TDS concentrations make the groundwater highly undesirable for use as a drinking water source. https://www.lasvegasgmp.com/wells-groundwater/facts/index.html

exposure pathways due to the groundwater depth at approximately 33 to 40 ft bgs in Parcel E.

The cumulative cancer risk and noncancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risks and noncancer HIs for chemicals via direct contact with soil and VOCs via inhalation of soil gas migrating to air (see Table ES-1). However, only asbestos was identified as a soil COPC, and asbestos risks were evaluated separately from other chemical risks because these risk estimates are not additive. Therefore, the cumulative cancer risk and noncancer HI were equal to the estimated excess lifetime cancer risk and noncancer HI for VOCs via inhalation of soil gas migrating to air.

The estimated upper-bound cumulative cancer risk is 4×10^{-7} for future indoor commercial/industrial workers (the highest exposed receptor), which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The upper-bound cumulative HI is 0.003, for future indoor commercial/industrial workers, which is well below the threshold of greater than one for noncancer effects. The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil gas to indoor air. Chloroform is the primary contributor to the total estimated cancer risk; however, such contribution is not expected to pose an unacceptable health risk for future commercial/industrial development in Parcel E. Based on the spatial distribution of COPC concentrations and associated risk estimates, there are no areas within Parcel E with elevated concentrations that would require further investigation or remediation.

Based on the health risk levels presented herein, the potential exposures to COPCs in soil (0-10 ft bgs), soil gas, or shallow groundwater in Parcel E are not expected to pose unacceptable health risks for future commercial/industrial development in Parcel E. Additionally, future development on Parcel E is highly unlikely due to the easement with OSSM encumbering the entire parcel and the presence of OSSM’s extractions wells and infiltration trench on the parcel. Furthermore, any NFA issued for the parcel will require the recording of an environmental covenant restricting the use of the property to non-residential.

1. INTRODUCTION

This report has been prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll; formerly Ramboll US Consulting, Inc.) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) and presents the Health Risk Assessment (HRA) for Parcel E at the NERT Site in Henderson, Nevada (the "NERT Site" or the "Site", Figure 1-1). The HRA evaluated potential risks to on-Site workers from exposures to residual levels of chemicals, asbestos, and radionuclides[5] in soils and from exposures associated with inhalation of vapors released from soil gas and groundwater to indoor, outdoor, and trench air within Parcel E. Consistent with the risk assessments completed for Parcels C, D, F, G, and H, exposure via domestic use of groundwater was not evaluated because on-Site groundwater is not and will not be used as a domestic water supply given the high concentrations of total dissolved solids (TDS) in the area.[6] Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities were not considered complete exposure pathways due to the groundwater depth at approximately 33 to 40 feet (ft) below ground surface (bgs) in Parcel E. The cumulative risks associated with potential exposures to chemicals in soil via direct contact and to volatile organic compounds (VOCs) via inhalation of soil gas migrating to air were also evaluated.

The HRA Report for Sale Parcel E was submitted to NDEP on November 18, 2022 (Ramboll 2022b), and NDEP comments were received on February 8, 2023. This revised version was prepared to address those NDEP comments. Subsequent to the initial version of the HRA Report submitted in 2022, NDEP released updated Basic Comparison Level (BCL) tables (NDEP 2023b) and User's Guide and Background Technical Document (NDEP 2023a). In the updates, extensive modifications were made to the soil BCLs, and some toxicity values and methodology used to derive the BCLs were also updated. In addition, the United States Environmental Protection Agency (USEPA) updated toxicity values in recent regional screening level (RSL) tables released in May 2023 (USEPA 2023a). The relevant updates from NDEP and USEPA as described above have been incorporated into this revised HRA Report.

Operable Unit 1 (OU-1) (Figure 1-2), designated for the Remedial Investigation and Feasibility Study (RI/FS) that is currently in progress, comprises approximately 346 acres located within the Black Mountain Industrial (BMI) Complex in unincorporated Clark County, Nevada; it is surrounded by the City of Henderson (Figure 1-1). OU-1 consists of property owned by NERT (the NERT Site, approximately 257 contiguous acres and approximately 8 acres of the non-contiguous Sale Parcel E) as well as five former sale parcels (former Parcels C, D, F, G, and H, comprising 81 acres) which have been transferred from NERT to TRECO, LLC (TRECO) and are no longer owned by NERT (Figure 1-3).[7] Within the Site, the

---

[5] Chemicals, asbestos, and radionuclides are referred to as "chemicals" in this report unless it is necessary to distinguish among the three classes.

[6] High TDS concentrations make the groundwater highly undesirable for use as a drinking water source. https://www.lasvegasgmp.com/wells-groundwater/facts/index.html

[7] Prior to May 2020, OU-1 and the NERT Site were interchangeable terms, both referring to property owned by NERT. Since May 2020, the NERT Site refers to the area excluding former sale parcels which are no longer owned by NERT, while OU-1 and the NERT Site Study Area refers to the same area as before.

Operations Area[8] is used by the Trust for groundwater treatment operations and its tenant EMD Acquisition LLC (EMD) for the operation of its chemical manufacturing business. Outside the Operations Area is one sale parcel (i.e., Sale Parcel E) that is not currently used by the Trust or its tenant.

Parcel E is located in the northwest corner of the Site and is not contiguous with the Operations Area (Figure 1-3). Since 1983, Parcel E has been occupied with the southeastern portion of an extraction well field and the recharge trench for a groundwater extraction and treatment system (GWETS) jointly operated by Olin, Stauffer Chemical Company (Stauffer), Syngenta, and Montrose Chemical Company (Montrose) (collectively referred to as OSSM) as required by OSSM's April 4, 1983 Consent Order with the State of Nevada, Department of Conservation and Natural Resources, Division of Environmental Protection (State of Nevada 1983) to treat impacts to groundwater from the OSSM properties. Most of Parcel E is vacant land, with limited features including extraction wells, monitoring wells, and a recharge trench (Ramboll 2021c). There are no buildings on Parcel E and no buildings are anticipated as long as the OSSM GWETS continues to operate; accordingly, there are no onsite indoor workers on Parcel E at this time. Prior to the Trust receiving ownership of the Site, Tronox identified Parcel E as a parcel suitable for potential future sale. Unlike the other Sale Parcels, this makes Parcel E unique in that the entire parcel is encumbered with an easement. The terms of the easement and the presence and configuration of OSSM's GWETS prevent development, or contemplation for sale, of this parcel in the foreseeable future. OSSM has not expressed any interest in purchasing this parcel. The BMI Complex facilities surrounding the Site are shown in Figure 1-4.

Environmental investigations at Parcel E have generally been conducted separately from investigations in the Operations Area of the Site because there were no reported industrial activities in this area and the OSSM GWETS is present on Parcel E. Field investigation work for soils at Parcel E was conducted in 2018 and 2019. Soil gas samples were collected within Parcel E in 2008 and 2019. Shallow groundwater monitoring has been ongoing since the late 1990's.

This HRA follows the methodologies described in the *Baseline Health Risk Assessment (BHRA) Work Plan* (ENVIRON 2014a) prepared as part of the RI/FS Work Plan (ENVIRON 2014b), the *Identification of Chemicals of Potential Concern (COPCs) and Decision Units for OU-1 Soils* (Ramboll Environ 2017b), and the *Baseline Health Risk Assessment Work Plan for OU-1 and OU-2 Soil Gas and Groundwater* (Ramboll 2018a).

In addition to the risks for Parcel E being evaluated under this HRA, the risks for all other properties within OU-1 were/are being evaluated and/or managed pursuant to other assessments. Specifically, separate post-remediation HRAs for Parcels C, D, F, G and H were completed in late 2017 and early 2018, all of which have been granted No Further Action determinations by the Nevada Division of Environmental Protection (NDEP). A BHRA report for soil in the Operations Area of OU-1 (the "OU-1 Soil BHRA") was submitted to

---

[8] The Operations Area is equivalent to the area referred to as the "Facility Area" in previous reports (with the exception of Parcel E, previously considered as part of the Facility Area for risk assessment purposes). These reports include, e.g., the *Remedial Investigation and Feasibility Study Work Plan* (ENVIRON International Corporation [ENVIRON] 2014b) and the associated risk assessment work plan and report (ENVIRON 2014a; Ramboll Environ US Corporation [Ramboll Environ] 2015a).

NDEP in January 2020 (Ramboll 2020a). Revision 1 of the OU-1 Soil BHRA Report (Ramboll 2021a) was submitted on October 14, 2021 addressing NDEP comments received in June 2020. Revision 2 of the OU-1 Soil BHRA report was submitted on May 6, 2022 (Ramboll 2022a) to address the NDEP comments received in December 2021. Revision 2 of the report was approved by NDEP on June 2, 2022. A BHRA report for soil gas and groundwater in the Operations Area of OU-1 (the "OU-1 Soil Gas and Groundwater BHRA") (Ramboll 2021b) was submitted to NDEP on September 29, 2021; annotated response to comment letter was submitted on June 24, 2022 to respond to NDEP comments received on March 9, 2022; NDEP's responses on the annotated response to comment letter were received on November 3, 2022, and the revised report and annotated response to the NDEP comment letter was submitted to NDEP on November 3, 2023 (Ramboll 2023a).

The findings of this Parcel E HRA report, as well as the two BHRA reports for the Operations Area, will be used in the forthcoming FS for OU-1 and Operable Unit 2 (OU-2) to determine which areas, if any, may require remediation to address unacceptable risk to on-Site worker populations.

The remainder of this report is organized as follows:

- Section 2 provides background information on the Site.
- Section 3 summarizes the results of soil, soil gas, and groundwater investigations conducted at this parcel.
- Section 4 presents the data usability evaluation (DUE), including the data analysis step of the DUE.
- Section 5 presents the methodology and results from each of the four steps of the risk assessment, i.e., 1) identification of COPCs, 2) exposure assessment, 3) toxicity assessment, and 4) risk characterization.
- Section 6 presents the uncertainty analysis, which discusses the relative impact of data uncertainties and the primary assumptions used in the HRA on the risk results.
- Section 7 provides the data quality assessment.
- Section 8 presents the cumulative cancer risks and noncancer hazards.
- Section 9 summarizes the HRA and presents conclusions regarding current conditions within Parcel E.
- Section 10 lists the references cited in this report.

Supporting tables, figures, and appendices follow the text of the report.

2. SITE BACKGROUND

2.1 Site Description

The 346-acre OU-1 is located approximately 13 miles southeast of the City of Las Vegas in an unincorporated area of Clark County, Nevada, within Sections 12 and 13 of Township 22 S, Range 62 E (Figure 1-1). OU-1 is located within the BMI complex, which consists of several facilities that are owned and/or operated by various entities. The City of Henderson surrounds the BMI complex. Prior to May 2020, OU-1 was designated as property owned by NERT, which comprised the NERT Site, consisting of the Operations Area and six sale parcels (Parcels C, D, E, F, G, and H). Since May 2020, five parcels (former Sale Parcels C, D, F, G, and H) are no longer owned by NERT, which reduced the NERT Site to the Operations Area plus the one remaining sale parcel (Parcel E), while OU-1 remains the same, consisting of the NERT Site as well as former Parcels C, D, F, G, and H (Figure 1-3).

Tronox, LLC (Tronox) leased a portion of the Site within the Operations Area from February 2011 to August 2018, on which it operated a chemical manufacturing business (Figure 1-3). In August 2018, the Tronox lease was assigned to EMD, and EMD is continuing similar manufacturing operations at the Site. Although NERT does not have an obligation to oversee EMD's operations, NERT monitors activities within the Leasehold through implementation of the Site Management Plan (SMP), which requires work plans for soil disturbing activities. These work plans are reviewed by NERT and submitted to NDEP for approval. EMD provides an annual certification of SMP compliance and provides work plans and reports for projects conducted under the SMP. Additionally, EMD must notify NERT if a spill occurs, and EMD must copy NERT on all spill-related correspondence with NDEP. The Interim Consent Agreement (NDEP 2011a) between the Trust and NDEP, effective February 14, 2011, set forth specific requirements for the Trust to investigate and remediate contamination associated with historical operations at the NERT Site, including the requirement to perform an RI/FS.

The BMI complex, including OU-1 or previously the NERT Site, has a long, complex ownership and operational history. The BMI complex was first developed by the United States (U.S.) Government in 1942 as a magnesium plant to support World War II operations. Following the war, the Site continued to be the location of industrial activities, including production of perchlorates, boron, and manganese compounds. Former industrial processes and waste management activities conducted at the Site, as well as those conducted at adjacent BMI Complex properties, resulted in contamination of environmental media at the Site, including soil, groundwater, and surface water.

OU-1, or previously the NERT Site, has been the subject of extensive environmental investigations and removal actions since the 1970s. In 1994, NDEP issued a Letter of Understanding (LOU) that identified 70 specific areas or items of interest[9] at the Site and the level of environmental investigation required for each LOU (NDEP 1994). The locations of the LOUs on the NERT Site are shown in Figure 2-1.

---

[9] NDEP identified 69 source areas referred to as LOUs (NDEP 1994). Subsequently, an additional potential source area, the former U.S. Vanadium site, was identified during planning for the 2008 Phase B Investigation (NDEP 2011). Although not formally designated as an LOU, the U.S. Vanadium site is commonly referred to as LOU-70.

In 2005, a Site-wide Conceptual Site Model (Site-wide CSM) Report was prepared, which was the first comprehensive effort to integrate information from the soil and groundwater investigations conducted to date in order to document information on Site-specific sources, release mechanisms, transport pathways, exposure routes, and potentially exposed populations (ENSR 2005). Historical Site investigations conducted since completion of the 2005 Site-wide CSM primarily include the Phase A and Phase B Source Area Investigations, which were designed to further characterize soil, groundwater, and soil gas across the Site, as described in the RI/FS Work Plan (ENVIRON 2014b). The Site-wide CSM was revised and presented in the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c). Tronox continued field investigation and remediation efforts at the Site until February 13, 2011. On February 14, 2011, the Trust took title to the Site and transitioned the existing investigation and removal activities pursuant to an Interim Consent Agreement with NDEP. Section 3 provides details about the environmental investigations conducted by the Trust and other parties within Parcel E.

2.2 Climate

The Site is located within Las Vegas Valley, for which the climate is arid, consisting of mild winters and dry, hot summers. Average annual precipitation as measured in Las Vegas between 1980 and 2020 was 4.20 inches (NOAA 2021). Precipitation generally occurs during two periods, December through March and July through September. Winter storms generally produce low intensity rainfall over a large area. Summer storms generally produce high intensity rainfall over a smaller area for a short duration. The violent summer thunderstorms account for most of the documented floods in the Las Vegas area. Winds frequently blow from the south or northwest at a mean velocity of approximately nine miles per hour (mph); however, velocities in excess of 50 mph are not atypical when weather fronts move through the area. During these windy events, dust, sand, and soil at the ground surface can become airborne and may travel several miles. Temperatures can rise to 120 degrees Fahrenheit (°F) in the summer, and the average relative humidity is approximately 20% (Schevenell 1996). The mean annual evaporation from lake and reservoir surfaces ranges from 60 to 82 inches per year (Shevenell 1996).

2.3 Geologic and Hydrogeological Setting

The Las Vegas Valley occupies a topographic and structural basin trending northwest-southeast and extending approximately 55 miles from near Indian Springs on the north to Railroad Pass on the south. The valley is bounded by the Las Vegas Range, Sheep Range, and Desert Range to the north, by the Frenchman and Sunrise Mountains to the east, by the McCullough Range and River Mountains to the south and southeast, and by the Spring Mountains to the west. The mountain ranges bounding the east, north, and west sides of the valley consist primarily of Paleozoic and Mesozoic sedimentary rocks (limestones, sandstones, siltstones, and fanglomerates), whereas the mountains on the south and southeast consist primarily of Tertiary volcanic rocks (basalt, rhyolite, andesite, and related rock types) that overlie Precambrian metamorphic and granitic basement (ENSR 2007).

The Site is located on Quaternary alluvial deposits (Qal) that slope north toward the Las Vegas Wash. The thickness of the alluvial deposits ranges from less than one foot to more than 50 ft beneath the NERT Site. Soil types identified in on-Site soil borings include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand (ENSR 2005). The Upper Muddy Creek Formation (UMCf) of Tertiary age occurs in the Las Vegas

Valley as valley-fill deposits that are coarse-grained near mountain fronts and become progressively finer-grained toward the center of the valley. Where encountered beneath the Site, the UMCf is composed of at least two thicker units of fine-grained sediments of clay and silt (the first and second fine-grained facies, respectively) interbedded with at least two thinner units of coarse-grained sediments of sand, silt, and gravel (the first and second coarse-grained facies, respectively) (Ramboll 2023b).

Depth to groundwater at the NERT Site ranges from approximately 20 to 60 ft bgs across the Site, with the majority of the samples between 30 and 45 ft bgs. Groundwater is generally deepest in the southernmost portion of the Site. For Parcel E, groundwater depth is approximately 33 to 40 ft bgs. The groundwater flow direction at the Site is generally north to north-northwesterly, whereas north of the Site, the direction changes slightly to the north-northeast (ENVIRON 2014a).

A major feature of the alluvial deposits is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the UMCf during infrequent flood runoff periods (shown on Figure 1-3). These deposits are thickest within the paleochannel boundaries, which are narrow and linear and trend northeastward. The paleochannels act as preferential pathways for groundwater flow, which may significantly influence the chemical distribution in the alluvium (ENSR 2005). Within OU-1, the alluvium was historically saturated below the northern portion of OU-1, while in the southern portion of OU-1 the first groundwater occurred in the UMCf. However, except for a few small areas, the alluvium, including paleochannels, has become dewatered and the first groundwater encountered now generally occurs within the underlying UMCf across OU-1 (Ramboll 2023b). Additional details on the regional and local geology and hydrogeology, including information on the water-bearing zones, are provided in the RI/FS Work Plan (ENVIRON 2014b) and summarized in the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c).

The southeastern portion of the GWETS operated by OSSM located in Parcel E generally captures groundwater with higher contaminant concentrations and is located downgradient of OSSM's source areas, as discussed further in Section 4.3.2.

3. ENVIRONMENTAL INVESTIGATIONS

This section summarizes the soil, soil gas, and groundwater investigations conducted within Parcel E. The soil, soil gas, and groundwater monitoring well locations within Parcel E are shown in Figure 3-1. There have been no reported industrial activities within Parcel E that would have resulted in significant chemical impacts, and NDEP did not identify any LOUs for investigation within Parcel E (Figure 2-1).

3.1 Soil Investigation

During the sampling conducted in September 2018 and September 2019 as part of the Phase 2 RI Modification No. 12 (Ramboll 2018b), soil samples were collected from seven locations within Parcel E, at depths beginning at 1 and 10 ft bgs (Figure 3-1). Both random (RISB-ER-01 to RISB-ER-03) and judgmental (RISB-EJ-01 to RISB-EJ-04) locations were sampled, with judgmental locations adjacent to existing shallow groundwater monitoring wells. The results were reported in the associated data validation summary reports (DVSRs) (Ramboll 2020b, 2020c), approved by NDEP on April 9, 2020 and March 30, 2020, respectively.

3.2 Soil Gas Investigation

Soil gas samples were collected at five locations in Parcel E in 2008 and 2019. The soil gas sampling results for VOCs, along with the groundwater data described below, were both used to evaluate the vapor intrusion pathway, consistent with agency guidance on using multiple lines of evidence (USEPA 2015). Soil gas data is the preferred primary line of evidence for assessing vapor intrusion risks as opposed to groundwater or soil data. Soil gas sampling results for VOCs are summarized below:

- **Phase B soil gas investigation**: The Phase B soil gas investigation was conducted in 2008. One soil gas sample was collected within Parcel E (SG17; see Figure 3-1) at approximately 5 ft bgs as part of this investigation. Details of the soil gas sampling are provided in the *Phase B Source Area Investigation Soil Gas Survey Work Plan* (the "2008 Site-Wide Soil Gas Work Plan"; ENSR 2008a). Sampling locations were based on the following: (1) results of the Phase A investigation (ENSR 2007), which identified the presence of several VOCs in soil and/or groundwater samples collected at the Site; (2) historic soil and groundwater data collected during prior investigations; and (3) an assessment of former chemical usage at the individual LOUs. Analytical results for samples collected during the soil gas survey were presented in a DVSR (ENSR 2008b) that was submitted to NDEP on October 13, 2008, and approved by NDEP on October 20, 2008.
- **Phase 2 RI soil gas investigation**: The Phase 2 RI investigation was conducted in March 2019. It included sampling at four soil gas sample locations within Parcel E (RISG-31, RISG-32, RISG-33, and RISG-34; see Figure 3-1), co-located with existing shallow groundwater monitoring wells. Soil gas samples were collected at both 5 ft bgs and 15 ft bgs consistent with current vapor intrusion guidance (USEPA 2015) recommending the collection of both shallow samples and deeper samples closer to the source (i.e., VOCs in groundwater). However, only a 5 ft bgs sample could be

collected at RISG-31.[10] Details of this sampling are described in the *Phase 2 RI Modification No. 12* (Ramboll 2018b). The results were reported in the associated DVSRs (Ramboll 2020b).

- **Phase 3 RI soil gas investigation**: The Phase 3 RI Modification No. 9 (Ramboll 2019a), which was submitted to NDEP on October 7, 2019, and approved by NDEP on October 14, 2019, included planned sampling in OU-1 and OU-2, including Parcel E. Soil gas sampling for VOCs was conducted in November 2019 at 5 and 15 ft bgs at the four locations previously sampled during implementation of *Phase 2 RI Modification No. 12*, as described above, except at RISG-31, where only a 5 ft bgs sample was collected. Details of this sampling are described in the *Phase 3 RI Modification No. 9* (Ramboll 2019a). The results were reported in the associated DVSR (Ramboll 2020d).

3.3 Groundwater Investigation

Groundwater sampling results for volatile compounds[11] collected from shallow monitoring wells (with top of well screens less than 60 ft bgs) in Parcel E from 2015 to 2019 were evaluated in this HRA for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation, as summarized below:

- **Phase 1 RI**: The Phase 1 RI groundwater investigation in Parcel E was conducted in February 2015. Shallow groundwater samples were collected from two locations within Parcel E (MC-29 and MC-97; see Figure 3-1). The results of the Phase 1 RI were summarized in the *Technical Memorandum, Remedial Investigation Data Evaluation* (the "RI Tech Memo"; Ramboll Environ 2016a). Data gaps to be addressed in the Phase 2 RI were identified in the same submittal. Data for volatile compounds collected from these two locations are included in the groundwater HRA data set for Parcel E.
- **Phase 2 RI**: The Phase 2 RI groundwater investigation in Parcel E was conducted in March 2019. During sampling conducted in March 2019 as part of the Phase 2 RI Modification No. 12 (Ramboll 2018b), shallow groundwater samples were collected from five locations within Parcel E (MC-09R, MC-111, MC-29, MC-94 and MC-97; see Figure 3-1). These samples, taken from existing groundwater monitoring wells in Parcel E, were collected to support this HRA, and were determined to provide adequate spatial coverage. The samples were analyzed for VOCs; these data are included in the groundwater HRA data set for Parcel E.
- **Remedial Performance Monitoring**: As directed by NDEP, VOCs were first added to the groundwater monitoring program as part of the *2016 Groundwater Monitoring Optimization Plan* (Ramboll Environ 2016b) after initial evaluations of Phase 1 RI data suggested that these chemicals were present at detectable levels throughout the NERT Site and the NERT Off-Site Study Area (Figure 1-2) (Ramboll Environ

---

[10] A deeper probe was not installed at RISG-31 because saturated conditions were encountered at 12 ft bgs, although the depth to groundwater is between 33 and 40 ft bgs in Parcel E.

[11] Volatile compounds are identified using the following criteria consistent with USEPA (2023a): 1) vapor pressure greater than 1 millimeter of mercury (mm Hg) or 2) Henry's Law constant greater than 0.00001 atmosphere-cubic meter per mole (atm-m^3/mol). Therefore, in addition to volatile organic compounds (VOCs), any chemicals labelled as semivolatile organic compounds (SVOCs) that meet the USEPA definition of volatile compounds are also included in the vapor intrusion analysis.

2016a). Shallow groundwater samples were collected from one location in Parcel E (MC-97; see Figure 3-1) and analyzed for VOCs as part of the 2017, 2018, and 2019 remedial performance monitoring programs. Data for VOCs collected from this location during the remedial performance monitoring in 2017, 2018 and 2019 are included in the groundwater HRA data set for Parcel E.

4. DATA USABILITY EVALUATION AND DATA ANALYSIS

This section presents the DUE conducted for soil, soil gas, and groundwater (in Sections 4.1, 4.2, and 4.3, respectively). For each medium, the first component of the DUE focuses on the quality of each individual data point to ensure that the quality of the data is sufficient to support the HRA. The second component of the DUE, data analysis, focuses on the entire HRA data set.

The DUE was conducted in accordance with NDEP's *Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Facility in Henderson, Nevada* (NDEP 2010a), which is based on the USEPA's *Guidance for Data Usability in Risk Assessment* (Parts A and B) (USEPA 1992a, b). The USEPA DUE framework provides the basis for identifying and evaluating uncertainties in HRAs with regard to site characterization data. USEPA (1992a) states that "data usability is the process of assuring or determining that the quality of data generated meets the intended use," and that when risk assessment is the intended use, USEPA's guidance "provide[s] direction for planning and assessing analytical data collection activities for the HRA." USEPA has established a specific framework to provide risk assessors a consistent basis for making decisions about the minimum quality and quantity of environmental analytical data to support risk assessment decisions (USEPA 1992a, b; NDEP 2010a). The USEPA data usability guidance identifies the following data quality criteria for evaluating the usability of site investigation data in the risk assessment process:

- Criterion I – Reports to Risk Assessor;
- Criterion II – Documentation;
- Criterion III – Data Sources;
- Criterion IV – Analytical Methods and Detection Limits;
- Criterion V – Data Review; and
- Criterion VI – Data Quality Indicators.

Criteria I through VI are discussed in Sections 4.1.1, 4.2.1, and 4.3.1 for soil, soil gas, and groundwater, respectively.

The second component of the DUE (data analysis) is presented in Sections 4.1.2, 4.2.2, and 4.3.2 for soil, soil gas, and groundwater, respectively. As described in NDEP guidance (NDEP 2010a), the purpose of the data analysis step is to "use simple exploratory data analysis (EDA) to compare data to the expectations of the CSM, to determine if the data adequately represent the source terms and exposure areas or evaluation areas." In particular, through statistical summaries, background evaluation (for soil metals and radionuclides only), spatial plots, and other exploratory analyses, the data are reviewed relative to our current understanding of Parcel E (as represented by the Parcel E CSM) and for possible data gaps or other investigation issues. A discussion of results from the EDA and a comparison of Parcel E data to expectations of the Parcel E CSM is presented in Section 4.4.

4.1 Soil

4.1.1 Data Usability Evaluation

The soil data set evaluated using the data quality criteria is identified in Section 4.1.1.1. Sections 4.1.1.2 through 4.1.1.7 describe the results of the evaluation.

4.1.1.1 Soil Data Set and Data Processing

The soil HRA data set comprises the analytical results that are representative of current conditions within Parcel E. Specifically, the data set includes soil samples collected at depths beginning at 1 and 10 ft bgs as part of the Phase 2 RI Modification No. 12 (Ramboll 2018b).

The "NERT project database" maintained by Ramboll on behalf of the Trust, houses the analytical data collected during historical and recent investigations at the Site.[12] After identifying the preliminary set of data for the HRA, an initial task before the DUE was implemented to 1) identify and correct inconsistencies in data field entries and 2) create additional fields to support data management and interpretation. The following steps of data processing were completed:

- Standardize chemical names and Chemical Abstract Service (CAS) registry numbers;
- Standardize reporting units (e.g., sample results for dioxins/furans, reported in picogram per gram (pg/g), were converted to milligram per kilogram (mg/kg); these units are consistent with those reported for the other chemical groups);
- Standardize analytical method names;
- Correct errors in data entry (e.g., typos in sample identification codes);
- Identify a unique result for use in the HRA for sample/analyte pairs for which more than one result was reported. For example, if two results were reported for benzo(a)pyrene (BaP) in the same sample – one by USEPA Method 8270 and the other by USEPA Method 8270 Selective Ion Monitoring (SIM) – the result used in the HRA was identified as that from the 8270 SIM analysis because of the greater sensitivity (lower reporting limits) of this method;
- Enter BCLs and confirm that BCLs correspond to the chemical form or species reported. For example, the database compared analytical results for phosphorus with the BCL for white phosphorus. There is no evidence to suggest that white phosphorus is present in parcel soils. The most abundant form of phosphorus in soil is orthophosphate. Analytical methods were reviewed to confirm that the analyses were not for white phosphorus; and
- Develop database queries and confirm that queries returned the correct output.

No change was made to a datum without first understanding the issue and the steps necessary to correct the issue. As needed, the sampling plan, laboratory reports, DVSRs, and other supporting documents were reviewed. Data points were considered unusable for risk assessment if information could not be located to confirm and/or correct an identified

---

[12] Historically, the database has been managed by different entities responsible for investigations and data collection at the Site. Ramboll assumed responsibility for the database in early 2011.

issue. Soil data excluded from the HRA data set during data processing and the reasons why these data were excluded are summarized in Appendix A, Table A-1.

To ensure calculation consistency, dioxin toxicity equivalents (TEQs) were calculated using the results for dioxins, furans, and dioxin-like polychlorinated biphenyls (PCBs) and the World Health Organization (WHO) toxicity equivalency factors (TEFs) scheme (van den Berg et al. 2006). BaP equivalents (BaPEqs) were also calculated (or recalculated) for the seven carcinogenic polynuclear aromatic hydrocarbons (PAHs) (i.e., BaP, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene) for which USEPA has derived TEFs (USEPA 2023b). Non-detects were addressed using the Kaplan-Meier approach from USEPA's TEQ calculator.

Total petroleum hydrocarbon (TPH) data were excluded from the soil HRA data set, consistent with NDEP guidance (NDEP 2023a). TPH was evaluated through the indicator chemicals, including benzene, toluene, ethylbenzene, and total xylenes (BTEX); methyl tert-butyl ether (MTBE); and PAHs.

The soil HRA data set for Parcel E is presented in Appendix B (Table B-1 for chemical and radionuclide data, Table B-2 for dioxin/furan, dioxin-like PCB, and carcinogenic PAH data used for the dioxin TEQ and BaPEq calculations, and Table B-3 for asbestos data), which includes 15 samples collected at depths beginning at 1 and 10 ft bgs from seven sampling locations (including one field duplicate).

In the following sections, the usability of the soil HRA data set was evaluated using the data quality criteria described in NDEP (2010a).

4.1.1.2 Criterion I – Reports to Risk Assessor

Criterion I requires confirmation that the reports relied upon are complete and appropriate for use in the HRA. The required information specified under this criterion was verified and is available from the following documentation:

- Parcel E is described in Section 2.1 of this report. Information on the regional and local geology and hydrogeology is provided in the RI/FS Work Plan (ENVIRON 2014b) and was summarized in the RI report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c).
- The soil investigation conducted in Parcel E is described in the Phase 2 RI Modification No. 12 (Ramboll 2018b, approved by NDEP on July 19, 2018).
- The soil results of the Phase 2 RI Modification No. 12 were summarized in the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c).
- The soil analytical data are presented in the Data Validation Summary Report and Electronic Data Deliverable for the Phase 2 Remedial Investigation Sampling, March 2018 through March 2019 Data (Ramboll 2020b, approved by NDEP on April 9, 2020) and the Data Validation Summary Report for Asbestos Data Associated with the Remedial Investigation at the Nevada Environmental Response Trust (NERT) Site (Ramboll 2020c, approved by NDEP on March 30, 2020) (included in Appendix A of this report).

- The laboratories provide a quality assurance/quality control (QA/QC) narrative with each analytical data package, and the data review provides a narrative of qualified analytical results. A description of the analytical methods and detection limits is included. These narratives are included as part of the DVSRs.
- Method-specific QC results are provided in each laboratory report, along with the associated raw data. The laboratory reports and QC results are included as part of the DVSRs.
- Data flags used by the laboratory are defined adequately and are discussed further in Sections 4.1.1.6 and 4.1.1.7.
- Laboratory reports include the name and address of the laboratory, unique identification of the test report, client and project name, and dates of sample receipt and analysis. Each analytical report describes the analytical method used, the analytical results on a sample-by-sample basis, and the practical quantitation limits (PQLs). The results of the QC samples, including method blanks, laboratory control spike (LCS) samples, surrogate recoveries, internal standard recoveries, matrix spike (MS) samples, matrix spike duplicate (MSD) samples, second column confirmation, interference checks, and serial dilutions are also provided. All laboratory reports contained data equivalent to a Contract Laboratory Program (CLP) deliverable, inclusive of CLP QC summary forms where applicable, and the supporting raw data. Reported sample analysis results were imported into the NERT project database.

The available reports, and the accompanying laboratory reports and DVSRs, are considered complete for HRA purposes.

4.1.1.3 Criterion II – Documentation

The objective of the documentation review is to ensure that each analytical result can be associated with a specific sampling location, and that the procedures used to collect the samples are appropriate. As part of this DUE step, Ramboll completed a comprehensive review of the soil samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. Also, as discussed in the work plan listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved Quality Assurance Project Plans (QAPPs; Ramboll Environ 2017c, Ramboll 2019b) in place at the time the soil samples were collected and analyzed. Ramboll reviewed the chain-of-custody (COC) forms prepared in the field and compared them with the analytical data results provided by the laboratories to ensure completeness of the data set.

Figure 3-1 depicts the location of all soil samples included in the Parcel E HRA data set; the analytical results for each sample are included in Appendix B.

The available information is adequate to relate each analytical result retained in the soil HRA data set to a geographic location, depth interval, and sampling procedure.

4.1.1.4 Criterion III – Data Sources

The objective of the data sources review is to ensure that adequate sample coverage of source areas was obtained and the analytical methods used were appropriate to identify chemicals and derive associated exposure point concentrations (EPCs) for the HRA.

The review of sample coverage is based on the distribution of sample locations from soil investigation listed in Section 4.1.1.1. Samples were collected in accordance with the work plan listed under Criterion I, with both judgmental and random sampling collected. As noted in Section 3.1, judgmental samples were collected adjacent to existing shallow groundwater monitoring wells. The vertical coverage of the soil samples ranged from surface down to 10 ft bgs. Based on this review, sample coverage from the soil investigation in Parcel E is considered adequate for purposes of the HRA.

As part of the QAPP, the use of standard USEPA analytical methods (listed under Criterion IV) was approved by NDEP. Analyses were conducted by NDEP-certified laboratories for various classes of chemical compounds, including chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos, dioxins/furans, organic acids, PAHs, PCBs, organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), SVOCs, and VOCs. The USEPA methods are adequate for characterizing potential contaminants in soils and provide quantitative analytical results that are of adequate quality for deriving EPCs.

4.1.1.5 Criterion IV – Analytical Methods and Detection Limits

Criterion IV requires that the analytical method appropriately identifies the chemical form or species, and that for each chemical, the sample quantitation limit (SQL) is sufficiently low for risk characterization. Standard analytical methods were used for all analytes as listed below:

- USEPA Method 300.1 (chlorate)
- USEPA Method 314.0 (perchlorate)
- USEPA Method 6020 or 6010 (metals)
- USEPA Method 7199 (chromium VI)
- USEPA Method 7471 (mercury)
- USEPA Method 4500 (ammonia)
- USEPA Method 9056 (bromide, chloride, fluoride, nitrate, nitrite, ortho-phosphate, and sulfate)
- USEPA Method 300.1 (chlorite)
- Department of Energy (DOE) Method U-02-RC (uranium [U])
- Australian Laboratory Services (ALS) 714 Revision 14 (thorium [Th])
- USEPA Method 903.0 (radium [Ra]-226)
- USEPA Method 904.0 (Ra-228)
- USEPA Method 540-R-97-028 / Berman and Kolk (2000) (asbestos)
- USEPA Method 8290 (dioxins/furans)
- Volatile fatty acids ion chromatography (organic acids)
- USEPA Method 8270 or 8270 SIM (PAHs)
- USEPA Method 1668A (PCB congeners)

- USEPA Method 8081 (OCPs)
- USEPA Method 8141A (OPPs)
- USEPA Method 8270 (SVOCs)
- USEPA Method 8260 (VOCs)

The above methods are adequate to characterize the corresponding chemical groups in soil.

For analytes where the detection frequency was less than 100%[13], the SQLs from the soil HRA data set were compared to 10% of the BCL[14] (NDEP 2023b) to confirm that they were sufficiently low for risk characterization. For chemicals where a BCL was not available, representative surrogates were identified and used for the comparison. Table 4-1 presents the results of the SQL evaluation for Parcel E along with the screening levels.

As shown in Table 4-1, maximum SQLs in Parcel E were less than the screening levels, with the exception of benzidine, hexachlorobenzene, and n-nitroso-di-n-propylamine, which were not detected in any soil samples; the SQLs exceeded 10% of the BCL in 100% of the non-detected samples for these three chemicals.

Overall, the SQLs are sufficiently low for risk characterization. The impacts of the few exceptions with elevated SQLs on the overall soil risk evaluation are further discussed in Section 6.1.2.

4.1.1.6 Criterion V – Data Review

The data review included evaluation of completeness, instrument calibration, laboratory precision, laboratory accuracy, blanks, adherence to method specification and QC limits, and method performance in sample matrix. The laboratory results for the Parcel E soil investigation were subjected to formal data validation consistent with USEPA guidelines (USEPA 1999a, 2001, 2004a, 2005a, 2005b, 2008, 2009a), the BMI Plant Site Specific Supplemental Guidance on Data Validation (NDEP 2009a), and Basic Remediation Company (BRC) Standard Operating Procedure (SOP) 40 and Data Review/Validation (BRC 2009). The USEPA guidelines, which were prepared for CLP data, were adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events and NDEP guidance.

The DVSRs listed in Criterion I for soil data included in the HRA data set are provided in Appendix A, in which the specific data validation procedures, and the qualification findings are presented. The non-asbestos DVSR includes the following tabular summaries of the data qualifications:

- Summary of data qualified due to holding time exceedances
- Summary of data qualified due to detection below quantitation limit
- Summary of data qualified due to laboratory blank contamination

---

[13] Based on NDEP (2008a), the uncensored data for radionuclides were used in the soil HRA; therefore, the detection frequency for radionuclides is 100% and radionuclide data are not included in Table 4-1.

[14] The lower of the indoor and outdoor industrial/commercial worker BCL was used for the comparison.

- Summary of data qualified due to field blank contamination
- Summary of data qualified due to MS/MSD recovery exceedances
- Summary of data qualified due to LCS recovery exceedances
- Summary of data qualified due to field/laboratory duplicate
- Summary of data qualified due to surrogate recovery exceedances
- Summary of data qualified due to calibration violations
- Summary of data qualified due to calibration range exceedances
- Summary of data qualified due to internal standard recovery exceedances
- Summary of data qualified due to serial dilutions
- Summary of qualified data results
- Summary of rejected data results

These data qualifications are further discussed below as a component of Criterion VI.

For the asbestos DVSR, data qualifications were also conducted, but some of the above data qualifications have been adjusted to accommodate the uniqueness of asbestos data. For example, data qualifications for holding time or matrix spikes were not applicable, while data qualification for blanks and calibration were applicable but were evaluated differently. As indicated in the DVSR, no Parcel E asbestos data were qualified for any reason.

4.1.1.7 Criterion VI – Data Quality Indicators

The project QAPPs (Ramboll Environ 2017c; Ramboll 2019b), which were in effect when the soil samples were collected and analyzed, identified five data quality indicators (DQIs) to ensure that the overall quality of the data is sufficient to support the risk assessment, as follows: completeness, comparability, representativeness, precision, and accuracy. The DQIs provide quantitative and qualitative measures for evaluating the risk assessment data as they relate to uncertainties in the selection of COPCs, characterization of EPCs, and risk descriptors used in support of the HRA. Specifically, the DQIs address field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment.

Completeness

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results, which is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. The completeness goal stated in the QAPP is 90% or greater.

First, completeness was reviewed as reported in the DVSRs prepared for the investigations contributing to the soil HRA data set; 99.8% completeness was achieved based on validated data for non-asbestos analytes, with 0.2% of the data qualified as rejected (“R” qualified), and the completeness for the asbestos DVSR was 100%.

Rejected ("R" qualified) data for non-asbestos analytes associated with soil samples collected at depths beginning at 1 and 10 ft bgs in Parcel E are summarized in Appendix A, Table A-3. Completeness for the soil HRA data set for Parcel E (Appendix B) was calculated as 99%.

In summary, the completeness for the soil HRA data meets the goal of 90% or greater established in the QAPPs. Rejected data are excluded from the soil HRA data set, and a discussion of how these rejected data occurrences potentially affect the overall soil risk evaluation is presented in Section 6.1.3.

Comparability

Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. More specifically, comparability is a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. In general, comparability of data is maximized by using standard methods for sampling and analysis, reporting data, and data validation.

Soil samples identified for the HRA were collected from a single investigation conducted by Ramboll and all the analytes (except asbestos) were analyzed using the same analytical methods by the same analytical laboratory. However, different reporting limits for the same analyte may impact the comparability of the data set. The ranges of the SQLs for each analyte for which the detection frequency was less than 100% are presented in Table 4-1. As discussed in Section 4.1.1.5, for most of the analytes, the SQLs are well below 10% of the BCL; therefore, different reporting limits for the same analyte would not affect the overall soil risk evaluation. There are a few analytes with SQLs exceeding 10% of the BCL, and their impacts on the overall soil risk evaluation are further discussed in Section 6.1.2.

Of particular concern are possible differences between the Parcel E soil data set and the BRC/Titanium Metals Corporation (TIMET) regional background soil data set (BRC and TIMET 2007) for both metals and radionuclides as a result of different sample preparation methods, modified (or different) analytical methods, and possible systematic differences among the internal laboratory SOPs. For example, the quartile to quartile (Q-Q) plots for cobalt, copper, phosphorus (total), and zirconium indicate that Parcel E concentrations are generally less than background (see Section 4.1.2.2). These observations indicate possible differences in the data sets, possibly associated with sample extraction, analytical methods, or other less-identifiable differences across the SOPs used by the different laboratories. For radionuclides, such issues were even more obvious, and may be important factors in explaining some of the radionuclide data anomalies. BRC/TIMET regional background samples were collected and analyzed in 2005 (before NDEP issued guidance for evaluating radionuclide data [NDEP 2009b]), while Parcel E samples were collected and analyzed in 2019). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. The impacts of different sample preparation and analytical methods on the overall soil risk evaluation are further discussed in Section 6.1.4.

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition. There is no standard method or formula for evaluating representativeness, which is a qualitative term. Spatial representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific investigation, and by collection of an adequate number of samples from locations identified in relation to the investigation objectives. Concentration representativeness is achieved by obtaining analytical results of sufficient quality, as specified in the QAPP.

Spatial representativeness was discussed previously under Criterion III. As noted, soil samples were collected in accordance with the NDEP-approved work plan listed under Criterion I. Both judgmental and random sampling approaches were followed, with judgmental samples collected adjacent to existing shallow groundwater monitoring wells. The vertical coverage of the soil samples is also adequate for Parcel E. Overall, the objectives of the investigation were met, and the placement of the sample locations is deemed representative to evaluate the Parcel E soil conditions in the context of the Parcel E CSM.

As presented in the DVSRs listed under Criterion I, standard methods for sampling and analysis were used for the soil investigation, which confirmed that the analytical data are representative of the soil concentrations at the locations sampled.

Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Field precision is evaluated by calculating the relative percent difference (RPD) between the primary field sample and its field duplicate. Laboratory precision is quantitated for each laboratory data batch by calculating the RPD using data for the LCS/laboratory control spike duplicate (LCSD) and/or data for the MS/MSD. The field precision goal established in the QAPPs is a RPD of less than or equal to 50%, except for the case in which one (or both) of the primary or duplicate results is less than five times the PQL. For the latter case, the acceptance criteria is the PQL (i.e., the absolute value of the difference between the primary and duplicate result is less than or equal to the PQL). Laboratory precision goals are defined for specific analytical methods, as indicated in the QAPPs (see Table 2 of Ramboll Environ 2017c and Ramboll 2019b).

Field precision for the Parcel E samples was assessed by evaluating the field duplicate results in accordance with the *Statistical Analysis Recommendations for Field Duplicates and Field Splits* (NDEP 2008b), where the primary sample and field duplicate are independent samples. A total of four pairs of primary and field duplicate results for Parcel E were qualified due to RPD criterion exceedance and no results were qualified due to PQL criterion exceedance (see Appendix A, Table A-3). For laboratory duplicates, there were nine data points (all U-235) qualified due to RPD or PQL criterion exceedance (see DVSRs tables in Appendix A). All data with precision exceedances were qualified as “J/Estimated” or “UJ/Estimated non-detected” and are determined to be usable for purposes of the HRA, and the effects of these qualified data on the overall soil risk evaluation are further discussed in Sections 6.1.5 and 6.1.6.

Accuracy

Accuracy measures the level of bias that an analytical method or measurement exhibits. Both field accuracy and laboratory accuracy are evaluated under this DQI. Accuracy in the field is assessed through the use of trip and equipment blanks and through adherence to all sample handling, preservation, and holding time requirements. Accuracy in the laboratory analytical data is a measure of the overestimation or underestimation of reported concentrations. Several QC parameters are used to evaluate the accuracy of reported analytical results, including:

- Holding times;
- Field and laboratory blanks;
- MS/MSD percent recovery;
- Surrogate spike recovery; and
- LCS percent recovery.

All qualified results (i.e., U, J, J-, and J+ qualified data)[15] for the non-asbestos analytes are presented in Appendix B, Table B-1, and the reasons for these qualified results are summarized in the DVSRs (see Appendix A). Although laboratory limits were exceeded for certain compounds or analyses, as identified by the laboratory (and confirmed during data validation), there does not appear to be a systematic or widespread impact on the quality of the analytical results. Furthermore, based on a review of the laboratory narratives (provided in the laboratory reports in the DVSRs), the laboratory indicated that the observed exceedances of laboratory criteria are not of any concern. Therefore, the qualified data are determined to be usable and valid for purposes of the HRA and are included in the HRA data set. The impacts of qualified data on the overall soil risk evaluation are further discussed in Section 6.1.6.

4.1.1.8 Data Usability Conclusions

Evaluation of the soil analytical data for Parcel E in terms of usability for the risk assessment was conducted in accordance with USEPA and NDEP guidance. Based on the evaluation, the overall goals for data quality for risk assessment were achieved, and all DVSRs were reviewed and approved by NDEP. In summary, with the exception of the rejected data discussed above and listed in Appendix A, Table A-2, all Parcel E soil data are deemed to be usable for risk assessment purposes.

4.1.2 Data Analysis

As described by NDEP (2010a), the purpose of the data analysis step is to "use simple EDA to compare data to the expectations of the CSM, to determine if the data adequately represent the source terms and exposure areas or evaluation areas." Consistent with guidance (NDEP 2010a), the steps of the EDA, as described in the following sections, include (1) preparation of summary statistics for the soil HRA data set (Section 4.1.2.1), (2) evaluation of background conditions for metals and radionuclides (Section 4.1.2.2), and (3) preparation and review of spatial plots for detected analytes (Section 4.1.2.3).

---

[15] J, estimated value; J-, estimated, biased low; J+, estimated, biased high; U, not detected.

4.1.2.1 Summary Statistics

Summary statistics for analytical data collected from shallow soils (i.e., samples collected at depths beginning at 1 and 10 ft bgs) in Parcel E are presented in Table 4-2. Table 4-2 includes analytes detected in one or more soil samples; Appendix C presents summary statistics for all analytes (i.e., detected analytes and analytes reported at less than the SQL in all samples). Individual sample locations are shown in Figure 3-1. In developing the summary statistics, soil samples with primary and field duplicate results were treated as independent samples. The effects of duplicate treatment on the overall soil risk evaluation are further discussed in Section 6.1.7.

Table 4-3 presents the soil data summary results for asbestos (long amphibole and chrysotile fibers). Results are reported in terms of the number of long fibers (i.e., >10 micrometer [µm] long and <0.4 µm wide) observed in the sample. As shown in Table 4-3, no long amphibole or chrysotile fibers were observed in any of the soil samples collected from a depth of 1 foot bgs in Parcel E. As agreed upon by NDEP during the meeting on April 6, 2023, the asbestos analysis for Parcel E is supplemented by considering the surface soil results for adjacent former Sale Parcels C and D. Eight chrysotile long fibers were identified in six of the seventeen samples in former Parcel C; while seven chrysotile long fibers were identified in three of the nine samples in former Parcel D. Most of the fibers were located in samples on the east side of former Parcels C and D approximately 1,000 - 1,500 ft away from Parcel E. For amphibole long fibers, the best estimate was zero fibers for both parcels (Ramboll Environ 2017a).

4.1.2.2 Background Evaluation

To support the EDA, a background evaluation was conducted for Parcel E. As recommended in Neptune (2017), analytical results for the BRC/TIMET regional background soil samples were used as the background data set for COPC identification and delineation of exposure areas for surface soils at the NERT Site.[16] A detailed discussion of the BRC/TIMET regional background data set is presented in the *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007). The BRC/TIMET regional background data set is a combination of soil background data collected by ENVIRON for the City of Henderson in 2003 and by BRC/TIMET in 2005. Specifically, as recommended by Neptune (2018), the 95 McCullough samples collected from 30 sampling locations on 10 undeveloped properties near and upgradient from the Site at 0 to 0.5, 4 to 6, and 9 to 11 ft bgs as part of the 2005 BRC/TIMET study were used in the background evaluation for the northern portion of the Site, which is located north of the McCullough Range on alluvial soils generated from McCullough Range substrate. The sampling locations of the 2005 BRC/TIMET study were presented in Appendix A of the *Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity, prepared by BRC and TIMET* (BRC and TIMET 2007), which were off-Site locations in relatively close proximity to the Site but were upgradient and sufficiently distant so that impacts from Site operations were not likely. The BRC/TIMET background data set used for the background evaluation are included in Appendix D.

---

[16] More recent background soil data collected by Ramboll, which were used in the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c), were from depths below 10 ft bgs. These soil background data are not applicable to the Parcel E HRA, which focused on soil data from depths of 0 to 10 ft bgs to evaluate human exposure through direct contact.

The background evaluation was performed using normal and lognormal Q-Q plots, and side-by-side box-and-whisker plots (box plots). These plots are included in Appendix E. Normal and lognormal Q-Q plots provide a visual assessment of how closely the data follow a normal or lognormal distribution. Data points that fall roughly on a straight line may be considered to follow a normal or lognormal distribution. Both background and Parcel E data are included on these plots such that the Q-Q plots provide a direct visual comparison of the two distributions. The Shapiro-Wilk test was used to more formally evaluate the consistency of each data set with a normal or lognormal distribution.

Box plots provide a visual comparison between Parcel E and background data. For each data set, the "box" in the box-and-whisker plot encompasses the central 50 percent of the results (i.e., the results from the 25th to 75th percentiles, or equivalently, between the first quartile [Q1] and the third quartile [Q3]). Substantial overlap between the boxes for background and Parcel E data indicates that the Parcel E data may not be significantly different from background. The whiskers demarcate one "step" above the 75th percentile and one step below the 25th percentile. One "step" is defined as 1.5 times the interquartile range (IQR, the difference between the 75th and 25th percentiles). Data points above and below the whiskers are considered potential outliers from the distribution and are shown on the plots as open circles for non-detected values and as crosses for detected values. As used here, "outliers" may indicate potential hotspots for spatial analysis.

The computer statistical software program R was used to perform all statistical tests, and a copy of the R codes used in the background evaluation is presented in Appendix E.[17] Specifically, statistical background comparisons were performed using the t-test, Gehan test, Quantile test, and Slippage test. This suite of tests is sometimes referred to as "Gilbert's Toolbox." The t-test is a parametric test (i.e., an underlying condition is that the data or log-transformed data are normally distributed). In contrast, the Gehan test, Quantile test, and Slippage test are nonparametric, and thus do not require that the data are normally or lognormally distributed (USEPA 2002a; NDEP 2009c). These tests are described below:

The two-sample t-test tests for equality of the means of Parcel E and background concentrations. An underlying assumption of the test is that concentrations are normally distributed for both data sets.

The Gehan test is a modification of the Wilcoxon Rank Sum test that evaluates the difference between the sums of the ranks for two populations. This is a nonparametric method for assessing differences in the centers of the distributions and is based solely on the relative order (or ranking) of the observations from the two samples. This test has less power than the two-sample t-test when the data are normally distributed, but the assumptions are not as restrictive. The Gehan test uses the Mantel approach for ranking the data, which is equivalent to using the Gehan ranking system. The Gehan ranking system is used to rank non-detects with the detected concentrations (NDEP 2009c).

The Quantile test evaluates "tail effects" that are not specifically considered in the Wilcoxon Rank Sum test. The Quantile test looks for differences in the right tails (upper end

---

[17] Neptune provided Ramboll with a copy of the R codes used for the statistical background evaluation on May 18, 2020.

of the distribution), rather than evaluating central tendency. The Quantile test was performed using a defined quantile of 0.80, consistent with the approach used in the Parcels Soil HRA (Northgate Environmental Management, Inc. [Northgate] 2014).

The Slippage test looks for a shift to the right in the extreme right tail of the background data set as compared with the extreme right tail of the Parcel E data set. This test evaluates whether the number of Parcel E samples with concentrations greater than the maximum background concentration is greater than would be expected statistically if the Parcel E and background distributions were the same.

NDEP guidance (2008a) recommends including field duplicates in a data set when the variance of the duplicates is similar to the variance of the primary samples. As noted in the guidance, field duplicate samples represent a discrete and unique measurement of soil chemical conditions proximal to the primary sample (unlike split samples). For the background evaluation presented in this report, soil samples with primary and field duplicate results were treated as independent samples, consistent with Option 2 in NDEP guidance (NDEP 2008b). The effects of duplicate treatment on the overall soil risk evaluation are further discussed in Section 6.1.7.

Consistent with NDEP guidance (NDEP 2009c), non-detect results are set equal to the detection limit for the non-parametric tests, because substitution is not required for the non-parametric tests, which use the Gehan ranking scheme to rank non-detects. For the parametric tests (i.e., t-test), the Gehan ranking scheme cannot be used, and non-detect results are set equal to one half the detection limit.

Metals

The background evaluation for metals in Parcel E is presented in Appendix E, as follows:

- Table E-1 presents summary statistics for each metal, including the total number of samples, number of detections, percent detections, minimum SQL, maximum SQL, minimum detected value, maximum detected value, median, mean, and standard deviation. Consistent with NDEP guidance (NDEP 2008c), the median, mean, and standard deviation are calculated based on detected concentrations only. The results of the Shapiro-Wilk test are also presented;
- Table E-2 includes the calculated probability (p-values) for the four statistical tests and the overall determination as to whether soil concentrations in Parcel E are greater than background levels (five results are shown in the table because the t-test was performed twice, once on the raw data set and once on the log-transformed data set);
- Figures E1-1 through E1-22 present boxplots for metals in background soils and Parcel E soils (upper 10 ft);
- Figures E2-1 through E2-22 present normal and lognormal Q-Q plots for metals in background soils and Parcel E soils (upper 10 ft).

A significance level of alpha = 0.025 was used to evaluate the statistical significance of the Gilbert's Toolbox results, consistent with NDEP guidance (NDEP 2009c).

While most metals were either identified as consistent with background or a valid comparison was not applicable due to low frequency of detections, there were four metals (boron, iron, mercury, and vanadium) identified as not consistent with the background data (see Table E-2).

Radionuclides

The background (BRC/TIMET) data set includes results for the long-lived radionuclides in the U-238 decay series (U-238, U-234, Th-230, and Ra-226) and in the Th-232 series (Th-232, Ra-228, and Th-228). The BRC/TIMET background data set also includes data for U-235, but not for the U-235 decay chain. NDEP guidance (2009b) notes that most isotopes of the U-235 decay chain are barely discernible from the minimal detectable concentrations. The background evaluation and tests for secular equilibrium are presented in Appendix E, as follows:

- Table E-3 presents summary statistics for each radionuclide, including the total number of samples, number of detections, percent detections, minimum detected value, maximum detected value, median, mean, and standard deviation. Consistent with NDEP guidance (NDEP 2008c), the median, mean, and standard deviation are calculated based on detected concentrations. The results of the Shapiro-Wilk test are also presented;
- Table E-4 includes the p-values for the four statistical tests and the overall determination as to whether soil concentrations in Parcel E are greater than background levels (five results are shown in the table because the t-test was performed twice, once on the raw data set and once on the log-transformed data set);
- Tables E-5a and E-5b present the results of the equivalence testing for secular equilibrium of the uranium decay series (U-238 chain) and thorium decay series (Th-232 chain), respectively;
- Table E-6 presents the correlation matrices for the uranium decay series and the thorium decay series;
- Figures E1-23 through E1-30 present the boxplots for radionuclides in background soils and Parcel E soils (upper 10 ft);
- Figures E2-23 through E2-30 present normal and lognormal Q-Q plots for radionuclides in background soils and Parcel E soils (upper 10 ft).

The significance level used for the background evaluation of metals (alpha = 0.025) was also used for the background evaluation of radionuclides.

Of the eight radionuclides analyzed for the soil data collected in Parcel E, one radionuclide in the U-238 decay series (i.e., Th-230) was identified to be inconsistent with background, while all radionuclides in the Th-232 decay series as well as U-235 are presented at activities consistent with background (see Table E-4).

4.1.2.3 Spatial Analysis of Chemicals in Soil

Spatial quartile plots (Appendix F1) were prepared for detected chemicals exceeding 10% of the BCL (or other applicable soil screening level) in Parcel E soil to illustrate the spatial distribution of the data, identify potential areas of higher concentrations, and compare the results to the expectations of the Parcel E CSM. Each spatial quartile plot presents the following information:

- Sample locations;
- Chemical concentrations. The concentration shown at each sample location is the maximum detected concentration for all samples collected at that location for soils collected at depths beginning at 1 and 10 ft bgs, unless results for all samples at that location were reported as less than the detection limits; concentration bins are defined as follows:
- Dark green - concentrations < detection limits;
- Light green - concentrations <Q1;
- Yellow - concentrations within the IQR;
- Orange - concentrations >Q3 and <=(Q3 + 1.5×IQR); and
- Red - concentrations >(Q3 + 1.5×IQR).

Spatial quartile plots are presented for four detected analytes that exceed 10% of the BCL (exceedances shown in Table 4-2) for Parcel E, as follows:

- Radionuclides – U-238, Th-232, and U-235 (the parent radionuclides); and
- Zirconium.

The plots are presented in Appendix F1 (organized alphabetically by chemical name) and discussed in Section 4.4. The EDA (including the review of the Appendix F1 spatial quartile plots) is presented in Table 4-4.

4.2 Soil Gas

4.2.1 Data Usability Evaluation

The soil gas data set evaluated using the data quality criteria previously described for soil are identified in Section 4.2.1.1 and the evaluation of the soil gas sample results relative to these criteria is presented in Sections 4.2.1.2 through 4.2.1.7. A summary of the soil gas DUE is presented in Section 4.2.1.8.

4.2.1.1 Soil Gas Data Set and Data Processing

The soil gas data set comprises analytical results that are representative of current conditions within Parcel E. Specifically, the data set includes soil gas samples collected at 5 and 15 ft bgs as part of the following three investigations:

- 2008 Soil Gas Investigation: soil gas samples were collected from across the Site (including Parcel E) in 2008 during the Phase B site-wide soil gas survey. One soil gas sample (SG17) was collected within the boundary of Parcel E.
- 2019 Phase 2 RI Modification No. 12 soil gas sampling: soil gas samples were collected in March 2019 to support this HRA. Eight soil gas samples were collected within the boundary of Parcel E at 5 ft bgs at RISG-31 and at 5 ft and 15 ft bgs at

RISG-32, RISG-33, and RISG-34. One field duplicate sample was also collected at 5 ft bgs at RISG-33.

- 2019 Phase 3 RI Modification No. 9 soil gas sampling: soil gas samples were collected in November 2019 to support this HRA. Seven soil gas samples were collected within the boundary of Parcel E at 5 ft bgs at RISG-31 and at 5 ft and 15 ft bgs at RISG-32, RISG-33, and RISG-34.

The "NERT project database" maintained by Ramboll on behalf of the Trust houses the analytical data collected during historical and recent investigations at the Site. After identifying the preliminary set of data for the HRA, an initial task before the DUE was implemented to 1) identify and correct inconsistencies in data field entries and 2) create additional fields to support data management and interpretation. The following steps of data processing were completed:

- Standardize chemical names and CAS registry numbers;
- Standardize reporting units (e.g., microgram per cubic meter [$\mu g/m^3$] for soil gas);
- Standardize analytical method names;
- Correct errors in data entry (e.g., typos in sample identification codes);
- Identify a unique result for use in the HRA for sample/analyte pairs for which more than one result was reported; and
- Develop database queries and confirm that queries returned the correct output.

No change was made to a datum without first understanding the issue and the steps necessary to correct the issue. As needed, the sampling plan, laboratory reports, DVSRs, and other supporting documents were reviewed. Data points were considered unusable for risk assessment if information could not be located to confirm and/or correct an identified issue. No soil gas data were excluded from the HRA data set for Parcel E during data processing. The soil gas HRA data set for Parcel E is presented in Appendix G of this report.

In the following sections, the usability of the soil gas HRA data set was evaluated using the data quality criteria described in NDEP (2010a).

4.2.1.2 Criterion I – Reports to Risk Assessor

Criterion I requires confirmation that the reports relied upon are complete and appropriate for use in the HRA. The required information specified under this criterion was verified and is available from the following documentation:

- A description of Parcel E is provided in Section 2.1 of this HRA. Information on the regional and local geology, hydrogeology, and historical industrial operations is provided in the RI/FS Work Plan (ENVIRON 2014b) and the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c).
- The sampling design, rationale, and sampling procedures for the 2008 and 2019 soil gas investigations are provided in the following work plan and technical memorandum, respectively:

- Phase B Source Area Investigation Work Plan, Soil Gas Survey, Tronox LLC Facility (ENSR 2008a, approved by NDEP on March 26, 2008).
- Phase 2 RI Modification No. 12. Recommended Soil, Soil Gas, and Groundwater Sampling in Parcel E (Ramboll 2018b, approved by NDEP on July 19, 2018).
- Phase 3 RI Modification No. 9, Proposed Soil Gas Sampling in OU-1 and OU-2 (Ramboll 2019c, approved by NDEP on October 14, 2019).
- A report summarizing the soil gas results of the Phase B Source Area Investigation was not identified. The results of the Phase 2 RI Modification No. 12 are summarized in the Soil Gas Sampling Results for OU-1 and OU-2 (Ramboll 2020c, NDEP response received on January 28, 2021);
- The 2008 Phase B soil gas analytical data are presented in the Revised Draft Data Validation Summary Report, Phase B Source Area Investigation Soil Gas Survey (ENSR 2008b, approved by NDEP on October 20, 2008). The March 2019 soil gas results from the Phase 2 RI Modification No. 12 investigation are presented in the Phase 2 Remedial Investigation Data Validation Summary Report and Electronic Data Deliverable for March 2018 through March 2019 Data (Ramboll 2020c, approved by NDEP on April 29, 2020). The November 2019 soil gas results from the Phase 3 RI Modification No. 9 investigation are presented in the Remedial Investigation Data Validation Summary Report and Electronic Data Deliverable, Phase 3 RI Modification No. 4, 5, 6, and 9 (Ramboll 2020e, NDEP approved January 13, 2021). These DVSRs are included in Appendix A of this report.
- The laboratories provide a QA/QC narrative with each analytical data package, and the data review provides a narrative of qualified analytical results. A description of the analytical methods and detection limits is included. These narratives are included as part of the DVSRs.
- Method-specific QC results are provided in each laboratory report, along with the associated raw data. The laboratory reports and QC results are included as part of the DVSRs.
- Data flags used by the laboratory are defined adequately and are discussed further below.
- Laboratory reports for the 2008 and 2019 soil gas data are included in the 2008 and 2019 DVSRs (Appendix A). The laboratory reports include the name and address of the laboratory, a unique identifier for the test report, client and project name, and dates of sample receipt and analysis. Laboratory reports include the name and address of the laboratory, unique identification of the test report, client and project name, and dates of sample receipt and analysis. Each analytical report describes the analytical method used, the analytical results on a sample-by-sample basis, and the PQLs. The results of the QC samples, including method blanks, LCS samples, surrogate recoveries, internal standard recoveries, MS samples, MSD samples, second column confirmation, interference checks, and serial dilutions are also provided. All laboratory reports contained data equivalent to a CLP deliverable, inclusive of CLP QC summary forms where applicable, and the supporting raw data. Reported sample analysis results were imported into the NERT project database.

The available reports, and the accompanying laboratory reports and DVSRs, are considered complete for HRA purposes.

4.2.1.3 Criterion II - Documentation

The objective of the documentation review is to ensure that all analytical data can be associated with a specific sample location and appropriate sample collection procedure and that the procedures used to collect the samples are appropriate. As part of this DUE step, Ramboll completed a comprehensive review of the soil gas samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. Also, as discussed in the work plan listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved QAPP (ENSR 2008c; Ramboll 2017c; Ramboll 2019b). Also, as discussed in the work plan listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved QAPP in place at the time the soil gas samples were collected and analyzed. Ramboll reviewed the COC forms prepared in the field and compared them with the analytical data results provided by the laboratories to ensure completeness of the data set.

Figure 3-1 shows the location of all soil gas samples included in the HRA data set for Parcel E; a complete set of the soil gas analytical results is summarized in Appendix G and also included in the electronic data deliverable (EDD) (Appendix A).

The available information is adequate to relate each analytical result retained in the soil gas HRA data set to a geographic location, depth interval, and sampling procedure.

4.2.1.4 Criterion III – Data Sources

The objective of the data sources review is to ensure that adequate sample coverage of source areas has been obtained and that the analytical methods used were appropriate to identify COPCs and derive associated EPCs for the HRA.

The review of sample coverage is based on the distribution of sample locations from soil gas investigations listed in Section 4.2.1.1. Samples collected in accordance with the 2008 Work Plan were (1) located within LOUs where VOCs may have been used in historical operations; (2) located to evaluate soil gas concentrations associated with on-Site plumes; and (3) co-located with existing groundwater monitoring wells to obtain spatial coverage. Samples collected in 2019 were co-located with existing groundwater wells. The 2008 and 2019 sampling locations are shown in Figure 3-1. As shown in the figure, the one 2008 soil gas sampling location (SG17) and the four 2019 soil gas sample locations (RISG-31, RISG-32, RISG-33, and RISG-34) are located throughout Parcel E and adjacent to shallow groundwater monitoring wells. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 micrograms per liter (µg/L). Based on this review, sample coverage is considered adequate for purposes of this HRA, assuming groundwater conditions remain stable.

As part of the QAPP, the use of standard USEPA analytical methods (listed under Criterion IV) was approved by NDEP. Analyses were conducted at NDEP-certified laboratories for VOCs in soil gas samples from Parcel E. The USEPA method is of adequate quality for deriving EPCs.

4.2.1.5 Criterion IV – Analytical Method and Detection Limits

Criterion IV requires that the analytical method appropriately identifies the chemical form or species, and that for each chemical, the SQL is sufficiently low for risk characterization. Standard analytical method USEPA Method TO-15 (USEPA 1999b) was used for analyzing VOCs in soil gas. This method is adequate to characterize the corresponding chemical group (i.e., VOCs) analyzed for the soil gas samples.

Because NDEP has not derived BCLs for soil gas, risk–based target concentrations (RBTCs) were derived corresponding to the more stringent of (1) a cancer risk of 1 × 10^{-6} or (2) a noncancer hazard quotient (HQ) of 1. The RBTCs were derived using the outputs from the Johnson and Ettinger (1991) model and values for exposure assumptions and toxicity criteria presented in Section 5 of this HRA. The lowest RBTCs among the RBTCs developed for indoor workers, outdoor workers, and construction workers were used in the evaluation of SQLs of the 5 ft and 15 ft bgs soil gas HRA data sets, respectively, for Parcel E.

For analytes for which the detection frequency was less than 100%, the maximum SQL for each soil gas analyte from the 2008 and 2019 soil gas data set for Parcel E was conservatively compared to the lowest soil gas RBTC. Table 4-6 lists the maximum SQLs from the soil gas data set (all samples were approximately 5 ft bgs or 15 ft bgs samples) and the lowest RBTCs for soil gas at 5 ft bgs, presents the ratio of the maximum SQL to 10% of the RBTC, and includes the number of soil gas samples with SQLs greater than 10% of the RBTC for Parcel E. For the soil gas samples collected in Parcel E, the maximum SQLs were less than 10% of the respective RBTCs for all analytes (i.e., no non-detects were greater than 10% of the RBTC) except that the SQL for one chemical (1,2-dibromo-3-chloropropane) in the November 2019 soil gas samples is higher than 10% of the RBTC. This result is in general consistent with the QAPP goal that SQLs are less than 10% of the RBTCs, as established by NDEP for the BMI Complex and Common Areas (NDEP 2010a). Overall, the SQLs achieved were confirmed to be adequate for risk assessment. The uncertainty associated with the SQLs for 1,2-dibromo-3-chloropropane for the November 2019 soil gas samples collected during the Phase 3 RI Modification No. 9 soil gas investigation is discussed in Section 6.1.2.

4.2.1.6 Criterion V – Data Review

The data review included evaluation of completeness, instrument calibration, laboratory precision, laboratory accuracy, blanks, adherence to method specification and QC limits, and method performance in sample matrix. The laboratory results for the Parcel E soil gas investigations were subjected to formal data validation consistent with USEPA guidelines (USEPA 1999a; 2001; 2004a; 2005a,b; 2008; 2009a), the BMI Plant Site Specific Supplemental Guidance on Data Validation (NDEP 2009a), and BRC SOP 40 and Data Review/Validation (BRC 2009). The USEPA guidelines, which were prepared for CLP data, were adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events and NDEP guidance.

The DVSRs listed in Criterion I for soil gas data included in the HRA data set for Parcel E are provided in Appendix A, in which the names and qualifications of the reviewers, the specific data validation procedures, and the qualification findings are presented. The DVSRs include the following tabular summaries of the data qualifications:

- Summary of data qualified due to holding time exceedances;
- Summary of data qualified due to detection below quantitation limit;
- Summary of data qualified due to laboratory blank contamination;
- Summary of data qualified due to field blank contamination;
- Summary of data qualified due to MS/MSD recovery exceedances;
- Summary of data qualified due to LCS recovery exceedances;
- Summary of data qualified due to field/laboratory duplicate;
- Summary of data qualified due to surrogate recovery exceedances;
- Summary of data qualified due to calibration violations;
- Summary of data qualified due to calibration range exceedances;
- Summary of data qualified due to internal standard recovery exceedances;
- Summary of data qualified due to serial dilutions;
- Summary of qualified data results; and
- Summary of rejected data results.

These data qualifications are further discussed below as a component of Criterion VI.

4.2.1.7 Criterion VI – Data Quality Indicators

The QAPP identified five DQIs to ensure the overall quality of the data is sufficient to support the risk assessment, as follows: completeness, comparability, representativeness, precision, and accuracy. The DQIs provide quantitative and qualitative measures for evaluating the risk assessment data as they relate to uncertainties in the selection of COPCs, characterization of EPCs, and risk descriptors used in support of the HRA. Specifically, the DQIs address field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment.

Completeness

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results, which is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. The completeness goal stated in the QAPP is 90% or greater.

First, completeness was reviewed as reported in the DVSRs prepared for the investigation contributing to the soil gas HRA data set. No rejected data were identified in the soil gas data set for Parcel E. Completeness achieved for each of the 2008, March 2019, and November 2019 data sets was 100%, 99.8%, and 99.99%, respectively, based on the number of requested analyses on the chain-of-custodies as compared with the number reported by the laboratory. Overall data completeness was over 99% for all the soil gas data sets, based on the number of validated data points, exceeding the QAPP goal of 90%.

Comparability

Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. More specifically, comparability is a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. In general, comparability of data was maximized by using standard methods for sampling and analysis, data reporting, and data validation over the 2008, March 2019, and November 2019 sampling programs.

In 2008, one soil gas sample was collected at 5 ft bgs at SG17. In the March 2019 and November 2019 investigations, soil gas samples were collected at both 5 ft bgs at four locations (RISG-31 through RISG-34) and 15 ft bgs at three locations (RISG-32 through RISG-34) in Parcel E. Helium was used as the tracer gas for leak checking during sample collection in all three soil gas investigations; helium was analyzed in the soil gas samples collected in 2008 and November 2019. USEPA Method TO-15 (USEPA 1999b) was used for analysis of samples collected in 2008 and 2019, and all sampling results were reported in $\mu g/m^3$. Additionally, the same sample preservation, extraction, and preparation techniques were used in both 2008 and 2019.

Temporal factors were also considered in the comparability evaluation. Soil gas concentrations would be expected to follow trends in groundwater concentrations, in cases where groundwater is the source of VOCs. Therefore, the 2019 soil gas location RISG-31, which is co-located with the only 2008 soil gas sampling location (SG17) in Parcel E, is used to evaluate soil gas concentration trends. The concentration trend at this location is discussed in Section 4.2.3.2.

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or across an area (e.g., represented by the average concentration). There is no standard method or formula for evaluating representativeness. Spatial representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific investigation and by collection of an adequate number of samples from locations identified in relation to the investigation objectives. Concentration representativeness is achieved by obtaining analytical results of sufficient quality, as specified in the QAPP.

Spatial representativeness is discussed in Section 4.2.1.4. Locations sampled in 2008 and/or 2019 were co-located with existing groundwater sampling locations. At three of four locations sampled in 2019, samples were collected at 15 ft bgs as well as 5 ft bgs, consistent with current vapor intrusion guidance (USEPA 2015) recommending samples closer to the source (i.e., VOCs in groundwater). RISG-31 is located in the southeastern portion of Parcel E and is adjacent to shallow groundwater monitoring well MC-97 and soil sample location RISB-EJ-04. RISG-32 is located in the northeastern portion of Parcel E and is adjacent to shallow groundwater monitoring well MC-94 and soil sample location RISB-EJ-03. RISG-33 is located in the southern portion of Parcel E and is adjacent to shallow groundwater monitoring well MC-29 and soil sample location RISB-EJ-02. RISG-34 is located in the northwestern portion of Parcel E and is adjacent to shallow groundwater monitoring well MC-09R and soil sample location RISB-EJ-01. As shown in Figure 1-3, the southeastern portion of the GWETS operated by OSSM located in Parcel E generally captures groundwater with higher contaminant concentrations and is located downgradient of the source areas. The GWETS and its associated recharge trench have significantly decreased chemical concentrations in Parcel E. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 µg/L. Therefore, the soil gas sample locations are considered spatially representative of the current conditions in Parcel E.

The degree to which the analytical data are representative of soil gas concentrations at the locations sampled is evaluated in this section by reviewing the helium leak check results from the 2008, March 2019 and November 2019 investigations. Analytical precision and accuracy, also considered in the evaluation of representativeness, are discussed in Section 4.2.1.7.

Entrainment of contaminants and dilution with surface air can impact the representativeness of analytical results. Helium gas was used in the 2008, March 2019 and November 2019 investigations as a leak check compound during purging and sampling.

For the 2008 investigation, all sample results with helium concentrations between 1% and 10% of the shroud average were qualified as estimated (J) based on possible contamination and dilution by surface air. This rule was based on a conservative interpretation of the Interstate Technology Regulatory Council (ITRC) document *Vapor Intrusion Pathway: A Practical Guideline* (ITRC 2007) and *Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (New York State Department of Health 2006). The analytical results from the 2008 soil gas sample (SG17) collected within Parcel E were J-qualified due to this criterion. The average helium concentration detected in the shroud is 7.8% and the average leak percentage is 2.4% at SG17 (see Table C-8 in Appendix A.3). Therefore, the analytical results for this sample were not corrected.

For the March 2019 investigation for Parcel E, helium concentrations in shrouds were monitored for leak check purposes during sampling and no helium leak was noted during the soil gas sampling. Helium concentrations in the soil gas samples were not analyzed by the laboratory and helium leak percentages were not calculated for the soil gas samples collected in this investigation. The analytical results from this soil gas investigation were not corrected.

For the November 2019 investigation, helium concentrations in shrouds were monitored for leak check purposes during sampling and helium concentrations in the soil gas samples were also analyzed by the laboratory. Helium was detected in the soil gas samples collected at 15 ft bgs at RISG-33 and RISG-34 in Parcel E. The average helium concentrations in the shroud are 14.4% and 17.5% for these two samples, respectively; the average calculated leak percentages for these two samples are 0.9% and 0.8%, respectively, less than the QAPP criterion of 5%. Therefore, the analytical results for these two samples were not corrected (Appendix A.6).

A sensitivity analysis was conducted to evaluate the impact of the helium detections on the exposure concentrations used in the HRA, as discussed in Section 6.1.6.

Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Field precision is evaluated by calculating the RPD between primary field sample and its field duplicate. Replicate measurements can be made on the same sample or on two samples from the same source. Laboratory precision is quantitated for each laboratory data batch by calculating the RPD using data for the LCS/LCSD and/or data for the MS/MSD. The field precision goal established in the QAPP is a RPD of less than or equal to 50%, except for the case in which one (or both) of the primary or duplicate results is less than five times the reporting limit. For the latter case, the acceptance criteria is the reporting limit (i.e., the absolute value of the difference between the primary and duplicate result is less than or equal to the reporting limit). Laboratory precision goals are defined for specific analytical methods, as indicated in the QAPP (see Table 2 of Ramboll 2019b).

Field precision for the Parcel E samples was assessed by evaluating the field duplicate results in accordance with the *Statistical Analysis Recommendations for Field Duplicates and Field Splits* (NDEP 2008b), where the primary sample and field duplicate are independent samples for the 2008, March 2019, and November 2019 investigations, as summarized below:

- 2008 Investigation: Although field duplicate samples were collected during the Phase B soil gas sampling in 2008, none of the duplicate samples were collected from location SG17 in Parcel E.
- 2019 Phase 2 RI Modification No. 12 Investigation: One field duplicate was collected at 5 ft bgs at RISG-33 in Parcel E in this investigation, and none of the paired values were qualified based on RPDs that exceeded the QAPP criteria or the PQL criterion exceedance.
- 2019 Phase 3 RI Modification No. 9 Investigation: Although field duplicate samples were collected in the Phase 3 RI Modification No. 9 investigation, none of the duplicate samples were collected from soil gas sampling locations in Parcel E.

The laboratory duplicate precision was within the limits established in the analytical programs in applicable QAPPs.

Accuracy

Accuracy measures the level of bias that an analytical method or measurement exhibits. Both field accuracy and laboratory accuracy are evaluated under this DQI. Accuracy in the field is assessed through the use of trip and equipment blanks and through adherence to all sample handling, preservation, and holding time requirements. Accuracy in the laboratory analytical data is a measure of the overestimation or underestimation of reported concentrations. Several QC parameters are used to evaluate the accuracy of reported analytical results, including:

- Holding times;
- Field and laboratory blanks;
- MS/MSD percent recovery;

- Surrogate spike recovery; and
- LCS percent recovery.

All qualified results (i.e., U, J, J-, and J+ qualified data)[18] and the reasons for these qualified results are presented in the DVSRs (see Appendix A) and summarized in Appendix A, Table A-5. Although laboratory limits were exceeded for certain compounds or analyses, as identified by the laboratory (and confirmed during data validation), there does not appear to be a systematic or widespread impact on the quality of the analytical results. Furthermore, based on a review of the laboratory narratives (provided in the laboratory reports in the DVSRs), the laboratory indicated that the observed exceedances of laboratory criteria are not of any concern. Therefore, the qualified soil gas data are determined to be usable and valid for purposes of the HRA and are included in the HRA data set. The impacts of qualified data on the overall soil gas risk evaluation are further discussed in Section 6.1.6.

4.2.1.8 Data Usability Conclusions

Evaluation of the soil gas analytical data for Parcel E in terms of usability for the risk assessment was conducted in accordance with USEPA and NDEP guidance. Based on this evaluation, the overall goals for data quality for risk assessment were achieved, and all DVSRs were reviewed and approved by NDEP. All analytical results from the soil gas samples for Parcel E were deemed usable for conducting the HRA. As shown in Figure 3-1, the soil gas HRA data set for Parcel E includes one sample collected in 2008, collected at a depth of approximately 5 ft bgs, eight samples collected in March 2019 at depths of either 5 ft or 15 ft bgs, and seven samples collected in November 2019 at depths of either 5 ft or 15 ft bgs.

All J-qualified data were considered usable and were retained for purposes of the HRA and are summarized in Table A-5 of Appendix A. The impact of "J" qualified data on the HRA risk results is discussed in Sections 6.1.5 and 6.1.6. In summary, all soil gas data collected in Parcel E are deemed to be usable for risk assessment purposes.

4.2.2 Data Analysis

As described by NDEP (2010a), the purpose of the data analysis step is to "use simple EDA to compare data to the expectations of the CSM, to determine if the data adequately represent the source terms and exposure areas or evaluation areas." Consistent with the NDEP guidance, the steps of the EDA, as described in the following sections, include (1) preparation of summary statistics for the soil gas HRA data set (Section 4.2.2.1), and (2) preparation and review of spatial distribution for VOCs in soil gas (Section 4.2.2.2). Additionally, specific data analyses requested by NDEP were conducted, as described below.

4.2.2.1 Summary Statistics

Summary statistics for the soil gas data sets collected at approximately 5 ft bgs and 15 ft bgs for Parcel E are presented in Tables 4-7a and 4-7b, respectively. For the soil gas dataset used in the Parcel E HRA, 50 VOCs were detected in at least one soil gas sample collected at 5 ft bgs (as shown in Table 4-7a) and 36 VOCs were detected in at least one soil gas sample collected at 15 ft bgs (as shown in Table 4-7b). Individual soil gas sample

---

[18] J, estimated value; J-, estimated, biased low; J+, estimated, biased high; U, not detected.

locations are shown in Figure 3-1. In developing the summary statistics, soil gas samples with primary and field duplicate results were treated as independent samples. The effects of duplicate treatment on the overall soil gas risk evaluation are further discussed in Section 6.1.7.

4.2.2.2 Spatial Analysis of VOCs in Soil Gas

Spatial quartile plots (Appendix F2) were prepared for detected chemicals in soil gas exceeding 10% of the minimum RBTC in Parcel E. These plots illustrate the spatial distribution of the soil gas data, identify potential areas of higher concentrations, and compare the results to the expectations of the Parcel E CSM. Each spatial quartile plot presents the following information:

- Sample locations;
- Chemical concentrations. The concentration shown at each sample location is the maximum detected concentration for all samples collected at that location for soil gas collected at depths of 5 and 15 ft bgs, unless results for all samples at that location were reported as less than the detection limits; concentration bins are defined as follows:
- Dark green - concentrations < detection limits;
- Light green - concentrations <Q1;
- Yellow - concentrations within the IQR;
- Orange - concentrations >Q3 and <=(Q3 + 1.5×IQR); and
- Red - concentrations >(Q3 + 1.5×IQR).

Spatial quartile plots are presented for chloroform, the only detected analyte exceeding 10% of the minimum RBTC in soil gas for Parcel E (see exceedances in Tables 4-7a and 4-7b for soil gas chloroform results collected from 5 ft bgs and 15 ft bgs, respectively). Chloroform only exceeds this threshold for 15 ft bgs soil gas samples, but a quartile plot for 5 ft bgs chloroform data is also presented for a more complete and consistent analysis for soil gas data collected at 5 ft bgs and 15 ft bgs in Parcel E.

A spatial plot was prepared for chloroform based on the following criteria:

- Contribution to total cancer risk: Chloroform alone contributes to over 90% of the total risk for soil gas, as discussed in Section 5.4.2.
- Detection frequency and detected concentration: The detection frequency of chloroform in soil gas was 90% in the 5 ft bgs samples and 100% in the 15 ft bgs samples; the maximum detected concentration of chloroform is among the highest detected VOCs in soil gas in Parcel E, as shown in Tables 4-7a and 4-7b.
- Chemical class: Chloroform was selected to examine the spatial distribution and co-location of the chlorinated VOCs in soil gas and shallow groundwater in Parcel E.

The quartile plots for soil gas are presented in Appendix F2. The concentrations of chloroform in soil gas at 5 ft bgs used on the spatial plots are presented in Figure F2-1. As shown in the figure, the soil gas sample locations (SG17, RISG-31, RISG-32, RISG-33, and

RISG-34) are located throughout Parcel E. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 µg/L. Similarly, the highest chloroform concentration in soil gas at 5 ft bgs (i.e., 1,000 µg/m^3) was detected at RISG-33 located near OSSM's extraction well field. The chloroform concentrations in the 5 ft bgs soil gas samples beyond the extraction well field are significantly lower. As shown in Figure F2-2, the same spatial distribution of chloroform concentrations was observed in samples collected from 15 ft bgs, though as shown in Figure 4-1, the chloroform concentrations detected at 15 ft bgs are consistently 2-3-fold higher than those detected at 5 ft bgs at the same soil gas sample location. The quartile plots for soil gas are further discussed in Section 4.4.

Soil gas samples were collected at 5 ft bgs from approximately the same area in 2008 (location SG17) and in March and November 2019 (RISG-31). Chloroform was detected at a higher concentration in the 2008 sampling event (180 µg/m^3) at SG17; chloroform was not detected in the March 2019 soil gas investigation at RISG-31 (<2.3 µg/m^3) and was detected at a low level (1.8 µg/m^3) at RISG-31 in the November 2019 soil gas investigation.

4.2.2.3 Temporal Changes in VOC Soil Gas Concentrations

To analyze the temporal trend of chloroform concentrations in soil gas in Parcel E, soil gas samples collected from 5 ft bgs in Parcel E during the Phase B Investigation in May 2008, the Phase 2 RI Modification No. 12 in March 2019, and the Phase 3 RI Modification No. 9 in May 2019 were selected for time series plots. Because SG17 is the only location in Parcel E that was sampled during the Phase B Investigation in May 2008, only SG17 and RISG-31 (the nearest location in Parcel E that was sampled during the Phase 2 RI Modification No. 12 and Phase 3 RI Modification No. 9 events) are presented in Figure 4-2. Since soil gas samples at or around 15 ft bgs were not collected during the 2008 Phase B Investigation or the Phase 2 RI investigation in Parcel E, a temporal trend analysis was not conducted for deep soil gas samples.

As indicated in Figure 4-2, the chloroform concentrations at RISG-31/SG17 decreased approximately 99.9% from 2008 to 2019.

4.3 Groundwater

4.3.1 Data Usability Evaluation

Considering USEPA's vapor intrusion guidance (USEPA 2015) which states that both soil gas and groundwater data should be considered in a line-of-evidence approach, risks for the vapor intrusion pathway were evaluated using both soil gas and groundwater results.

The objectives of groundwater sampling at the Site have been primarily to characterize the contaminants present in groundwater near suspected source areas and for plume delineation. Only the 2019 groundwater sampling performed as part of the Phase 2 RI Modification No. 12 was conducted specifically to evaluate the vapor intrusion pathway. During this sampling event, groundwater samples were collected from shallow wells co-located with soil gas sample locations.

To provide groundwater data for this HRA, the NERT project database (discussed in Section 4.1.1.1) was queried to identify wells within Parcel E and for which VOC or SVOC results were available from 2015 to 2019 for shallow groundwater wells with the top of the well screen shallower than 60 ft bgs. The identified wells include wells owned and sampled by NERT and OSSM (Figure 3-1).

The shallow groundwater data set evaluated using the data quality criteria is identified in Section 4.3.1.1. Sections 4.3.1.2 through 4.3.1.7 describe the results of the groundwater DUE.

4.3.1.1 Groundwater Data Set

The shallow groundwater HRA data set comprises the analytical results that are representative of current conditions within Parcel E. Specifically, VOC results were identified from five wells within Parcel E. The survey coordinates for each well were plotted to verify that the wells are located within the parcel. A complete set of the groundwater analytical results is included in Appendix H. The data set includes groundwater samples collected as part of the remedial performance groundwater monitoring program, the Phase 1 RI, and the Phase 2 RI.

Similar to the data processing steps described in Section 4.1.1.1 for soils, the groundwater data from the NERT database was reviewed to 1) identify and correct inconsistencies in data field entries and 2) create additional fields to support data management and interpretation. The following steps of data processing were completed:

- Standardize chemical names and CAS registry numbers;
- Standardize reporting units (e.g., µg/L for VOCs);
- Standardize analytical method names;
- Correct errors in data entry (e.g., errors in sample identification codes);
- Identify a unique result for use in the HRA for sample/analyte pairs for which more than one result was reported. For example, if two results were reported for 1,2,3-trichloropropane in the same sample – one by USEPA Method 8260 and the second by USEPA Method 8260 SIM – the result to be used in the HRA was identified as that from the 8260 SIM analysis because of the greater sensitivity (lower reporting limits) of this method.
- Develop database queries and confirm that queries returned the correct output.

No change was made to a datum without first understanding the issue and the steps necessary to correct the issue. As needed, the sampling plan, laboratory reports, DVSRs, and other supporting documents were reviewed. Data points were considered unusable for risk assessment if information could not be located to confirm and/or correct an identified issue. Shallow groundwater data excluded from the HRA data set during data processing are summarized in Appendix A, Table A-6.

4.3.1.2 Criterion I – Reports to Risk Assessor

Criterion I requires confirmation that the reports relied upon are complete and appropriate for use in the HRA. The required information specified under this criterion was verified and is available from the following documentation:

- Parcel E is described in Sections 1 and 2.1 of this report. Information on the regional and local geology and hydrogeology is provided in the RI/FS Work Plan (ENVIRON 2014b) and the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c).
- The groundwater investigations conducted in Parcel E are described in the following work plans:
    - Remedial Investigation and Feasibility Study Work Plan (ENVIRON 2014b, approved by NDEP on July 2, 2014);
    - Phase 2 RI Modification No. 12. Recommended Soil, Soil Gas, and Groundwater Sampling in Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada (Ramboll 2018b, approved by NDEP on July 19, 2018);
    - 2016 Groundwater Monitoring Optimization Plan (Ramboll Environ 2016b, approved by NDEP on June 24, 2016); and
    - 2017 Remedial Performance Groundwater Sampling and Analysis Plan (Ramboll Environ 2017d).
- The groundwater results of the groundwater investigations conducted in Parcel E are described in the following:
    - Remedial Investigation Data Evaluation Technical Memorandum (Ramboll Environ 2016a, approved by NDEP on July 13, 2016);
    - Remedial Investigation Report for OU-1 and OU-2 (Ramboll 2021c);
    - 2017 Annual Remedial Performance Report for Chromium and Perchlorate (Ramboll Environ 2017e, approved by NDEP on February 6, 2018);
    - 2018 Annual Remedial Performance Report for Chromium and Perchlorate (Ramboll 2018c, approved by NDEP on January 18, 2019); and
    - 2019 Annual Remedial Performance Report for Chromium and Perchlorate (Ramboll 2019a, approved by NDEP on March 16, 2020).
- The groundwater analytical data from investigations conducted in Parcel E are presented in the following DVSRs:
    - DVSR, Groundwater Data Collected as Part of the NERT Phase 1 Remedial Investigation (Ramboll 2018d, approved by NDEP on August 14, 2018);
    - DVSR, Phase 2 Remedial Investigation, March 2018 through March 2019 (Ramboll 2020c, approved by NDEP on April 29, 2020);
    - DVSR, 2017 Annual Remedial Performance Report (Ramboll 2018e, approved by NDEP on March 5, 2018);
    - DVSR, 2018 Annual Remedial Performance Report (Ramboll 2019d, approved by NDEP on May 14, 2019); and
    - DVSR, 2019 Annual Remedial Performance Report (Ramboll 2019e, approved by NDEP on January 13, 2020).

- The laboratories provide a QA/QC narrative with each analytical data package, and the data review provides a narrative of qualified analytical results. A description of the analytical methods and detection limits is included. These narratives are included as part of the DVSRs.
- Method-specific QC results are provided in each laboratory report, along with the associated raw data. The laboratory reports and QC results are included as part of the DVSRs.
- Data flags used by the laboratory are defined adequately and are discussed further below.
- Laboratory reports include the name and address of the laboratory, unique identification of the test report, client and project name, and dates of sample receipt and analysis. Each analytical report describes the analytical method used, the analytical results on a sample-by-sample basis, and the PQLs. The results of the QC samples, including method blanks, LCS samples, surrogate recoveries, internal standard recoveries, MS samples, MSD samples, second column confirmation, interference checks, and serial dilutions are also provided. All laboratory reports contained data equivalent to a CLP deliverable, inclusive of CLP QC summary forms where applicable, and the supporting raw data. Reported sample analysis results were imported into the NERT project database.
- The available reports, and the accompanying laboratory reports and DVSRs, are considered complete for HRA purposes.

4.3.1.3 Criterion II – Documentation

The objective of the documentation review is to ensure that each analytical result can be associated with a specific sampling location and that the procedures used to collect the samples are appropriate. As part of this DUE step, Ramboll completed a comprehensive review of the groundwater samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. Also, as discussed in the work plan listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved QAPP in place at the time the groundwater samples were collected and analyzed (ENVIRON 2014c; Ramboll Environ 2017c; Ramboll 2019b). Ramboll reviewed the COC forms prepared in the field and compared them with the analytical data results provided by the laboratories to ensure completeness of the data set.

Figure 3-1 depicts the location of all shallow groundwater samples included in the Parcel E HRA data set; the analytical results for each shallow groundwater sample included in the HRA data set are included in Appendix H.

The available information is adequate to relate each analytical result retained in the groundwater HRA data set to a geographic location, depth interval, and sampling procedure.

4.3.1.4 Criterion III – Data Sources

The review of data sources is performed to ensure that adequate sample coverage of source areas has been obtained and that the analytical methods are appropriate to identify COPCs and derive associated EPCs.

The review of sample coverage is based on the distribution of sample locations from the groundwater investigations listed in Section 4.3.1.1. Samples were collected in accordance with the work plans listed under Criterion I, with both judgmental and random sampling performed.

Based on the review, sample coverage from the groundwater investigations in Parcel E is considered adequate for the purpose of the HRA.

As part of the QAPP, the use of standard USEPA analytical methods (listed under Criterion IV) was approved by NDEP. The USEPA methods are adequate for characterizing potential contaminants in groundwater and provide quantitative analytical results that are of adequate quality for deriving EPCs. Standard USEPA methods were used, specifically USEPA Method SW-8260, SW-8260 SIM, and SW-8260B SIM for VOCs.

4.3.1.5 Criterion IV – Analytical Method and Detection Limits

Criterion IV requires that the analytical method appropriately identifies the chemical form or species, and that for each chemical, the SQL is sufficiently low for risk characterization. Standard analytical methods were used for all analytes as listed below:

- USEPA Methods SW-8260, SW-8260 SIM and SW-8260B SIM for VOCs

The above methods are adequate to characterize the corresponding chemical groups in groundwater.

Under Criterion IV, the SQLs were evaluated to confirm that they were sufficiently sensitive for risk characterization. Because NDEP has not derived groundwater BCLs for the vapor intrusion pathway, groundwater RBTCs were derived corresponding to the more stringent of (1) a cancer risk of 1×10^{-6} or (2) a noncancer HQ of 1. The RBTCs were derived using outputs from the Johnson and Ettinger (1991) model and the values for exposure assumptions and toxicity criteria presented in Section 5.

For each groundwater analyte for which the detection frequency was less than 100%, the maximum SQL was compared to the RBTC. Table 4-8 lists the maximum SQL, the most stringent groundwater RBTC, the ratio of the maximum SQL to 10% of the RBTC, and the number of samples with SQLs greater than 10% of the RBTC. For all analytes in the shallow groundwater data set for Parcel E, the maximum SQL was less than 10% of the respective RBTC (i.e., no non-detects were greater than 10% of the RBTC), with the following exceptions:

- Bromodichloromethane was detected in one out of 11 shallow groundwater samples and the SQL exceeded 10% of the RBTC in two out of 10 samples reported as non-detects.
- Carbon tetrachloride was detected in one out of 11 shallow groundwater samples, and the SQL exceeded 10% of the RBTC in two out of 10 samples reported as non-detects.
- Chloroform was detected in seven out of 11 shallow groundwater samples, and the SQL exceeded 10% of the RBTC in one out of four samples reported as non-detects.

- 1,2-dibromo-3-chloropropane was not detected in any shallow groundwater samples; the SQLs exceeded 10% of the RBTC in two out 11 of the non-detected samples.
- 1,2-dibromoethane was not detected in any shallow groundwater samples; the SQLs exceeded 10% of the RBTC in two out of 11 of the non-detected samples.
- Hexachlorobutadiene was not detected in any shallow groundwater samples; the SQLs exceeded 10% of the RBTC in two out of 11 of the non-detected samples.
- Vinyl chloride was not detected in any shallow groundwater samples; the SQLs exceeded 10% of the RBTC in two out of 11 of the non-detected samples.

Overall, the SQLs are generally low enough for risk characterization. The impacts of the few exceptions listed above on the groundwater risk estimates are further discussed in Section 6.1.2.

4.3.1.6 Criterion V – Data Review

The data review included evaluation of completeness, instrument calibration, laboratory precision, laboratory accuracy, blanks, adherence to method specification and QC limits, and method performance in sample matrix. The laboratory results of the groundwater samples included for this HRA were subjected to formal data validation consistent with (1) USEPA guidance on data validation (USEPA 1999a; 2001; 2004a; 2005a, b; 2008; 2009a), (2) the BMI Plant Site Specific Supplemental Guidance on Data Validation (NDEP 2009a), and (3) BRC SOP 40 and Data Review/Validation (BRC 2009). The USEPA guidelines, which were prepared for CLP data, were adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events and NDEP guidance.

The DVSRs for groundwater data included in the HRA are provided in Appendix A, in which the names and qualifications of the reviewers, the specific data validation procedures, and the qualification findings are presented. Each DVSR includes the following summaries of the data qualifications:

- Summary of data qualified due to holding time exceedances
- Summary of data qualified due to detection below quantitation limit
- Summary of data qualified due to laboratory blank contamination
- Summary of data qualified due to field blank contamination
- Summary of data qualified due to MS/MSD recovery exceedances
- Summary of data qualified due to LCS recovery exceedances
- Summary of data qualified due to field/laboratory duplicate
- Summary of data qualified due to surrogate recovery exceedances
- Summary of data qualified due to calibration violations
- Summary of data qualified due to calibration range exceedances
- Summary of data qualified due to internal standard recovery exceedances
- Summary of data qualified due to serial dilutions

- Summary of qualified data results
- Summary of rejected data results

These data qualifications are further discussed below as a component of Criterion VI.

4.3.1.7 Criterion VI – Data Quality Indicators

The project QAPP (Ramboll 2019b) identified five DQIs to ensure that the overall quality of the data is sufficient to support the risk assessment, as follows: completeness, comparability, representativeness, precision, and accuracy. The DQIs provide quantitative and qualitative measures for evaluating the risk assessment data as they relate to uncertainties in the selection of COPCs, characterization of EPCs, and risk descriptors used in support of the HRA. Specifically, the DQIs address field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment.

Completeness

Completeness is defined as the percentage of acceptable sample results compared to the total number of sample results, which is evaluated to determine if an acceptable amount of usable data were obtained so that a valid scientific site assessment can be completed. The completeness goal stated in the QAPP is 90% or greater.

Only one rejected groundwater result was identified in the groundwater data set for Parcel E. The completeness achieved for each data set was 100%, based on the number of requested analyses on the chain-of-custodies as compared with the number reported by the laboratory. Rejected ("R" qualified) data associated with groundwater samples in Parcel E are summarized in Appendix A, Table A-7. Overall data completeness was 99.99% for the 2017 remedial performance monitoring groundwater data set, 99.995% for the 2018 remedial performance monitoring groundwater data set, 100% for the 2019 remedial performance monitoring groundwater data set, 98.8% for the Phase 1 RI data set, and 100% for the Phase 2 RI Modification No. 12 data set, based on the number of validated data points, exceeding the QAPP goal of 90%.

In summary, the completeness for the soil HRA data meets the goal of 90% established in the QAPP. Rejected data are excluded from the soil HRA data set, and a discussion of how these rejected data occurrences potentially affect the overall soil risk evaluation is presented in Section 6.1.3.

Comparability

Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. More specifically, comparability is a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. In general, comparability of data is maximized by using standard methods for sampling and analysis, reporting data, and data validation.

The same analytical methods were used across most investigations; specifically, USEPA Method SW-8260 for VOCs. In some investigations, the more sensitive SW-8260 SIM or SW-8260B SIM was used for VOCs. All groundwater sampling results were reported in µg/L.

Because maximum detected concentrations from groundwater samples collected from 2015 to 2019 were used in the risk calculations for this HRA (and SQLs were sufficiently low in those samples, as discussed in Section 4.3.1.5), the differences in detection limits does not impact the results of the HRA.

Among the two wells (MC-29 and MC-97) that were sampled over time for VOCs in Parcel E, samples from well MC-29 have the highest chloroform concentration detected within the parcel. Temporal analysis was performed based on the groundwater chloroform concentrations measured in groundwater samples from well MC-29 from 2015 to 2019. As shown in Figure 4-3, chloroform was detected at higher concentrations during the earlier sampling event in this well with the highest chloroform concentrations detected in February 2015 at 710 µg/L. The chloroform concentrations were detected at much lower concentrations in 2019, (non-detect at 50 µg/L) in groundwater samples from this well. Chloroform concentrations also showed a slightly declining trend in groundwater at well MC-97. The highest detected concentration of chloroform in groundwater at this well was in February 2015 (0.71 µg/L), but chloroform was not detected in groundwater at this well in 2018 and 2019 (<0.25 µg/L).

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition. There is no standard method or formula for evaluating representativeness, which is a qualitative term. Spatial representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific investigation, and by collection of an adequate number of samples from locations identified in relation to the investigation objectives. Concentration representativeness is achieved by obtaining analytical results of sufficient quality, as specified in the QAPP.

Spatial representativeness was discussed previously under Criterion III. As noted, groundwater samples were collected in accordance with the NDEP-approved work plans listed under Criterion I. Both judgmental and random sampling approaches were followed. Overall, the objectives of the investigation were met, and the placement of the sample locations is deemed representative to evaluate the Parcel E groundwater conditions in the context of the Parcel E CSM.

As presented in the DVSRs listed under Criterion I, standard methods for sampling and analysis were used for the groundwater investigation, which confirmed that the analytical data are representative of the groundwater concentrations at the locations sampled.

Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Field precision is expressed by the RPD between the primary field sample and its field duplicate. Laboratory precision is quantitated for each laboratory data batch by calculating the RPD using data for the LCS/LCSD and/or data for the MS/MSD. The field precision goal established in the QAPP is a RPD of less than or equal to 50%, except for the case in which one (or both) of the primary or duplicate results is less than five times the reporting limit. For the latter case, the acceptance criteria is the reporting limit (i.e., the absolute value of the difference between the primary and duplicate result is less than or equal to the reporting limit). Laboratory precision goals are defined for specific analytical methods, as indicated in the QAPP (see Table 2 of Ramboll 2019b).

Field precision was assessed by evaluating the field duplicate results in accordance with the *Statistical Analysis Recommendations for Field Duplicates and Field Splits* (NDEP 2008b), where the primary and field duplicate are independent samples. One field duplicate (MC-94-20190313-FD, see Appendix H) was collected at MC-94 for the groundwater data evaluated in the Parcel E HRA. No associated field sample results in the one primary sample/field duplicate pair were qualified based on exceedance of the QAPP criteria described above. All paired results in the groundwater dataset are shown in Appendix H.

For laboratory duplicates, there were no data points qualified due to RPD or reporting limit exceedance (see DVSR tables in Appendix A). All data with precision exceedances were qualified as "J/Estimated" or "UJ/Estimated non-detected" and are determined to be usable for purposes of the HRA, and the effects of these qualified data on the overall groundwater risk evaluation are further discussed in Sections 6.1.5 and 6.1.6.

Accuracy

Accuracy measures the level of bias that an analytical method or measurement exhibits. Both field accuracy and laboratory accuracy are evaluated under this DQI. Accuracy in the field is assessed through the use of trip and equipment blanks and through adherence to all sample handling, preservation, and holding time requirements. Accuracy in the laboratory analytical data is a measure of the overestimation or underestimation of reported concentrations. Several QC parameters are used to evaluate the accuracy of reported analytical results, including:

- Holding times;
- Field and laboratory blanks;
- MS/MSD percent recovery;
- Surrogate spike recovery; and
- LCS percent recovery.

All qualified results (i.e., U, J, J-, and J+ qualified data)[19] are presented in Appendix A, Table A-8, and the reasons for these qualified results are summarized in the DVSR (see Appendix A). Although laboratory limits were exceeded for certain compounds or analyses, as identified by the laboratory (and confirmed during data validation), there does not appear to be a systematic or widespread impact on the quality of the analytical results. Furthermore, based on a review of the laboratory narratives (provided in the laboratory reports in the DVSRs), the laboratory indicated that the observed exceedances of laboratory criteria are not of any concern. Therefore, the qualified data are determined to be usable and valid for purposes of the HRA and are included in the HRA data set. The impact of

---

[19] J, estimated value; J-, estimated, biased low; J+, estimated, biased high; U, not detected.

qualified data on the overall groundwater risk evaluation is further discussed in Section 6.1.6.

4.3.1.8 Data Usability Summary

Evaluation of the groundwater analytical data for Parcel E in terms of usability for the risk assessment was conducted in accordance with USEPA and NDEP guidance. Based on the evaluation, the overall goals for data quality for risk assessment were achieved and all DVSRs were reviewed and approved by NDEP. In summary, with the exception of the rejected data discussed above and listed in Appendix A, Table A-7, all Parcel E groundwater HRA data are deemed to be usable for risk assessment purposes.

4.3.2 Data Analysis

As described by NDEP (2010a), the purpose of the data analysis step is to "use simple EDA to compare data to the expectations of the CSM, to determine if the data adequately represent the source terms and exposure areas or evaluation areas." Consistent with the NDEP guidance, the steps of the EDA, as described in the following sections, include (1) preparation of summary statistics for the shallow groundwater HRA data set (Section 4.3.2.1), and (2) preparation and review of spatial distribution for VOCs in shallow groundwater (Section 4.3.2.2). Additionally, specific data analyses requested by NDEP were conducted, as described below.

4.3.2.1 Summary Statistics

Summary statistics for the 11 shallow groundwater samples collected from 2015 to 2019 within Parcel E are presented in Table 4-9. Appendix H presents all analytical data for the shallow groundwater HRA data set. Individual shallow groundwater sample locations are shown in Figure 3-1. In developing the summary statistics, shallow groundwater samples with primary and field duplicate results were treated as independent samples. The effects of duplicate treatment on the overall groundwater risk evaluation are further discussed in Section 6.1.7.

4.3.2.2 Spatial Analysis of VOCs in Groundwater

Spatial quartile plots (Appendix F3) were prepared for detected chemicals in shallow groundwater exceeding 10% of the minimum RBTC in Parcel E to illustrate the spatial distribution of the data, identify areas of higher concentrations, and compare the results to the expectations of the Parcel E CSM. Each spatial quartile plot presents the following information:

- Sample locations;
- Chemical concentrations. The concentration shown at each sample location is the maximum detected concentration for all samples collected at that location for shallow groundwater, unless results for all samples at that location were reported as less than the detection limits; concentration bins are defined as follows:
    - Dark green - concentrations < detection limits;
    - Light green - concentrations <Q1;
    - Yellow - concentrations within the IQR;

  - Orange - concentrations >Q3 and <=(Q3 + 1.5×IQR); and
  - Red - concentrations >(Q3 + 1.5×IQR).

Spatial quartile plots are presented for three chemicals in shallow groundwater that exceed 10% of the minimum RBTC for Parcel E (see Table 4-9), as follows:

- Chlorobenzene;
- Chloroform; and
- 1,4-Dichlorobenzene.

The plots are presented in Appendix F3 (organized alphabetically by chemical name) and further discussed in Section 4.4.

4.3.2.3 Temporal Changes in VOC Groundwater Concentrations

In NDEP's January 29, 2013, comment letter on the *Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H* (NDEP 2013, Comment #9b), NDEP requested a comparison of the groundwater VOC concentrations presented in the 2010 Site-Wide Soil Gas HRA (Northgate and Exponent 2010) with the most recent groundwater sampling results for the same wells to evaluate temporal changes in concentration.

Among the three wells that were sampled over time for VOCs in Parcel E, MC-97 is the well that was sampled most frequently from 2015 to 2019. Groundwater adjacent to well MC-29 had the highest detected concentration of chloroform within Parcel E over the same time period. Temporal analysis was performed based on the groundwater chloroform concentrations measured in well MC-29 from 2015 to 2019. As shown in Figure 4-3, chloroform was detected at higher concentrations during the earlier sampling events with the highest chloroform concentrations detected in February 2015 at 710 µg/L. The chloroform concentrations were detected at much lower concentrations in 2019 (non-detect at 50 µg/L) in this well. Chloroform concentrations also declined over the same time period in groundwater adjacent to well MC-97. The highest detected chloroform concentration in groundwater adjacent to this well was in February 2015 (0.71 µg/L), but chloroform was not detected in this well in 2018 and 2019 (<0.25 µg/L).

4.4 Comparison with Conceptual Site Model

As the last step of the DUE, results from the EDA (i.e., summary statistics, background evaluation, and spatial analysis) should be used to compare site data to the expectations of the CSM (NDEP 2010a). The Site-wide CSM was summarized in the RI Report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c). The sections below focus on the comparison of EDA results to the Parcel E CSM components of historical operations, sources of impacts, and migration and distribution of contaminants in Parcel E, which included:

- No significant soil impacts are expected because Parcel E was not historically used for industrial activities
- Soil gas impacts are coming from groundwater.
- Groundwater impacts are coming from migration from upgradient source(s).

- The groundwater and soil gas concentrations are generally lower on the downgradient side of the OSSM extraction wells.

Comparison of EDA results to the Parcel E CSM is presented in Section 4.4.1 for Parcel E soil data and Section 4.4.2 for Parcel E soil gas and groundwater data.

4.4.1 Soil

Parcel E is located in the northwest corner of the Site and is not contiguous with the Operations Area. Former activities within Parcel E are not expected to have resulted in significant chemical impacts to the soils in this parcel. The following presents a summary of the soil data used in the Parcel E HRA in the context of our understanding of current and former land use and operations within Parcel E and the Parcel E CSM (also see Tables 4-4 and 4-5).

- **Chlorine Oxyanions.** Chlorate and perchlorate manufacturing operations have been conducted at the Site since approximately 1945 (Ramboll Environ 2016a), although the former manufacturing and disposal areas were not located in Parcel E. These compounds are detected throughout Parcel E soils, but concentrations in Parcel E ranging from 0.057 to 4.2 mg/kg for chlorate and from <0.01 to 6.1 mg/kg for perchlorate (see Table 4-2) are substantially lower than the concentrations reported in former manufacturing areas (above 1,000 mg/kg for chlorate and perchlorate).
- **Metals.** The 2011 NDEP Action Memorandum (NDEP 2011b) identified "metals" as possible contaminants at many of the LOUs within the Operations Area, but not as specific contaminants for Parcel E. Therefore, the soil metal concentrations in Parcel E are anticipated to be different from other former sales parcels or other areas in the Operations Area of the NERT Site. Results of the background evaluation of metals (Appendix E) show that soil concentrations were greater than background (as compared with the BRC/TIMET regional background dataset) for boron, iron, mercury, and vanadium in Parcel E.
- **Other Inorganics.** This group of inorganic compounds includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. All compounds were historically identified as Site-related chemicals (SRCs) at the Operations Area but not Parcel E.
- **Radionuclides.** Radionuclides are not known to be associated with any of the former operations identified in Parcel E (or in the Operations Area). Although no specific source areas were identified, the Parcel E soil investigation included analyses for radionuclides in the U-238 and Th-232 decay series and for U-235. Although Th-230 failed the statistical testing for background soil (Appendix E), the validity of the statistical testing is confounded by several analytical and other issues (see detailed discussion in Section 5.1.1.2).
- **Dioxins/Furans.** Dioxins/furans are formed during various combustion processes (in the presence of a source of hydrocarbons and chlorine) and are by-products of the production of certain chlorinated chemicals, including pesticides. Dioxins/furans are typically detected in shallow surface soils as a result of airborne deposition. They are extremely persistent in soils and over time will accumulate in the presence of a

continuing source. The soil concentrations of dioxin TEQ in Parcel E are below the Site-specific action level of 0.0027 mg/kg.

- **PAHs.** PAHs are ubiquitous environmental contaminants and formed during incomplete combustion of organic materials. Only naphthalene was detected in Parcel E soils with a very low detection frequency.
- **OCPs.** The detections of OCPs is consistent with former site operations, including the manufacture of chlorobenzenes and dichlorodiphenyltrichloroethane (DDT) by Hardesty/AMECCO from 1945 to 1949 (Kleinfelder 1993; Ramboll Environ 2016a), as well as with the manufacture of chlorinated compounds at the adjacent OSSM facility. Stauffer produced lindane at the former Lindane Plant from 1946 through 1958, and Montrose produced organic chemicals, including chlorobenzene, chloral, and 4,4′-dichlorobenzil from 1947 through 1983. In addition to possible air emissions (and deposition) from these processes, associated wastes streams were conveyed to the former Beta Ditch between 1971 and 1976 (Ramboll Environ 2016a).
- **OPPs.** Only one OPP (propazine) was detected in Parcel E with a very low detection frequency. Although OPPs were historically listed as SRCs, NDEP did not identify propazine as a specific contaminant for Parcel E in their 2011 Action Memorandum for the NERT Site (NDEP 2011b).
- **VOCs.** Consistent with results observed in investigations at other industrial facilities, a number of VOCs were detected in soils, but at low frequencies (typically less than 15%). The detected VOCs include several that have been identified by USEPA (1989) as "common laboratory contaminants", including acetone and toluene. All VOCs in soil were detected at low concentrations, not indicative of a potential source area.

A review of the spatial quartile plots (Appendix F1) did not identify a particular spatial pattern of the chemicals in soils or the presence of areas of higher concentrations or potential point sources of contamination. Spatial quartile plots were plotted for detected analytes in soil that exceed 10% of the BCL: Th-232, U-235, U-238, and Zirconium. In summary, the soil data are consistent with the Parcel E CSM, indicating that no significant impacts from soil are expected because Parcel E wasn't historically used for industrial activities.

4.4.2 Soil Gas and Groundwater

As part of the ongoing RI/FS, Ramboll completed an extensive review of existing information and data generated previously at the Site and developed a preliminary Site-wide CSM, as presented in the RI/FS Work Plan (ENVIRON 2014b). More recently, Ramboll conducted a comprehensive review and analysis of historical and recently collected sampling results to assess the magnitude and extent of chloroform impacts to soil, soil gas, and groundwater at the Site, including groundwater sampling within Parcel E (Ramboll Environ 2017e; Ramboll 2018c, 2019b) and developed a Site-wide CSM which was presented in the RI report for OU-1 and OU-2 submitted to NDEP on July 9, 2021 (Ramboll 2021c). The conclusions of the review considering the RI investigation results and the remedial performance monitoring results for Parcel E are presented below:

- As shown in Figures 4-1, F2-1, and F2-2, soil gas chloroform concentrations generally increased with depth indicating that VOCs present in soil gas are migrating upward from groundwater rather than from a source in the vadose zone. This is consistent with the Parcel E CSM because no industrial activities were reported to have occurred in Parcel E. Chloroform is migrating onto Parcel E from the adjacent source(s). Chloroform in the dissolved phase is present in shallow groundwater beneath the southern portion of Parcel E.
- As shown in Figure F3-2, the southern boundary of Parcel E overlaps with the nearby chloroform groundwater plume (as defined by 70 µg/L chloroform isoconcentration contour). As shown in Figure 1-3, the southeastern portion of the GWETS operated by OSSM located in Parcel E generally captures groundwater with higher contaminant concentrations and is located downgradient of the source areas. The GWETS and its associated recharge trench have significantly decreased chemical concentrations in Parcel E. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 µg/L, and the VOC concentrations in soil gas and shallow groundwater are generally low, as shown in the spatial concentration plots in Appendix F4 for soil gas and F5 for groundwater.

In summary, the soil gas and shallow groundwater data are consistent with the Parcel E CSM, indicating that no significant impacts from the groundwater chloroform plume from adjacent source(s) are expected in areas downgradient of the GWETS operated by OSSM in Parcel E.

5. HEALTH RISK ASSESSMENT

This section presents the HRA, which includes the following elements:

- Identification of COPCs;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

The HRA follows the basic procedures outlined in USEPA's Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (USEPA 1989). Other guidance documents consulted in preparing the HRA include:

- Guidelines for Exposure Assessment (USEPA 1992c);
- Exposure Factors Handbook (USEPA 2011);
- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA 2004b);
- Soil Screening Guidance: Technical Background Document (USEPA 1996);
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002b);
- Soil Screening Guidance for Radionuclides (USEPA 2000);
- Technical Support Document for a Protocol to Assess Asbestos-Related Risk, Final Draft (USEPA 2003);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009b);
- Office of Solid Waste and Emergency Response (OSWER) Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) (USEPA 2002c);
- User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (USEPA 2004c);
- OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (USEPA 2015);
- Regional Screening Levels (RSLs) User's Guide (USEPA 2023b);
- Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline (ITRC 2007);
- User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas (NDEP 2023a); and
- Soil Physical and Chemical Property Measurement and Calculation Guidance, BMI Plant Sites and Common Areas Projects, Henderson, Nevada (NDEP 2010b).

5.1 Identification of COPCs

5.1.1 Soil COPCs

Soil COPCs for quantitative evaluation in the HRA were identified from the soil HRA data set discussed in Section 4 for Parcel E based on the following three-step approach:

1. Concentration/toxicity screen;
2. Background evaluation for metals and radionuclides; and
3. Chemical-specific considerations.

The chemicals that "fail" these steps are retained as COPCs and those that "pass" are excluded as COPCs,[20] as described in Sections 5.1.1.1 through 5.1.1.3 and shown in Figure 5-1.

5.1.1.1 Step 1 – Concentration/Toxicity Screen

The concentration/toxicity screen is conducted to identify those chemicals that could contribute significantly to the cancer risk and/or noncancer hazard estimate (i.e., the hazard index [HI]). The screen considers the maximum detected concentration in soils in Parcel E and chemical-specific toxicity, as reflected in the BCL (or other criteria established for the Site). Specifically, a chemical is excluded as a COPC if the maximum detected concentration is less than or equal to 10% of the BCL. Chemicals that pass this screen are eliminated as COPCs. Chemicals that fail this screen (i.e., are present at concentrations greater than 10% of the BCL) are further screened under Step 2 and/or Step 3.

The soil HRA data set identified in Section 4 is the starting point for the concentration/toxicity screen. This data set includes the results for all analytes detected in one or more samples collected at depths beginning at 0 and 10 ft bgs depth interval,[21] with the exception of the analytical results excluded based on the DUE, as discussed in Section 4. For most analytes, the BCL used for the concentration/toxicity screen is the minimum of the indoor and outdoor commercial/industrial worker BCL (NDEP 2023b). Because BCLs have not been established for all analytes in Parcel E soils, surrogate values were identified where possible. Surrogates and other chemical-specific exceptions, as well as the results of the screen, are presented in Table 5-1 and discussed below.

<u>Surrogates</u>

The concentration/toxicity screen can be implemented only for chemicals for which a BCL or appropriate surrogate is available. Surrogates were identified for most, but not all, chemicals for which a BCL was not available, as follows:

---

[20] The three screening steps are consistent with the COPC identification steps outlined in the Baseline Health Risk Assessment Work Plan for Operations Area (ENVIRON 2014a). However, as agreed upon by NDEP (Ramboll Environ 2015b), the order of the steps has been changed; the original order was 1) background evaluation, 2) concentration/toxicity screen, and 3) chemical-specific considerations. Though the final list of COPCs is independent of the order of the steps, the concentration/toxicity screen was conducted before the background evaluation in order to streamline the COPC selection process (Ramboll Environ 2015b).

[21] An underlying assumption is that soils from depths of up to 10 ft could be brought to the surface during excavation or other activities, leading to potential worker exposures.

Analyte	Surrogate
2,4'-Dichlorodiphenyldichloroethylene (DDE)	4,4'-DDE
Phosphorus (total)	Phosphoric acid
ortho-Phosphate	Phosphoric acid

Surrogates were identified for all but one analyte (sulfate). By default, this analyte is carried forward, not to Step 2 (metals and radionuclides only) but to Step 3 (all other analytes) of the COPC selection process.

Chemicals with Non-Health Based BCLs

In general, the BCLs listed in the BCL table are health-based. However, for soil BCLs, there are two exceptions as follows (NDEP 2023a):

- For the relatively less toxic non-VOCs with health-based BCLs exceeding the NDEP established non-health based upper-limit soil concentration (or a "not-to-exceed" concentration) of 100,000 mg/kg, the upper-limit value of 100,000 mg/kg is listed in the BCL table.
- For VOCs, when the health-based BCL for a VOC is greater than its soil saturation limit, the BCL listed in the BCL table is based on the saturation limit of the VOC.

For the concentration/toxicity screening, the health-based BCLS for commercial/industrial workers are used (NDEP 2023b). The chemicals for which health-based BCLs are used in place of non-health based BCLs are identified in Table 5-1.

Arsenic, Dioxin TEQs, and Lead

As presented in the BHRA Work Plan (ENVIRON 2014a), Site-specific screening values are used for arsenic and dioxin TEQs:

- For arsenic, the maximum detected concentration is compared to the Site-specific remediation goal of 7.2 mg/kg (NDEP 2010c), which is the maximum arsenic concentration reported for the BRC/TIMET background data set (BRC and TIMET 2007); arsenic would be eliminated as a COPC if the maximum concentration is less than this screening value.
- For dioxin TEQs, the maximum detected value is compared to the Site-specific action level of 0.0027 mg/kg; this value was derived based on an in vitro soil bioaccessibility study conducted using Site soils (Northgate 2010); NDEP (2010c) approved this value based on the information presented in the study.

USEPA has not established toxicity values (i.e., a cancer slope factor [CSF] or reference dose [RfD]) for lead (USEPA 2023a). Instead, USEPA used a blood-lead model to establish a RSL of 800 mg/kg, which NDEP has adopted as the BCL for commercial/industrial workers. Because the health endpoint for lead (i.e., a blood lead concentration) is not a cancer risk or noncancer HI, the maximum detected concentration is compared directly to the commercial/industrial worker BCL of 800 mg/kg, and not to 10% of the BCL.

Asbestos

BCLs have not been established for asbestos (long amphibole and chrysotile fibers). Exposure and risk assessments for asbestos are highly dependent on sample size. Even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than 1 × 10^{-6}, depending on sample size. Therefore, although no long amphibole or chrysotile fibers were observed in any soil samples collected in Parcel E, asbestos was still retained as a COPC per NDEP guidance (Neptune 2015).

Results of Concentration/Toxicity Screen

The concentration/toxicity screen for Parcel E is presented in Table 5-1. For each listed chemical, the maximum detected concentration and the BCL (or other applicable screening value) are presented. The final column indicates whether the chemical "passed" or "failed" the screen or did not have a screening level. Of the 44 detected analytes listed in Table 5-1, 34 chemicals passed, nine chemicals (zirconium and all eight radionuclides) failed based on the BCL comparison, and one chemical (sulfate) did not have a screening level. Chemicals that failed or that did not have a screening level are carried forward to Steps 2 and/or 3.

It is noted that the maximum detected concentrations for the four metals that were identified as not consistent with the background data (i.e., boron, iron, mercury, and vanadium, see Section 4.1.2.2 and Table E-2 in Appendix E) were well below 10% of their respective BCLs. Therefore, they are not expected to contribute significantly to the health risks and were not identified as COPCs in soil for this HRA (see Table 5-1).

5.1.1.2 Step 2 – Background Evaluation

The background evaluation step is consistent with USEPA (1989) and NDEP (2009c) guidance, which indicate that metals and radionuclides can be eliminated as COPCs if site concentrations are consistent with background levels. Metals and radionuclides that are present at concentrations greater than background and those for which a background data set is not available are then further screened under Step 3.

The metals and radionuclides that either failed the concentration/toxicity screen or for which a BCL was not available for screening are listed in Tables 5-2 and 5-3, respectively. The results of the background evaluation presented in Section 4.1.2.2 and Appendix E are also presented. Zirconium was the only metal carried forward from Step 1. It was present at concentrations consistent with background and is eliminated as a COPC. Of the eight radionuclides carried forward from Step 1, only Th-230 was identified as being inconsistent with background, while activities of all other radionuclides were consistent with background.

For radionuclides, as presented in the NDEP flowchart (Appendix I), when approximate secular equilibrium[22] is exhibited in an isotope decay chain, in theory radionuclides in the same decay chain should yield similar background comparison results; therefore, if any radionuclide is greater than background, all the radionuclides in that decay chain would be carried forward in the risk assessment. When approximate secular equilibrium is not exhibited in an isotope decay chain, individual radionuclides that fail the background

---

[22] Secular equilibrium exists when the quantity of a radioactive isotope remains constant because its production rate (due to the decay of a parent isotope) is equal to its decay rate.

evaluation would be carried forward in the risk assessment. As indicated in Table 5-3, secular equilibrium is not exhibited in either the U-238 decay series or the Th-232 decay series in Parcel E. One radionuclide in the U-238 decay series (Th-230) was inconsistent with background, while all radionuclides in the Th-232 decay series as well as U-235 are presented at activities consistent with background.

Sample preparation and analytical methods were important factors in explaining some of the radionuclide data anomalies. BRC/TIMET regional background samples were collected and analyzed in 2005 (before NDEP issued guidance for evaluating radionuclide data [NDEP 2009b]), while Parcel E samples were collected and analyzed in 2019 (after NDEP issued guidance for evaluating radionuclide data [NDEP 2009b]). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. For example, the analytical methods for Ra-228 included both beta spectroscopy and gamma spectroscopy, depending on the laboratory, which may be the reason for the lack of correlation with Ra-228 in the Th-232 decay chain (Table E-6).

Given that the validity of the statistical testing is complicated by several issues identified above, it is difficult to interpret the results of background evaluation for radionuclides. However, the background data is still usable for drawing conclusions for the purpose of COPC selection. To provide a point of comparison from a health risk perspective between radionuclides in Parcel E soils and in background soils, the total radionuclide cancer risks were estimated for the Parcel E soils, Remediation Zone A (RZ-A) background soils, and BRC/TIMET regional background soils by taking the ratio of soil activities to the commercial/industrial worker BCLs corresponding to a cancer risk of 1×10^{-6} based on the 95% upper confidence limit (UCL) on the mean soil activity, calculated by the R codes provided by Neptune.[23]

The results of radionuclide cancer risks are presented in Table 5-4, and the UCL output files, along with a copy of the R codes used in the UCL calculation, are included in Appendix J. As indicated in Table 5-4, the total radionuclide cancer risk for Parcel E was 2×10^{-4}; the total radionuclide cancer risks for RZ-A background and BRC/TIMET regional background were also 2×10^{-4} using the 95% UCL. Using the mean concentrations, the total radionuclide cancer risk for Parcel E was 2×10^{-4}; the total radionuclide cancer risks for RZ-A background was 1×10^{-4}; and BRC/TIMET regional background was 2×10^{-4} when rounded to one significant digit. Overall, the total cancer risks for radionuclides in Parcel E were approximately 10% greater than the RZ-A background and 10% less than the BRC/TIMET background. Although the total radionuclide cancer risk for Parcel E was slightly above the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}, it is consistent with background risk in the area. Th-230 was the only radionuclide that failed the statistical testing for background consistency. Th-230's contribution to the total risk was 2×10^{-7}. Additionally, radionuclides are not known to be associated with any of the former operations within Parcel E. Based on the above discussion, radionuclides were not identified as COPCs.

---

[23] The radionuclide data used in the 95% UCL calculation were not censored based on NDEP guidance (NDEP 2008a). The higher UCL value generated between the bias-corrected accelerated bootstrap method (BCA UCL) and the t-test method was selected. Neptune provided Ramboll with a copy of the R codes used for the UCL calculation on May 18, 2020.

The impacts of excluding radionuclides as COPCs on the overall soil risk evaluation are further discussed in Section 6.2.1.

5.1.1.3 Step 3 – Chemical-specific Evaluations

For the final step of COPC identification, chemicals commonly recognized as having low toxicity and for which a BCL was not available (such that a concentration/toxicity screen could not be conducted) were further reviewed. As indicated in Table 5-1, chloride and sulfate are the only chemicals for which BCLs were not available. However, both chloride and sulfate are essential macronutrient with high consumption from foods and is listed on the Generally Recognized as Safe (GRAS) list developed by the U.S. Food and Drug Administration (21 CFR Part 184). Therefore, chloride and sulfate were eliminated as COPCs based on their low toxicity.

5.1.1.4 Summary of Soil COPCs

In summary, asbestos (long amphibole and chrysotile fibers) was the only soil COPC identified for Parcel E. Although asbestos was identified as a COPC in soil, spatial concentration plots were not prepared because no asbestos fibers were detected in any sample.

5.1.2 Soil Gas COPCs

All chemicals detected in one or more validated soil gas sample were selected as COPCs, as recommended by NDEP in their April 9, 2013, comment letter on the *Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H* (NDEP 2013, Comment #3). Using this selection criterion, 52 VOCs[24] were identified as COPCs in soil gas for Parcel E (Table 5-5). Spatial concentration plots for both depths are presented in Appendix F4 for one COPC (chloroform) that exceeds 10% of the minimum RBTC (at both 5 ft bgs and 15 ft bgs). The spatial distributions shown on these spatial concentration plots are consistent with the trends found in the spatial quartile plots for soil gas chloroform results, as shown in Appendix F2. Due to the OSSM-operated treatment system located in Parcel E, chloroform concentrations in soil gas throughout Parcel E are generally low, as shown in the spatial concentration plots in Appendix F4 for soil gas.

5.1.3 Groundwater COPCs

All VOCs detected in one or more validated shallow groundwater samples collected from 2015 to 2019 in Parcel E were selected as COPCs (USEPA 2015). Using this selection criterion, 18 VOCs were identified as COPCs in shallow groundwater for Parcel E (Table 5-5). As shown in Table 5-5, with the exception of 1,2,3-trichlorobenzene and 1,2,3-trichloropropane, the VOCs detected in groundwater were also detected in soil gas. Spatial concentration plots are presented in Appendix F5 for three COPCs that exceed 10% of the minimum RBTC: chlorobenzene, chloroform, and 1,4-dichlorobenzene. The spatial distribution shown on these spatial concentration plots are consistent with the trends found in the spatial quartile plots for shallow groundwater results, as shown in Appendix F3. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform

---

[24] Any chemicals labelled as SVOCs that are included in the USEPA definition of volatile compounds are also included in the vapor intrusion analysis. The volatile compounds are currently identified using the following criteria consistent with recommendation from the USEPA Regional Screening Levels Table (USEPA 2023a): 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law constant greater than 0.00001 atm-m^3/mol.

downgradient of the extraction well field are below 70 µg/L. In addition, the concentration of other VOCs in shallow groundwater are generally low as shown in the spatial concentration plots in Appendix F5 for groundwater.

5.2 Exposure Assessment

The exposure assessment analyzes chemical releases and the physical setting, identifies exposed populations and exposure pathways, and estimates exposure concentrations and chemical intakes for the identified pathways. This exposure assessment includes the Parcel E CSM, estimation of EPCs, and exposure assumptions and calculations, as discussed in the following sections.

5.2.1 Conceptual Site Model and Exposure Scenarios

To evaluate the human health risks posed by a site, it is necessary to identify the populations that may potentially be exposed to the chemicals present and to determine the pathways by which these exposures may occur. Specifically, a CSM outlines information relevant to conducting the exposure assessment by (1) evaluating potential chemical sources and releases, (2) identifying populations that could potentially be exposed to chemicals present, and (3) identifying complete exposure pathways and routes through which human exposure might occur. The CSM is an important tool in guiding site characterization, evaluating data quality in the context of potential risks to exposure populations, and developing exposure scenarios. A Parcel E CSM was developed to characterize the historical operations, sources of impacts, migration and distribution of contaminants, and potential exposures for the on-Site populations in Parcel E, as shown in Figure 5-2. The historical operations, sources of impacts and migration and distribution of contaminants were discussed in Section 4.4 as the last step of DUE, while the elements of Parcel E CSM evaluated as part of the exposure assessment in the HRA are discussed below.

5.2.1.1 Potential Chemical Sources and Release Mechanisms

Historically, NDEP concurred with a list of SRCs that had been identified based on a review of historical site operations and practices, as well as those at neighboring facilities. Based on the CSM, many of the SRCs identified for the Site as a whole were not related to Parcel E, which housed no operations, and were therefore not expected to be detected in Parcel E soils. Specifically, as summarized in Section 2.1, with the exception of the OSSM GWETS, Parcel E has never been developed, and no LOUs were identified in Parcel E. However, as a conservative investigation approach, soil samples collected in Parcel E were analyzed for the same chemicals identified for analysis in samples collected within the Operations Area, including chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos, dioxins/furans, organic acids, PAHs, PCBs, OCPs, OPPs, SVOCs, and VOCs.

As discussed in Section 4.4 and indicated in the Parcel E CSM (Figure 5-2), no industrial activities were reported to have occurred in Parcel E, and chemicals were released from potential on-Site and adjacent off-Site sources to surface soils and groundwater through several primary release mechanisms, such as spills and leaks/infiltration and groundwater transport. In addition to the potential primary release mechanisms, secondary/tertiary release mechanisms included resuspension of chemicals in surface soils into ambient air, migration of VOCs present in subsurface media through the soil column to indoor air, outdoor air, or trench air, and leaching of chemicals in soils to groundwater.

5.2.1.2 Potentially Exposed Human Populations and Exposure Pathways

The identification of potentially exposed populations and exposure pathways is supported by the Parcel E CSM. For a complete exposure pathway to exist, all of the following elements must be present (USEPA 1989):

- A source and mechanism for chemical release;
- An environmental transport medium (i.e., air, water, soil);
- A point of potential human contact with the exposure medium; and
- A route of exposure (e.g., inhalation, ingestion, dermal contact).

As noted previously, the land within Parcel E is mostly vacant. Future land use is anticipated to be restricted to industrial and/or commercial purposes through a land-use covenant. Accordingly, the potentially exposed on-parcel populations evaluated in the HRA included indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers, consistent with the BHRA Work Plan (ENVIRON 2014a) and USEPA guidance (2002b).

Other potential on-parcel populations, such as visitors or trespassers, do not warrant additional assessment; as discussed by USEPA (2002b), evaluation of exposures to members of the public under a non-residential land-use scenario is generally not warranted, based on the following considerations:

- Public access is generally restricted at industrial sites; and
- While the public may have access to commercial sites, on-Site workers have a much higher exposure potential because they spend substantially more time at a site.

Off-Site populations were not quantitatively evaluated in the HRA. Current and future off-Site populations include indoor and outdoor commercial/industrial workers and residents located outside the Site boundaries who could be exposed to airborne chemicals (vapors and particulates) emitted during routine operations or construction projects (USEPA 2002b). The Site is located within the BMI complex, surrounding by several industrial facilities. For Parcel E, there are off-Site industrial/commercial workers at the OSSM GWETS to the west, at the Google data center directly north across Warm Springs Road, at the Joker’s Wild Casino on the corner of Warm Springs Road and Boulder Highway, and in businesses to the northwest along Warm Springs Road, near Eastgate Road and to the northeast along Boulder Highway. The nearest residents are located approximately 1,600 ft north/northeast of Parcel E. A qualitative discussion of the potential risks to off-Site populations is presented in Section 6.2.2.1.

Based on the source and release mechanisms presented in the Parcel E CSM, the following receptor populations and exposure pathways were identified for quantitative evaluation:

- Indoor commercial/industrial workers[25]
    - Inhalation of airborne dust particulates,[26]
    - Inhalation of vapors migrating from soil gas/groundwater to indoor air
- Outdoor commercial/industrial workers
    - Inhalation of airborne soil particulates;[26,27] and
    - Inhalation of vapors migrating from soil gas/groundwater to outdoor air.
- Construction workers
    - Inhalation of airborne soil particulates;[26,27] and
    - Inhalation of vapors migrating from soil gas/groundwater to trench air.

Since asbestos was the only soil COPC identified in Section 5.1.1.4, inhalation of airborne soil particulates was the only exposure pathway quantitatively evaluated for soil.

Construction workers were assumed to be exposed to vapors migrating from soil gas/groundwater while standing in a 10-ft deep trench in the unsaturated zone, placing them closer to the potential sources.

Consistent with the risk assessments completed for Parcels C, D, F, G, and H, exposure via domestic use of groundwater was not evaluated because on-Site groundwater is not and will not be used as a domestic water supply given the high concentrations of TDS in the area. Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities were not considered complete exposure pathways because the groundwater depth beneath Parcel E is approximately 33 to 40 ft bgs.

5.2.2 Exposure Point Concentrations

An EPC of a COPC is the estimated concentration of that chemical in an environmental medium to which a receptor (i.e., a member of a potentially exposed population) is exposed over an assumed duration of exposure. EPCs are used in the dose equation for evaluating the potential exposure (dose) of each receptor and exposure pathway. The derivation of EPCs for airborne soil particulates and VOCs migrating from soil gas and groundwater to indoor, outdoor, or trench air are described in the following sections.

5.2.2.1 Airborne Soil/Dust Particulates for Asbestos

As discussed in Section 5.2.1.2, exposures to asbestos are evaluated for the inhalation pathway only. Air EPCs for asbestos were derived based on the concentration of asbestos in surface soils (only surface samples were analyzed for asbestos), consistent with the NDEP guidance (Neptune 2015) which is based on the protocols described in USEPA guidance

---

[25] In accordance with USEPA (2002b) guidance, dermal absorption is not considered to be a complete exposure pathway for an indoor worker. Soil ingestion is identified by USEPA (2002b) as a potentially complete exposure pathway for an indoor worker due to the potential for contact through ingestion of soil tracked indoors. Inhalation of indoor dust (particulates) is identified by NDEP (2017) as a potentially complete exposure pathway for an indoor worker.

[26] Includes asbestos exposures. For asbestos, ingestion is a less significant pathway, and is not included in the risk evaluation, consistent with NDEP guidance (Neptune 2015).

(USEPA 2003) and has been modified for application to the BMI Complex. Asbestos concentrations in surface soils were estimated for fibers identified as carcinogenic, specifically, fibers of dimensions >10 µm long and <0.4 µm wide, using the following equations:

$$C_{soil} = f \times \text{Pooled } AS$$

$$Pooled\ AS = 1 \times \frac{1}{\sum_{i=1}^{n} AS_n}$$

where:

C_{soil} = Soil Concentration (fiber [f]/g)

F = Number of long fibers observed in soil samples (unitless)

AS = Analytical Sensitivity (f/g) [27]

N = Sample Size

Two types of asbestos soil concentrations were estimated, i.e., a best estimate and an upper-bound estimate, as defined by USEPA (2003) and Neptune (2015). The best-estimate concentration is similar to a central tendency exposure (CTE) estimate, whereas the upper-bound concentration is comparable to a reasonable maximum exposure (RME) estimate. For the best estimate, the number of long fibers observed in all soil samples was incorporated into the calculation above. The upper bound estimate was calculated as the 95% UCL of the number of long fibers from a Poisson distribution as follows (Neptune 2015):

$$f_{UCL} = \frac{\chi^2{}_{0.95}\left(2 \times (f+1)\right)}{2}$$

where:

f_{UCL} = 95% UCL of the number of long fibers observed in soil samples from a Poisson distribution (unitless)

f = Number of long fibers observed in soil samples (unitless)

$\chi^2{}_{0.95}$ = Chi-squared distribution at 95%

The f_{UCL} was then multiplied by the pooled analytical sensitivity (AS) to estimate the upper-bound soil concentration.

The air EPCs were derived from soil concentrations by applying the particulate emission factors (PEFs) (USEPA 2002b), as follows:

---

[27] The laboratory results are reported as "structures per g"; however, the unit "fibers per g" is used herein for simplicity.

$$EPC_{air} = C_{soil} \times CF \times \left(\frac{1}{PEF}\right)$$

where:

EPC_{air} = Air Exposure Point Concentration (f/m^3)

C_{soil} = Soil Concentration (f/g)

PEF = Particulate Emission Factor (m^3/kg)

CF = Conversion Factor (1000 g/kg)

The site-specific dispersion factor (Q/C) used in the calculation of PEFs is based on information for Las Vegas, Nevada, as presented in Appendix E of USEPA (2002b). The calculation of a PEF is also a function of the areal extent of site surface contamination, which is assumed to be equivalent to the area of Parcel E. For commercial/industrial indoor and outdoor workers, the PEF is estimated based on emissions from wind erosion of surface soils and was calculated using the equations presented by Neptune (2015). The PEF for short-term construction workers includes two components: (1) emissions from unpaved roads and (2) emissions from wind erosion, excavation, dozing, grading, and tilling (USEPA 2002b). These two components were calculated and then combined into a single PEF using the equations presented in Neptune (2015).

For asbestos, the soil concentrations, PEFs, and air EPCs (and associated health risks) were calculated using NDEP's "asbestos guidance riskcalcs.xls" spreadsheet and are presented in Appendix K-1.

5.2.2.2 Indoor, Outdoor, and Trench Air: VOCs

The following subsections describe the derivation of the exposure concentrations and includes descriptions of the source terms and the fate and transport modeling conducted to estimate the exposure concentrations in indoor air, outdoor air, and trench air.

Source Terms

Chemicals detected in soil gas (sourcing from groundwater and/or soil) can potentially migrate through the unsaturated zone to ambient or indoor air (USEPA 2004c). For this evaluation, the soil gas and groundwater data are used as the source term to model the indoor, outdoor and trench air concentrations (i.e., the exposure concentrations in the exposure medium or air). For all volatile COPCs evaluated for Parcel E, the exposure concentrations in air used in risk characterization for vapors migrating from soil gas and shallow groundwater are conservatively modeled using the maximum concentrations detected in the soil gas HRA data set or in the shallow groundwater HRA data set across entire Parcel E, respectively, regardless of sample location.

As recommended in agency guidance (USEPA 2015), multiple lines of evidence should be used in the vapor intrusion analysis to reduce uncertainty associated with individual lines of evidence due to the spatial and temporal variability; multiple lines of evidence are used to provide a more comprehensive understanding of the vapor intrusion analysis and improve confidence in decision making. Lines of evidence may be weighted differently depending on their characteristics and quality; soil gas data is generally the preferred primary line of evidence for assessing vapor intrusion risks as opposed to groundwater or soil data primarily due to higher uncertainties associated with vapor intrusion modeling based on groundwater or soil data (i.e., uncertainty in predicting contaminant partitioning from groundwater or soil moisture to soil gas and in predicting transport through the capillary fringe). Therefore, this HRA considers the soil gas data as the primary line of evidence for the vapor intrusion pathway; the groundwater data were evaluated to provide an additional line of evidence for a more comprehensive understanding of the evaluation and to check consistency between soil gas and groundwater results.

Fate and Transport Modeling

The migration of chemicals detected in soil gas (sourcing from soil and groundwater) or groundwater is quantified for the purposes of this assessment through an intermedia transfer factor. When the transfer factor is multiplied by the source concentration of a chemical in soil gas (in $\mu g/m^3$) or groundwater (in µg/L), the product is the predicted steady-state concentration in indoor, outdoor, or trench air (in $\mu g/m^3$).

For the receptors evaluated in this HRA (future on-Site workers), transfer factors for vapors migrating to indoor air, outdoor air, and trench air were derived based on migration of groundwater vapors from the shallow groundwater table or soil gas from 5 ft bgs and 15 ft bgs to a commercial slab-on-grade building, outdoor air, and trench air, respectively. The transfer factors were estimated using the screening-level model described by Johnson and Ettinger (1991); this model was developed to predict vapor migration into buildings using a combination of diffusion and advection. Specifically, Version 6.0 of the spreadsheet implementation developed by the USEPA was used (USEPA 2017). The parcel-specific modeling parameters are listed in Table 5-6.

The COPC physical/chemical properties are presented in Table 5-7. The source of all physical/chemical properties is noted in the table. In general, priority is given to the most recent physical/chemical data as well as the most relevant for a site located in Nevada. As such, the hierarchy for selecting physical/chemical properties was: 1) NDEP values from BCL tables (NDEP 2023b); 2) USEPA values from RSLs (USEPA 2023a); 3) USEPA values from the original Johnson and Ettinger model (USEPA 2004c); 4) USEPA values from EPISuite (2012) combined with using surrogate chemicals for chemical diffusivities.

Soil gas or groundwater concentrations were used as the source term for modeling the following scenarios:

- Soil gas from 5 ft bgs migrating to indoor air in a commercial building and outdoor air in Parcel E;
- Soil gas from 15 ft bgs migrating to indoor air in a commercial building and outdoor air in Parcel E;
- Soil gas migrating from 5 ft below the base of a 10-ft construction trench or 5 ft away from the side walls of the trench in Parcel E; and
- Groundwater from 30 ft bgs migrating to commercial indoor air, outdoor air, or a 10-ft construction trench in Parcel E.

As reported in the 2010 Site-Wide Soil Gas HRA (Northgate and Exponent 2010), soil samples were collected to determine site-specific soil properties representative of the unsaturated zone. Samples were collected at 16 locations at depths of 9 to 15 ft bgs (mostly at 10 ft) across the Site (sampling locations and boring logs are included in Appendix L) to determine volumetric water content, total porosity, dry bulk density, and grain density in accordance with NDEP guidance (NDEP 2010c). The soil property results (shown in Table 5-8) were used for modeling purposes and are the average of 15 site-specific values measured from 9-10 ft bgs. One sample collected at a depth of 15 ft bgs was not included as it represents wetter than average conditions at the site. A map showing the location of these samples is shown in Appendix L.

A review of site stratigraphy and boring logs indicated that these samples collected at 9-10 ft bgs should be representative of the entire Qal stratigraphic unit and there is not expected to be significant variation laterally or with depth in that stratigraphic unit. In general, the Qal extends from the ground surface to the groundwater table over the Site, as well as beneath Parcel E. In places, the groundwater table occurs as much as 10 ft below the base of the Qal in the underlying fine-grained UMCf. For simplicity and to be conservative, the entire vadose zone was modeled as Qal with no UMCf included. Each sample was also plotted on a ternary diagram to determine soil typing for Johnson and Ettinger modeling as well. The samples clustered well near the sand to loamy sand border, with the average soil type being loamy sand. A careful review of boring logs from the on-Site area where soil properties were collected, as well as from Parcel E, was used to confirm these soil properties and this soil type would be representative of conditions at Parcel E. Boring logs from Parcel E are also included in Appendix L. Soil types identified in the on-Site soil borings include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand (ENSR 2005) and are consistent with an average soil type of loamy sand in Parcel E. Based on that evaluation, it was concluded that the on-Site soil samples would be representative of conditions expected to be seen at Parcel E.

Depth to groundwater for Parcel E was determined by evaluating both current and historic groundwater elevations measured at monitoring wells within the parcel. The depth to groundwater was selected to be a conservative estimate given both current and recent historic measurements.

Depth to the top and base of soil contamination was determined based on conservative worst-case assumptions. It was assumed that the soil could be contaminated with VOCs from one centimeter (cm) bgs all the way down to the water table.

A conservative default building (with building characteristics shown on Table 5-6), was assumed for modeling. The default building area of 1500 square meters (USEPA 2017) was selected. The default building has an assumed vapor flow rate of 337.5 liters/minute into the building (USEPA 2017). Default air exchange rate of 1.5 air change per hour (USEPA 2017) was used. A conservative building height of 3 meters was assumed.

When modeling the above-ground outdoor air scenarios, the Q/C model described in the Soil Screening Users Guidance (USEPA 2002b) was used with a Site-specific area. For construction trench scenarios, a box model was used to simulate dispersion. Construction trench dimensions of 10 ft deep, 20 ft long, and 5 ft wide were assumed. For this box model, the air flow through the construction trench was controlled by a Site-specific windspeed that was reduced by a factor of 20 to ensure it would be conservative for a construction trench scenario where the breathing zone may be a few ft bgs. Additionally, soil gas samples were assumed to be 5 ft away from the side walls of the construction trench (the 5 ft bgs soil gas samples) or 5 ft below the base of the construction trench (the 15 ft bgs soil gas samples), and VOCs were emitted from all the construction trench walls in addition to the base of the construction trench. These assumptions allow us to conservatively evaluate the 5 ft soil gas samples using the 10-ft trench model.

Benzene is well known to degrade naturally due to aerobic respiration at many sites. Measured concentrations of benzene at shallow depths are consistently lower than would be predicted from deeper sources (soil gas and groundwater) using typical diffusion modeling with no biodegradation providing evidence for biodegradation at the Site. To account for this, the software bioVapor (American Petroleum Institute [API] 2012) was used to calculate the relative impact of biodegradation between the samples collected at depth and the surface for all soil gas and groundwater scenarios. The modeling parameters for this calculation are also presented in Table 5-6 and were consistent with the input parameters for the rest of the modelling.

Table 5-9a summarizes the transfer factors from soil gas to indoor air, outdoor air, and trench air for Parcel E. Table 5-9b summarizes the transfer factors from groundwater to indoor air, outdoor air, and trench air for Parcel E. The modeling files are included in Appendix M of this report. The conservative nature of the model input parameters and modeling uncertainties are discussed in Section 6.2.2.3.

Exposure Point Concentrations

Using the maximum soil gas or groundwater concentration of each volatile COPC within the parcel as the source term, indoor air, outdoor air, and trench air concentrations were modeled using the Johnson and Ettinger model and a basic diffusion model, respectively. The contaminant concentration in air, rather than contaminant intake, is used as the basis for estimating chemical inhalation risks based on guidance described in *Part F, Supplemental Guidance for Inhalation Risk Assessment* (USEPA 2009b). The EPCs for noncarcinogens and carcinogens are estimated as follows:

$$EPC_{air} = EPC_{SG/GW} \times TF$$

where:

EPC_{air} = Air Exposure Point Concentration (µg/m^3)

$EPC_{SG/GW}$ = Exposure Point Concentration (µg/m^3 for soil gas, µg/L for groundwater)

TF = Transfer Factor (µg/m^3 per µg/m^3 for soil gas, µg/m^3 per µg/L for groundwater)

Tables 5-10a and 5-10b present the calculated EPCs in indoor air, outdoor air, and trench air based on the maximum detected concentrations in the soil gas HRA data set for Parcel E at 5 ft bgs and 15 ft bgs, respectively. Table 5-11 presents the calculated EPCs in indoor air, outdoor air, and trench air based on the maximum detected concentrations in the shallow groundwater HRA data set for Parcel E.

5.2.3 Exposure Assumptions and Calculations

The magnitude of exposure for any given receptor is a function of the amount of chemical in the exposure medium (e.g., air, groundwater, soil), and the frequency, intensity, and duration of contact with that medium. Only inhalation pathways were quantitatively evaluated for soil, soil gas, and groundwater in this HRA, and in order to quantify inhalation exposures, the air EPC adjusted by the intake factor, rather than exposure dose, is used as the basis for estimating inhalation risks based on *Risk Assessment Guidance for Superfund, Part F, Supplemental Guidance for Inhalation Risk Assessment* (USEPA 2009b). This section provides the equations and assumptions used to develop the intake factors used in the risk characterization.

5.2.3.1 Chemicals

For soil gas and groundwater COPCs, as shown in Table 5-12, exposure assumptions recommended by NDEP (2023a) were used for the indoor and outdoor commercial/industrial workers. For the construction workers, exposure assumptions recommended by USEPA (2023b) were used. In addition, a construction trench scenario was evaluated assuming that construction workers could be exposed to volatile compounds migrating from soil gas and groundwater to air in a 10-ft deep construction trench. The construction workers are assumed to be conducting excavation activities for four hours per day, 30 days per year for one year based on approach recommended by the Virginia Department of Environmental Quality (VDEQ) for evaluating the construction trench scenario (VDEQ 2023) and NDEP's recommendation (NDEP 2017, General Comment #3 and Specific Comment #3).[28]

The intake factor for inhalation of airborne particulates or vapor migrating from soil gas or groundwater to air was calculated using the following equation (USEPA 2009b):

$$IF_{inh} = \frac{ET \times EF \times ED}{AT \times CF}$$

where:

IF_{inh} = Intake Factor for air inhalation (unitless)

ET = Exposure Time (hour/day)

EF = Exposure Frequency (day/year)

---

[28] In the evaluation of the construction workers exposed to volatile compounds migrating from subsurface soil, soil gas, and groundwater to air in a construction trench, the exposure frequency is assumed to be 30 days based on NDEP's recommendation (NDEP 2017, General Comment #3); the exposure time of 4 hours per day and the exposure duration of one year are both based on VDEQ's recommendations (VDEQ 2023) per NDEP's comment (NDEP 2017, Specific Comment #3).

ED = Exposure Duration (year)
AT = Averaging Time (day)
CF = Conversion Factor (hour/day)

5.2.3.2 Asbestos

Asbestos was identified as the only COPCs for soil in Parcel E. The exposure assumptions for asbestos are presented in NDEP's "asbestos guidance riskcalcs.xls" spreadsheet (Appendix K-1), and the intake equation was analogous to that presented above for evaluating inhalation exposures to chemicals with carcinogenic effects (averaged over a 70—year lifetime), with an exception that an indoor attenuation factor was incorporated as follows:

$$IF_{inh} = \frac{[ET_{out} + (ET_{in} \times ATT_{in})] \times EF \times ED}{AT \times CF}$$

where:

ET_{out} = Outdoor Exposure Time (hour/day)
ET_{in} = Indoor Exposure Time (hour/day)
ATT_{in} = Indoor Attenuation Factor (unitless)
EF = Exposure Frequency (day/year)
ED = Exposure Duration (year)
AT = Averaging Time (day)
CF = Conversion Factor (hour/day)

5.3 Toxicity Assessment

The purpose of a toxicity assessment is to present the weight-of-evidence regarding the potential for a chemical to cause adverse effects in exposed individuals, and to quantitatively characterize, where possible, the relationship between exposure to a chemical and the increased likelihood and/or severity of adverse effects (i.e., the dose-response assessment). Well conducted epidemiological studies that show a positive association between exposure to a chemical and a specific health effect are the most convincing evidence for predicting potential hazards for humans. However, human data that would be adequate to serve as the basis for the dose-response assessment are available for only a few chemicals. In most cases, toxicity assessment for a chemical has to rely on information derived from experiments conducted on non-human mammals, such as rat, mouse, rabbit, guinea pig, hamster, dog, or monkey.

Chemicals are usually evaluated for their potential health effects in two categories, carcinogenic and non-carcinogenic. Different methods are used to estimate the potential for carcinogenic and non-carcinogenic health effects to occur. Several chemicals produce non-carcinogenic effects at sufficiently high doses but only some chemicals are associated with carcinogenic effects. Most regulatory agencies consider carcinogens to pose a risk for cancer at all exposure levels (i.e., a "no-threshold" assumption); that is, any increase in dose is associated with an increase in the probability of developing cancer. In contrast, non-carcinogens generally are thought to produce adverse health effects only when some minimum exposure level is reached (i.e., a threshold dose).

Only inhalation pathways were quantitatively evaluated for soil, soil gas, and groundwater in this HRA. Inhalation unit risks (IURs), which are expressed in units of $(\mu g/m^3)^{-1}$, are chemical specific and experimentally derived potency values that are used to calculate the risk of cancer resulting from inhalation exposure to potentially carcinogenic chemicals. The IUR is defined as an upper-bound estimate of the probability of an individual developing cancer per unit intake of a potential carcinogen over a lifetime. With IURs, a higher value implies a more potent carcinogenic potential. Inhalation reference concentrations (RfCs), which are expressed in units of $\mu g/m^3$, are experimentally derived “no-effect” levels that are used to quantify the extent of toxic effects other than cancer due to inhalation exposure to chemicals. The RfC is intended to represent the dose or concentration of a chemical that is not expected to cause adverse health effects, assuming daily exposure over the exposure duration, even in sensitive individuals, with a substantial margin of safety. With RfCs, a lower value implies a more potent toxicant.

The toxicity values used for the soil gas and shallow groundwater COPCs and asbestos evaluated in this HRA are discussed in the following subsections.

5.3.1 Chemicals

For soil gas and groundwater COPCs, an initial list of chronic toxicity values was developed based on the values used by NDEP for the derivation of the 2023 BCLs (NDEP 2023b). For most chemicals in the BCL table, NDEP selected toxicity values from the USEPA’s Integrated Risk Information System (IRIS); however, on a case-by-case basis, values provided by other sources, e.g., California, were selected over the IRIS values. Also, for chemicals not included in IRIS, NDEP relied on other sources for toxicity values. The chronic toxicity values from the 2023 BCL table were checked against the identified source to confirm that the most current values were being used.

For COPCs not listed in the 2023 BCL table, the following approach was used:

- Toxicity values from IRIS were selected; if not in IRIS, toxicity values from the USEPA RSL table (USEPA 2023a) were used; and
- For COPCs for which toxicity values were not available from any of the sources listed, the toxicity values from surrogate chemicals (chemicals with similar chemical structure) were used.

For construction workers who were assumed to be present at Parcel E for one year, subchronic toxicity values were used whenever available for the evaluation of adverse noncancer effects in accordance with recommendations by USEPA (USEPA 2023b). The subchronic toxicity values were obtained from the USEPA RSL table (USEPA 2023c).

Route-to-route extrapolation was not applied, which is consistent with the updated BCL Guidance (NDEP 2023a) and Risk Assessment Guidance for Superfund, Part F, Supplemental Guidance for Inhalation Risk Assessment (USEPA 2009b).

Also, the USEPA weight-of-evidence classification was identified for each carcinogenic COPC.

Table 5-13 presents chronic and subchronic toxicity values for all COPCs identified in the soil gas and shallow groundwater HRA data sets included in the risk evaluation for Parcel E. The uncertainties in the selection of toxicity values are further discussed in Section 6.2.3.

5.3.2 Asbestos

Asbestos was identified as the only COPCs for soil in Parcel E. The IURs for asbestos are based on the estimated additional deaths from lung cancer or mesothelioma due to constant lifetime exposure, which are calculated using the following equation (Neptune 2015):

$$R = 0.5 \times \left(\left(0.786 \times (NSM + NSF) \right) + \left(0.214 \times (SM + SF) \right) \right)$$

where:

R = Estimated additional deaths from lung cancer or mesothelioma per 100,000 persons from constant lifetime exposure to 0.0001 transmission electron microscopy fiber per cubic centimeter (f/cm^3) longer than 10 µm and thinner than 0.4 µm

NSM = Risk coefficient for population of non-smoking males

NSF = Risk coefficient for population of non-smoking females

SM = Risk coefficient for population of smoking males

SF = Risk coefficient for population of smoking females

The parameter values for NSM, NSF, SM, and SF, which are "optimized" risk coefficients for pure fiber types obtained from Berman and Crump (2003) and presented in Neptune (2015), are used in the calculation of R, representing a weighted average of the combined risks to the general population with the assumption that 50% of the fibers will be longer than 10 um. The R values are calculated separately for long amphibole and chrysotile fibers, reflecting the difference in potency between fiber types. Then, the R value is used to calculate the IUR as follows:

$$IUR = \frac{10^{-5}}{0.0001} \times R = \frac{1}{10} \times R$$

where:

IUR = Inhalation Unit Risk (f/cm^3)$^{-1}$

R = Estimated additional deaths from lung cancer or mesothelioma per 100,000 persons from constant lifetime exposure to 0.0001 f/cm^3 longer than 10 µm and thinner than 0.4 µm

The resulting IURs for lung cancer and mesothelioma are 6.3206 (f/cm^3)$^{-1}$ for long amphibole fibers and 0.0569 (f/cm^3)$^{-1}$ for long chrysotile fibers. These values were used to estimate inhalation risks associated with exposure to asbestos in Parcel E soils (see Appendix K-1).

5.4 Risk Characterization

Risk characterization represents the final step in the risk assessment process. In this step, the results of exposure and toxicity assessments are integrated into quantitative or qualitative estimates of potential health risks. For soil gas and groundwater, potential excess lifetime cancer risks and noncancer adverse health effects for each COPC were characterized separately. In addition, potential cancer risks associated with exposure to asbestos in soil were also characterized.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is the basis for the target cancer risk management range established by NDEP (2023a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}).[29] According to the NCP and NDEP (2023a), non-carcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a HI greater than one).

It should be noted that the cancer risk and noncancer hazard estimated in this HRA do not represent actual estimates of health risks that may occur for the on-Site workers in Parcel E, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks. Therefore, the actual health risks associated with exposure through the vapor intrusion pathway from soil gas and shallow groundwater within Parcel E for the on-Site workers are expected to be lower than the risk estimates reported in this HRA.

5.4.1 Soil

Asbestos was identified as the only COPC for soil in Parcel E. The equation for assessing inhalation cancer risk for asbestos is analogous to that used for other inhalation carcinogens (Neptune 2015), as follows:

$$Cancer\ Risk = EPC_{air} \times IF_{inh} \times IUR$$

where:

EPC_{air} = Air Exposure Point Concentration (f/m^3)

---

[29] According to NDEP (2023a), the acceptability of any calculated incremental cancer risk is generally evaluated relative to the target risk range of 1×10^{-6} to 1×10^{-4} described in the NCP.

IF_{inh} = Intake Factor for air inhalation (unitless)

IUR = Inhalation Unit Risk $(f/cm^3)^{-1}$

The inhalation cancer risks for asbestos (combined risks associated with death from lung cancer and mesothelioma) were calculated using the NDEP's "asbestos guidance riskcalcs.xls" spreadsheet and are presented in Appendix K-1. The best estimate and upper-bound estimate of asbestos cancer risks for Parcel E are summarized in Table 5-14.

No asbestos fibers were detected in any soil samples. For long amphibole and chrysotile fibers, the best estimates were zero. The upper-bound estimates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers from potential inhalation exposure to long chrysotile fibers in Parcel E were all less than 1×10^{-6}, which were below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. For long amphibole fibers, the upper-bound estimates for indoor and outdoor commercial/industrial workers were less than 1×10^{-6}, and was 4×10^{-6} for construction workers. It should be noted that the upper-bound risk estimates for both types of long fibers were based on an observed count of zero fibers in eight soil samples in Parcel E.[30]

As Parcel E is a relatively small parcel and is bordered to the south, east, and north by former Parcels C and D, the results of the asbestos evaluation conducted for former Parcels C and D reported in Ramboll Environ (2017a) are presented as representative of Parcel E, as agreed upon by NDEP during the meeting on April 6, 2023 to discuss their comments received on February 8, 2023, on the Parcel E HRA Report, Revision 0. The best estimates and upper-bound estimates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers from potential inhalation exposure to chrysotile long fibers were all less than 1×10^{-6} for former Parcels C and D, which were below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. Eight chrysotile long fibers were identified in six of the seventeen samples in former Parcel C; while seven chrysotile long fibers were identified in three of the nine samples in former Parcel D. Most of the fibers were located in samples on the east side of former Parcels C and D approximately 1,000 - 1,500 ft away from Parcel E. For amphibole long fibers, the best estimate was zero for both parcels. The upper-bound estimates for indoor and outdoor commercial/industrial workers were less than 1×10^{-6} for both parcels and were 2×10^{-6} (former Parcel C) and 4×10^{-6} (former Parcel D) for construction workers. All risk results for asbestos exposure in former Parcels C and D were below or within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. Uncertainties in the risk estimates for asbestos, including the impact of sample size, are discussed in Section 6.2.2.2.

Overall, potential exposure to asbestos in soil in Parcel E is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated.

---

[30] For asbestos, risks are estimated even in the case of zero fiber counts. As discussed in detail in Neptune (2015), the risk assessment results are affected by the calculation of the 95% UCL, which for a fiber count of zero in soil samples, yields a value of three fibers per gram of soil (also see the discussion in Section 6.2.2.2).

Uncertainties in the risk estimates for asbestos, including the impact of sample size, are discussed in Section 6.2.2.2.

5.4.2 Soil Gas VOCs

Soil gas data is generally the preferred primary line of evidence for assessing health risks through the vapor intrusion pathway as opposed to groundwater or soil data due to higher uncertainties associated with vapor intrusion modeling based on groundwater or soil data per agency guidance (USEPA 2015) (see additional discussions in Section 5.2.2.2).

5.4.2.1 Assessment of Cancer Risks

Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the COPCs identified in soil gas at 5 ft bgs and 15 ft bgs for Parcel E, respectively, as shown in Table 5-5. The following equations were used to calculate chemical-specific excess lifetime cancer risk and total cancer risk:

$$Chemical\text{-}Specific\ Cancer\ Risk_{inhalation} = EPC_{air} \times IFinh \times IUR$$

where:

EPC_{air} = Exposure concentration in air (µg/m^3)

IF_{inh} = Inhalation intake factor (unitless)

IUR = Inhalation Unit risk (µg/m^3)$^{-1}$

and

$$Total\ Cancer\ Risk = \sum Chemical\text{-}Specific\ Risk$$

The estimated excess lifetime cancer risks were calculated for Parcel E using the air concentrations for each COPC estimated based on the maximum chemical concentrations detected in the soil gas samples collected at approximately 5 ft or 15 ft bgs across entire Parcel E, respectively, regardless of sample location.

The estimated maximum excess lifetime cancer risks for all COPCs detected in soil gas associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from approximately 5 ft and 15 ft bgs soil gas to indoor, outdoor, and trench air in Parcel E are summarized in Tables 5-15a and 5-15b, respectively. As shown in Table 5-15a, the total excess lifetime cancer risks estimated for the 5 ft bgs soil gas samples in Parcel E are 4×10^{-7} for an indoor commercial/industrial worker, 8×10^{-11} for an outdoor commercial/industrial worker, and 2×10^{-12} for a construction worker. As shown in Table 5-15b, the total excess lifetime cancer risks estimated for the 15 ft bgs soil gas samples in Parcel E are 4×10^{-7} for an indoor commercial/industrial worker, 7×10^{-11} for an outdoor commercial/industrial worker, and

5×10^{-12} for a construction worker. Chloroform is the primary contributor to the total estimated cancer risks for all on-Site worker populations for soil gas.

Figure 5-3 plots the estimated excess lifetime cancer risk results for the indoor commercial/industrial workers at each 5 ft bgs soil gas sampling location and shows the relation to the nearby chloroform groundwater plume in shallow groundwater (as defined by <70 μg/L chloroform concentration). As shown in Figure 5-3, the highest cancer risk (i.e., 4×10^{-7}) associated with the 5 ft bgs soil gas sample occurs at RISG-33, located near the extraction well field at the edge of the chloroform plume near the southern boundary of Parcel E. The estimated excess lifetime cancer risks for all 5 ft bgs soil gas sampling locations are below 1×10^{-6}.

Figure 5-4 plots the estimated excess lifetime cancer risk results for the indoor commercial/industrial workers at each 15 ft bgs soil gas sampling location and shows the relation to the nearby chloroform groundwater plume in shallow groundwater (as defined by <70 μg/L chloroform concentration). As shown in Figure 5-4, the highest cancer risk (i.e., 3×10^{-7}) associated with the 15 ft bgs soil gas samples also occurs at RISG-33 located near the extraction well field at the edge of the chloroform plume at the southern portion of Parcel E. The estimated excess lifetime cancer risks for all three 15 ft bgs soil gas sampling locations are below 1×10^{-6}.

As discussed above, all soil gas risk results for Parcel E are below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. Therefore, the potential exposure to COPCs in soil gas in Parcel E is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated.

5.4.2.2 Assessment of Noncancer Health Effects

For each COPC identified in soil gas at 5 ft bgs and 15 bgs in Parcel E, respectively, the potential for noncancer adverse health effects was estimated as follows:

$$HQ_{inhalation} = \frac{EC \times IFinh}{RfC}$$

where:

EC = Exposure concentration (μg/m^3)
IF_{inh} = Inhalation intake factor (unitless)
RfC = Reference concentration (μg/m^3)

The HQs for each COPC are summed to obtain the HI:

$$HI = \sum HQ$$

The estimated maximum HQs for all COPCs detected in soil gas and the total HIs associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from 5 ft and 15 ft bgs soil gas to indoor, outdoor, and trench air in Parcel E are summarized in Tables 5-15a and 5-15b, respectively. As shown in Table 5-15a, the total HIs estimated for the soil gas at 5 ft bgs in Parcel E are 0.003 for an indoor commercial/industrial worker, 0.000001 for an outdoor commercial/industrial worker, and 0.0000001 for a construction worker. As shown in Table 5-15b, the total HIs estimated for the soil gas at 15 ft bgs in Parcel E are 0.003 for an indoor commercial/industrial worker, 0.0000008 for an outdoor commercial/industrial worker, and 0.0000003 for a construction worker. Therefore, the potential exposure to COPCs in soil gas in Parcel E is not expected to pose an unacceptable noncancer health effect under the conditions evaluated.

5.4.3 Groundwater VOCs

The shallow groundwater data is evaluated as a secondary line of evidence in addition to the soil gas data in this analysis since soil gas data is generally the preferred primary line of evidence for assessing health risks through the vapor intrusion pathway as opposed to groundwater or soil as recommended in agency guidance (USEPA 2015) (see additional discussions in Section 5.2.2.2).

5.4.3.1 Assessment of Cancer Risks

Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the COPCs identified in the shallow groundwater in Parcel E.

The cancer risk estimates were calculated using the air concentrations for each COPC estimated based on maximum chemical concentrations detected in the shallow groundwater in Parcel E using the same equations for calculating cancer risks listed in Section 5.4.2.

The estimated maximum excess lifetime cancer risks for all COPCs detected in shallow groundwater and the total cancer risk associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from shallow groundwater to indoor, outdoor, and trench air in Parcel E are summarized in Table 5-16. As shown in Table 5-16, the excess lifetime cancer risks estimated for Parcel E are 5×10^{-6} for an indoor commercial/industrial worker, 1×10^{-7} for an outdoor commercial/industrial worker, and 3×10^{-9} for a construction worker.

Chloroform is the primary contributor to the total estimated cancer risks for all on-Site worker populations for shallow groundwater. As shown in Table 5-16, the cancer risk estimate for an indoor commercial/industrial worker for chloroform only is 3.1×10^{-6}. The cancer risk results are upper-bound estimates based on the maximum detected concentration for each COPC in shallow groundwater data from 2015 to 2019. The highest chloroform concentration (710 µg/m^3) detected in shallow groundwater in Parcel E is from a sample collected in 2015 at MC-29. A more recent sample was collected in 2019 from this location and the chloroform concentration measured in this sample is lower (50 µg/m^3); the cancer risk estimated for an indoor commercial/industrial worker associated with this more recent chloroform concentration is 2.2×10^{-7}, with a total estimated excess lifetime cancer risk of 1×10^{-6} based on all chemicals.

Figure 5-5 plots the estimated excess lifetime cancer risk results at each shallow groundwater well and shows the relation to the nearby chloroform groundwater plume in shallow groundwater (as defined by <70 µg/L chloroform concentration). As shown in Figure 5-5, there is only one location (MC-29) located near the extraction well field at the edge of the chloroform plume at the southern portion of Parcel E with a total estimated excess lifetime cancer risk greater than the lower end but still within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4} (i.e., 5×10^{-6} based on 2015 groundwater sampling results; the total cancer risk estimate for this location is 1×10^{-6} based on the 2019 sampling results). The estimated excess lifetime cancer risks for all the other four shallow monitoring wells in Parcel E located outside the chloroform groundwater plume and downgradient of OSSM's GWETS are all well below 1×10^{-6}. As shown in Figure 5-6, the cancer risk estimates based on 2019 shallow groundwater data are generally comparable to the soil gas cancer risk estimates for each co-located soil gas sample collected in the same time frame (i.e., March 2019).

As discussed above, all groundwater risk results for Parcel E are either below or within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. Therefore, the potential exposure to COPCs in shallow groundwater in Parcel E is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated. The cancer risk estimates for the on-Site workers through the vapor inhalation pathway based on the most recent shallow groundwater data in Parcel E are generally comparable to the cancer risk estimates for co-located soil gas samples collected in Parcel E in the same time frame (i.e., March 2019). As discussed in Section 5.2.2.2, various factors could contribute to the uncertainties in the vapor intrusion analysis based on groundwater data. Soil gas data is generally preferred as a line of evidence for assessing health risks through vapor intrusion as opposed to groundwater. Groundwater data is used as a second line of evidence in this analysis. The uncertainties associated with evaluating health risks through the vapor intrusion pathway based on groundwater data are further discussed in Section 6.2.2.3.

5.4.3.2 Assessment of Noncancer Health Effects

For each COPC, the potential for noncancer adverse health effects were calculated using the air concentrations for each COPC estimated based on maximum chemical concentrations detected in the shallow groundwater in Parcel E using the same equations for calculating noncancer HQ listed in Section 5.4.2. Groundwater data is used as a secondary line of evidence in addition to the soil gas data in the noncancer hazard evaluations in this analysis since soil gas data is generally the preferred primary line of evidence for assessing health risks through the vapor intrusion pathway as opposed to groundwater or soil as recommended in agency guideline (USEPA 2015) (see additional discussions in Section 5.2.2.2)

The estimated maximum HQs for all COPCs detected in shallow groundwater and total HIs associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from shallow groundwater to indoor, outdoor, and trench air for Parcel E are summarized in Table 5-16. As shown in Table 5-16, the total HIs estimated for Parcel E are 0.4 for an indoor commercial/industrial worker, 0.008 for an outdoor commercial/industrial worker, and 0.0007 for a construction worker, all below the target HI of greater than 1. Chlorobenzene is the primary contributor to the total estimated HIs for all on-Site worker populations for shallow groundwater. As shown in Table 5-16, the HQ estimate for an indoor commercial/industrial worker for chlorobenzene is 0.38.

Therefore, potential exposure to COPCs in shallow groundwater in Parcel E is not expected to pose an unacceptable noncancer health effect under the conditions evaluated. The upper-bound HI estimates for shallow groundwater are approximately 100-fold higher than those for soil gas in Parcel E. As discussed in Section 5.2.2.2, various factors could contribute to the uncertainties in the vapor intrusion analysis based on groundwater data. Soil gas data is generally the preferred primary line of evidence for assessing health risks through the vapor intrusion pathway as opposed to groundwater. Groundwater data is used as the second line of evidence in this analysis. The uncertainties associated with evaluating health risks through the vapor intrusion pathway based on groundwater data are further discussed in Section 6.2.2.3.

6. UNCERTAINTY ANALYSIS

The process of risk assessment has inherent uncertainties associated with the calculations and assumptions used in the HRA, resulting from lack of knowledge and variability of site conditions as well as chemical toxicity and exposure. The approach used in the HRA is health protective and tends to overestimate potential exposure, resulting in estimated cancer risks and hazard levels that are likely to be higher than the actual risks or hazards experienced by the potentially exposed populations. These uncertainties are generally difficult to quantify. A qualitative discussion of key uncertainties associated with the available data and the methodology used in the HRA is presented below.

6.1 Uncertainties Identified in the Data Usability Evaluation

6.1.1 Site Characterization Data

For field sampling, it is impossible to collect samples from every possible location; therefore, there are always some uncertainties associated with the representativeness of site characterization data.

Soil data used in the HRA came from an investigation following both judgmental and random sampling approaches, with judgmental samples collected adjacent to existing shallow groundwater monitoring wells in Parcel E. Soil samples collected from these locations were analyzed for a full suite of chemicals. Also, an adequate number of soil samples were collected at depths beginning at 0 and10 ft bgs. Overall, the placement of the soil sample locations was deemed representative to evaluate the soil conditions of Parcel E in the context of the Parcel E CSM, and the relative uncertainty in the site characterization data was considered to be low.

Soil gas samples collected in 2008 (5 ft bgs sample from one location) and 2019 (5 ft bgs samples from four locations and 15 ft bgs samples from three locations) within Parcel E were used to estimate cancer risks and noncancer hazards in the HRA. The 2008 Site-Wide Soil Gas Work Plan (ENSR 2008a) states that the majority of sampling locations were selected to (1) sample near or within one of the 18 LOUs identified as being a potential source of VOCs; (2) co-locate with groundwater wells; and/or (3) sample areas where VOCs had been detected in soil or groundwater. This sample placement is consistent with the Parcel E CSM in which groundwater is identified as the primary source of VOCs in soil gas. In order to ensure adequate spatial coverage for this HRA, soil gas samples were collected at four locations in Parcel E co-located with existing groundwater monitoring wells as proposed in the Phase 2 RI Modification No. 12 (Ramboll 2018b) and Phase 3 RI Modification No. 9 (Ramboll 2019c); samples were collected at both 5 ft bgs and 15 ft bgs consistent with current vapor intrusion guidance (USEPA 2015) recommending samples closer to the source (i.e., VOCs in groundwater). Further, the analyses included both (1) VOCs associated with historical operations and (2) those VOCs that had been detected in soil or groundwater within OU-1. Collectively, the placement of the soil gas sample locations is representative of potential areas overlying the highest VOC concentrations in groundwater within Parcel E and are deemed representative to evaluate the soil gas conditions of Parcel E in the context of the Parcel E CSM, and the relative uncertainty in the site characterization soil gas data was considered to be low. The DVSRs for the 2008 and 2019 soil gas analytical data are included in Appendix A. As noted in Section 4.2 and discussed in more detail in Section 6.1.2 through 6.1.7, four data points were qualified based on minor method blank and quantitation issues but were deemed acceptable and were not biased low. All soil gas data were deemed usable for risk assessment. Discussions of the impact on the risk results from helium detections in the sampling train and the findings for blank contamination and precision are provided in Section 6.1.6.

In response to NDEP comments (NDEP 2017), groundwater data was also incorporated in this HRA to evaluate potential risks for the vapor intrusion pathway to provide an additional line of evidence for the analysis. The identified wells to include in the Parcel E HRA are all sampled by NERT on the Site (Figure 3-1). The findings of the review of sample coverage included consideration of both spatial and temporal coverage and are summarized as follows. There are five wells in Parcel E. Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 µg/L. Eighteen volatile compounds were detected at least once in these wells from 2015 to 2019. As discussed in Section 4.3.1, groundwater samples were collected in accordance with the NDEP-approved work plans listed in Section 4.3.1.2. Overall, the objectives of the investigation were met, and the placement of the sample locations is deemed representative to evaluate the Parcel E groundwater conditions in the context of the Parcel E CSM, and the relative uncertainty in the shallow groundwater characterization data was considered to be low. The DVSRs for the groundwater analytical data collected at the shallow monitoring wells in Parcel E from 2015 to 2019 are included in Appendix A. As noted in Section 4.3 and discussed in more detail in Sections 6.1.2 through 6.1.7, 29 data points were qualified based on minor method blank and quantitation issues but were deemed acceptable and were not biased low. All groundwater data were deemed usable for risk assessment. Discussions of the impact on the risk results from blank contamination and precision are provided in Section 6.1.6. Along with the soil gas data, these groundwater data are adequate for the evaluation of the vapor intrusion pathway.

6.1.2 Detection Limits

For soil analytes for which the detection frequency was less than 100%, the SQLs from the soil HRA data set were compared to 10% of the BCL to confirm that they were sufficiently low for risk characterization (see Section 4.1.1.5). As presented in Table 4-1, most of the SQLs in Parcel E were less than the screening levels, with a few exceptions. The impacts of elevated SQLs on the overall soil risk evaluation are discussed below.

- Benzidine was not detected in any samples; the SQLs exceeded 10% of the BCL in 100% of these samples. The maximum SQL of benzidine would correspond to an estimated cancer risk of 1×10^{-5} for a commercial/industrial scenario, which is within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.00007 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Therefore, if benzidine was identified as a soil COPC for Parcel E, it is not expected to have a significant impact on the overall soil risk evaluation.
- n-Nitroso-di-n-propylamine was not detected in any samples, and the SQLs exceeded 10% of the BCL in 100% of these samples. The maximum SQLs of n-nitroso-di-n-propylamine would correspond to an estimated cancer risk of 2×10^{-7} for a commercial/ industrial scenario, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. N-nitroso-di-n-propylamine does not have any noncancer effects. Therefore, if n-nitroso-di-n-

propylamine was identified as a soil COPC for Parcel E, it is not expected to have a significant impact on the overall soil risk evaluation.

For soil gas analytes for which the detection frequency was less than 100%, the SQLs for the soil gas dataset included in this HRA were compared to 10% of the RBTC to confirm that they were sufficiently low for risk characterization (see Section 4.2.1.5). As presented in Table 4-6, the maximum SQLs were all less than 10% of the respective RBTCs for all analytes except for one analyte (1,2-dibromo-3-chloropropane) in seven soil gas samples collected in Parcel E in November 2019. The SQLs for 1,2-dibromo-3-chloropropane for these samples were approximately three to 36-fold higher than 10% of the RBTC. Other than the SQLs for 1,2-dibromo-3-chloropropane, the SQLs are consistent with the QAPP goal of less than 1/10th of the screening level, as established by NDEP for the BMI Complex and Common Areas (NDEP 2010a). The SQLs achieved were confirmed to be generally adequate for risk assessment, and the uncertainty associated with the detection limits for 1,2-dibromo-3-chloropropane is discussed below:

- The maximum SQL of 1,2-dibromo-3-chloropropane would correspond to an estimated cancer risk of 2×10^{-6}, which is within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.004, which is well below the NDEP target HQ of greater than one. If it had been identified as a soil gas COPC for Parcel E, it is not expected to have a significant impact on the overall soil gas risk evaluation.

For shallow groundwater analytes for which the detection frequency was less than 100%, the SQLs from the shallow groundwater HRA data set were compared to 10% of the RBTC to confirm that they were sufficiently low for risk characterization (see Section 4.3.1.5). As presented in Table 4-8, the SQLs in Parcel E were less than the screening levels, with a few exceptions. The impacts of elevated SQLs on the overall shallow groundwater risk evaluation are discussed below.

- Bromodichloromethane was detected in one out of 11 samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of bromodichloromethane would correspond to an estimated cancer risk of 1×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.00002, which is well below the NDEP target HQ of greater than one. Therefore, the maximum SQL of bromodichloromethane is not expected to have a significant impact on the overall groundwater risk evaluation.
- Carbon tetrachloride was detected in one out of 11 samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of carbon tetrachloride would correspond to an estimated cancer risk of 3×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.001, which is well below the NDEP target HQ of greater than one. Therefore, the maximum of SQL of carbon tetrachloride is not expected to have a significant impact on the overall groundwater risk evaluation.

- Chloroform was detected in seven out of 11 samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of chloroform would correspond to an estimated cancer risk of 2×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.0003, which is well below the NDEP target HQ of greater than one. Since the maximum chloroform concentration (710 µg/L) detected in shallow groundwater was conservatively used in estimating the upper bound cancer risks and HIs in Parcel E, the maximum SQL of chloroform of 50 µg/L is not expected to have any impact on the overall groundwater risk evaluation.
- 1,2-dibromethane was not detected in any samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of 1,2-dibromoethane would correspond to an estimated cancer risk of 6×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.0003, which is well below the NDEP target HQ of greater than one. Therefore, if 1,2-dibromethane had been identified as a groundwater COPC for Parcel E, it is not expected to have a significant impact on the overall groundwater risk evaluation.
- 1,2-dibromo-3-chloropropane was not detected in any samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of 1,2-dibromo-3-chloropropane would correspond to an estimated cancer risk of 2×10^{-6}, which is within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.005, which is well below the NDEP target HQ of greater than one. Therefore, if 1,2-dibromo-3-chloropropane had been identified as a groundwater COPC for Parcel E, it is not expected to have a significant impact on the overall groundwater risk evaluation.
- Hexachlorobutadiene was not detected in any samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of hexachlorobutadiene would correspond to an estimated cancer risk of 2×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. Therefore, if hexachlorobutadiene had been identified as a groundwater COPC for Parcel E, it is not expected to have a significant impact on the overall groundwater risk evaluation.
- Vinyl chloride was not detected in any samples; the SQL exceeded 10% of the RBTC in 18% of the non-detected samples. The maximum SQL of vinyl chloride would correspond to an estimated cancer risk of 5×10^{-7}, which is below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The estimated noncancer HQ associated with the maximum SQL would be 0.003, which is well below the NDEP target HQ of greater than one. Therefore, if vinyl chloride had been identified as a groundwater COPC for Parcel E, it is not expected to have a significant impact on the overall groundwater risk evaluation.

In summary, the total estimated excess lifetime cancer risk associated with the elevated SQLs in the soil BHRA data would be 1×10^{-5}, within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. The total HIs associated with the elevated SQLs in the soil BHRA data are well below the target HI of one. The total estimated excess lifetime cancer risk associated with the elevated SQLs in the soil gas BHRA data would be 2 × 10^{-6} at 5 ft bgs, which is within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. No SQLs were identified as exceeding 10% of the RBTC in the at 10 to 15 ft bgs samples. The total HIs associated with the elevated SQLs in the soil gas BHRA data are well below the target HI of one at 5 ft bgs and 10 to 15 ft bgs. For the groundwater BHRA data, the total estimated excess lifetime cancer risk associated with the elevated SQLs would be 2 × 10^{-6}. This is within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. The total HIs associated with the elevated SQLs in groundwater BHRA data are well below the target HI of one. Therefore, the elevated SQLs are not expected to have a significant impact on either the soil gas risk evaluation or the overall groundwater risk evaluation for Parcel E BHRA Area.

6.1.3 Completeness

The rejected ("R" qualified) data associated with soil samples collected at depths beginning at 0 and 10 ft bgs in Parcel E are summarized in Appendix A, Table A-2. The percent completeness for the soil HRA data set is 99%. Among the 15 soil samples collected in Parcel E, aniline, benzidine, and ortho-phosphate data were rejected in 12, 13, and nine soil samples, respectively, which limited the spatial coverage for these chemicals. However, all the rejected data were non-detects, and all three chemicals with rejected data were never detected except for one ortho-phosphate result detected at RISB-EJ-01 (but this detected result was lower than 10% of the BCL, so ortho-phosphate was not identified a soil COPC). None of the aniline and ortho-phosphate rejected data were above 10% of the BCL; therefore, even if these data are not rejected, it is not expected to affect the COPC identification. All the 13 rejected benzidine values were above 10% of the BCL, reported as non-detects at 0.17 to 0.20 mg/kg. The maximum rejected result for benzidine would correspond to an estimated cancer risk of 2 × 10^{-5} for a commercial/industrial scenario, which is within the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. The estimated noncancer HQ associated with the maximum rejected result for benzidine would be 0.00007, which is below the NDEP target HQ of greater than one. Even if this chemical is identified as a soil COPC, its associated risks are not above the NDEP and USEPA cancer risk management range or the target HQ and not related to historical operations in Parcel E. Therefore, the rejected data are not expected to have a significant impact on the overall soil risk evaluation.

There are no rejected ("R" qualified) data associated with soil gas samples in Parcel E.

Styrene from a 2018 groundwater sample collected at MC-97 is the only rejected ("R" qualified) data associated with shallow groundwater samples in Parcel E, as shown in Table A-7 in Appendix A. The percent completeness for the groundwater dataset included for Parcel E is over 99%. Given the small percentage of rejected data and that there is no apparent spatial grouping of rejected data, this rejected data point has little impact on the spatial coverage of the groundwater HRA data set. Additionally, styrene was not detected in this sample and the detection limit was below 10% of RBTC. Therefore, the impact of the rejected data on the risk evaluation for Parcel E is considered low.

6.1.4 Comparability

As discussed in Section 4.1.1.7, different reporting limits for the same analyte in soil may impact the comparability of the data set. The ranges of the SQLs for each soil analyte for which the detection frequency was less than 100% are presented in Table 4-1. For most of the soil analytes, the SQLs are well below 10% of the BCL; there are a few soil analytes with SQLs exceeding 10% of the BCL, and their impacts on the overall soil risk evaluation are discussed in Section 6.1.2. In summary, different reporting limits for the same soil analyte are not expected to have a significant impact on the overall soil risk evaluation.

Also, differences in sample preparation and analytical methods exist between the Parcel E soil HRA data set and the BRC/TIMET regional background data set for both metals and radionuclides, which may affect the statistical testing results of the background evaluation. However, as discussed in Section 5.1.1.2, zirconium was eliminated as a soil COPC based on the statistical testing results of the background evaluation. As indicated in the box plots and Q-Q plots in Appendix E, concentrations of zirconium were well below the BRC/TIMET regional background levels, providing an adequate margin of safety.

In addition, radionuclides, except thorium-230, were excluded as soil COPCs based on the comparison of background. The calculated risk for thorium-230, the only carcinogenic chemical exceeding 10% of its BCL, at the maximum detected concentration and 95% UCL was below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. As shown in Table 5-4, the total cancer risks from Parcel E radionuclides was at the same level as the cancer risks in background data. It is expected that for historical background data, the concentrations of radionuclides were underestimated due to the differences in the preparation and analytical method. Therefore, potential changes in statistical testing results of the background evaluation due to the incomparability issues of analytical methods are not expected to have a significant impact on the COPC selection and overall soil risk evaluation.

The single 2008 sample was part of the Phase B Site-wide soil gas sampling program; the objective of the 2019 investigation was to provide sufficient spatial coverage to support this HRA. In addition, one location (RISG-31) was located at the former location of SG17, previously sampled in 2008, to evaluate concentration trends. Temporal trends are discussed in Section 4.2.2.3. Spatial representativeness was discussed previously in Section 4.2.1.4. For the locations sampled in the 2019 investigation, samples were collected at both 5 ft bgs and 15 ft bgs consistent with current vapor intrusion guidance (USEPA 2015) recommending samples closer to the source (i.e., volatile compounds in shallow groundwater). Due to the OSSM-operated treatment system located in Parcel E, concentrations of chloroform downgradient of the extraction well field are below 70 µg/L. All locations sampled in 2019 were co-located with shallow groundwater monitoring wells. Additionally, the maximum soil gas COPC concentrations across Parcel E were conservatively used in the risk evaluation, and the maximum concentration of chloroform, the primary risk driver in soil gas at Parcel E, is from one of the more recent 2019 soil gas samples (at RISG-33). Collectively, the soil gas data set provides adequate coverage of Parcel E, and the use of the maximum detected concentrations for the exposure estimates is considered conservative.

For the groundwater data used in the HRA, as discussed in Section 4.3, the same analytical methods were used across most investigations; specifically, USEPA Method SW-8260 for VOCs. In some investigations, the more sensitive SW-8260 SIM or SW-8260B SIM was used for VOCs. All groundwater sampling results were reported in µg/L. Because maximum detected concentrations from samples taken from 2015 to 2019 were used in the HRA (and SQLs were sufficiently low as discussed in Section 4.3.1.5), and the health risks associated with the few chemicals with SQL exceeding 10% of the lowest groundwater RBTCs are very low (as discussed in Section 6.1.2), the differences in detection limits does not impact the results of the HRA. Two out of the five wells (i.e., MC-29 and MC-97) have been sampled over time in at least two investigations for VOCs and/or SVOCs. In general, the detected concentrations were found to be lower in the more recent sampling events from 2015 to 2019 in Parcel E. Collectively, the shallow groundwater data set provides adequate coverage of Parcel E, and the use of the maximum detected concentrations for the risk estimates is considered conservative.

6.1.5 Precision

As presented in Appendix A, Table A-3, in the soil HRA data set, a total of four pairs of primary and field duplicate results for dioxin-like PCBs were qualified due to RPD exceedance. Soil samples with qualified primary and field duplicate dioxin-like PCB results were treated as independent samples in the calculation of dioxin TEQs. Dioxin TEQ was not identified as a soil COPC (Table 5-1) based on the maximum detected concentration, and therefore, the field duplicate dioxin-like PCB data qualified due to RPD exceedance would not change the selection of COPCs. Also, no metal or radionuclide duplicate data were qualified due to RPD or PQL criterion exceedance, and the statistical testing results of the background evaluation and the selection of COPCs would not change for metals or radionuclides. In summary, the field duplicate data qualified due to RPD exceedance are not expected to have a significant impact on the overall soil risk evaluation. For laboratory duplicates, there were nine data points qualified due to RPD or PQL criterion exceedance (see DVSR tables in Appendix A). The effects of these qualified data on the overall soil risk evaluation are further discussed in Section 6.1.6 below along with other J qualified data.

For the soil gas dataset used in the HRA, field precision for the samples was assessed by evaluating the field duplicate results as discussed below:

- 2008 Soil Gas Investigation: None of the duplicate samples were collected from locations in Parcel E.
- March 2019 Soil Gas Investigation: One field duplicate was collected at RISG-33 at 5 ft bgs in the March 2019 investigation in Parcel E; none of the results were qualified based on RPDs or PQL criterion exceedance.
- November 2019 soil gas investigation: None of the duplicate samples were collected from locations in Parcel E.

In summary, the field duplicate data qualified due to RPD exceedance are not expected to have a significant impact on the overall soil gas risk evaluation. For laboratory duplicates, there were no data points qualified due to RPD or PQL criterion exceedance (see DVSR tables in Appendix A). Therefore, no effect on the overall soil gas risk evaluation is anticipated.

For the shallow groundwater dataset used in the HRA, field precision for the samples was assessed by evaluating the field duplicate results. None of the pairs of primary and field duplicate results in the shallow groundwater BHRA data set were qualified due to RPD or PQL criterion exceedance (see DVSR tables in Appendix A). For laboratory duplicates, there were no data points qualified due to RPD or reporting limit exceedances. Therefore, no effect on the overall groundwater risk evaluation is anticipated.

6.1.6 Accuracy

The soil analytical data were evaluated in DVSRs presented in Appendix A, with a subset of the data qualified with a J qualifier (J, J-, or J+) based on method blank, field duplicate, and/or other quantitation issues (108 out of 3,296 data points, see Table B-1); that is, the reported value was estimated, with no (J), low (J-), or high (J+) bias. The potential impact of the J qualified data on the overall soil risk analysis was evaluated:

- J and J+ Qualified Data: A review of the J and J+ qualified data indicated that the estimated results were either below 10% of the BCL (or other applicable screening criteria) or below/equal to the maximum detected concentration used in the COPC selection (Appendix A, Table A-4). Asbestos was the only soil COPC identified for Parcel E, and no chemical was identified as a soil COPC based on a maximum detected concentration with a J or J+ qualifier (see Table 5-1). Therefore, the J and J+ qualified data would not affect the COPC selection. Further, given the fact that the only metal failing the concentration/toxicity screen and shown in Table 5-2, zirconium, had no J or J+ qualified data, the J or J+ qualified data would not change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and the amount of J or J+ qualified data for radionuclides was limited (approximately 5.0%); therefore, the J or J+ qualified data would not affect the exclusion of radionuclides as soil COPCs.
- J- Qualified Data: A review of the J- qualified data indicated that the results estimated with low bias were equal to the maximum detected concentration used in the COPC selection but significantly below 10% of the BCL (Appendix A, Table A-4). No chemical was identified as a soil COPC based on a maximum detected concentration with a J- qualifier (see Table 5-1). Therefore, correction for the low bias would not change the selection of COPCs. Further, given that there are no J-qualified data for zirconium, the only metal failing the concentration/toxicity screen and shown in Table 5-2, the J- qualified data would not change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and there were no J-qualified data for radionuclides; therefore, the J- qualified data would not affect the exclusion of radionuclides as soil COPCs.

The soil gas HRA dataset, as presented in the DVSRs in Appendix A and Appendix G, has a subset of the data qualified with a J qualifier based on method blank, field duplicate, and/or other quantitation issues (130 out of 402 data points, see Table L-1); that is, the reported value was estimated, with no (J) bias. The potential impact of the J qualified data on the HRA results was evaluated. The maximum detected concentrations for each COPC in Parcel

E were used in the risk evaluations. A review of the J qualified soil gas data indicated that some of the maximum detected concentrations for the primary contributors to the total estimated risk (i.e., chloroform, and 1,2-dibromo-3-chloropropane) were based on the estimated results, but with no bias (J). Therefore, the J qualified data are not expected to have any significant impact on the overall risk evaluation.

Also, as noted in Section 4.2.1.7, helium gas was used as part of the leak-check procedure for the 2008 and 2019 soil gas sampling events. The field helium measurements in the shrouds are used to allow personnel to take corrective action in the field in response to potential leaks. Helium leak was not observed in any of the 2008 and 2019 soil gas samples during field sampling. Helium concentrations in soil gas samples were analyzed in the 2008 and November 2019 soil gas sampling events. The average leak percentage is 2.4% in the only 2008 soil gas sample collected at 5 ft bgs at SG17 (see Table C-8 in Appendix A.3). Helium was detected in the soil gas samples collected at 15 ft bgs at RISG-33 and RISG-34 in Parcel E; the average calculated leak percentages for these two samples are 0.9% and 0.8%, respectively. The average lead percentages for these three samples are all less than the QAPP criterion of 5%. Therefore, the sample results for this sample were not corrected.

The shallow groundwater analytical data were evaluated in DVSRs presented in Appendix A, with a subset of the data qualified with a J qualifier (J or UJ) based on field duplicate and/or other quantitation issues (25 out of 659 data points, see Appendix A); that is, the reported value was estimated, with no (J) bias. A review of the J qualified data indicated that the estimated results were below the 10% of the RBTC. Therefore, the soil gas data from these samples are not expected to have a significant impact on the overall risk evaluation.

6.1.7 Duplicate Treatment

In the HRA, soil samples with primary and field duplicate results were treated as independent samples, although the variance of the duplicate and primary samples was not tested. The impacts are discussed as follows:

- First, no chemical was identified as a soil COPC based on the maximum concentration detected in a sample with a duplicate (Table 5-1). Therefore, the COPC selection would not change regardless of how the duplicates were treated.
- Second, given the limited amount of duplicate data for zirconium, the only metal failing the concentration/toxicity screen and shown in Table 5-2 (approximately 6.7%), treatment of duplicate samples would not significantly change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and the amount of duplicate data for radionuclides was limited (approximately 6.7%); therefore, treatment of duplicate samples would not affect the exclusion of radionuclides as soil COPCs.
- Finally, the asbestos risk calculations employed both original and field duplicate samples, resulting in an increase of sample size and decrease of pooled AS. As indicated in Table 4-3, Parcel E contained only one field duplicate sample. Excluding this field duplicate sample would slightly increase the calculated upper-bound cancer

risks from long amphibole and chrysotile fibers. However, the best estimates would remain zero, and upper-bound estimates would still be less than 1 × 10^{-6} for all the receptor populations in Parcel E, except for the upper-bound estimates from long amphibole fibers for construction workers due to zero fibers and sample size issues (see discussion in Section 6.2.2.2).

In summary, duplicate treatment is not expected to have a significant impact on the overall soil risk evaluation.

Soil gas samples with primary and field duplicate results were treated as independent samples, although the variance of the duplicate and primary samples was not tested. One field duplicate sample was collected within Parcel E at RISG-33 at 5 ft bgs during the March 2019 investigation (Table G-1). The soil gas HRA included both the parent sample and field duplicate sample, resulting in an increase of sample size. None of the paired values were qualified based on RPDs that exceeded the QAPP criteria or the PQL criterion exceedance. The maximum detected chloroform concentration in soil gas at 5 ft bgs is from the primary sample (1000 $\mu g/m^3$) which is slightly higher than chloroform concentration from the field duplicate sample (980 $\mu g/m^3$). Therefore, excluding this field duplicate sample would not change the calculated upper-bound health risks for soil gas at 5 ft bgs. In summary, duplicate treatment is not expected to have a significant impact on the overall soil gas risk evaluation.

Groundwater samples with primary and field duplicate results were treated as independent samples, although the variance of the duplicate and primary samples was not tested. One field duplicate (Table H-1) was collected at MC-94 for the shallow groundwater data set in Parcel E. For shallow groundwater, the groundwater HRA included both the parent samples and field duplicate samples, resulting in an increase of sample size. The maximum detected concentration of the risk driver, chloroform, was not from this location. Therefore, excluding the field duplicate samples are expected to have negligible impact on the calculated risk estimates for shallow groundwater.

6.2 Uncertainties Identified in the Risk Assessment

6.2.1 Identification of COPCs

Chemicals detected in at least one soil sample were included in the COPC selection process. None of the 44 detected chemicals in Parcel E were identified as soil COPCs. For most of the chemicals that were not selected as soil COPCs, the maximum detected concentrations were generally a factor of 10, if not a factor of 100 or more, lower than the screening levels (see Table 5-1); therefore, exclusion of these chemicals from the quantitative risk assessment is not expected to have a significant impact on the overall soil risk results of the HRA. For a few chemicals, the SQLs were higher than the screening levels in a few soil samples (see Table 4-1). The impacts of elevated SQLs on the soil risk evaluation are discussed in Section 6.1.2, and the elevated SQLs are not expected to have a significant impact on the overall soil risk results of the HRA.

Surrogate BCLs were used for the toxicity screen and COPC selection for 2,4′-DDE, ortho-phosphate, and phosphorus (total) in the absence of NDEP-derived BCLs for these compounds. As shown in Table 5-1, these compounds were excluded as soil COPCs based on the toxicity screen. The surrogates identified are considered to be toxicologically representative of these compounds, and given that the ratios of the BCLs to the maximum detected concentrations were at least a factor of 3,800, the detected concentrations of these compounds would not be expected to contribute significantly to the total soil risk estimates.

There may be some uncertainties with the background evaluation for metals during the process of COPC identification. However, based on comparison to BRC/TIMET regional background, zirconium was the only metal excluded as a soil COPC due to consistency with background (Table 5-2), and an adequate margin of safety exists (see Appendix E). Other metals either passed the concentration/toxicity screen or are essential nutrients. Also, for the majority of metals, there is no reason to believe they are related to historical activities in Parcel E, based on the Parcel E CSM. Therefore, uncertainties with the background evaluation for metals are not expected to have a significant impact on the selection of soil COPCs and overall risk evaluation.

One radionuclide (Th-230) failed the statistical testing of background consistency (see Table 5-3), but given that the validity of the statistical testing is confounded by several issues (see discussion in Section 5.1.1.2), all radionuclides were excluded as soil COPCs based on a comparison of cancer risks between Parcel E soils and Site/regional background soils. As indicated in Table 5-4, although the estimated total radionuclide cancer risk for Parcel E was slightly above the NDEP and USEPA cancer risk management range of 10^{-6} to 10^{-4}, it was consistent with the estimated total radionuclide cancer risks for the RZ-A background and BRC/TIMET regional background data sets. For this reason, excluding radionuclides as soil COPCs is not expected to have a significant impact on the overall soil risk evaluation.

A total of over 54 VOCs were detected in the soil gas or groundwater dataset selected for the risk evaluations. Of these, 52 were detected in at least one soil gas sample and 18 were detected in at least one shallow groundwater sample collected from 2015 to 2019. As a conservative approach, all detected analytes were identified as COPCs (Table 5-6). For the chemicals reported as “not detected” in all samples, the SQLs were less than their respective RBTCs (Tables 4-6, and 4-8). Thus, it is unlikely the risks estimated in the HRA were underestimated as a result of the COPC selection process.

6.2.2 Exposure Assessment

6.2.2.1 Exposure Scenarios

The exposure assessment in this HRA is based on a RME scenario, which is defined by the USEPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (USEPA 1989). To achieve this goal, the RME scenario uses highly conservative exposure assumptions. For example, this HRA assumes that an outdoor commercial/industrial worker is present in Parcel E for eight hours per day, 225 days per year, for 25 years. These and other upper-bound, default exposure assumptions most likely overestimate the potential health risks associated with Parcel E.

As discussed in USEPA’s *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (2002b), evaluation of exposures to members of the public entering an operating facility is generally not warranted for two reasons: (1) public access is restricted or controlled at industrial sites and (2) while the public may have access to a property, exposures of an on-Site worker would be much higher than those of a visitor because workers spend substantially more time at a site. Accordingly, visitors and trespassers for Parcel E were not quantitatively evaluated in the HRA. The potential health risks for workers in Parcel E were estimated to be below the levels of concern, and the potential health risks for visitors and trespassers would also be below the levels of concern.

Off-Site populations include off-Site indoor and outdoor commercial/industrial workers as well as off-Site residents, and the potential risks to off-Site populations were not quantitatively evaluated in this HRA. Off-site populations could be exposed to airborne chemicals (vapors and particulates) emitted during on-Site activities, e.g., routine operations or construction projects (USEPA 2002b).

For inhalation of asbestos in airborne particulates, the PEF for the on-parcel construction worker (on the order of 10^{+6} cubic meter per kilogram [m^3/kg]) is much lower (approximately 1,000-fold) than the PEF during and after construction for off-Site receptors (on the order of 10^{+9} m^3/kg) (see NDEP's "asbestos guidance riskcalcs.xls" spreadsheets presented in Appendix K-1). Therefore, off-Site populations would be exposed to much lower airborne particulate concentrations than on-parcel construction workers. As compared with other exposure factors that may be higher (but much lower than 1,000-fold) for the off-Site populations, the exposures through inhalation of airborne particulates by off-site populations are expected to be lower than the exposures by on-parcel construction workers.

Tables 5-13 and 5-14 present the estimated EPCs for air based on the maximum concentrations detected in soil gas at approximately 5 ft bgs and shallow groundwater, respectively. For Parcel E, the predicted outdoor concentration for chloroform, the major chemical contributor to the soil gas and groundwater risks, is 0.024 $\mu g/m^3$ based on shallow groundwater, and 0.000038 $\mu g/m^3$ based on soil gas (5 ft bgs). All chloroform concentrations are below the commercial RSL for air of 0.53 $\mu g/m^3$ or the residential RSL for air of 0.12 $\mu g/m^3$.

6.2.2.2 EPCs

For asbestos, which was identified as the only soil COPC, the estimated EPCs are highly dependent on sample size. As described in Section 5.2.2.1, the soil concentration used to estimate the asbestos air EPC was equal to the number of long fibers detected multiplied by the pooled AS. For the best estimate, the number of long fibers observed in the soil samples collected in Parcel E is used in the calculation. For the upper bound estimate, the 95% UCL on the number of long fibers observed in the soil samples collected in Parcel E assuming a Poisson distribution is used in the calculation. Pooled AS, which was used in both calculations, is a function of sample size. Specifically, pooled AS decreases with increasing sample size (the equation for calculating pooled AS is presented in Section 5.2.2.1), resulting in a lower estimate of soil concentration and hence, a lower asbestos air EPC as sample size increases.

For the special case in which no fibers were detected, as was the case for long amphibole and chrysotile fibers in Parcel E (and amphibole long fibers in the asbestos data collected in former Parcels C and D which were used to supplement the asbestos risk analysis for Parcel E ; see Sections 4.1.2.1 and 5.4.1), the best estimate risk was zero (i.e., long amphibole or chrysotile fibers were not detected in any sample, so that both the soil concentration and air

EPC were zero); while for the upper-bound estimate, the 95% UCL of the Poisson distribution for the case in which no fibers were detected was three fibers, and the risk was a function of the small sample size. As shown in Table 5-14, although long amphibole or chrysotile fibers were not detected in any of the eight soil samples collected in Parcel E, the upper-bound estimate risk to construction workers was 4×10^{-6}. Therefore, the uncertainties with the asbestos EPCs were considered low for the best estimate, but were considered high for the upper-bound estimate due to the Poisson distribution used in the calculation and the small sample size.

Soil gas and groundwater concentrations were used as the source term concentrations, combined with the transfer factors, for modeling volatile chemical concentrations in indoor air, outdoor air, and trench air. As a screening-level approach, the maximum detected COPC concentrations in soil gas and shallow groundwater were used as the model source terms in the soil gas and shallow groundwater risk evaluations, respectively. This approach is expected to overestimate the exposure concentrations (and associated risks), and the maximum concentration is not likely representative for an entire building footprint. Furthermore, this may be an overly conservative procedure for purposes of estimating potential health risks associated with inhalation of vapors in outdoor air and a construction trench, because it is unlikely that an outdoor worker or a construction worker would stay at only a single location. The uncertainties associated with fate and transporting modeling are discussed in detail in Section 6.2.2.3.

6.2.2.3 Fate-and-Transport Modeling

The fate-and-transport modeling for soil is limited to estimating PEFs of airborne particulates for construction workers and commercial/industrial workers. PEFs were estimated according to USEPA guidance (2002b) based on a combination of site-specific and default input parameters. For asbestos, which was evaluated as a carcinogen only for the inhalation route of exposure, the potential uncertainty in the PEFs could contribute to the overall soil risk estimates. This is particularly important for the construction worker scenario because the estimated PEF was large relative to the commercial/industrial scenario (see NDEP's "asbestos guidance riskcalcs.xls" spreadsheets presented in Appendix K-1). The PEF for the construction worker scenario accounted for several potential sources of particulates, including wind erosion, excavation, dozing, grading, and tilling; however, the largest contributor to the overall PEF was driving over unpaved roads. In this case, the majority of the input parameters were based on default values recommended by USEPA (2002b). USEPA provides the basis for most of these default values, except the average weight of the vehicle (eight tons) and the number of vehicles that will drive across the area every day (30). The applicability of these and other assumptions to future construction in Parcel E is unknown; however, it is believed that, in combination, these assumptions are more likely to overestimate than underestimate potential health risks, especially when dust control measures will be implemented during construction.

Fate-and-transport models were used to estimate indoor and outdoor air concentrations from measured soil gas concentrations. For indoor air, the USEPA Johnson and Ettinger (1991) model spreadsheet was used. As discussed in Section 5.2.3, the Johnson and Ettinger model has numerous assumptions and limitations, each of which may over- or underestimate the predicted indoor air concentration. In this case, site-specific soil physical parameters were used in the modeling, which should reduce the uncertainty in the model estimates. For outdoor air, an approach analogous to that used by USEPA to estimate outdoor air concentrations from chemicals in soil was used. This model also has assumptions that may over- or underestimate the predicted concentrations.

The soil properties used for the Johnson and Ettinger model were conservatively selected assuming that the entire unsaturated zone in Parcel E is Qal. This is a conservative assumption in that for areas where the UMCf is part of the unsaturated zone, the finer-grained UMCf would act to reduce vapor transport of COPCs. Further, the site-specific soil properties used in the model (Table 5-8) were based on samples collected in the Qal. Additionally, to be conservative the one sample collected from below 10 ft bgs was not used in our evaluation due to extraordinarily wet soil properties measured at that location.

If default soil properties were used in the evaluation of the 5 ft bgs samples, the results would increase by approximately a factor of 2. Currently, the estimated excess lifetime cancer risk for soil gas at 5 ft bgs is 4×10^{-7}. The use of default soil properties would raise this to 8×10^{-7}, still below the target cancer risk management range of 1×10^{-6} to 1×10^{-4}.

Soil gas sampling depths are based on site-specific values for evaluating indoor and outdoor above-ground commercial scenarios. When evaluating construction trench scenarios, it was conservatively assumed that air containing VOCs would be migrating from the walls of the construction trench in addition to the base to maximize exposure potential. Depth to groundwater was Site-specific and selected to be conservative considering both current and historical data for the parcel.

A conservative default building (with building characteristics shown on Table 5-6) was assumed for modeling. The default building size was selected, although many commercial buildings are larger. However, larger buildings are often partitioned into smaller areas or offices that represent an exposure zone. A conservative height of 3 meters was assumed, although many commercial buildings have higher first floor ceilings.

When modeling the dispersion in the construction trench scenarios, a box model was used to simulate dispersion, and the air flow through the construction trench was controlled by a site-specific windspeed that was reduced by a factor of 20 to ensure it would be conservative for a construction trench scenario where the breathing zone may be a few ft bgs. This is especially conservative because many construction trenches include a fan to increase airflow through the construction trench or are shallower than 10 ft bgs, potentially placing the breathing zone to above the ground surface.

6.2.3 Toxicity Assessment

One of the largest sources of uncertainty in any risk assessment is the limited understanding of toxicity to humans who are exposed to lower concentrations generally encountered in the environment than those used in toxicity studies. The majority of the available toxicity data are from animal studies; these data are extrapolated using mathematical models or multiple uncertainty factors to predict what might occur in humans. Sources of uncertainty and/or conservatism in the toxicity criteria used in this HRA include:

- The use of conservative methods and assumptions to extrapolate from high-dose animal studies to predict the possible response in humans at exposure levels far below those administered to animals;
- The assumption that chemicals considered to be carcinogens do not have thresholds (i.e., for all doses greater than zero, some risk is assumed to be present); and
- The fact that epidemiological studies (i.e., human exposure studies) are limited and are not generally considered in a quantitative manner in deriving toxicity values.

Chemical-specific uncertainties in toxicity criteria are provided below for the only soil COPC, asbestos, the major cancer risk drivers with soil gas and/or shallow groundwater cancer risks above 10^{-6}, and the soil gas and groundwater COPCs with noncancer toxicity criteria obtained from Provisional Peer Reviewed Toxicity Value (PPRTV) appendices, followed by a discussion regarding soil gas and groundwater COPCs for which surrogate criteria were used.

Asbestos

The potential risk associated with exposure to long amphibole and chrysotile fibers in soil was assessed based on methodology from USEPA (2003), as specified in NDEP's asbestos risk assessment guidance (Neptune 2015). The methodology distinguishes between different fiber types (chrysotile and amphiboles) and sizes (greater than 10 µm in length and less than 0.4 µm in width). USEPA (2003) developed two sets of risk coefficients—one set is "optimized" based on the entirety of the available data, and the other set is "conservative" based on data from a single epidemiology study. Per NDEP guidance (Neptune 2015), the optimized risk coefficients were used in this HRA, which are considered more appropriate for assessing asbestos risk from soil at the BMI Complex and Common Areas. In addition, the risk coefficients are intended to assess long-term average exposure, such as on-Site commercial/industrial workers. Applying this methodology to short-term workers such as construction workers, as was done in this HRA, increases uncertainty[31] in the risk estimates (USEPA 2003).

Chloroform

The IUR for chloroform is obtained from IRIS based primarily on a mouse gavage study (USEPA 2023d). The tumor type considered in the derivation of IUR was hepatocellular carcinoma, and USEPA used a linearized multistage procedure to extrapolate metabolism-dependent carcinogenic responses from mice to humans. The IUR was derived by taking a geometric mean of the slope factor and assuming 100% for low doses of chloroform in air. Adequate numbers of animals were treated and observed, and the risks estimates derived are generally supported by male rat kidney tumor data from other studies. Therefore, the uncertainty associated with the IUR for chloroform is expected to be low.

1.4-Dichlorobenzene

The IUR for 1,4-dichlorobenzene is obtained from OEHHA based primarily on a mouse chronic oral study (Cal/EPA 2009). The tumor types considered in the derivation of IUR

---

[31] According to USEPA (2003), applying the risk coefficients to short-term workers could either overestimate or underestimate the asbestos risk, depending on how the short-term workers are compared to the averaged population in terms of age, gender, whether or not smoking, etc.

were hepatocarcinoma and adenoma. USEPA used a linearized multistage procedure to estimate the oral cancer potency of 1,4-dichlorobenzene and the IUR was derived based on route-to-route extrapolation. This bioassay was well-designed with adequate numbers of animals and adequate data for dose-response modeling, and no issues were identified with this bioassay that might have contributed to uncertainty in the cancer assessment. Therefore, the uncertainty associated with the IUR for 1,4-diochlorobenzene is expected to be low.

Surrogates for VOCs

As identified in Table 5-13, surrogate toxicity criteria were used to estimate HQs (for the noncancer endpoint) for 13 of the 54 soil gas and shallow groundwater COPCs. All of these surrogates are those identified in the NDEP BCLs Table (NDEP 2023b) and as identified in Appendix B of the Users' Guide for BCLs (NDEP 2023a).

The use of surrogate RfCs for evaluating soil gas and groundwater COPCs may overestimate or underestimate the potential for noncancer health effects. However, recognizing the very low HQs estimated for these COPCs (<0.002 in indoor air and less than 0.00003 in outdoor air), use of surrogate RfCs is unlikely to have significantly impacted the noncancer evaluation or conclusions.

6.2.4 Risk Characterization

The uncertainties associated with risk characterization are generally the result of combined uncertainties in the site characterization data, COPC selection, exposure assessment, and toxicity assessment. In addition, risks cannot be quantitatively characterized for chemicals for which toxicity criteria have not been established. In this HRA, potential health risks were quantified for indoor and outdoor commercial/industrial workers and construction workers in Parcel E associated with inhalation of airborne soil particulates and inhalation of vapors migrating from soil gas or groundwater to indoor, outdoor, or trench air. The potential health risks associated with direct contact with soil were not quantitatively evaluated because no chemicals other than asbestos were identified as soil COPCs. Given the highly conservative nature of the exposure parameters used to characterize these pathways, especially for the RME scenario, it is highly unlikely that the same receptor would be exposed at that level over the entire duration of exposure. These conservative estimates of exposure were then combined with even more conservative estimates of toxicity values to estimate the magnitude (noncancer) or likelihood (cancer) of potential effects. This methodology is unlikely to underestimate the true risk, but could overestimate the true risk by a considerable degree, and the true risk could be as low as zero.

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 few data are available regarding potential chemical interactions following environmental exposure to chemical mixtures. Some studies have been carried out in rodents that were given simultaneous doses of multiple chemicals. The results of these studies indicated that no interactive effects were observed for mixtures of chemicals that affect different target organs (i.e., each chemical acted independently), whereas antagonism was observed for mixtures of chemicals that affect the same target organ, but by different mechanisms (Risk Commission 1997). While there are no data on chemical interactions in humans exposed 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 additive, synergistic, and antagonistic interactions (Seed et al. 1995).

USEPA guidance for risk assessment of chemical mixtures (USEPA 1986) recommends assuming an additive effect following exposure to multiple chemicals. Subsequent recommendations by other parties, such as the National Research Council (NRC 1988) and the Presidential/Congressional Commission on Risk Assessment and Risk Management (Risk Commission 1997), have also advocated a default assumption of additivity. As currently practiced in this HRA, risk assessments of chemical mixtures summed cancer risks regardless of tumor type, and summed noncancer HQs 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.

As discussed in Section 6.2.1, radionuclides were excluded as soil COPCs in the quantitative risk evaluation due to consistency with background risks. Another source of uncertainty for radionuclides risk is the inhalation of radon gas (radon-222) within a commercial building, which is not addressed in the radionuclide BCLs (NDEP 2023b). This exposure pathway could be a significant contributor to potential human health risks, potentially of greater concern than exposure to Ra-226 via soil ingestion, inhalation of particulates, and external irradiation, particularly if activities of Ra-226 are elevated in soils beneath a building. However, as indicated in Appendix E, the activities of Ra-226 in Parcel E were consistent with the BRC/TIMET regional background; therefore, activities of Ra-226 are not considered elevated in soils beneath a building in Parcel E, and the risk associated with inhalation of radon-222 within a commercial building should not be a concern. Excluding radionuclides as soil COPCs is not expected to have a significant impact on the overall risk evaluation.

In summary, assumptions used in each step of risk assessment contribute to the overall uncertainty in the HRA results. However, given that the largest sources of uncertainty generally cause overestimates of exposure or risk, the results presented in this HRA are considered to represent conservative estimates of the carcinogenic and non-carcinogenic risks, if any, posed by residual chemicals in Parcel E.

7. DATA QUALITY ASSESSMENT

Data quality assessment is an analysis that is performed after the risk assessment to determine whether enough data has been collected to support the risk-based decisions that are recommended by the risk assessment. The data quality assessment was not conducted for soil, because no chemicals other than asbestos were identified as soil COPCs and the impacts of sample size on the asbestos risk results are discussed in Section 6.2.2.2. The results of data quality assessment for soil gas and groundwater data are discussed below.

7.1 Soil Gas Data

The evaluation of the risk of vapor intrusion was based on maximum detected soil gas concentrations, rather than on a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was conceptualized as a statistical test of the proportion of the soil gas samples that are associated with an unacceptable risk of vapor intrusion. As summarized in Tables 5-15a and 5-15b, the maximum cumulative cancer risk estimates for each exposed populations for soil gas samples at 5 ft bgs and 15 ft bgs are all below the lower limit of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}, and the noncancer HI estimates do not exceed the threshold of greater than 1 for noncancer hazard. The total numbers of samples for most chemicals of concern, especially risk drivers, are 10 for soil gas samples at 5 ft bgs and 6 for soil gas samples at 15 ft bgs based on Tables 4-7a and 4-7b. Because the estimated risks and hazards at all the sampling locations did not exceed their respective thresholds, the proportion of samples with unacceptable risk is 0 out of the total number of samples, or 0%.

In a hypothesis testing framework, a binomial test of proportions was used to evaluate the possibility that there is a greater-than-zero proportion of samples with unacceptable risk. The null hypothesis is that the proportion of samples with an unacceptable risk is 0 ($p1=0$). The alternative hypothesis is that the proportion is greater than p2, which is p1 plus an appropriate effect size (i.e., population proportion) that the test should be able to detect.

For the purposes of evaluating if a sufficient number of samples were collected to support the risk assessment, the number of samples required was determined using the Exact – Generic binomial test in the software program G*Power version 3.1.9 (Faul et al. 2009). In the HRA, a null hypothesis with a proportion of 0 indicates that the false rejection error rate (α) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on false acceptance rate (β), p1, and p2. The number of samples required for β at 15%, 20% to 25% for soil gas samples at 5 ft bgs and 15 ft bgs were tested separately in this assessment.

As a starting point, an effect size of one over the total number of samples was considered, which would be equivalent to one sample having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if one or more samples with unacceptable risk were observed. As shown in Table 7-1, the number of samples required are larger than the corresponding total number of samples. The null hypothesis that no soil gas samples would have unacceptable risk is rejected with effect size of 1 sample over the total number of samples and β smaller than 25%. Therefore, no sample having unacceptable risk within the current sample size cannot guarantee that all samples would have unacceptable risk.

Given the null hypothesis is rejected with effect size of one sample over the total number of samples, an effect size of two over the total number of samples was considered, which would be equivalent to two samples having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if two or more samples with unacceptable risk were observed. As shown in Table 7-1, the number of samples required is smaller than the corresponding total number of samples. With effect size of two samples over the total number of samples and β smaller than 25%, the null hypothesis that no soil gas samples would have unacceptable risk is not rejected, and the alternative hypothesis that two or more than two samples having unacceptable risk is rejected. Therefore, no sample having unacceptable risk within the current sample size can guarantee that no more than one sample would have unacceptable risk.

7.2 Groundwater Data

The evaluation of the risk of vapor intrusion was based on maximum concentrations for COPCs detected in shallow groundwater, rather than on a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was conceptualized as a statistical test of the proportion of the groundwater samples that are associated with an unacceptable risk of vapor intrusion. As summarized in Table 5-16, the total cancer risk estimates for each exposed population for shallow groundwater samples included in the risk evaluation are all below the upper limit of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}, and the total noncancer hazard for these groundwater samples also did not exceed the threshold of greater than 1 for noncancer hazard. The total number of samples for most chemicals of concern is 11, based on Table 4-9. Because the estimated risks and hazards at all evaluated shallow monitoring wells in Parcel E are within the target risk management range, the proportion of samples with unacceptable risk is 0 out of the total number of samples, or 0%.

In a hypothesis testing framework, a binomial test of proportions was used to evaluate the possibility that there is a greater-than-zero proportion of samples with unacceptable risk. The null hypothesis is that the proportion of samples with an unacceptable risk is 0 (p1=0). The alternative hypothesis is that the proportion is greater than p2, which is p1 plus an appropriate effect size (i.e., population proportion) that the test should be able to detect.

For the purposes of evaluating if a sufficient number of samples were collected to support the risk assessment, the number of samples required was determined using the Exact – Generic binomial test in the software program G*Power version 3.1.9 (Faul et al. 2009). In the HRA, a null hypothesis with a proportion of 0 indicates that the false rejection error rate (ɑ) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on the false acceptance rate (β), p1, and p2. The number of samples required for β at 15%, 20%, and 25% were tested in this assessment.

As a starting point, an effect size of one over the total number of samples was considered, which would be equivalent to one sample having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if one or more samples with unacceptable risk were observed. As shown in Table 7-2, the number of samples required is larger than the total number of samples. The null hypothesis that no groundwater samples would have unacceptable risk is rejected with effect size of one sample over the total number of samples and β smaller than 25%. Therefore, no sample having unacceptable risk within the current sample size cannot guarantee that all samples would have unacceptable risk.

Given the null hypothesis is rejected with effect size of one sample over the total number of samples, an effect size of two over the total number of samples was considered, which would be equivalent to two samples having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if two or more samples with unacceptable risk were observed. As shown in Table 7-2, the number of samples required is smaller than the total number of samples. With effect size of two samples over the total number of samples and β smaller than 25%, the null hypothesis that no groundwater samples would have unacceptable risk is not rejected, and the alternative hypothesis that two or more than two samples having unacceptable risk is rejected. Therefore, no sample having unacceptable risk within the current sample size can guarantee that no more than one sample would have unacceptable risk.

8. CUMULATIVE RISKS

The cumulative cancer risk and noncancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risks and noncancer HIs for chemicals via direct contact with soil and VOCs via inhalation of soil gas migrating to air (see Table 8-1). As discussed in detail in Section 5.2.2.2, the health risk results for soil gas were used because soil gas data is the preferred primary line of evidence for assessing health risks through the vapor intrusion pathway as opposed to groundwater or soil data primarily due to higher uncertainties associated with vapor intrusion modeling based on groundwater or soil data, as described in agency guidance (USEPA 2015).

Asbestos was the only chemical identified as a soil COPC, and asbestos risks were evaluated separately from other chemical risks because risk estimates for asbestos are not additive. The basis for the carcinogenic toxicity criteria between chemicals and asbestos is different; for soil gas COPCs, the IURs are defined as the 95% UCLs of the probability of a carcinogenic response, whereas the IURs for asbestos in soil are based on the estimated number of additional deaths from lung cancer and mesothelioma. Therefore, the cumulative cancer risk and noncancer HI were equal to the estimated excess lifetime cancer risk and noncancer HI for VOCs via inhalation of soil gas migrating to air.

As shown in Table 8-1, the estimated cumulative cancer risks for soil and soil gas at 5 ft bgs are 4×10^{-7}, 8×10^{-11}, and 2×10^{-12} for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel E, respectively, which are all below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. The cumulative HIs are 0.003, 0.000001, and 0.0000001 for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel E, respectively, which are well below the threshold of greater than one for noncancer effects. Similar results were produced for soil gas at 15 ft bgs (see Table 8-1). The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil gas to indoor air. Chloroform is the primary contributor to the total estimated cancer risk; however, such contribution is not expected to pose an unacceptable health risks for future commercial/industrial development in Parcel E.

Based on the cumulative health risk results presented herein, the health risk levels for potential worker populations due to exposures to soil and soil gas are below the lower end of NDEP and USEPA's cancer risk management range of $1 \text{ x } 10^{-6}$ to $1 \text{ x } 10^{-4}$, and noncancer threshold of greater than 1 for future commercial/industrial development in Parcel E.

9. SUMMARY AND CONCLUSIONS

The HRA for Parcel E was conducted to evaluate potential risks to on-Site workers from exposures to residual levels of chemicals, radionuclides, and asbestos in soils and VOCs released from soil gas and groundwater to indoor, outdoor, and trench air. The HRA follows the procedures outlined in USEPA's risk assessment guidance and applicable NDEP guidance.

The NCP (40 CFR § 300) is the basis for the target cancer risk range established by NDEP (2023a). Per the NCP, lifetime incremental cancer risks posed by a site should not exceed 10^{-6} to 10^{-4}. Per the NCP and NDEP (2023a), noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., an HI greater than one). It should be noted that the cancer risk and noncancer hazard estimated in this HRA do not represent actual health risks that may occur for the on-Site receptors in Parcel E, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks. Therefore, the actual health risks associated with exposures for the on-Site workers within Parcel E are expected to be lower than the risk estimates reported in this HRA.

Analytical results of soil samples collected at depths beginning at 1 and 10 ft bgs in Parcel E were assessed through the data processing and DUE steps (see Section 4.1.1) and data representative of current conditions were selected for purposes of the HRA. The soil evaluation, COPCs, and estimated cancer risks and noncancer HIs are summarized as follows:

- Based on the Parcel E CSM, potential exposure to soil was considered for on-Site indoor and outdoor commercial/industrial workers and construction workers via direct contact with soil (i.e., incidental ingestion and dermal contact) and inhalation of airborne particulates and vapors. Soil COPCs were selected according to a multi-step process, including a concentration/ toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. Based on this process, asbestos (long amphibole and long chrysotile fibers) was identified as the only soil COPC. Asbestos was selected as a COPC even though no asbestos fibers were detected in any soil samples. This is because exposure and risk assessments for asbestos are highly dependent on sample size. Even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than $1 \times 10\text{-}^{6}$, depending on sample size. Therefore, although no long amphibole or chrysotile fibers were observed in any soil samples collected in Parcel E, asbestos was still retained as a COPC per NDEP guidance (Neptune 2015).
- A best estimate and an upper-bound estimate of potential cancer risk via inhalation of long amphibole and long chrysotile fibers in airborne particulates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers were calculated for Parcel E. No asbestos fibers were detected in any soil sample, and the estimated combined risks for death from lung cancer and mesothelioma associated with asbestos exposures were all less than 1×10^{-6}, except for the upper-bound risk estimate for exposure to amphibole fibers by construction workers, which was 4×10^{-6}. However, the upper-bound estimate was based on an

observed count of zero long amphibole fibers[32] in the soil samples, considered representative of current conditions within Parcel E.

- As Parcel E is a relatively small parcel and is bordered to the south, east, and north by former Parcels C and D, the results of the asbestos evaluation conducted for former Parcels C and D reported in Ramboll Environ (2017a) are considered as representative of Parcel E and have been included in this evaluation.[33] The best estimates and upper-bound estimates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers from potential inhalation exposure to chrysotile long fibers were all less than 1×10^{-6} for former Parcels C and D, which were below the lower end of the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}. For amphibole long fibers, the best estimate was zero for both parcels. The upper-bound estimates for indoor and outdoor commercial/industrial workers were less than 1×10^{-6} for both parcels; the upper-bound estimates for construction workers were 2×10^{-6} and 4×10^{-6} for former Parcels C and D, respectively. All risk results for asbestos exposure in former Parcels C and D were below or within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}.
- Overall, potential exposure to asbestos in Parcel E soil is expected to be below or within the NDEP and USEPA cancer risk management range of 1×10^{-6} to 1×10^{-4}.

Consistent with agency guidance (USEPA 2015), multiple lines of evidence were utilized in the HRA to evaluate migration of vapors from the subsurface. There are no buildings on Parcel E and no buildings are anticipated as long as the OSSM GWETS continues to operate; accordingly, no indoor workers are foreseeable on Parcel E. Soil gas data collected within Parcel E in 2008 and 2019 was used to evaluate potential exposure to vapors migrating from the subsurface to indoor air, outdoor air, and trench air. Soil gas data is the preferred primary line of evidence for assessing vapor intrusion risks as opposed to groundwater or soil data primarily due to higher uncertainties associated with vapor intrusion modeling based on groundwater or soil data (i.e., uncertainty in predicting contaminant partitioning from groundwater or soil moisture to soil gas and in predicting transport through the capillary fringe). Therefore, this HRA considers the soil gas data as the primary line of evidence for evaluation of the vapor intrusion pathway; the groundwater data were evaluated to provide a secondary line of evidence and to check consistency between soil gas and groundwater results. VOCs detected in at least one soil gas sample were selected as soil gas COPCs. A total of 52 VOCs were identified as soil gas COPCs for Parcel E. Noncancer HIs and excess lifetime cancer risks associated with inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air were calculated. The results are summarized as follows:

- The estimated HIs were well below the NDEP significant threshold of greater than one for noncancer effects for future on-Site indoor and outdoor commercial/industrial

---

[32] Although amphibole fiber counts were zero (0), upper-bound fiber concentrations in soil are estimated assuming a Poisson distribution, which yields an upper-bound risk estimate that is greater than 0.

[33] As agreed upon by NDEP during the meeting on April 6, 2023 to discuss the NDEP comments received on February 8, 2023, on the Parcel E HRA Report, Revision 0.

workers and construction workers under the conditions evaluated. The maximum estimated HI was 0.003 for the indoor commercial/industrial worker.

- The estimated excess lifetime cancer risks were below the lower end of the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4} for future on-Site indoor and outdoor commercial/industrial workers and construction workers under the conditions evaluated. The maximum estimated excess lifetime cancer risk was 4 × 10^{-7} for the indoor commercial/industrial worker. Chloroform is the primary contributor to the total estimated cancer risk for soil gas; however, such contribution is not expected to pose an unacceptable health risk for future commercial/industrial development in Parcel E.

In addition to soil gas, shallow groundwater sampling results were evaluated as a second line of evidence in the health risk evaluation for the vapor intrusion pathway. Groundwater results for volatile compounds from shallow monitoring wells (with top of well screens less than 60 ft bgs) collected from 2015 to 2019 within Parcel E were included in this analysis. Similar to soil gas, the estimated excess lifetime cancer risks for vapor intrusion from groundwater were estimated within the lower end of the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}, and all estimated HIs were below one. Chloroform was the major chemical contributor to the estimated cancer risk for both media. The potential exposure to COPCs in shallow groundwater in Parcel E is not expected to pose an unacceptable cancer risk or adverse noncancer health effects under the conditions evaluated.

Consistent with the risk assessments completed for Parcels C, D, F, G, and H, exposure via domestic use of groundwater was not evaluated because on-Site groundwater is not and will not be used as a domestic water supply given the high concentrations of TDS in the area.[34] Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities were not considered complete exposure pathways due to the groundwater depth at 33 to 40 ft bgs in Parcel E.

The cumulative cancer risk and noncancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risks and noncancer HIs for chemicals via direct contact with soil and VOCs via inhalation of soil gas migrating to air (see Table ES-1). However, asbestos was the only chemical identified as a soil COPC, and asbestos risks were evaluated separately from other chemical risks because the asbestos risk estimates are not additive. Therefore, the cumulative cancer risk and noncancer HI were equal to the estimated excess lifetime cancer risk and noncancer HI for VOCs via inhalation of soil gas migrating to air.

The estimated upper-bound cumulative cancer risk is 4 × 10^{-7} for future indoor commercial/industrial workers, which is below the lower end of the NDEP and USEPA cancer risk management range of 1 × 10^{-6} to 1 × 10^{-4}. The upper-bound cumulative HI is 0.003, for future indoor commercial/industrial workers, which is well below the threshold of greater than one for noncancer effects. The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil

---

[34] High TDS concentrations make the groundwater highly undesirable for use as a drinking water source. https://www.lasvegasgmp.com/wells-groundwater/facts/index.html

gas to indoor air. Chloroform is the primary contributor to the total estimated cancer risk; however, such contribution is not expected to pose an unacceptable health risk for future commercial/industrial development in Parcel E. Based on the spatial distribution of COPC concentrations and associated risk estimates, there are no areas within Parcel E with elevated concentrations that would require further investigation or remediation.

Based on the health risk levels presented herein, the potential exposures to COPCs in soil (0-10 ft bgs), soil gas, or shallow groundwater in Parcel E are not expected to pose unacceptable health risks for future commercial/industrial development in Parcel E. Additionally, future development on Parcel E is highly unlikely due to the easement with OSSM encumbering the entire parcel and the presence of OSSM's extractions wells and infiltration trench on the parcel. Furthermore, any NFA issued for the parcel will require the recording of an environmental covenant restricting the use of the property to non-residential.

10. REFERENCES

ATSDR (Agency for Toxic Substances & Disease Registry). 2020. Minimal Risk Levels (MRLs). October.

API (American Petroleum Institute). 2012. BioVapor Indoor Vapor Intrusion Model. http://www.api.org/oil-and-natural-gas/environment/clean-water/ground-water/vapor-intrusion/biovapor

BRC (Basic Remediation Company). 2009. BRC Standard Operating Procedure (SOP) 40. Data Review Validation. Revision 4. May 7. NDEP approved May 11, 2009.

BRC and TIMET (Basic Remediation Company and Titanium Metals Corporation). 2007. Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity. March 16. NDEP approved July 26, 2007.

Berman, D.W. and K.S. Crump. 2003. Final draft: Technical Support Document for a Protocol to Assess Asbestos-Related Risk, October.

Berman D.W. and A. Kolk. 2000. Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material, Revision 1: Submitted to the U.S. Environmental Protection Agency, Region 8. May 23.

Cal/EPA (California Environmental Protection Agency). 2009. Air Toxics Hot Spots Program Technical Support Document for Cancer Potencies. Appendix B. Chemical-specific summaries of the information used to derive unit risk and cancer potency values. Updated 2011.

CFR (Code of Federal Regulations). Title 40, Environmental Protection Agency. Part 300, National Oil and Hazardous Substances Pollution Contingency Plan. (40 CFR § 300).

CFR. Title 21. Direct Food Substances Affirmed as Generally Recognized as Safe (21 CFR Part § 184).

ENSR (ENSR International). 2005. Conceptual Site Model (CSM). Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22, 2005.

ENSR. 2007. Phase A Source Area Investigation Results Report, Tronox LLC Facility, Henderson, Nevada, September. NDEP approved the Report November 30, 2007 and Appendix G – Data Validation Summary Report (DVSR) December 17, 2007.

ENSR. 2008a. Phase B Source Area Investigation Work Plan, Soil Gas Survey, Tronox LLC Facility, Henderson, Nevada, March. NDEP approved March 26, 2008.

ENSR. 2008b. Revised Draft Data Validation Summary Report, Phase B Source Area Investigation Soil Gas Survey, Tronox LLC Facility, Henderson, Nevada, October. NDEP approved October 20, 2008.

ENSR. 2008c. Quality Assurance Project Plan, Tronox LLC Facility, Henderson, Nevada. Revision 3. April. NDEP approved April 16, 2008.

ENVIRON (ENVIRON International Corporation). 2014a. Baseline Health Risk Assessment Work Plan, Revision 0, Nevada Environmental Response Trust Site, Henderson, Nevada. February 28. NDEP approved May 20, 2014.

ENVIRON. 2014b. Remedial Investigation and Feasibility Study Work Plan, Revision 2, Nevada Environmental Response Trust Site, Henderson Nevada, June 19, 2014. NDEP approved July 2, 2014.

ENVIRON. 2014c. Quality Assurance Project Plan, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. July 18. NDEP approved August 1, 2014.

Faul, F. 2009. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. Behavior Research Methods, 41, 1149-1160.

ITRC (Interstate Technology & Regulatory Council). 2007. Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline. January.

Johnson, P.C. and R.A. Ettinger. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings. Environmental Science and Technology, 25, 1445-1452.

Kleinfelder (Kleinfelder, Inc.). 1993. Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada Facility. April.

Neptune (Neptune and Company, Inc.). 2015. Technical Guidance for the Calculation of Asbestos Related Risk in Soils for the Basic Management Incorporated (BMI) Complex and Common Areas. February.

Neptune. 2017. NERT Surface Soils COPC Identification and Delineation of Exposure Areas. May.

Neptune. 2018. History of Soil Background Datasets at BMI Complex and Common Areas. June 18.

NDEP (Nevada Division of Environmental Protection). 1994. Phase II Letter of Understanding between NDEP and Kerr-McGee. August 15.

NDEP. 2008a. BMI Plant Sites and Common Areas Projects, Henderson, Nevada: Detection Limits and Data Reporting. December 3.

NDEP. 2008b. BMI Plant Sites and Common Areas Projects, Henderson, Nevada: Statistical Analysis Recommendations for Field Duplicates and Field Splits. November 14.

NDEP. 2008c. Guidance on the Development of Summary Statistics Tables, BMI Complex and Common Areas Projects, Henderson, Nevada. December 10.

NDEP. 2009a. Data Verification and Validation Requirements – Supplement, April 13, 2009, Henderson, Nevada. April 13.

NDEP. 2009b. Guidance for Evaluating Radionuclide Data for the BMI Plant Sites and Common Areas Projects, Henderson, Nevada. February 6.

NDEP. 2009c. Significance Levels for the Gilbert Toolbox of Background Comparison Tests, BMI Plant Sites and Common Areas Projects, Henderson, Nevada. July. (Prepared for NDEP by Neptune and Company).

NDEP. 2010a. Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Complex and Common Areas Projects, Henderson, Nevada. September 1.

NDEP. 2010b. Soil Physical and Chemical Property Measurement and Calculation Guidance, BMI Plant Sites and Common Areas Projects, Henderson, Nevada. March 11.

NDEP. 2010c. Letter to Mr. Matt Paque, Tronox LLC, from Ms. Shannon Harbour, regarding NDEP Response to Revised Removal Action Work Plan for Phase B Soil Remediation Zones RZ-B through RZ-E, Tronox LLC, Henderson, Nevada. August 15.

NDEP. 2011a. Interim Consent Agreement, Nevada Environmental Response Trust. February 14.

NDEP. 2011b. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July 21.

NDEP. 2013. NDEP Response to: Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H, Nevada Environmental Response Trust Site, Henderson, Nevada, Dated: October 2012. January 29.

NDEP. 2017. Response to: Soil Gas Investigation and Health Risk Assessment for Parcels C, D, F, G, and H, Revision 1. January 12.

NDEP. 2023a. User’s Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. December 2008, Revision 16, June.

NDEP. 2023b. Basic Comparison Level (BCL) Table. Revision 16. June.

New York State Department of Health. 2006. Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York. October.

Northgate Environmental Management, Inc. (Northgate) and Exponent Inc. (Exponent). 2010. Closure and Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H, Henderson, Nevada. December 10. NDEP commented on May 19, 2011.

NOAA (National Oceanic and Atmospheric Administration). 2021. Climate Data Online: Las Vegas Weather Station #USW00023169. Data from January 1980 to December 2020. https://www.ncdc.noaa.gov/cdo-web/. Accessed December 8, 2021.

Northgate. 2010. Results of Bioaccessibility Study for Dioxin/Furans in Soil, Tronox LLC, Henderson, Nevada. May 24. NDEP approved May 25, 2010.

Northgate. 2014. Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H, Revision 3, Henderson, Nevada. June 19. NDEP responded May 6, 2015.

NRC (National Research Council). 1988. Chemical Mixtures. National Research Council, National Academy Press, Washington, DC.

Ramboll Environ (Ramboll Environ US Corporation). 2015a. Interim Report, Preliminary Selection of Facility Area COPCs, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May.

Ramboll Environ. 2015b. July 15, 2015. Meeting Summary and BHRA Path Forward. Letter from Ramboll Environ to the Nevada Environmental Response Trust Site, dated August 19, 2015. Nevada Environmental Response Trust Site, Henderson, Nevada.

Ramboll Environ. 2016a. Technical Memorandum, Remedial Investigation Data Evaluation. Nevada Environmental Response Trust, Henderson, Nevada, May 2. NDEP approved August 23, 2016.

Ramboll Environ. 2016b. 2016 Groundwater Monitoring Optimization Plan. April 29, 2016. NDEP approved June 24, 2016.

Ramboll Environ. 2017a. Health Risk Assessment for Parcels C, D, and G, Revision 1. Nevada Environmental Response Trust Site, Henderson, Nevada. November 3.

Ramboll Environ. 2017b. Identification of COPCs and Decision Units for OU-1 Soils, Revision 1. November 15. NDEP approved December 27, 2017.

Ramboll Environ. 2017c. Quality Assurance Project Plan, Revision 2. Nevada Environmental Response Trust Site, Henderson, Nevada. October 26. NDEP approved November 8, 2017.

Ramboll Environ. 2017d. Remedial Performance Groundwater Sampling and Analysis Plan. Nevada Environmental Response Trust Site, Henderson, Nevada. April 7.

Ramboll Environ. 2017e. Annual Remedial Performance Report for Chromium and Perchlorate. Nevada Environmental Response Trust Site, Henderson, Nevada. December 8. NDEP approved February 6, 2018.

Ramboll (Ramboll US Corporation). 2018a. Baseline Health Risk Assessment Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Nevada Environmental Response Trust Site, Henderson, Nevada. December 19. NDEP approved January 24, 2019.

Ramboll. 2018b. RI Phase 2 Modification No. 12. Recommended Soil, Soil Gas, and Groundwater Sampling in Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada. July 17. NDEP approved July 19, 2018.

Ramboll 2018c. Annual Remedial Performance Report for Chromium and Perchlorate. Nevada Environmental Response Trust Site, Henderson, Nevada. November 9. NDEP approved January 18, 2019.

Ramboll. 2018d. Data Validation Summary Report (DVSR) and Electronic Data Deliverable (EDD) for Groundwater Data collected as part of the NERT Phase 1 Remedial Investigation (RI) completed in 2014 and 2015. June 22. NDEP approved August 14, 2018.

Ramboll. 2018e. Data Validation Summary Report for Annual Remedial Performance Sampling January through June 2017 and Artesian Well Sampling August 2017, Revision 1 and Associated EDD, Response to Comments. February 13. NDEP approved March 5, 2018.

Ramboll. 2019a. Annual Remedial Performance Report for Chromium and Perchlorate, Nevada Environmental Response Trust Site, Henderson, Nevada. December 31. NDEP approved April 30, 2020.

Ramboll. 2019c. Phase 3 Remedial Investigation (RI) Modification No. 9: Proposed Soil Gas Sampling in OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada. October 7. NDEP approved October 14, 2019.

Ramboll. 2019b. Quality Assurance Project Plan, Revision 3. Nevada Environmental Response Trust Site, Henderson, Nevada. April 8. NDEP approved April 17, 2019.

Ramboll. 2019d. Revised Data Validation Summary Report for the Annual Remedial Performance Sampling for January through June 2018, Nevada Environmental Response Trust Henderson, Nevada. January 17. NDEP approved May 14, 2019.

Ramboll. 2019e. Data Validation Summary Report for the Annual Remedial Performance Sampling for January through June 2019, Nevada Environmental Response Trust Henderson, Nevada. December 31. NDEP approved January 13, 2020.

Ramboll. 2020a. Baseline Health Risk Assessment Report for OU-1 Soils, Nevada Environmental Response Trust Site, Henderson, Nevada. January 30. NDEP commented on June 12, 2020.

Ramboll. 2020b. Data Validation Summary Report, Remedial Investigation Sampling Phase 2, March 2018 through March 2019, Revision 1, Nevada Environmental Response Trust, Henderson, Nevada. February 14. NDEP approved April 9, 2020.

Ramboll. 2020c. Data Validation Summary Report for Asbestos Data from Parcel E and Associated with the Remedial Investigation at the Nevada Environmental Response Trust (NERT) Site. March 3. NDEP approved March 30, 2020.

Ramboll. 2020d. Soil Gas Sampling Results for OU-1 and OU-2, Nevada Environmental Response Trust, Henderson, Nevada. March 31. NDEP response received on January 28, 2021.

Ramboll. 2020e. Remedial Investigation Data Validation Summary Report and Electronic Data Deliverable, Phase 3 RI Modification No. 4, 5, 6, and 9, Nevada Environmental Response Trust, Henderson, Nevada. May 27. NDEP approved January 13, 2021.

Ramboll. 2021a. Baseline Health Risk Assessment Report for OU-1 Soils, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. October 14. NDEP commented December 22, 2021.

Ramboll. 2021b. Baseline Health Risk Assessment Report for OU-1 Soil Gas and Groundwater, Nevada Environmental Response Trust Site, Henderson, Nevada. September 29. NDEP commented March 9, 2022 and provided responses on the annotated response to comment letter on November 3, 2022.

Ramboll. 2021c. Remedial Investigation Report for OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada. July 9. NDEP commented February 9, 2022.

Ramboll. 2022a. Baseline Health Risk Assessment Report for OU-1 Soils, Revision 2, Nevada Environmental Response Trust Site, Henderson, Nevada. May 6. NDEP approved June 2, 2022.

Ramboll. 2022b. Health Risk Assessment for Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada. November 18.

Ramboll. 2023a. Baseline Health Risk Assessment Report for OU-1 Soil Gas and Groundwater, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. November 3. Under NDEP review.

Ramboll. 2023b. Remedial Investigation Report for OU-1 and OU-2, Revision1, Nevada Environmental Response Trust Site, Henderson, Nevada. August 15. Under NDEP review.

Risk Commission. 1997. Final report, Volume 2, Risk management in regulatory decision-making. Presidential/Congressional Commission of Risk Assessment and Risk Management, Washington, DC.

Seed, J., R.P. Brown, S.S. Olin, and J.A. Foran. 1995. Chemical mixtures: Current risk assessment methodologies and future directions. Regulatory Toxicol. Pharmacol. 22:76-94.

Shevenell L. 1996. *Statewide Potential Evapotranspiration Maps for Nevada*, Nevada Bureau of Mines and Geology, Report 48.

State of Nevada. 1983. Consent Order between the State of Nevada, Department of Conservation and Natural Resources, Division of Environmental Protection; and the Stauffer Chemical Company and Montrose Chemical Corporation of California. April 4, 1983.

USEPA (United States Environmental Protection Agency). 1986. Guidelines for health risk assessment of chemical mixtures. U.S. Environmental Protection Agency, Federal Register 51(185):34104–34025.

USEPA. 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. U.S. EPA/540/1-89/002. December.

USEPA. 1992a. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

USEPA. 1992b. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

USEPA. 1992c. Guidelines for Exposure Assessment. Federal Register, 57(104):22888-22938. May.

USEPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response, Washington, DC. U.S. EPA/540/R-96/018. April.

USEPA. 1997. Health Effects Assessment Summary Tables. July.

USEPA. 1999a. Contract Laboratory Program, National Functional Guidelines for Organic Data Review. Office of Solid Waste and Emergency Response. October.

USEPA. 1999b. Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) In Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). January.

USEPA. 2000. Soil Screening Guidance for Radionuclides. Office of Radiation and Indoor Air, Washington, DC. U.S. EPA/540-R-00-007 and U.S. EPA/540-R-00-006.

USEPA. 2001. Office of Solid Waste and Emergency Response. Contract Laboratory Program, National Functional Guidelines for Low Concentration Data Review. June.

USEPA. 2002a. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response, Washington, DC. EPA 540-R-01-003. September.

USEPA. 2002b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, Washington, DC. OSWER 9355.4-24. December.

USEPA. 2002c. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). EPA530-D-02-004. November.

USEPA. 2003. Technical Support Document for a Protocol to Assess Asbestos-Related risk. Final Draft. Office of Emergency and Remedial Response, Washington, DC. EPA #9345.4-06. October.

USEPA. 2004a. Office of Solid Waste and Emergency Response. Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review. October.

USEPA. 2004b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R/99/005. July.

USEPA. 2004c. User’s Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February.

USEPA. 2005a. Test Methods for Evaluation Solid Waste Physical/Chemical Methods (SW-846), Third Edition, July.

USEPA. 2005b. Office of Emergency and Remedial Response. Contract Laboratory Program Statement of Work for Chlorinated Dibenzo-p-dioxin and Chlorinated Dibenzofuran: Multi-media, Multi-concentration. January.

USEPA. 2008. Office of Solid Waste and Emergency Response. Contract Laboratory Program, National Functional Guidelines for Organic Data Review. June.

USEPA. 2009a. Office of Solid Waste and Emergency Response. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. January 2009.

USEPA. 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final. EPA-540-R-070-002. January.

USEPA. 2011. Exposure Factors Handbook. Office of Research and Development, Washington DC. U.S. EPA/600/R-09/052F. September.

USEPA. 2015. OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. EPA9200.2-154. June.

USEPA. 2017. Johnson and Ettinger Model Spreadsheet Tool for Modeling Subsurface Vapor Intrusion, Version 6.0. September.

USEPA. 2023a. Regional Screening Levels. May.

USEPA. 2023b. Regional Screening Levels User’s Guide. May.

USEPA. 2023c. Regional Screening Levels – Subchronic Toxicity Values. May.

USEPA. 2023d. Integrated Risk Information System (IRIS). Available online at https://www.epa.gov/iris. Accessed on August 5, 2023.

Van den Berg M. et al. 2006. The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. Toxicology. Science 92:223-241.

VDEQ (Virginia Department of Environmental Quality). 2023. Virginia Unified Risk Assessment Model – VURAM User's Guide for Risk Assessors. August.

TABLES

TABLE ES-1. Summary of Cumulative Estimated Risks for Soil and Soil Gas

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure [1]	Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
	Cancer Risk	Non-Cancer HI	Cancer Risk	Non-Cancer HI	Cancer Risk	Non-Cancer HI
Cumulative Risk for Soil and Soil Gas (5 ft) [2]	4E-07	0.003	8E-11	0.000001	2E-12	0.0000001
Cumulative Risk for Soil and Soil Gas (15 ft) [2]	4E-07	0.003	7E-11	0.0000008	5E-12	0.0000003
Asbestos - Best Estimate	0E+00	--	0E+00	--	0E+00	--
Asbestos - Upper-Bound Estimate [3]	2E-07	--	4E-07	--	4E-06	--

Notes:

-- = Not applicable
ft = feet
COPC = Chemical of potential concern
HI = Hazard index
VOC = Volatile organic compound

[1] Asbestos cancer risk was not included in the cumulative risk calculation.

[2] No analytes except asbestos were identified as soil COPCs. Therefore, the cumulative cancer risk and non-cancer HI were equal to the cancer risk and non-cancer HI for VOCs via inhalation of soil gas migrating to air.

[3] Although fiber counts were zero (0), upper-bound fiber concentrations in soil are estimated assuming a Poisson distribution, which yields an upper-bound risk estimate that is greater than 0.

TABLE 4-1. Evaluation of Soil Sample Quantitation Limits

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
Chlorine Oxyanions	Perchlorate	908	mg/kg	15	13	87	0.010	0.010	0	0	--
Metals	Antimony	3,450	mg/kg	15	3	20	0.27	0.31	0	0	--
	Cadmium	8,180	mg/kg	15	0	0	0.25	0.28	0	0	--
	Chromium VI	117	mg/kg	15	2	13	0.15	0.17	0	0	--
	Mercury	5,540	mg/kg	15	11	73	0.012	0.013	0	0	Use Mercury compounds BCL
	Molybdenum	6,490	mg/kg	15	0	0	1.0	1.1	0	0	--
	Silver	162,000	mg/kg	15	0	0	0.89	1.0	0	0	Use health-based BCL instead of non-health based upper-limit
	Thallium	13	mg/kg	15	0	0	0.25	0.28	0	0	--
	Tungsten	1,040	mg/kg	15	0	0	2.5	2.8	0	0	--
Other Inorganics	Bromide	519,000	mg/kg	15	3	20	3.5	4.0	0	0	Use health-based BCL instead of non-health based upper-limit
	Chlorite	38,900	mg/kg	15	0	0	0.041	0.046	0	0	--
	Fluoride	51,900	mg/kg	15	0	0	3.5	4.0	0	0	--
	Nitrate	2,080,000	mg/kg	15	10	67	3.8	4.1	0	0	Use health-based BCL instead of non-health based upper-limit
	Nitrite	130,000	mg/kg	15	0	0	3.6	4.3	0	0	Use health-based BCL instead of non-health based upper-limit
	ortho-Phosphate	1,270,000	mg/kg	6	1	17	4.0	4.3	0	0	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit
Other Organics	Acetic acid	--	mg/kg	15	0	0	1.3	1.6	--	--	--
	Butyric acid	--	mg/kg	15	0	0	1.4	1.7	--	--	--
	Formic acid	122	mg/kg	15	0	0	1.9	2.4	0	0	--
	Lactic acid	--	mg/kg	15	0	0	2.6	3.2	--	--	--
	Propionic acid	--	mg/kg	15	0	0	1.5	1.8	--	--	--
	Pyruvic acid	--	mg/kg	15	0	0	2.1	23	--	--	--
PAHs	Acenaphthene	50,200	mg/kg	15	0	0	0.0040	0.0046	0	0	Use health-based BCL instead of soil saturation level
	Acenaphthylene	25,100	mg/kg	15	0	0	0.0040	0.0046	0	0	Use acenaphthene as a surrogate; use health-based BCL instead of soil saturation level
	Anthracene	251,000	mg/kg	15	0	0	0.0040	0.0046	0	0	Use health-based BCL instead of soil saturation level
	BaPEq*	3.5	mg/kg	15	0	0	0.0046	0.0053	0	0	--
	Benzo(g,h,i)perylene	25,100	mg/kg	15	0	0	0.0040	0.0046	0	0	--
	Fluoranthene	33,500	mg/kg	15	0	0	0.0040	0.0046	0	0	--
	Fluorene	33,500	mg/kg	15	0	0	0.0040	0.0046	0	0	Use health-based BCL instead of soil saturation level
	1-Methylnaphthalene	121	mg/kg	15	0	0	0.15	0.17	0	0	--
	2-Methylnaphthalene	3,350	mg/kg	15	0	0	0.071	0.081	0	0	Use health-based BCL instead of soil saturation level
	Naphthalene	11	mg/kg	15	1	6.7	0.0040	0.0046	0	0	--
	Phenanthrene	4,450	mg/kg	15	0	0	0.0040	0.0046	0	0	Use health-based BCL instead of soil saturation level
	Pyrene	25,100	mg/kg	15	0	0	0.0040	0.0046	0	0	Use health-based BCL instead of soil saturation level
Pesticides - OCPs	Aldrin	0.20	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	alpha-BHC	274	mg/kg	15	1	6.7	0.0015	0.0016	0	0	--
	beta-BHC	55	mg/kg	15	6	40	0.0015	0.0016	0	0	--
	delta-BHC	333	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	gamma-BHC	11	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	alpha-Chlordane	9.8	mg/kg	15	0	0	0.0020	0.0023	0	0	Use chlordane as a surrogate
	gamma-Chlordane	9.8	mg/kg	15	0	0	0.0015	0.0017	0	0	Use chlordane as a surrogate
	4,4'-DDD	15	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	2,4'-DDE	10	mg/kg	15	1	6.7	0.0015	0.0017	0	0	Use 4,4'-DDE as a surrogate
	4,4'-DDE	10	mg/kg	15	3	20	0.0015	0.0017	0	0	--
	4,4'-DDT	11	mg/kg	15	1	6.7	0.0015	0.0017	0	0	--

TABLE 4-1. Evaluation of Soil Sample Quantitation Limits
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
Pesticides - OCPs	Dieldrin	0.22	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	Endosulfan I	7,790	mg/kg	15	0	0	0.0015	0.0017	0	0	Use endosulfan as a surrogate
	Endosulfan II	7,790	mg/kg	15	0	0	0.0015	0.0017	0	0	Use endosulfan as a surrogate
	Endosulfan sulfate	7,790	mg/kg	15	0	0	0.0020	0.0023	0	0	Use endosulfan as a surrogate
	Endrin	274	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	Endrin aldehyde	274	mg/kg	15	0	0	0.0015	0.0017	0	0	Use endrin as a surrogate
	Endrin ketone	274	mg/kg	15	0	0	0.0020	0.0023	0	0	Use endrin as a surrogate
	Heptachlor	0.70	mg/kg	15	0	0	0.0020	0.0023	0	0	--
	Heptachlor epoxide	0.37	mg/kg	15	0	0	0.0020	0.0023	0	0	--
	Hexachlorobenzene	1.1	mg/kg	15	0	0	0.071	0.081	0	0	Use health-based BCL instead of soil saturation level
	Methoxychlor	4,560	mg/kg	15	0	0	0.0015	0.0017	0	0	--
	Toxaphene	3.2	mg/kg	15	0	0	0.051	0.058	0	0	--
Pesticides - OPPs	Atrazine	15	mg/kg	15	0	0	0.012	0.014	0	0	--
	Chlorpyrifos	912	mg/kg	15	0	0	0.0062	0.0073	0	0	--
	Coumaphos	--	mg/kg	15	0	0	0.0027	0.0032	--	--	--
	Dasanit	--	mg/kg	15	0	0	0.0079	0.0093	--	--	--
	Dichlorovos	12	mg/kg	15	0	0	0.0071	0.0084	0	0	--
	Demeton (O + S)	36	mg/kg	15	0	0	0.0073	0.0085	0	0	--
	Diazinon	638	mg/kg	15	0	0	0.0070	0.0083	0	0	--
	Dimethoate	2,010	mg/kg	15	0	0	0.0068	0.0080	0	0	--
	Disulfoton	36	mg/kg	15	0	0	0.0075	0.0088	0	0	--
	EPN	9.1	mg/kg	15	0	0	0.0036	0.0042	0	0	--
	Ethoprop	--	mg/kg	15	0	0	0.0048	0.0056	--	--	--
	o-Ethyl o-2,4,5-trichlorophenyl ethyl-phosphonothioate	--	mg/kg	15	0	0	0.0060	0.0071	--	--	--
	Famphur	--	mg/kg	15	0	0	0.0031	0.0037	--	--	--
	Fenthion	--	mg/kg	15	0	0	0.0084	0.0099	--	--	--
	Guthion	2,740	mg/kg	15	0	0	0.0034	0.0040	0	0	--
	Malathion	18,200	mg/kg	15	0	0	0.0045	0.0053	0	0	--
	Merphos	39	mg/kg	15	0	0	0.0050	0.0058	0	0	Use health-based BCL instead of soil saturation level
	Methyl parathion	228	mg/kg	15	0	0	0.0061	0.0072	0	0	--
	Mevinphos	--	mg/kg	15	0	0	0.0045	0.0053	--	--	--
	Parathion	5,470	mg/kg	15	0	0	0.0051	0.0060	0	0	--
	Phorate	182	mg/kg	15	0	0	0.0055	0.0065	0	0	--
	Propazine	18,200	mg/kg	15	1	6.7	0.0083	0.0093	0	0	--
	Prothiophos	--	mg/kg	15	0	0	0.0038	0.0044	--	--	--
	Ronnel	64,900	mg/kg	15	0	0	0.015	0.017	0	0	Use health-based BCL instead of soil saturation level
	Simazine	29	mg/kg	15	0	0	0.021	0.025	0	0	--
	Sulfotepp	456	mg/kg	15	0	0	0.0060	0.0071	0	0	--
	Sulprofos	--	mg/kg	15	0	0	0.0041	0.0048	--	--	--
	Thionazin	--	mg/kg	15	0	0	0.0054	0.0063	--	--	--
SVOCs	Aniline	619	mg/kg	3	0	0	0.14	0.15	0	0	--
	Benzidine	0.015	mg/kg	2	0	0	0.17	0.18	2	2	--
	Benzoic acid	3,650,000	mg/kg	15	0	0	0.48	0.55	0	0	Use health-based BCL instead of non-health based upper-limit

TABLE 4-1. Evaluation of Soil Sample Quantitation Limits

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
SVOCs	Benzyl alcohol	91,200	mg/kg	15	0	0	0.42	0.47	0	0	--
	bis(2-Chloroethoxy)methane	2,740	mg/kg	15	0	0	0.14	0.15	0	0	--
	bis(2-Chloroethyl) ether	1.1	mg/kg	15	0	0	0.071	0.081	0	0	--
	bis(2-Ethylhexyl)phthalate	252	mg/kg	15	0	0	0.091	0.10	0	0	--
	4-Bromophenyl-phenyl ether	--	mg/kg	15	0	0	0.076	0.087	--	--	--
	Butylbenzylphthalate	1,860	mg/kg	15	0	0	0.081	0.092	0	0	--
	4-Chloro-3-methylphenol	91,200	mg/kg	15	0	0	0.20	0.23	0	0	--
	4-Chloroaniline	18	mg/kg	15	0	0	0.15	0.17	0	0	--
	2-Chloronaphthalene	67,000	mg/kg	15	0	0	0.068	0.077	0	0	Use health-based BCL instead of soil saturation level
	2-Chlorophenol	6,490	mg/kg	15	0	0	0.071	0.081	0	0	--
	4-Chlorophenyl-phenyl ether	--	mg/kg	15	0	0	0.20	0.23	--	--	--
	Dibenzofuran	1,300	mg/kg	15	0	0	0.14	0.16	0	0	Use health-based BCL instead of soil saturation level
	3,3'-Dichlorobenzidine	7.8	mg/kg	15	0	0	0.15	0.17	0	0	--
	2,4-Dichlorophenol	2,740	mg/kg	15	0	0	0.068	0.077	0	0	--
	Diethylphthalate	729,000	mg/kg	15	0	0	0.097	0.11	0	0	Use health-based BCL instead of non-health based upper-limit
	2,4-Dimethylphenol	18,200	mg/kg	15	0	0	0.13	0.15	0	0	--
	Dimethylphthalate	9,120,000	mg/kg	15	0	0	0.068	0.077	0	0	Use health-based BCL instead of non-health based upper-limit
	Di-n-butylphthalate	91,200	mg/kg	15	0	0	0.091	0.10	0	0	--
	2,4-Dinitrophenol	1,820	mg/kg	15	0	0	1.0	1.2	0	0	--
	2,4-Dinitrotoluene	11	mg/kg	15	0	0	0.081	0.092	0	0	--
	2,6-Dinitrotoluene	2.4	mg/kg	15	0	0	0.097	0.11	0	0	--
	Di-n-octylphthalate	9,120	mg/kg	15	0	0	0.091	0.10	0	0	--
	Hexachlorobutadiene	5.6	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	Hexachlorocyclopentadiene	7.5	mg/kg	15	0	0	0.32	0.36	0	0	--
	Hexachloroethane	8.5	mg/kg	15	0	0	0.071	0.081	0	0	--
	Isophorone	3,710	mg/kg	15	0	0	0.068	0.077	0	0	--
	2-Methylphenol	45,600	mg/kg	15	0	0	0.081	0.092	0	0	--
	3&4-Methylphenol	45,600	mg/kg	15	0	0	0.14	0.15	0	0	Minimum BCL of 4-methylphenol and 3-methylphenol
	2-Nitroaniline	8,840	mg/kg	15	0	0	0.17	0.20	0	0	--
	3-Nitroaniline	3,650	mg/kg	15	0	0	0.14	0.15	0	0	Use 4-nitroaniline as a surrogate (noncancer endpoint)
	4-Nitroaniline	176	mg/kg	15	0	0	0.14	0.15	0	0	--
	Nitrobenzene	22	mg/kg	15	0	0	0.071	0.081	0	0	--
	2-Nitrophenol	7,290	mg/kg	15	0	0	0.14	0.15	0	0	Use 4-nitrophenol as a surrogate
	4-Nitrophenol	7,290	mg/kg	15	0	0	0.51	0.58	0	0	--
	n-Nitrosodiphenylamine	720	mg/kg	15	0	0	0.16	0.18	0	0	--
	n-Nitroso-di-n-propylamine	0.50	mg/kg	15	0	0	0.071	0.081	0	15	--
	Octachlorostyrene	--	mg/kg	15	0	0	0.12	2.7	--	--	--
	Pentachlorophenol	8.4	mg/kg	15	0	0	0.35	0.39	0	0	--
	Phenol	273,000	mg/kg	15	0	0	0.091	0.10	0	0	Use health-based BCL instead of non-health based upper-limit
	Pyridine	1,300	mg/kg	15	0	0	0.15	0.17	0	0	--
	2,4,5-Trichlorophenol	91,200	mg/kg	15	0	0	0.27	0.31	0	0	--
	2,4,6-Trichlorophenol	321	mg/kg	15	0	0	0.16	0.18	0	0	--
VOCs	Acetone	746,000	mg/kg	15	1	6.7	0.0062	0.018	0	0	Use health-based BCL instead of non-health based upper-limit
	tert-Amyl methyl ether	64,400	mg/kg	15	0	0	0.00078	0.0022	0	0	Use methyl tert-butyl ether as a surrogate (noncancer endpoint)

TABLE 4-1. Evaluation of Soil Sample Quantitation Limits

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
VOCs	Benzene	5.3	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Bromobenzene	1,970	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	Bromochloromethane	628	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	Bromodichloromethane	1.3	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Bromoform	95	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	Bromomethane	30	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	2-Butanone	215,000	mg/kg	15	0	0	0.0039	0.011	0	0	Use health-based BCL instead of soil saturation level
	tert-Butyl alcohol	7,270	mg/kg	15	0	0	0.0078	0.022	0	0	--
	n-Butylbenzene	64,900	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	sec-Butylbenzene	130,000	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	tert-Butylbenzene	130,000	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	Carbon tetrachloride	3.0	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Chlorobenzene	1,370	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Chloroethane	56,700	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	Chloroform	1.4	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Chloromethane	464	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	2-Chlorotoluene	26,000	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	4-Chlorotoluene	26,000	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	Cumene	10,400	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	p-Cymene	1,490	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,2-Dibromo-3-chloropropane	0.065	mg/kg	15	0	0	0.0016	0.0045	0	0	--
	Dibromochloromethane	43	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,2-Dibromoethane	0.17	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Dibromomethane	99	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,2-Dichlorobenzene	9,760	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,3-Dichlorobenzene	2,820	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,4-Dichlorobenzene	12	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Dichlorodifluoromethane	368	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	1,1-Dichloroethane	16	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,2-Dichloroethane	2.1	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,1-Dichloroethene	1,000	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	cis-1,2-Dichloroethene	400	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	trans-1,2-Dichloroethene	304	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,2-Dichloropropane	12	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	1,3-Dichloropropane	26,000	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	2,2-Dichloropropane	66	mg/kg	15	0	0	0.00078	0.0022	0	0	Use 1,2-dichloropropane as a surrogate (noncancer endpoint)
	1,1-Dichloropropene	310	mg/kg	15	0	0	0.00039	0.0011	0	0	Use 1,3-dichloropropene as a surrogate (noncancer endpoint)
	cis-1,3-Dichloropropene	9.1	mg/kg	15	0	0	0.00039	0.0011	0	0	Use 1,3-dichloropropene as a surrogate
	trans-1,3-Dichloropropene	9.1	mg/kg	15	0	0	0.00039	0.0011	0	0	Use 1,3-dichloropropene as a surrogate
	Ethyl tert-butyl ether	64,400	mg/kg	15	0	0	0.00078	0.0022	0	0	Use methyl tert-butyl ether as a surrogate (noncancer endpoint)
	Ethylbenzene	27	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	2-Hexanone	1,490	mg/kg	15	0	0	0.0039	0.011	0	0	--
	Methyl tert-butyl ether	217	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	4-Methyl-2-pentanone	139,000	mg/kg	15	0	0	0.0019	0.0056	0	0	Use health-based BCL instead of soil saturation level

TABLE 4-1. Evaluation of Soil Sample Quantitation Limits

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
VOCs	Methylene Chloride	1,130	mg/kg	15	0	0	0.0039	0.011	0	0	--
	Diisopropyl ether	9,380	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	n-Propylbenzene	27,000	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	Styrene	37,600	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,1,1,2-Tetrachloroethane	9.1	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	1,1,2,2-Tetrachloroethane	2.9	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	Tetrachloroethene	107	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Toluene	52,000	mg/kg	15	2	13	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,2,3-Trichlorobenzene	1,040	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	1,2,4-Trichlorobenzene	125	mg/kg	15	1	6.7	0.00078	0.0022	0	0	--
	1,1,1-Trichloroethane	35,800	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level
	1,1,2-Trichloroethane	5.3	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Trichloroethene	6.3	mg/kg	15	0	0	0.00039	0.0011	0	0	--
	Trichlorofluoromethane	389,000	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	1,2,3-Trichloropropane	0.12	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	1,2,4-Trimethylbenzene	2,030	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	1,3,5-Trimethylbenzene	77,900	mg/kg	15	0	0	0.00078	0.0022	0	0	Use health-based BCL instead of soil saturation level
	Vinyl chloride	1.9	mg/kg	15	0	0	0.00078	0.0022	0	0	--
	m,p-Xylene	2,390	mg/kg	15	0	0	0.00078	0.0022	0	0	Minimum BCL of m-xylene and p-xylene; use health-based BCL instead of soil saturation level
	o-Xylene	2,810	mg/kg	15	0	0	0.00039	0.0011	0	0	Use health-based BCL instead of soil saturation level

Notes:

-- = Not applicable
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EPN = Ethyl P-nitrophenyl benzenethiophosphate

NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
SQL = Sample Quantitation Limit
SVOC = Semivolatile organic compound
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text
[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2023), unless noted.

Source:

NDEP. 2023. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 16, June.

TABLE 4-2. Summary Statistics for Soil Data

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects										Screening Level Note
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	Ratio of Maximum to Screen	
Chlorine Oxyanions	Chlorate	38,900	mg/kg	15	15	100	--	--	0.057	4.2	0.53	1.0	1.2	1.2	RISB-ER-03	0	0	0.00011	--
	Perchlorate	908	mg/kg	15	13	87	0.010	0.010	0.047	6.1	2.2	2.3	2.2	0.93	RISB-ER-03	0	0	0.0067	--
Metals	Antimony	3,450	mg/kg	15	3	20	0.27	0.31	0.29	0.36	0.31	0.32	0.036	0.11	RISB-ER-02	0	0	0.0001	--
	Arsenic	7.2	mg/kg	15	15	100	--	--	1.9	5.9	4.5	4.0	1.2	0.31	RISB-EJ-03	0	--	0.82	Maximum BRC/TIMET background
	Barium	1,630,000	mg/kg	15	15	100	--	--	120	260	160	170	43	0.26	RISB-EJ-01	0	0	0.00016	Use health-based BCL instead of non-health based upper-limit
	Boron	259,000	mg/kg	15	15	100	--	--	4.8	32	13	14	7.5	0.54	RISB-ER-01	0	0	0.00012	Use health-based BCL instead of non-health based upper-limit
	Chromium VI	117	mg/kg	15	2	13	0.15	0.17	0.26	0.33	0.30	0.30	0.049	0.17	RISB-EJ-01	0	0	0.0028	--
	Cobalt	385	mg/kg	15	15	100	--	--	3.8	6.6	5.6	5.6	0.79	0.14	RISB-ER-02	0	0	0.017	--
	Copper	51,900	mg/kg	15	15	100	--	--	11	19	16	16	2.3	0.14	RISB-EJ-04	0	0	0.00037	--
	Iron	908,000	mg/kg	15	15	100	--	--	11,000	16,000	15,000	14,500	1,460	0.10	RISB-EJ-03	0	0	0.018	Use health-based BCL instead of non-health based upper-limit
	Lead	800	mg/kg	15	15	100	--	--	5.6	10	7.4	7.5	1.3	0.17	RISB-ER-01	0	0	0.013	--
	Magnesium	5,170,000	mg/kg	15	15	100	--	--	5,500	16,000	10,000	10,000	2,830	0.28	RISB-ER-01	0	0	0.0031	Use health-based BCL instead of non-health based upper-limit
	Manganese	112,000	mg/kg	15	15	100	--	--	210	470	330	330	72	0.22	RISB-EJ-01	0	0	0.0042	Use health-based BCL instead of non-health based upper-limit
	Mercury	5,540	mg/kg	15	11	73	0.012	0.013	0.017	0.40	0.025	0.078	0.11	1.5	RISB-EJ-04	0	0	0.000072	Use Mercury compounds BCL
	Nickel	56,600	mg/kg	15	15	100	--	--	11	21	16	16	2.4	0.15	RISB-ER-02	0	0	0.00037	--
	Phosphorus (total)	9,630,000	mg/kg	15	15	100	--	--	730	1,300	910	930	140	0.15	RISB-EJ-03	0	0	0.00013	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit, adjust BCL based on molecular weight
	Strontium	779,000	mg/kg	15	15	100	--	--	120	330	200	210	68	0.32	RISB-EJ-02	0	0	0.00042	Use health-based BCL instead of non-health based upper-limit
	Vanadium	175,000	mg/kg	15	15	100	--	--	36	53	44	44	5.6	0.13	RISB-EJ-04	0	0	0.0003	Use health-based BCL instead of non-health based upper-limit
	Zirconium	104	mg/kg	15	15	100	--	--	8.4	22	18	18	3.8	0.21	RISB-EJ-03	0	93	0.21	--
Other Inorganics	Ammonia	27,900	mg/kg	15	15	100	--	--	3.2	4.9	3.7	3.9	0.52	0.13	RISB-EJ-04	0	0	0.00018	--
	Bromide	519,000	mg/kg	15	3	20	3.5	4.0	3.6	15	5.5	8.0	6.1	0.76	RISB-EJ-04	0	0	0.000029	Use health-based BCL instead of non-health based upper-limit
	Chloride	--	mg/kg	15	15	100	--	--	220	2,600	1,200	1,280	750	0.58	RISB-EJ-04	N/A	N/A	N/A	Excluded due to a lack of toxicity data and considered as a macronutrient
	Nitrate	2,080,000	mg/kg	15	10	67	3.8	4.1	4.3	230	55	78	71	0.92	RISB-ER-03	0	0	0.00011	Use health-based BCL instead of non-health based upper-limit
	ortho-Phosphate	1,270,000	mg/kg	6	1	17	4.0	4.3	29	29	29	29	--	--	RISB-EJ-01	0	0	0.000023	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit
	Sulfate	N/A	mg/kg	15	15	100	--	--	65	11,000	410	1,820	3,100	1.7	RISB-ER-01	N/A	N/A	N/A	--
Radionuclides	Radium-226	0.023	pCi/g	15	15	100	--	--	0.90	1.7	1.2	1.2	0.23	0.19	RISB-EJ-04	100	100	75	--
	Radium-228	0.046	pCi/g	15	15	100	--	--	0.69	1.8	0.97	1.1	0.36	0.33	RISB-EJ-01	100	100	39	--
	Thorium-232	13	pCi/g	15	15	100	--	--	1.3	2.0	1.6	1.7	0.21	0.12	RISB-EJ-02	0	100	0.15	--
	Thorium-228	0.026	pCi/g	15	15	100	--	--	1.6	2.2	1.7	1.8	0.19	0.11	RISB-EJ-01	100	100	83	--
	Thorium-230	14	pCi/g	15	15	100	--	--	1.1	2.9	1.4	1.6	0.50	0.32	RISB-EJ-04	0	47	0.21	--
	Uranium-234	18	pCi/g	15	15	100	--	--	0.85	2.4	1.1	1.3	0.44	0.35	RISB-ER-01	0	6.7	0.13	--
	Uranium-235	0.33	pCi/g	15	15	100	--	--	0.0034	0.16	0.038	0.052	0.042	0.82	RISB-ER-01	0	60	0.47	--
	Uranium-238	1.5	pCi/g	15	15	100	--	--	0.81	1.5	1.0	1.1	0.25	0.22	RISB-EJ-02	6.7	100	1.0	--
Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.0027	mg/kg	15	15	100	--	--	0.00000050	0.00014	0.0000044	0.000016	0.000035	2.3	RISB-EJ-04	0	0	0.052	Site-specific action level
PAHs	Naphthalene	11	mg/kg	15	1	6.7	0.0040	0.0046	0.0051	0.0051	0.0051	0.0051	--	--	RISB-EJ-04	0	0	0.00045	--
Pesticides - OCPs	alpha-BHC	274	mg/kg	15	1	6.7	0.0015	0.0016	0.0030	0.0030	0.0030	0.0030	--	--	RISB-EJ-04	0	0	0.000011	--
	beta-BHC	55	mg/kg	15	6	40	0.0015	0.0016	0.0017	0.010	0.0069	0.0062	0.0037	0.60	RISB-EJ-04	0	0	0.00018	--
	2,4'-DDE	10	mg/kg	15	1	6.7	0.0015	0.0017	0.0025	0.0025	0.0025	0.0025	--	--	RISB-EJ-04	0	0	0.00024	Use 4,4'-DDE as a surrogate
Pesticides - OCPs	4,4'-DDE	10	mg/kg	15	3	20	0.0015	0.0017	0.0024	0.017	0.0024	0.0073	0.0084	1.2	RISB-EJ-04	0	0	0.0016	--
	4,4'-DDT	11	mg/kg	15	1	6.7	0.0015	0.0017	0.0035	0.0035	0.0035	0.0035	--	--	RISB-EJ-04	0	0	0.00033	--
Pesticides - OPPs	Propazine	18,200	mg/kg	15	1	6.7	0.0083	0.0093	0.014	0.014	0.014	0.014	--	--	RISB-EJ-04	0	0	0.00000077	--
VOCs	Acetone	746,000	mg/kg	15	1	6.7	0.0062	0.018	0.016	0.016	0.016	0.016	--	--	RISB-EJ-04	0	0	0.000000021	Use health-based BCL instead of non-health based upper-limit
	Toluene	52,000	mg/kg	15	2	13	0.00039	0.0011	0.00049	0.00062	0.00055	0.00055	0.000092	0.17	RISB-ER-03	0	0	0.000000012	Use health-based BCL instead of soil saturation level
	1,2,4-Trichlorobenzene	125	mg/kg	15	1	6.7	0.00078	0.0022	0.0014	0.0014	0.0014	0.0014	--	--	RISB-ER-02	0	0	0.000011	--

Notes:

-- = No value
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BHC = Hexachlorocyclohexane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
N/A = BCL (other screening value) not available for screen

OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text

[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2023), unless noted. For arsenic, lead, and 2,3,7,8-TCDD TEQ, the maximum detected concentration is compared directly to the screening level.

Source:

NDEP. 2023. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 16, June.

TABLE 4-3. Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Sample ID	Sample Type	Sample Date	Start Depth (ft bgs)	Long Amphibole Protocol Structures Count (s/sample)	Long Chrysotile Protocol Structures Count (s/sample)	Long Amphibole Analytical Sensitivity (s/g PM_{10})	Long Chrysotile Analytical Sensitivity (s/g PM_{10})
RISB-EJ-01-1.0-20190911	N	9/11/2019	1.0	0	0	2,590,000	2,590,000
RISB-EJ-02-1.0-20190911	N	9/11/2019	1.0	0	0	2,470,000	2,470,000
RISB-EJ-03-1.0-20190911	N	9/11/2019	1.0	0	0	2,090,000	2,090,000
RISB-EJ-03-1.0-20190911-FD	FD	9/11/2019	1.0	0	0	2,490,000	2,490,000
RISB-EJ-04-1.0-20190911	N	9/11/2019	1.0	0	0	2,000,000	2,000,000
RISB-ER-01-1.0-20190911	N	9/11/2019	1.0	0	0	2,840,000	2,840,000
RISB-ER-02-1.0-20190911	N	9/11/2019	1.0	0	0	2,790,000	2,790,000
RISB-ER-03-1.0-20190911	N	9/11/2019	1.0	0	0	2,050,000	2,050,000

Notes:

bgs = below ground surface

ft = feet

s/g PM_{10} = fiber per gram of particulate matter (< 10 micrometer)

s/sample = fiber per sample

FD = Field duplicate

N = Normal sample

TABLE 4-4. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics, and Radionuclides (0-10 ft bgs Soils)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	2005 CSM SRC? [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Chlorine Oxyanions	Chlorate	15	15	4.2	Yes	NA	NA	NA	NA	Manufactured at the Site from approximately 1945-1998; chlorate and perchlorate are frequently co-located. No manufacturing or disposal areas were located in Parcel E. Parcel E soil concentrations (0.057 mg/kg to 4.2 mg/kg for chlorate and <0.01 mg/kg to 6.1 mg/kg for perchlorate) are substantially lower than the concentrations reported in former manufacturing areas (above 1,000 mg/kg for chlorate and perchlorate).
	Perchlorate	15	13	6.1	Yes	NA	NA	NA	NA	
Metals	Antimony	15	3	0.36	Yes	LDF	E-2	E1-1 E2-1	NA	Although historically listed as a SRC, NDEP did not identify antimony as a specific contaminant for Parcel E. Concentrations are <0.1xBCL.
	Arsenic	15	15	5.9	Yes	No	E-2	E1-2 E2-2	NA	Hardesty/AMECCO (LOU4) manufactured sodium arsenite solution. NDEP did not identify arsenic as a potential contaminant for Parcel E. Concentrations are consistent with background and below the NDEP-approved remediation goal of 7.2 mg/kg.
	Barium	15	15	260	Yes	No	E-2	E1-3 E2-3	NA	NDEP identified barium as a potential contaminant at several LOUs, but not for Parcel E. Concentrations are consistent with background and <0.1xBCL.
	Boron	15	15	32	Yes	Yes	E-2	E1-4 E2-4	NA	Kerr-McGee manufactured boron at the Site beginning in approximately 1994, and EMD continues to operate a boron plant. No boron manufacturing or disposal areas have been located in Parcel E. Concentrations are above background but <0.1xBCL.
	Chromium VI	15	2	0.33	Yes	LDF	E-2	E1-6 E2-6	NA	In unimpacted soils, chromium VI concentrations are typically below detection limits (i.e., <0.15 to 0.17 mg/kg). Historically, hexavalent chromium (as sodium dichromate) was used extensively for production of sodium chlorate and sodium perchlorate within the Operations Area, but there were no manufacturing activity located in Parcel E. Concentrations are <0.1xBCL.
	Cobalt	15	15	6.6	Yes	No	E-2	E1-7 E2-7	NA	Cobalt may be a by-product of manganese production and within the Operations Area, cobalt was generally found to co-locate with manganese. Cobalt is not known to have been used at Parcel E. Concentrations consistent with background and <0.1xBCL.
	Copper	15	15	19	Yes	No	E-2	E1-8 E2-8	NA	Although historically listed as a SRC, NDEP did not identify copper as a specific contaminant for Parcel E. Concentrations are consistent with background and <0.1xBCL.
	Iron	15	15	16,000	Yes	Yes	E-2	E1-9 E2-9	NA	NDEP identified iron as a potential contaminant at multiple LOUs within the Operations Area but did not identify iron as a specific contaminant for Parcel E. Concentrations are above background but <0.1xBCL.
	Lead	15	15	10	Yes	No	E-2	E1-10 E2-10	NA	NDEP identified lead as a potential contaminant at several LOUs within the Operations Area but did not identify lead as a specific contaminant for Parcel E. Concentrations are consistent with background and less than the lead BCL.
	Magnesium	15	15	16,000	Yes	No	E-2	E1-11 E2-11	NA	Produced at the Site from approximately 1942 to 1944. NDEP identified magnesium as a potential contaminant associated with numerous LOUs within the Operations Area, but did not identify magnesium as a specific contaminant for Parcel E. Concentrations are consistent with background and <0.1x the health-based BCL.
	Manganese	15	15	470	Yes	No	E-2	E1-12 E2-12	NA	Produced at the Site since 1951; ongoing production by EMD. Concentrations are consistent with background and <0.1xBCL.
	Mercury	15	11	0.40	Yes	Yes	E-2	E1-13 E2-13	NA	Although historically identified as a SRC, NDEP did not identify mercury as a specific contaminant for Parcel E. Concentrations are above background but <0.1xBCL.
	Nickel	15	15	21	Yes	No	E-2	E1-15 E2-15	NA	Although historically identified as a SRC, NDEP did not identify nickel as a specific contaminant for Parcel E. Concentrations are consistent with background and <0.1xBCL.
	Phosphorus (total)	15	15	1,300	Yes	No	E-2	E1-16 E2-16	NA	Although historically identified as a SRC, NDEP did not identify phosphorus as a specific contaminant for Parcel E. Concentrations are consistent with background and <0.1xBCL. *See related discussion for "phosphates."*
	Strontium	15	15	330	Yes	No	E-2	E1-18 E2-18	NA	Although historically listed as a SRC, NDEP did not identify strontium as a specific contaminant for Parcel E. Concentrations are consistent with background and <0.1xBCL.
	Vanadium	15	15	53	Yes	Yes	E-2	E1-21 E2-21	NA	Although historically identified as a SRC, NDEP did not identify vanadium as a specific contaminant for Parcel E. Concentrations are greater than background but <0.1xBCL.
	Zirconium	15	15	22	No	No	E-2	E1-22 E2-22	Figure F1-4	Not historically listed as a SRC. Concentrations are consistent with background.

TABLE 4-4. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics, and Radionuclides (0-10 ft bgs Soils)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	2005 CSM SRC? [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Other Inorganics	Ammonia	15	15	4.9	Yes	NA	NA	NA	NA	This group of inorganic compounds includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. All compounds were historically identified as SRCs in the Operations Area. These compounds are generally highly soluble when present as free anions or cations. Many of these compounds are physiological electrolytes and/or occur naturally in foods. At the concentrations detected in soil, these inorganics do not present human health concerns. (Many are physiological electrolytes and/or occur naturally in foods.) Generally, these inorganics are of greater concern when detected as contaminants in groundwater than when present at elevated concentrations in soil.
	Bromide	15	3	15	Yes	NA	NA	NA	NA	
	Chloride	15	15	2,600	Yes	NA	NA	NA	NA	
	Nitrate	15	10	230	Yes	NA	NA	NA	NA	
	ortho-Phosphate	6	1	29	Yes	NA	NA	NA	NA	
	Sulfate	15	15	11,000	Yes	NA	NA	NA	NA	
Radionuclides	Radium-226	15	15	1.7	Yes	No	E-4	E1-26 E2-26	NA	Although historically listed as SRCs, radionuclides are not known to be associated with any of the former/current operations at the Site. Although no potential source areas were identified, soil samples were analyzed for radionuclides. Although thorium-230 failed the statistical testing for background consistency, the results of background analysis must be interpreted with caution given the issues associated with sample preparation and analytical methods.
	Radium-228	15	15	1.8	Yes	No	E-4	E1-28 E2-28	NA	
	Thorium-232	15	15	2.0	Yes	No	E-4	E1-27 E2-27	Figure F1-1	
	Thorium-228	15	15	2.2	Yes	No	E-4	E1-29 E2-29	NA	
	Thorium-230	15	15	2.9	Yes	Yes	E-4	E1-25 E2-25	NA	
	Uranium-234	15	15	2.4	Yes	No	E-4	E1-24 E2-24	NA	
	Uranium-235	15	15	0.16	Yes	No	E-4	E1-30 E2-30	Figure F1-2	
	Uranium-238	15	15	1.5	Yes	No	E-4	E1-23 E2-23	Figure F1-3	

Notes:

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BCL = Basic comparison level
CSM = Conceptual site model

HRA = Health risk assessment
LDF = Low detection frequency (<25%) in either site or background datasets. Background comparison results may not be applicable.
LOU = Letter of Understanding
NA = Not applicable
NDEP = Nevada Division of Environmental Protection
SRC = Site related chemical, as identified in the Conceptual Site Model (ENSR 2005)

Listed analytes are those detected in one or more soil samples in the Parcel E HRA Study Area.

[1] Concentrations are in mg/kg for all groups except radionuclides; radionuclide activities are in pCi/g.

[2] From Table 5 of the ENSR (2005) Conceptual Site Model report.

[3] Based on information from: ENSR 2005; ENVIRON 2011; NDEP 2011; and Ramboll Environ 2016.
Statements as to whether an analyte was historically listed as a SRC are based on the list of SRCs in Table 5 of the ENSR (2005) Conceptual Site Model report.
Statements regarding NDEP's identification of an analyte as associated with an LOU are based on the NDEP 2011 Action Memorandum.
It is recognized that a specific analyte may have been identified as a SRC in later investigations or as an LOU contaminant in other documents prepared for the Site.

Sources:

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.

ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.

NDEP. 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July.

Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.

TABLE 4-5. Exploratory Data Analysis: Comments for Dioxins/Furans, Other Organics, PAHs, Pesticides, SVOCs, and VOCs (0-10 ft bgs Soils)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration (mg/kg)	2005 CSM SRC? [1]	Comment [2]
Dioxin/Furans	2,3,7,8-TCDD TEQ*	15	15	0.00014	Yes	Unintentional by-product of high-temperature processes, e.g., incomplete combustion and pesticide production (a source of chlorine is required). Highly persistent. High detection frequency due, in part, to sensitive analytical methods. Concentrations are below the NDEP-approved action level of 0.0027 mg/kg.
PAHs	Naphthalene	15	1	0.0051	Yes	Naphthalene was historically listed as a SRC. Low detection frequency. Concentrations are <0.1xBCL.
Pesticides - OCPs	alpha-BHC	15	1	0.0030	No	Not listed historically as a SRC. However, the former Stauffer facility (to the west) produced gamma-BHC (lindane) from 1946 through 1958; the alpha and beta isomers are by-products of lindane production. Concentrations are <0.1xBCL.
	beta-BHC	15	6	0.010	No	
	2,4'-DDE	15	1	0.0025	Yes	Historical information indicates that Hardesty/AMECCO (1946-1949, LOU4) listed DDT for production. Low detection frequencies. The detected concentrations of DDT and related compounds in Parcel E are relatively low and <0.1xBCL.
	4,4'-DDE	15	3	0.017	Yes	
	4,4'-DDT	15	1	0.0035	Yes	
Pesticides - OPPs	Propazine	15	1	0.014	No	Although OPPs were historically listed as SRCs, NDEP did not identify propazine as a specific contaminant for Parcel E. Low detection frequency. Concentrations are <0.1xBCL.
VOCs	Acetone	15	1	0.016	Yes	Historically, a number of individual VOCs were listed as SRCs. NDEP identified "VOCs" (as a general category) as possible contaminants at several LOUs in the Operations Area, but not for Parcel E. The soil sampling results show that VOCs were detected at low frequencies and low concentrations, not indicative of a source. Several of the VOCs are common field/laboratory contaminants, for example, acetone and toluene.
	Toluene	15	2	0.00062	Yes	
	1,2,4-Trichlorobenzene	15	1	0.0014	No	

Notes:

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
BCL = Basic comparison level
BHC = Hexachlorocyclohexane
CSM = Conceptual site model
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
HRA = Health risk assessment
LOU = Letter of Understanding
NA = Not applicable

NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticides
OPP = Organophosphorus pesticides
PAH = Polycyclic aromatic hydrocarbons
SRC = Site related chemical, as identified in the Conceptual Site Model (ENSR 2005)
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text

Listed analytes are those detected in one or more samples in the Parcel E HRA Study Area.

[1] From Table 5 of the ENSR (2005) Conceptual Site Model report.

[2] Based on information from: ENSR 2005; ENVIRON 2011; NDEP 2011; and Ramboll Environ 2016.
Statements as to whether an analyte was historically listed as a SRC are based on the list of SRCs in Table 5 of the ENSR (2005) Conceptual Site Model report.
Statements regarding NDEP's identification of an analyte as associated with an LOU are based on the NDEP 2011 Action Memorandum.
It is recognized that a specific analyte may have been identified as a SRC in later investigations or as an LOU contaminant in other documents prepared for the Site.

Sources:

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.

ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.

NDEP. 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July.

Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.

TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
Acrylonitrile	651	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	8	1	13	1.7	19	0	0
tert-Amyl methyl ether	79,800,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	1	0	0	0.082	0.082	0	0
Benzene	1.75E+17	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	9	56	1.3	1.3	0	0
Benzyl chloride	1,560	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	0	0	0.14	13	0	0
Bromodichloromethane	2,320	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	2	13	0.082	6.6	0	0
Bromoform	120,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	0	0	0.12	11	0	0
Bromomethane	89,100	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	9	0	0	0.082	19	0	0
2-Butanone	95,400,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	6	38	1.7	8.7	0	0
sec-Butylbenzene	13,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	1	0	0	0.095	0.095	0	0
tert-Butylbenzene	13,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	1	0	0	0.082	0.082	0	0
Carbon disulfide	11,800,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	11	69	0.44	4.8	0	0
Carbon tetrachloride	14,100	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	7	44	0.66	6.0	0	0
3-Chloro-1-propene	8,880	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	1	0	0	0.082	0.082	0	0
Chlorobenzene	1,210,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	7	44	0.062	1.5	0	0
Chloroethane	173,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	15	94	4.1	4.1	0	0
Chloroform	2,780	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	15	94	2.3	2.3	0	0
Chloromethane	1,330,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	2	13	0.082	6.0	0	0
Cumene	11,500,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	1	0	0	0.091	0.091	0	0
1,2-Dibromo-3-chloropropane	24	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	8	0	0	0.12	86	2	7
Dibromochloromethane	N/A	--	μg/m^3	16	0	0	0.11	10	--	--
1,2-Dibromoethane	184	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	0	0	0.024	8.6	0	0
1,2-Dichlorobenzene	6,140,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	5	31	0.11	3.9	0	0
1,3-Dichlorobenzene	5,060,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	7	44	0.20	3.3	0	0
1,4-Dichlorobenzene	7,970	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	5	31	0.10	4.5	0	0
Dichlorodifluoromethane	2,310,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	15	94	11	11	0	0
1,1-Dichloroethane	37,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	13	81	1.5	1.5	0	0
1,2-Dichloroethane	2,220	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	11	69	1.8	1.8	0	0
1,1-Dichloroethene	4,100,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	7	44	0.014	4.2	0	0
cis-1,2-Dichloroethene	802,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	2	13	0.0072	5.2	0	0
trans-1,2-Dichloroethene	809,000	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	5	31	0.0079	5.9	0	0
1,2-Dichloropropane	18,100	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	16	1	6.3	0.082	16	0	0
1,3-Dichloropropene	16,100	Indoor Commercial/Industrial Workers - 5ft bgs	μg/m^3	9	0	0	0.10	7.0	0	0

TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
Diisopropyl ether	18,600,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	1	0	0	0.096	0.096	0	0
1,4-Dioxane	8,970	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	8	1	13	0.11	1.2	0	0
Ethanol	1,280,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	8	6	75	1.8	3.7	0	0
Ethyl tert-butyl ether	931,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	1	0	0	0.083	0.083	0	0
Ethyl acetate	1,490,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	7	0	0	2.9	32	0	0
Ethylbenzene	28,500	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	5	31	0.0080	4.1	0	0
4-Ethyltoluene	9,360,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	1	6.3	0.086	14	0	0
1,2-Dichlorotetrafluoroethane	226,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	9	1	11	5.4	16	--	--
n-Heptane	11,300,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	8	1	13	0.28	3.0	0	0
Hexachlorobutadiene	8,010	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	4	25	1.2	68	0	0
n-Hexane	16,800,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	7	0	0	0.55	6.1	0	0
2-Hexanone	735,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	1	6.3	0.25	5.3	0	0
Methyl tert-butyl ether	251,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	1	0	0	0.082	0.082	0	0
4-Methyl-2-pentanone	74,400,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	1	6.3	0.046	8.2	0	0
Methylene Chloride	5,020,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	14	88	0.93	1.3	0	0
Methylmethacrylate	16,300,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	8	0	0	0.12	36	0	0
Naphthalene	2,350	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	8	1	13	0.13	1.4	0	0
Styrene	24,600,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	1	6.3	0.10	3.7	0	0
1,1,1,2-Tetrachloroethane	13,500	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	7	0	0	5.5	61	--	0
1,1,2,2-Tetrachloroethane	1,680	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	0	0	0.050	7.0	0	0
Tetrachloroethene	367,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	14	88	1.7	1.7	0	0
Tetrahydrofuran	35,500,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	7	2	29	0.34	3.8	0	0
Toluene	113,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	10	63	0.96	2.9	0	0
1,2,4-Trichlorobenzene	85,800	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	3	19	0.12	48	0	0
1,1,1-Trichloroethane	134,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	9	0	0	0.082	5.3	0	0
1,1,2-Trichloroethane	4,550	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	6	38	0.015	5.4	0	0
Trichloroethene	17,400	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	14	88	2.8	2.8	0	0
Trichlorofluoromethane	N/A	--	µg/m^3	16	8	50	5.5	16	--	--
1,2,3-Trichloropropane	8,980	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	7	0	0	4.8	53	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	226,000,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	6	38	1.1	19	0	0
1,2,4-Trimethylbenzene	1,710,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	2	13	0.057	12	0	0
1,3,5-Trimethylbenzene	1,730,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	0	0	0.081	9.1	0	0

TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
Vinyl acetate	4,160,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	1	6.3	0.55	7.6	0	0
Vinyl chloride	10,700	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	4	25	0.0060	4.6	0	0
Xylenes (total)	2,550,000	Indoor Commercial/Industrial Workers - 5ft bgs	µg/m^3	16	10	63	2.2	6.4	0	0

Notes:

-- = Not applicable

bgs = below ground surface

ft = feet

µg/m^3 = microgram per cubic meter

N/A = No screening level available

RBTC = Risk-based target concentration

SQL = Sample quantitation limit

[1] Screening levels are the lowest RBTCs among indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers.

TABLE 4-7a. Summary Statistics for Soil Gas (5 ft bgs)
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects									Ratio of Maximum to Screen
						Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	
Acetone	512,000,000	μg/m^3	10	10	100	--	--	3.1	19	7.3	9.9	6.2	0.63	SG17	0	0	3.7E-08
Acrylonitrile	651	μg/m^3	5	1	20	1.7	9.4	0.15	0.15	0.15	0.15	--	--	SG17	0	0	2.3E-04
tert-Amyl methyl ether	79,800,000	μg/m^3	1	0	0	0.082	0.082	--	--	--	--	--	--	--	--	--	--
Benzene	1.75E+17	μg/m^3	10	5	50	1.3	1.3	0.039	1.6	0.23	0.57	0.68	1.2	SG17	0	0	9.1E-18
Benzyl chloride	1,560	μg/m^3	10	0	0	0.14	4.2	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	2,320	μg/m^3	10	0	0	0.082	2.2	--	--	--	--	--	--	--	--	--	--
Bromoform	120,000	μg/m^3	10	0	0	0.12	3.6	--	--	--	--	--	--	--	--	--	--
Bromomethane	89,100	μg/m^3	6	0	0	0.082	6.5	--	--	--	--	--	--	--	--	--	--
2-Butanone	95,400,000	μg/m^3	10	4	40	1.7	2.9	0.48	5.5	0.64	1.8	2.5	1.4	SG17	0	0	5.8E-08
tert-Butyl alcohol	90,900,000	μg/m^3	1	1	100	--	--	0.62	0.62	0.62	0.62	--	--	SG17	0	0	6.8E-09
n-Butylbenzene	13,100,000	μg/m^3	1	1	100	--	--	0.22	0.22	0.22	0.22	--	--	SG17	0	0	1.7E-08
sec-Butylbenzene	13,000,000	μg/m^3	1	0	0	0.095	0.095	--	--	--	--	--	--	--	--	--	--
tert-Butylbenzene	13,000,000	μg/m^3	1	0	0	0.082	0.082	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	11,800,000	μg/m^3	10	7	70	0.44	2.4	1.5	14	11	8.9	4.8	0.54	RISG-32	0	0	1.2E-06
Carbon tetrachloride	14,100	μg/m^3	10	5	50	2.0	2.0	0.28	0.51	0.43	0.42	0.088	0.21	RISG-32	0	0	3.6E-05
3-Chloro-1-propene	8,880	μg/m^3	1	0	0	0.082	0.082	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	1,210,000	μg/m^3	10	4	40	0.062	1.5	0.11	2.5	0.38	0.84	1.1	1.3	RISG-33	0	0	2.1E-06
Chloroethane	173,000,000	μg/m^3	10	9	90	4.1	4.1	0.98	57	16	25	22	0.89	RISG-33	0	0	3.3E-07
Chloroform	2,780	μg/m^3	10	9	90	2.3	2.3	1.8	1,000	36	310	420	1.3	RISG-33	0	33	3.6E-01
Chloromethane	1,330,000	μg/m^3	10	1	10	0.082	2.0	0.19	0.19	0.19	0.19	--	--	RISG-31	0	0	1.4E-07
Cumene	11,500,000	μg/m^3	1	0	0	0.091	0.091	--	--	--	--	--	--	--	--	--	--
Cyclohexane	132,000,000	μg/m^3	4	4	100	--	--	0.088	9.0	0.34	2.4	4.4	1.8	RISG-33	0	0	6.8E-08
p-Cymene	9,360,000	μg/m^3	1	1	100	--	--	0.19	0.19	0.19	0.19	--	--	SG17	0	0	2.0E-08
1,2-Dibromo-3-chloropropane	24	μg/m^3	5	0	0	0.12	42	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	N/A	μg/m^3	10	0	0	0.11	3.4	--	--	--	--	--	--	--	N/A	N/A	N/A
1,2-Dibromoethane	184	μg/m^3	10	0	0	0.024	2.9	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	6,140,000	μg/m^3	10	2	20	0.11	3.9	4.8	4.9	4.9	4.9	0.071	0.015	RISG-33	0	0	8.0E-07
1,3-Dichlorobenzene	5,060,000	μg/m^3	10	4	40	0.20	3.3	0.14	12	4.2	5.1	5.9	1.2	RISG-33	0	0	2.4E-06
1,4-Dichlorobenzene	7,970	μg/m^3	10	2	20	0.10	4.5	0.52	2.0	1.3	1.3	1.0	0.83	RISG-33	0	0	2.5E-04
Dichlorodifluoromethane	2,310,000	μg/m^3	10	10	100	--	--	1.8	4.2	3.0	3.0	1.1	0.37	RISG-33	0	0	1.8E-06
1,1-Dichloroethane	37,000	μg/m^3	10	8	80	1.5	1.5	0.40	170	5.3	62	82	1.3	RISG-33	0	0	4.6E-03
1,2-Dichloroethane	2,220	μg/m^3	10	7	70	1.8	1.8	0.015	17	2.3	7.8	8.6	1.1	RISG-33	0	0	7.7E-03
1,1-Dichloroethene	4,100,000	μg/m^3	10	5	50	0.014	1.4	0.036	1.8	1.3	1.0	0.81	0.79	RISG-33	0	0	4.4E-07
cis-1,2-Dichloroethene	802,000	μg/m^3	10	1	10	0.0072	1.8	2.2	2.2	2.2	2.2	--	--	RISG-31	0	0	2.70E-06
trans-1,2-Dichloroethene	809,000	μg/m^3	10	2	20	0.0079	2.0	0.12	0.44	0.28	0.28	0.23	0.81	RISG-33	0	0	5.40E-07
1,2-Dichloropropane	18,100	μg/m^3	10	0	0	0.082	5.5	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropene	16,100	μg/m^3	6	0	0	0.10	2.4	--	--	--	--	--	--	--	--	--	--
Diisopropyl ether	18,600,000	μg/m^3	1	0	0	0.096	0.096	--	--	--	--	--	--	--	--	--	--
1,4-Dioxane	8,970	μg/m^3	5	1	20	0.11	0.59	0.51	0.51	0.51	0.51	--	--	SG17	0	0	5.7E-05
Ethanol	1,280,000,000	μg/m^3	5	4	80	1.8	1.8	0.52	7.3	0.62	2.3	3.4	1.5	SG17	0	0	5.7E-09
Ethyl tert-butyl ether	931,000	μg/m^3	1	0	0	0.083	0.083	--	--	--	--	--	--	--	--	--	--
Ethyl acetate	1,490,000	μg/m^3	4	0	0	2.9	16	--	--	--	--	--	--	--	--	--	--

TABLE 4-7a. Summary Statistics for Soil Gas (5 ft bgs)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects									
						Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	Ratio of Maximum to Screen
Ethylbenzene	28,500	µg/m^3	10	3	30	0.0080	1.4	0.014	0.16	0.025	0.066	0.081	1.2	SG17	0	0	5.6E-06
4-Ethyltoluene	9,360,000	µg/m^3	10	1	10	0.086	4.6	0.11	0.11	0.11	0.11	--	--	SG17	0	0	1.2E-08
1,2-Dichlorotetrafluoroethane	226,000,000	µg/m^3	6	1	17	5.4	5.4	0.098	0.098	0.098	0.098	--	--	SG17	0	0	4.3E-10
n-Heptane	11,300,000	µg/m^3	5	1	20	0.28	1.5	0.51	0.51	0.51	0.51	--	--	SG17	0	0	4.5E-08
Hexachlorobutadiene	8,010	µg/m^3	10	2	20	1.2	23	0.26	12	6.1	6.1	8.3	1.4	RISG-33	0	0	1.5E-03
n-Hexane	16,800,000	µg/m^3	4	0	0	0.55	3.0	--	--	--	--	--	--	--	--	--	--
2-Hexanone	735,000	µg/m^3	10	1	10	0.25	1.8	0.83	0.83	0.83	0.83	--	--	SG17	0	0	1.1E-06
alpha-Methyl styrene	27,600,000	µg/m^3	1	1	100	--	--	0.19	0.19	0.19	0.19	--	--	SG17	0	0	6.9E-09
Methyl tert-butyl ether	251,000	µg/m^3	1	0	0	0.082	0.082	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	74,400,000	µg/m^3	10	1	10	0.046	2.8	0.37	0.37	0.37	0.37	--	--	SG17	0	0	5.0E-09
Methylene Chloride	5,020,000	µg/m^3	10	8	80	0.93	1.3	1.8	35	7.5	12	11	0.98	RISG-31	0	0	7.0E-06
Methylmethacrylate	16,300,000	µg/m^3	5	0	0	0.12	18	--	--	--	--	--	--	--	--	--	--
Naphthalene	2,350	µg/m^3	5	1	20	0.13	0.69	0.92	0.92	0.92	0.92	--	--	SG17	0	0	3.9E-04
n-Octane	563,000	µg/m^3	1	1	100	--	--	0.36	0.36	0.36	0.36	--	--	SG17	0	0	6.4E-07
n-Propylbenzene	28,800,000	µg/m^3	1	1	100	--	--	0.088	0.088	0.088	0.088	--	--	SG17	0	0	3.1E-09
Styrene	24,600,000	µg/m^3	10	1	10	0.10	1.3	0.46	0.46	0.46	0.46	--	--	SG17	0	0	1.9E-08
1,1,1,2-Tetrachloroethane	13,500	µg/m^3	4	0	0	5.5	30	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	1,680	µg/m^3	10	0	0	0.050	2.4	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	367,000	µg/m^3	10	9	90	1.7	1.7	0.55	200	25	64	76	1.2	RISG-33	0	0	5.5E-04
Tetrahydrofuran	35,500,000	µg/m^3	4	1	25	0.34	1.8	0.40	0.40	0.40	0.40	--	--	RISG-31	0	0	1.1E-08
Toluene	113,000,000	µg/m^3	10	7	70	0.96	0.96	0.036	2.2	0.097	0.78	0.95	1.2	SG17	0	0	1.9E-08
1,2,4-Trichlorobenzene	85,800	µg/m^3	10	1	10	0.12	16	21	21	21	21	--	--	RISG-33	0	0	2.4E-04
1,1,1-Trichloroethane	134,000,000	µg/m^3	6	0	0	0.082	1.8	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	4,550	µg/m^3	10	5	50	0.015	1.8	0.032	3.5	1.2	1.7	1.6	0.93	RISG-33	0	0	7.7E-04
Trichloroethene	17,400	µg/m^3	10	9	90	2.8	2.8	0.18	71	11	26	29	1.1	RISG-33	0	0	4.1E-03
Trichlorofluoromethane	N/A	µg/m^3	10	5	50	5.5	5.5	1.0	1.3	1.2	1.2	0.12	0.10	RISG-33	N/A	N/A	N/A
1,2,3-Trichloropropane	8,980	µg/m^3	4	0	0	4.8	26	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	226,000,000	µg/m^3	10	4	40	1.1	6.2	0.46	0.56	0.52	0.52	0.042	0.082	RISG-34	0	0	2.5E-09
1,2,4-Trimethylbenzene	1,710,000	µg/m^3	10	1	10	0.057	4.0	0.35	0.35	0.35	0.35	--	--	SG17	0	0	2.0E-07
1,3,5-Trimethylbenzene	1,730,000	µg/m^3	10	0	0	0.081	3.1	--	--	--	--	--	--	--	--	--	--
Vinyl acetate	4,160,000	µg/m^3	10	1	10	0.55	3.0	5.1	5.1	5.1	5.1	--	--	SG17	0	0	1.2E-06
Vinyl chloride	10,700	µg/m^3	10	2	20	0.0060	1.5	0.086	0.19	0.14	0.14	0.074	0.53	RISG-31	0	0	1.8E-05
Xylenes (total)	2,550,000	µg/m^3	10	7	70	2.2	2.2	0.041	5.1	0.38	1.7	2.4	1.4	RISG-34	0	0	2.0E-06

Notes:

-- = No value	µg/m^3 = microgram per cubic meter
bgs = below ground surface	N/A = RBTC not available for screen
ft = feet	RBTC = Risk-based target concentration

[1] Screening levels are the lowest RBTCs among indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers at 5 ft bgs.

TABLE 4-7b. Summary Statistics for Soil Gas (15 ft bgs)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

						Nondetects		Detects									
Analyte	**Screening Levels[1]**	**Unit**	**No. of Samples**	**No. of Detects**	**% Detects**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Median**	**Mean**	**Standard Deviation**	**Coefficient of Variation**	**Location of Maximum**	**Percent of Samples Above Screen**	**Percent of Samples Above 10% of Screen**	**Ratio of Maximum to Screen**
Acetone	1,580,000,000	$\mu g/m^3$	6	6	100	--	--	4.0	20	6.8	9.3	5.9	0.63	RISG-34	0	0	1.3E-08
Acrylonitrile	2,010	$\mu g/m^3$	3	0	0	1.8	19	--	--	--	--	--	--	--	--	--	--
Benzene	4.08E+18	$\mu g/m^3$	6	4	67	1.3	1.3	0.13	17	3.5	6.0	7.5	1.3	RISG-33	0	0	4.2E-18
Benzyl chloride	4,960	$\mu g/m^3$	6	0	0	0.15	13	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	7,410	$\mu g/m^3$	6	2	33	1.9	6.6	0.27	0.48	0.38	0.38	0.15	0.40	RISG-34	0	0	6.5E-05
Bromoform	388,000	$\mu g/m^3$	6	0	0	0.26	11	--	--	--	--	--	--	--	--	--	--
Bromomethane	278,000	$\mu g/m^3$	3	0	0	6.5	19	--	--	--	--	--	--	--	--	--	--
2-Butanone	298,000,000	$\mu g/m^3$	6	2	33	2.9	8.7	0.80	2.0	1.4	1.4	0.85	0.61	RISG-32	0	0	6.7E-09
Carbon disulfide	36,700,000	$\mu g/m^3$	6	4	67	0.46	4.8	0.73	7.2	5.2	4.6	3.1	0.68	RISG-33	0	0	2.0E-07
Carbon tetrachloride	45,000	$\mu g/m^3$	6	2	33	0.66	6.0	0.52	0.55	0.54	0.54	0.021	0.040	RISG-34	0	0	1.2E-05
Chlorobenzene	3,840,000	$\mu g/m^3$	6	3	50	0.066	1.5	3.2	32	10	15	15	1.0	RISG-33	0	0	8.3E-06
Chloroethane	538,000,000	$\mu g/m^3$	6	6	100	--	--	8.9	200	60	85	82	0.96	RISG-33	0	0	3.7E-07
Chloroform	8,770	$\mu g/m^3$	6	6	100	--	--	39	2,900	84	840	1,250	1.5	RISG-33	0	33	3.3E-01
Chloromethane	4,070,000	$\mu g/m^3$	6	1	17	0.13	6.0	0.29	0.29	0.29	0.29	--	--	RISG-34	0	0	7.1E-08
Cyclohexane	416,000,000	$\mu g/m^3$	3	3	100	--	--	0.12	38	0.26	13	22	1.7	RISG-33	0	0	9.1E-08
1,2-Dibromo-3-chloropropane	78	$\mu g/m^3$	3	0	0	8.2	86	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	N/A	$\mu g/m^3$	6	0	0	0.14	10	--	--	--	--	--	--	--	N/A	N/A	N/A
1,2-Dibromoethane	593	$\mu g/m^3$	6	0	0	0.025	8.6	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	19,600,000	$\mu g/m^3$	6	3	50	0.15	3.9	1.7	27	19	16	13	0.81	RISG-33	0	0	1.4E-06
1,3-Dichlorobenzene	16,000,000	$\mu g/m^3$	6	3	50	0.22	3.3	1.8	130	57	63	64	1.0	RISG-33	0	0	8.1E-06
1,4-Dichlorobenzene	25,500	$\mu g/m^3$	6	3	50	0.11	4.5	0.80	28	16	15	14	0.91	RISG-33	0	0	1.1E-03
Dichlorodifluoromethane	7,290,000	$\mu g/m^3$	6	5	83	11	11	1.8	4.1	2.0	2.7	1.1	0.41	RISG-34	0	0	5.6E-07
1,1-Dichloroethane	116,000	$\mu g/m^3$	6	5	83	1.5	1.5	1.9	660	19	240	310	1.3	RISG-33	0	0	5.7E-03
1,2-Dichloroethane	6,970	$\mu g/m^3$	6	4	67	1.8	1.8	0.32	98	39	44	48	1.1	RISG-33	0	0	1.4E-02
1,1-Dichloroethene	12,900,000	$\mu g/m^3$	6	2	33	0.015	4.2	0.21	5.6	2.9	2.9	3.8	1.3	RISG-33	0	0	4.3E-07
cis-1,2-Dichloroethene	2,520,000	$\mu g/m^3$	6	1	17	0.0076	5.2	0.19	0.19	0.19	0.19	--	--	RISG-33	0	0	0.000000076
trans-1,2-Dichloroethene	2,540,000	$\mu g/m^3$	6	3	50	2.0	5.9	0.054	1.7	0.080	0.61	0.94	1.5	RISG-33	0	0	0.00000067
1,2-Dichloropropane	57,100	$\mu g/m^3$	6	1	17	0.14	16	1.9	1.9	1.9	1.9	--	--	RISG-33	0	0	3.3E-05
1,3-Dichloropropene	50,900	$\mu g/m^3$	3	0	0	2.4	7.0	--	--	--	--	--	--	--	--	--	--
1,4-Dioxane	27,700	$\mu g/m^3$	3	0	0	0.11	1.2	--	--	--	--	--	--	--	--	--	--
Ethanol	3,890,000,000	$\mu g/m^3$	3	2	67	3.7	3.7	0.81	1.5	1.2	1.2	0.49	0.42	RISG-32	0	0	3.9E-10
Ethyl acetate	4,680,000	$\mu g/m^3$	3	0	0	3.0	32	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	90,500	$\mu g/m^3$	6	2	33	0.089	4.1	0.013	0.084	0.049	0.049	0.050	1.0	RISG-34	0	0	9.3E-07
4-Ethyltoluene	29,600,000	$\mu g/m^3$	6	0	0	0.091	14	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorotetrafluoroethane	730,000,000	$\mu g/m^3$	3	0	0	5.4	16	--	--	--	--	--	--	--	--	--	--

TABLE 4-7b. Summary Statistics for Soil Gas (15 ft bgs)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects									
						Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	Ratio of Maximum to Screen
n-Heptane	35,900,000	$\mu g/m^3$	3	0	0	0.29	3.0	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	26,000	$\mu g/m^3$	6	2	33	1.3	68	6.8	54	30	30	33	1.1	RISG-33	0	0	2.1E-03
n-Hexane	53,000,000	$\mu g/m^3$	3	0	0	0.58	6.1	--	--	--	--	--	--	--	--	--	--
2-Hexanone	2,330,000	$\mu g/m^3$	6	0	0	0.26	5.3	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	236,000,000	$\mu g/m^3$	6	0	0	0.049	8.2	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	15,600,000	$\mu g/m^3$	6	6	100	--	--	2.8	24	16	13	8.9	0.66	RISG-33	0	0	1.5E-06
Methylmethacrylate	51,500,000	$\mu g/m^3$	3	0	0	3.5	36	--	--	--	--	--	--	--	--	--	--
Naphthalene	7,480	$\mu g/m^3$	3	0	0	0.13	1.4	--	--	--	--	--	--	--	--	--	--
Styrene	77,800,000	$\mu g/m^3$	6	0	0	0.11	3.7	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	43,200	$\mu g/m^3$	3	0	0	5.8	61	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	5,400	$\mu g/m^3$	6	0	0	0.052	7.0	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	1,170,000	$\mu g/m^3$	6	5	83	1.7	1.7	62	530	110	250	220	0.88	RISG-33	0	0	4.5E-04
Tetrahydrofuran	110,000,000	$\mu g/m^3$	3	1	33	0.36	3.8	0.65	0.65	0.65	0.65	--	--	RISG-34	0	0	5.9E-09
Toluene	356,000,000	$\mu g/m^3$	6	3	50	0.96	2.9	0.053	1.0	0.26	0.44	0.50	1.1	RISG-34	0	0	2.8E-09
1,2,4-Trichlorobenzene	277,000	$\mu g/m^3$	6	2	33	1.2	48	11	130	70	70	84	1.2	RISG-33	0	0	4.7E-04
1,1,1-Trichloroethane	426,000,000	$\mu g/m^3$	3	0	0	1.8	5.3	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	14,400	$\mu g/m^3$	6	1	17	0.016	5.4	2.5	2.5	2.5	2.5	--	--	RISG-34	0	0	1.7E-04
Trichloroethene	55,000	$\mu g/m^3$	6	5	83	2.8	2.8	0.70	240	4.0	86	120	1.3	RISG-33	0	0	4.4E-03
Trichlorofluoromethane	N/A	$\mu g/m^3$	6	3	50	5.5	16	1.2	1.3	1.2	1.2	0.058	0.047	RISG-32	N/A	N/A	N/A
1,2,3-Trichloropropane	28,600	$\mu g/m^3$	3	0	0	5.1	53	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	730,000,000	$\mu g/m^3$	6	2	33	2.2	19	0.49	0.52	0.51	0.51	0.021	0.042	RISG-34	0	0	7.1E-10
1,2,4-Trimethylbenzene	5,460,000	$\mu g/m^3$	6	1	17	0.060	12	0.14	0.14	0.14	0.14	--	--	RISG-34	0	0	2.6E-08
1,3,5-Trimethylbenzene	5,500,000	$\mu g/m^3$	6	0	0	0.086	9.1	--	--	--	--	--	--	--	--	--	--
Vinyl acetate	13,100,000	$\mu g/m^3$	6	0	0	0.58	7.6	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	33,200	$\mu g/m^3$	6	2	33	0.0063	4.6	0.060	1.2	0.63	0.63	0.81	1.3	RISG-33	0	0	3.6E-05
Xylenes (total)	8,070,000	$\mu g/m^3$	6	3	50	2.2	6.4	0.053	1.4	0.23	0.55	0.71	1.3	RISG-33	0	0	1.7E-07

Notes:

-- = No value	$\mu g/m^3$ = microgram per cubic meter
bgs = below ground surface	N/A = RBTC not available for screen
ft = feet	RBTC = Risk-based target concentration

[1] Screening levels are the lowest RBTCs among indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers at 15 ft bgs.

TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
Benzene	8.96E+16	Indoor Commercial/Industrial Workers	µg/L	11	5	45	0.25	0.25	0	0
Bromobenzene	294,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Bromochloromethane	181,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Bromodichloromethane	343	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.25	50	0	2
Bromoform	70,100	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.40	80	0	0
Bromomethane	3,340	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
2-Butanone	396,000,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	2.5	500	0	0
n-Butylbenzene	357,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.40	80	0	0
sec-Butylbenzene	315,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
tert-Butylbenzene	415,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Carbon tetrachloride	162	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.25	50	0	2
Chlorobenzene	131,000	Indoor Commercial/Industrial Workers	µg/L	11	8	73	0.25	0.25	0	0
Chloroethane	4,350,000	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.40	80	0	0
Chloroform	229	Indoor Commercial/Industrial Workers	µg/L	11	7	64	0.25	50	0	1
Chloromethane	39,100	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.25	50	0	0
2-Chlorotoluene	144,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
4-Chlorotoluene	120,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Cumene	392,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
p-Cymene	1,750	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,2-Dibromo-3-chloropropane	48	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.50	100	2	2
Dibromochloromethane	N/A	--	µg/L	11	0	0	0.25	50	--	--
1,2-Dibromoethane	87	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	2
Dibromomethane	44,800	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,2-Dichlorobenzene	1,150,000	Indoor Commercial/Industrial Workers	µg/L	11	2	18	0.25	0.25	0	0
1,3-Dichlorobenzene	584,000	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.25	50	0	0
1,4-Dichlorobenzene	1,180	Indoor Commercial/Industrial Workers	µg/L	11	3	27	0.25	0.25	0	0
Dichlorodifluoromethane	2,150	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	80	0	0
1,1-Dichloroethane	1,980	Indoor Commercial/Industrial Workers	µg/L	11	6	55	0.25	50	0	0

TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
1,2-Dichloroethane	568	Indoor Commercial/Industrial Workers	µg/L	11	2	18	0.25	50	0	0
1,1-Dichloroethene	45,600	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
cis-1,2-Dichloroethene	59,400	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	--	--
trans-1,2-Dichloroethene	25,900	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	--	--
1,2-Dichloropropane	2,020	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,3-Dichloropropane	30,600	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
2,2-Dichloropropane	1,330	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.40	80	0	0
1,1-Dichloropropene	2,060	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,3-Dichloropropene	1,480	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,4-Dioxane	433,000	Indoor Commercial/Industrial Workers	µg/L	11	8	73	0.50	100	0	0
Ethyl tert-butyl ether	124,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Ethylbenzene	1,260	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Hexachlorobutadiene	313	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	2
Methylene Chloride	447,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.88	180	0	0
Naphthalene	1,830	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.40	80	0	0
n-Propylbenzene	1,010,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Styrene	3,080,000	Indoor Commercial/Industrial Workers	µg/L	10	0	0	0.25	50	0	0
1,1,1,2-Tetrachloroethane	1,930	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,1,2,2-Tetrachloroethane	1,370	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Tetrachloroethene	7,120	Indoor Commercial/Industrial Workers	µg/L	11	5	45	0.25	50	0	0
Toluene	5,590,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,2,3-Trichlorobenzene	28,200	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.40	80	0	0
1,2,4-Trichlorobenzene	22,700	Indoor Commercial/Industrial Workers	µg/L	11	1	9.1	0.40	80	0	0
1,1,1-Trichloroethane	2,460,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,1,2-Trichloroethane	1,710	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0

TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Screening Level (RBTC) Scenario	Unit	No. of Samples	No. of Detects	% Detects	Nondetects			
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen
Trichloroethene	568	Indoor Commercial/Industrial Workers	µg/L	11	5	45	0.25	50	0	0
Trichlorofluoromethane	N/A	--	µg/L	11	0	0	0.25	50	--	--
1,2,3-Trichloropropane	8,020	Indoor Commercial/Industrial Workers	µg/L	11	5	45	0.0025	0.50	0	0
1,2,4-Trimethylbenzene	104,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
1,3,5-Trimethylbenzene	73,700	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	0
Vinyl chloride	103	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.25	50	0	2
Xylenes (total)	134,000	Indoor Commercial/Industrial Workers	µg/L	11	0	0	0.50	100	0	0

Notes:

-- = Not applicable

µg/L = microgram per liter

N/A = No screening level available

RBTC = Risk-based target concentration

SQL = Sample quantitation limit

[1] Screening levels are the lowest RBTCs among indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers.

TABLE 4-9. Summary Statistics for Shallow Groundwater

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

						Nondetects		Detects									
Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	Ratio of Maximum to Screen
Benzene	8.96E+16	µg/L	11	5	45	0.25	0.25	0.28	58,000	1.1	18,000	26,300	1.5	MC-29	0	0	6.5E-13
Bromobenzene	294,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	181,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	343	µg/L	11	1	9.1	0.25	50	0.29	0.29	0.29	0.29	--	--	MC-97	0	0	8.5E-04
Bromoform	70,100	µg/L	11	0	0	0.40	80	--	--	--	--	--	--	--	--	--	--
Bromomethane	3,340	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
2-Butanone	396,000,000	µg/L	11	0	0	2.5	500	--	--	--	--	--	--	--	--	--	--
n-Butylbenzene	357,000	µg/L	11	0	0	0.40	80	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	315,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
tert-Butylbenzene	415,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	162	µg/L	11	1	9.1	0.25	50	0.32	0.32	0.32	0.32	--	--	MC-97	0	0	2.0E-03
Chlorobenzene	131,000	µg/L	11	8	73	0.25	0.25	0.31	50,000	0.95	9,880	19,100	1.9	MC-29	0	25	3.8E-01
Chloroethane	4,350,000	µg/L	11	1	9.1	0.40	80	0.44	0.44	0.44	0.44	--	--	MC-09R	0	0	1.0E-07
Chloroform	229	µg/L	11	7	64	0.25	50	0.38	710	0.71	100	270	2.6	MC-29	14	14	3.1E+00
Chloromethane	39,100	µg/L	11	1	9.1	0.25	50	0.25	0.25	0.25	0.25	--	--	MC-97	0	0	6.4E-06
2-Chlorotoluene	144,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	120,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Cumene	392,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
p-Cymene	1,750	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	48	µg/L	11	0	0	0.50	100	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	N/A	N/A	N/A
1,2-Dibromoethane	87	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Dibromomethane	44,800	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	1,150,000	µg/L	11	2	18	0.25	0.25	670	1,000	840	840	230	0.28	MC-29	0	0	8.7E-04
1,3-Dichlorobenzene	584,000	µg/L	11	1	9.1	0.25	50	54	54	54	54	--	--	MC-29	0	0	9.2E-05
1,4-Dichlorobenzene	1,180	µg/L	11	3	27	0.25	0.25	0.50	1,800	1,100	970	910	0.94	MC-29	33	67	1.5E+00
Dichlorodifluoromethane	2,150	µg/L	11	0	0	0.25	80	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	1,980	µg/L	11	6	55	0.25	50	0.61	60	0.88	11	24	2.2	MC-29	0	0	3.0E-02
1,2-Dichloroethane	568	µg/L	11	2	18	0.25	50	0.53	1.1	0.82	0.82	0.40	0.49	MC-97	0	0	1.9E-03
1,1-Dichloroethene	45,600	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	59,400	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	25,900	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	2,020	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	30,600	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	1,330	µg/L	11	0	0	0.40	80	--	--	--	--	--	--	--	--	--	--

TABLE 4-9. Summary Statistics for Shallow Groundwater

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects									
						Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum	Percent of Samples Above Screen	Percent of Samples Above 10% of Screen	Ratio of Maximum to Screen
1,1-Dichloropropene	2,060	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropene	1,480	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,4-Dioxane	433,000	µg/L	11	8	73	0.50	100	2.4	3.6	2.8	2.9	0.42	0.14	MC-97	0	0	8.3E-06
Ethyl tert-butyl ether	124,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1,260	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	313	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	447,000	µg/L	11	0	0	0.88	180	--	--	--	--	--	--	--	--	--	--
Naphthalene	1,830	µg/L	11	0	0	0.40	80	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	1,010,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Styrene	3,080,000	µg/L	10	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	1,930	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	1,370	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	7,120	µg/L	11	5	45	0.25	50	0.66	64	0.87	13	28	2.1	MC-29	0	0	9.0E-03
Toluene	5,590,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	28,200	µg/L	11	1	9.1	0.40	80	0.50	0.50	0.50	0.50	--	--	MC-09R	0	0	1.8E-05
1,2,4-Trichlorobenzene	22,700	µg/L	11	1	9.1	0.40	80	120	120	120	120	--	--	MC-29	0	0	5.3E-03
1,1,1-Trichloroethane	2,460,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	1,710	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Trichloroethene	568	µg/L	11	5	45	0.25	50	0.25	0.33	0.28	0.28	0.030	0.10	MC-97	0	0	5.8E-04
Trichlorofluoromethane	--	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	N/A	N/A	N/A
1,2,3-Trichloropropane	8,020	µg/L	11	5	45	0.0025	0.50	0.0037	0.012	0.0042	0.0060	0.0035	0.58	MC-111	0	0	1.5E-06
1,2,4-Trimethylbenzene	104,000	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	73,700	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	103	µg/L	11	0	0	0.25	50	--	--	--	--	--	--	--	--	--	--
Xylenes (total)	134,000	µg/L	11	0	0	0.50	100	--	--	--	--	--	--	--	--	--	--

Notes:

-- = No value	N/A = RBTC not available for screen
µg/L = microgram per liter	RBTC = Risk-based target concentration

[1] Screening levels are the lowest RBTCs among indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers.

TABLE 5-1. Concentration/Toxicity Screen - Soil

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte [1]	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[2]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
Chlorine Oxyanions	Chlorate	mg/kg	15	15	100	4.2	RISB-ER-03	38,900	--	0	Pass
	Perchlorate	mg/kg	15	13	87	6.1	RISB-ER-03	908	--	0	Pass
Metals	Antimony	mg/kg	15	3	20	0.36	RISB-ER-02	3,450	--	0	Pass
	Arsenic	mg/kg	15	15	100	5.9	RISB-EJ-03	7.2	Maximum BRC/TIMET background	--	Pass
	Barium	mg/kg	15	15	100	260	RISB-EJ-01	1,630,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Boron	mg/kg	15	15	100	32	RISB-ER-01	259,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Chromium VI	mg/kg	15	2	13	0.33	RISB-EJ-01	117	--	0	Pass
	Cobalt	mg/kg	15	15	100	6.6	RISB-ER-02	385	--	0	Pass
	Copper	mg/kg	15	15	100	19	RISB-EJ-04	51,900	--	0	Pass
	Iron	mg/kg	15	15	100	16,000	RISB-EJ-03	908,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Lead	mg/kg	15	15	100	10	RISB-ER-01	800	--	--	Pass
	Magnesium	mg/kg	15	15	100	16,000	RISB-ER-01	5,170,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Manganese	mg/kg	15	15	100	470	RISB-EJ-01	112,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Mercury	mg/kg	15	11	73	0.40	RISB-EJ-04	5,540	Use Mercury compounds BCL	0	Pass
	Nickel	mg/kg	15	15	100	21	RISB-ER-02	56,600	--	0	Pass
	Phosphorus (total)	mg/kg	15	15	100	1,300	RISB-EJ-03	9,630,000	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit, adjust BCL based on molecular weight	0	Pass
	Strontium	mg/kg	15	15	100	330	RISB-EJ-02	779,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Vanadium	mg/kg	15	15	100	53	RISB-EJ-04	175,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Zirconium	mg/kg	15	15	100	22	RISB-EJ-03	104	--	14	Fail
Other Inorganics	Ammonia	mg/kg	15	15	100	4.9	RISB-EJ-04	27,900	--	0	Pass
	Bromide	mg/kg	15	3	20	15	RISB-EJ-04	519,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Chloride	mg/kg	15	15	100	2,600	RISB-EJ-04	--	Excluded due to a lack of toxicity data and considered as a macronutrient	N/A	N/A
	Nitrate	mg/kg	15	10	67	230	RISB-ER-03	2,080,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	ortho-Phosphate	mg/kg	6	1	17	29	RISB-EJ-01	1,270,000	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit	0	Pass
	Sulfate	mg/kg	15	15	100	11,000	RISB-ER-01	--	--	N/A	N/A
Radionuclides	Radium-226	pCi/g	15	15	100	1.7	RISB-EJ-04	0.023	--	15	Fail
	Radium-228	pCi/g	15	15	100	1.8	RISB-EJ-01	0.046	--	15	Fail
	Thorium-232	pCi/g	15	15	100	2.0	RISB-EJ-02	13	--	15	Fail
	Thorium-228	pCi/g	15	15	100	2.2	RISB-EJ-01	0.026	--	15	Fail
	Thorium-230	pCi/g	15	15	100	2.9	RISB-EJ-04	14	--	7	Fail
	Uranium-234	pCi/g	15	15	100	2.4	RISB-ER-01	18	--	1	Fail
	Uranium-235	pCi/g	15	15	100	0.16	RISB-ER-01	0.33	--	9	Fail
	Uranium-238	pCi/g	15	15	100	1.5	RISB-EJ-02	1.5	--	15	Fail

TABLE 5-1. Concentration/Toxicity Screen - Soil

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Group	Analyte [1]	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[2]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
Dioxin/Furans	2,3,7,8-TCDD TEQ*	mg/kg	15	15	100	0.00014	RISB-EJ-04	0.0027	Site-specific action level	0	Pass
PAHs	Naphthalene	mg/kg	15	1	6.7	0.0051	RISB-EJ-04	11	--	0	Pass
Pesticides - OCPs	alpha-BHC	mg/kg	15	1	6.7	0.0030	RISB-EJ-04	274	--	0	Pass
	beta-BHC	mg/kg	15	6	40	0.010	RISB-EJ-04	55	--	0	Pass
	2,4'-DDE	mg/kg	15	1	6.7	0.0025	RISB-EJ-04	10	Use 4,4'-DDE as a surrogate	0	Pass
	4,4'-DDE	mg/kg	15	3	20	0.017	RISB-EJ-04	10	--	0	Pass
	4,4'-DDT	mg/kg	15	1	6.7	0.0035	RISB-EJ-04	11	--	0	Pass
Pesticides - OPPs	Propazine	mg/kg	15	1	6.7	0.014	RISB-EJ-04	18,200	--	0	Pass
VOCs	Acetone	mg/kg	15	1	6.7	0.016	RISB-EJ-04	746,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Toluene	mg/kg	15	2	13	0.00062	RISB-ER-03	52,000	Use health-based BCL instead of soil saturation level	0	Pass
	1,2,4-Trichlorobenzene	mg/kg	15	1	6.7	0.0014	RISB-ER-02	125	--	0	Pass

Notes:

-- = Not applicable
COPC = Chemical of potential concern
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
BRC = Basic Remediation Company
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
N/A = BCL (other screening value) not available for screen

NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
TIMET = Titanium Metals Corporation
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text

[1] Only detected analytes were listed in this table for COPC identification Step 1.

[2] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2023), unless noted.

🟦 Indicates analyte is carried forward to COPC identification Step 2. For arsenic, lead, and 2,3,7,8-TCDD TEQ, the maximum detected concentration is compared directly to the screening level. For all other analytes, the maximum detected concentration is compared to 0.1 x screening level. If the maximum detected concentration is greater than or equal to the 0.1 x screening level, the analyte “fails” and is carried forward to Step 2. If less than the 0.1 x screening level, the analyte “passes” and is eliminated as a COPC. By default, analytes for which screening levels are not available are retained for Step 2 (metals) and Step 3 (organics).

Source:

NDEP. 2023. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 16, June.

TABLE 5-2. Results of the Soil Background Evaluation for Metals Carried Forward from the Concentration/Toxicity Screen

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Name	Parcel E Concentrations Greater than Background Levels?[1]
Zirconium	No

Notes:

[1] Based on the background evaluation presented in Appendix E.

TABLE 5-3. Results of the Soil Background Evaluation for Radionuclides Carried Forward from the Concentration/Toxicity Screen

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chain	Secular Equilibrium?	Radionuclide	Parcel E Concentrations Greater than Background Levels?[1],[2]	Hydrofluoric Acid Digestion?
Uranium-238	No	Uranium-238	No	Yes
		Uranium-234	No	
		Thorium-230	Yes	
		Radium-226	No	
Thorium-232	No	Thorium-232	No	Yes
		Radium-228	No	
		Thorium-228	No	
Uranium-235	Not evaluated	Uranium-235	No	Yes

Notes:

BRC = Basic Remediation Company

COPC = Chemical of potential concern

RZ-A = Remediation Zone A

TIMET = Titanium Metals Corporation

🟦 Radionuclide is present at concentrations greater than background.

[1] Based on background analysis presented in Appendix E.

[2] The validity of statistical testing for radionuclide background evaluation is confounded by sample preparation and analytical method issues in the Parcel E, BRC/TIMET, and RZ-A background datasets. For a full discussion of these limitations, see Section 5.1.1.2 of the report. No radionuclides are identified as COPCs in Parcel E, because the estimated total radionuclide cancer risk in Parcel E is consistent with the estimated total radionuclide cancer risks for the BRC/TIMET regional background and RZ-A background and radionuclides are not known to be associated with any of the former operations in Parcel E.

TABLE 5-4. Comparison of Cancer Risks for Radionuclides between Parcel E Soils and Background Soils

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chain	Radionuclide	Commercial/ Industrial BCL (pCi/g)	RZ-A Background		BRC/TIMET Background		Parcel E	
			95% UCL (pCi/g)	Cancer Risk	95% UCL (pCi/g)	Cancer Risk	95% UCL (pCi/g)	Cancer Risk
Uranium-238	Uranium-238	1.4	1.1	7.9E-07	1.2	8.9E-07	1.2	8.8E-07
	Uranium-234	11	1.2	1.1E-07	1.3	1.2E-07	1.5	1.3E-07
	Thorium-230	8.4	1.2	1.4E-07	1.4	1.6E-07	1.8	2.2E-07
	Radium-226	0.023	1.1	4.6E-05	1.2	5.3E-05	1.3	5.7E-05
Thorium-232	Thorium-232	7.4	1.6	2.1E-07	1.7	2.3E-07	1.8	2.4E-07
	Radium-228	0.041	1.4	3.5E-05	2.0	4.8E-05	1.2	3.0E-05
	Thorium-228	0.025	1.8	7.3E-05	1.8	7.1E-05	1.9	7.4E-05
Uranium-235	Uranium-235	0.35	0.065	1.9E-07	0.074	2.1E-07	0.073	2.1E-07
		Total Cancer Risk	--	**2E-04**	--	**2E-04**	--	**2E-04**

Chain	Radionuclide	Commercial/ Industrial BCL (pCi/g)	RZ-A Background		BRC/TIMET Background		Parcel E	
			Mean (pCi/g)	Cancer Risk	Mean (pCi/g)	Cancer Risk	Mean (pCi/g)	Cancer Risk
Uranium-238	Uranium-238	1.4	1.0	7.4E-07	1.2	8.4E-07	1.1	8.0E-07
	Uranium-234	11	1.1	9.7E-08	1.2	1.1E-07	1.3	1.1E-07
	Thorium-230	8.4	1.1	1.3E-07	1.3	1.6E-07	1.6	1.9E-07
	Radium-226	0.023	0.95	4.1E-05	1.1	5.0E-05	1.2	5.2E-05
Thorium-232	Thorium-232	7.4	1.5	2.0E-07	1.7	2.2E-07	1.7	2.3E-07
	Radium-228	0.041	1.3	3.1E-05	1.9	4.6E-05	1.1	2.6E-05
	Thorium-228	0.025	1.7	6.8E-05	1.7	6.9E-05	1.8	7.1E-05
Uranium-235	Uranium-235	0.35	0.051	1.5E-07	0.067	1.9E-07	0.052	1.5E-07
		Total Cancer Risk	--	**1E-04**	--	**2E-04**	--	**2E-04**

Notes:

-- = Not applicable
pCi/g = picocurie per gram
BCL = Basic Comparison Level
BRC = Basic Remediation Company
RZ-A = Remediation Zone A
TIMET = Titanium Metals Corporation
UCL = Upper Confidence Limit

TABLE 5-5. Soil Gas and Shallow Groundwater COPCs Identified for Parcel E
GMC - Linden, New Jersey
Henderson, Nevada

Chemical [1]	Soil Gas		Shallow Groundwater
	5 ft bgs	15 ft bgs	
Acetone	X	X	
Acrylonitrile	X		
Benzene	X	X	X
Bromodichloromethane		X	X
2-Butanone	X	X	
tert-Butyl alcohol	X		
n-Butylbenzene	X		
Carbon disulfide	X	X	
Carbon tetrachloride	X	X	X
Chlorobenzene	X	X	X
Chloroethane	X	X	X
Chloroform	X	X	X
Chloromethane	X	X	X
Cyclohexane	X	X	
p-Cymene	X		
1,2-Dichlorobenzene	X	X	X
1,3-Dichlorobenzene	X	X	X
1,4-Dichlorobenzene	X	X	X
Dichlorodifluoromethane	X	X	
1,1-Dichloroethane	X	X	X
1,2-Dichloroethane	X	X	X
1,1-Dichloroethene	X	X	
cis-1,2-Dichloroethene	X	X	
trans-1,2-Dichloroethene	X	X	
1,2-Dichloropropane		X	
1,2-Dichlorotetrafluoroethane	X		
1,4-Dioxane	X		X
Ethanol	X	X	
Ethylbenzene	X	X	
4-Ethyltoluene	X		
n-Heptane	X		
Hexachlorobutadiene	X	X	
2-Hexanone	X		
4-Methyl-2-pentanone	X		
Methylene Chloride	X	X	
alpha-Methyl styrene	X		
Naphthalene	X		
n-Octane	X		
n-Propylbenzene	X		
Styrene	X		
Tetrachloroethene	X	X	X
Tetrahydrofuran	X	X	

TABLE 5-5. Soil Gas and Shallow Groundwater COPCs Identified for Parcel E
GMC - Linden, New Jersey
Henderson, Nevada

Chemical [1]	Soil Gas		Shallow Groundwater
	5 ft bgs	15 ft bgs	
Toluene	X	X	
1,2,3-Trichlorobenzene			X
1,2,4-Trichlorobenzene	X	X	X
1,1,2-Trichloroethane	X	X	
Trichloroethene	X	X	X
Trichlorofluoromethane	X	X	
1,2,3-Trichloropropane			X
1,1,2-Trichloro-1,2,2-trifluoroethane	X	X	
1,2,4-Trimethylbenzene	X	X	
Vinyl acetate	X		
Vinyl chloride	X	X	
Xylenes (total)	X	X	

Notes:

bgs = below ground surface

COPC = Chemical of potential concern

ft = feet

HRA = Health Risk Assessment

VOCs = volatile organic compound

[1] VOCs detected in the soil gas samples at indicated depth interval or shallow groundwater samples included in the Parcel E HRA.

[2] Based on VOC results from the shallow monitoring wells (with top of well screens less than 60 ft bgs) collected between 2015-2019 in Parcel E.

TABLE 5-6. Johnson and Ettinger Modeling Parameters

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Parameter	Value	Unit	Note
Source/Receptor Parameters			
Soil temperature at source	17	Celsius	Estimated average temperature (USEPA 2017a)
Commercial Indoor and Outdoor Scenarios			
Depth to groundwater	914.4	cm	Site-specific estimate (30 feet)
Soil gas sampling depths	152.4	cm	Site-specific estimates based on sampling depths (5, 15 feet)
	457.2	cm	
Construction Trench Scenario			
Depth of construction trench	304.8	cm	Assumed (10 feet)
Soil Parameters			
USDA soil type	Loamy Sand	--	Site-specific estimate based on soil boring logs and site measurements. See text for further discussion.
Bulk density	1.722	g/cm^3	Site-specific measurement
Total porosity	0.358	unitless	Site-specific measurement
Water content	0.148	unitless	Site-specific measurement
Parameters Used For Benzene Degradation			
Fraction organic carbon	0.006	unitless	Default value (USEPA 2002)
Minimum oxygen content for aerobic respiration	1	%	Default value (API 2012)
First order biodegradation rate for benzene	0.79	1/hour	Default value (API 2012)
Building Foudation Parameters			
Commercial Indoor Scenario			
Depth to bottom of foundation	20	cm	Default value for commercial slab-on-grade building (USEPA 2017b)
Foundation thickness	20	cm	Default value for commercial slab-on-grade building (USEPA 2017b)
Foundation crack ratio	0.001	unitless	Default value for commercial slab-on-grade building (USEPA 2017b)
$Q_{soil}/Q_{building}$	0.003	unitless	Default value for commercial slab-on-grade building (USEPA 2017b)
Air Dispersion Parameters			
Commercial Indoor Scenario			
Air exchange rate	1.5	1/hour	Default value for commercial building (USEPA 2017b)
Enclosed floor space area	1500	m^2	Default value for commercial building (USEPA 2017b)
Mixing height of building, slab-on-grade	300	cm	Default value for commercial building (USEPA 2017b)
Outdoor Air Scenarios			
Site-specific dispersion factor (Q/C)	53.03	g/m^2-s per kg/m^3	Based on the total area of 7.4 acres for Parcel E
Construction Trench Scenarios			
Length of construction trench	609.6	cm	Assumed (20 feet)
Width of construction trench	152.4	cm	Assumed (5 feet)
Trench wind speed	0.205	m/s	Conservative estimate (1/20 of site-specific windspeed)
Site-specific dispersion factor (Q/C)	34.17	g/m^2-s per kg/m^3	Site-specific estimate based on box model

Notes:

-- =Not applicable

cm = centimeter

g/cm^3 = gram per cubic centimeter

g/m^2-s per kg/m^3 = (gram per square meter-second) per (kilogram per cubic meter)

m^2 = square meter

m/s = meter per second

API = American Petroleum Institute

USDA = United States Department of Agriculture

USEPA = United States Environmental Protection Agency

Sources:

API. 2012. BIOVAPOR – A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation. Version 2.1. November.

USEPA. 2002. Supplemental Guidance for Developing. Soil Screening Levels for Superfund Sites. December.

USEPA. 2017a. Documentation for EPA's Implementation of the Johnson and Ettinger Model to Evaluate Site Specific Vapor Intrusion into Buildings, Version 6.0. September.

USEPA. 2017b. EPA Spreadsheet for Modeling Subsurface Vapor Intrusion. Version 6.0. September.

TABLE 5-7. Physical and Chemical Properties for Soil Gas and Shallow Groundwater Analytes

GMC - Linden, New Jersey
Henderson, Nevada

Chemical [1]	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient K_{oc} (cm^3/g)	Diffusivity in Air D_a (cm^2/s)	Diffusivity in Water D_w (cm^2/s)	Pure Component Water Solubility S (mg/L)	Henry's Law Constant at 25° C H ($atm\text{-}m^3/mol$)	Normal Boiling Point T_B (^oK)	Critical Temperature T_C (^oK)	Enthalpy of Vaporization at the Normal Boiling Point ΔHv (cal/mol)	Source
Acetone	58.08	2.36E+00	1.06E-01	1.15E-05	1.00E+06	3.50E-05	328.50	508.10	6955.00	NDEP (2023)
Acrylonitrile	53.06	8.51E+00	1.14E-01	1.23E-05	7.45E+04	1.38E-04	350.30	519.00	7786.00	NDEP (2023)
tert-Amyl methyl ether	102.18	2.27E+01	6.54E-02	7.76E-06	1.07E+04	1.32E-03	359.45	--	--	EPISuite (USEPA 2012) + Diisopropyl Ether for diffusivities
Benzene	78.12	1.46E+02	8.95E-02	1.03E-05	1.79E+03	5.55E-03	353.00	562.16	7342.00	NDEP (2023)
Benzyl chloride	126.59	4.46E+02	6.34E-02	8.81E-06	5.25E+02	4.12E-04	452.00	685.00	8773.26	NDEP (2023)
Bromobenzene	157.01	2.34E+02	5.37E-02	9.30E-06	4.46E+02	2.47E-03	429.00	670.00	10628.64	NDEP (2023)
Bromochloromethane	129.38	2.17E+01	7.87E-02	1.22E-05	1.67E+04	1.46E-03	341.00	511.50	7167.65	NDEP (2023)
Bromodichloromethane	163.83	3.18E+01	5.63E-02	1.07E-05	3.03E+03	2.12E-03	363.00	585.85	7800.00	NDEP (2023)
Bromoform	252.73	3.18E+01	3.57E-02	1.04E-05	3.10E+03	5.35E-04	422.25	633.38	9472.63	NDEP (2023)
Bromomethane	94.94	1.32E+01	1.00E-01	1.35E-05	1.52E+04	7.34E-03	276.50	467.00	5714.00	NDEP (2023)
2-Butanone	72.11	4.51E+00	9.14E-02	1.02E-05	2.23E+05	5.69E-05	352.50	536.78	7480.70	NDEP (2023)
tert-Butyl alcohol	74.12	2.92E+00	9.00E-02	1.00E-05	1.81E+05	9.05E-06	--	--	--	NDEP (2023)
n-Butylbenzene	134.22	1.48E+03	5.28E-02	7.33E-06	1.18E+01	1.59E-02	456.30	720.00	12267.12	NDEP (2023)
sec-Butylbenzene	134.22	1.33E+03	5.28E-02	7.34E-06	1.76E+01	1.76E-02	451.50	677.25	11467.50	NDEP (2023)
tert-Butylbenzene	134.22	1.00E+03	5.30E-02	7.37E-06	2.95E+01	1.32E-02	443.15	664.73	11405.35	NDEP (2023)
Carbon disulfide	76.14	2.17E+01	1.06E-01	1.30E-05	2.16E+03	1.44E-02	319.00	552.00	6391.00	NDEP (2023)
Carbon tetrachloride	153.82	4.39E+01	5.71E-02	9.78E-06	7.93E+02	2.76E-02	349.80	556.60	7127.00	NDEP (2023)
3-Chloro-1-propene	76.53	3.96E+01	9.36E-02	1.08E-05	3.37E+03	1.10E-02	318.10	514.26	6936.08	NDEP (2023)
Chlorobenzene	112.56	2.34E+02	7.21E-02	9.48E-06	4.98E+02	3.11E-03	404.70	632.40	8410.00	NDEP (2023)
Chloroethane	64.52	2.17E+01	1.04E-01	1.16E-05	6.71E+03	1.11E-02	285.30	460.40	5879.40	NDEP (2023)
Chloroform	119.38	3.18E+01	7.69E-02	1.09E-05	7.95E+03	3.67E-03	334.10	536.40	6988.00	NDEP (2023)
Chloromethane	50.49	1.32E+01	1.24E-01	1.36E-05	5.32E+03	8.82E-03	249.00	416.25	5114.60	NDEP (2023)
2-Chlorotoluene	126.59	3.83E+02	6.29E-02	8.72E-06	3.74E+02	3.57E-03	432.00	654.10	9950.50	NDEP (2023)
4-Chlorotoluene	126.59	3.75E+02	6.26E-02	8.66E-06	1.06E+02	4.38E-03	435.40	658.70	10144.98	NDEP (2023)
Cumene	120.20	6.98E+02	6.03E-02	7.86E-06	6.13E+01	1.15E-02	425.40	631.10	10335.30	NDEP (2023)
Cyclohexane	84.16	1.46E+02	8.00E-02	9.11E-06	5.50E+01	1.50E-01	353.70	553.40	7153.60	NDEP (2023)
p-Cymene	134.00	2.20E+02	7.50E-02	7.10E-06	6.10E+01	1.20E+00	--	--	--	NDEP (2023)
1,2-Dibromo-3-chloropropane	236.33	1.16E+02	3.21E-02	8.90E-06	1.23E+03	1.47E-04	469.00	703.50	9960.05	NDEP (2023)
Dibromochloromethane	208.28	3.18E+01	3.66E-02	1.06E-05	2.70E+03	7.83E-04	393.00	678.20	5900.00	NDEP (2023)
1,2-Dibromoethane	187.86	3.96E+01	4.30E-02	1.04E-05	3.91E+03	6.50E-04	404.60	583.00	8310.03	NDEP (2023)
Dibromomethane	173.84	2.17E+01	5.51E-02	1.19E-05	1.19E+04	8.22E-04	370.00	583.00	7867.88	NDEP (2023)
1,2-Dichlorobenzene	147.00	3.83E+02	5.62E-02	8.92E-06	1.56E+02	1.92E-03	453.00	705.00	9700.00	NDEP (2023)
1,3-Dichlorobenzene	147.00	3.79E+02	6.90E-02	7.90E-06	1.56E+02	1.90E-03	--	--	--	NDEP (2023)
1,4-Dichlorobenzene	147.00	3.75E+02	5.50E-02	8.68E-06	8.13E+01	2.41E-03	447.00	684.75	9271.00	NDEP (2023)
Dichlorodifluoromethane	120.91	4.39E+01	7.60E-02	1.08E-05	2.80E+02	3.43E-01	243.20	384.95	9421.36	NDEP (2023)
1,1-Dichloroethane	98.96	3.18E+01	8.36E-02	1.06E-05	5.04E+03	5.62E-03	330.40	523.00	6895.00	NDEP (2023)
1,2-Dichloroethane	98.96	3.96E+01	8.57E-02	1.10E-05	8.60E+03	1.18E-03	356.50	561.00	7643.00	NDEP (2023)
1,1-Dichloroethene	96.94	3.18E+01	8.63E-02	1.10E-05	2.42E+03	2.61E-02	304.60	576.05	6247.00	NDEP (2023)
cis-1,2-Dichloroethene	96.94	3.96E+01	8.84E-02	1.13E-05	6.41E+03	4.08E-03	328.00	544.00	7192.00	NDEP (2023)
trans-1,2-Dichloroethene	96.94	3.96E+01	8.76E-02	1.12E-05	4.52E+03	9.38E-03	328.00	516.50	6717.00	NDEP (2023)
1,2-Dichloropropane	112.99	6.07E+01	7.33E-02	9.73E-06	2.80E+03	2.82E-03	368.50	572.00	7590.00	NDEP (2023)

TABLE 5-7. Physical and Chemical Properties for Soil Gas and Shallow Groundwater Analytes
GMC - Linden, New Jersey
Henderson, Nevada

Chemical [1]	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient K_{oc} (cm^3/g)	Diffusivity in Air D_a (cm^2/s)	Diffusivity in Water D_w (cm^2/s)	Pure Component Water Solubility S (mg/L)	Henry's Law Constant at 25° C H ($atm\text{-}m^3/mol$)	Normal Boiling Point T_B (^oK)	Critical Temperature T_C (^oK)	Enthalpy of Vaporization at the Normal Boiling Point ΔHv (cal/mol)	Source
1,3-Dichloropropane	112.99	7.22E+01	7.39E-02	9.82E-06	2.75E+03	9.76E-04	393.90	590.85	8102.51	NDEP (2023)
2,2-Dichloropropane	112.99	4.39E+01	7.33E-02	9.73E-06	3.44E+02	1.61E-02	342.45	--	--	EPISuite (USEPA 2012) + 1,2-Dichloropropane for diffusivities
1,1-Dichloropropene	110.97	6.07E+01	7.63E-02	1.01E-05	7.49E+02	5.00E-02	349.65	--	--	EPISuite (USEPA 2012) + 1,3-Dichloropropene for diffusivities
1,3-Dichloropropene	110.97	7.22E+01	7.63E-02	1.01E-05	2.80E+03	3.55E-03	385.00	587.38	7900.00	NDEP (2023)
Diisopropyl ether	102.18	2.28E+01	6.54E-02	7.76E-06	8.80E+03	2.56E-03	341.50	499.90	No DHv,b	NDEP (2023)
1,4-Dioxane	88.11	2.63E+00	8.74E-02	1.05E-05	1.00E+06	4.80E-06	374.65	585.15	8687.35	NDEP (2023)
Ethanol	46.00	1.00E+00	1.24E-01	1.37E-05	1.00E+06	5.00E-06	--	--	--	NDEP (2023)
Ethyl tert-butyl ether	102.18	2.11E+01	6.54E-02	7.76E-06	1.20E+04	1.64E-03	345.75	--	--	EPISuite (USEPA 2012) + Diisopropyl Ether for diffusivities
Ethyl acetate	88.11	5.58E+00	8.23E-02	9.70E-06	8.00E+04	1.34E-04	350.10	523.30	7633.66	NDEP (2023)
Ethylbenzene	106.17	4.46E+02	6.85E-02	8.46E-06	1.69E+02	7.88E-03	409.10	617.20	8501.00	NDEP (2023)
4-Ethyltoluene	120.19	2.20E+02	7.50E-02	7.10E-06	6.10E+01	1.20E+00	--	--	--	NDEP (2023)
1,2-Dichlorotetrafluoroethane	170.92	1.97E+02	3.76E-02	8.59E-06	1.30E+02	2.80E+00	276.95	--	--	EPISuite (USEPA 2012) + 1,1,2-Trichloro-1,2,2-trifluoroethane for diffusivities
n-Heptane	100.00	8.20E+03	6.16E-02	6.45E-06	3.40E+00	2.00E+00	371.50	No Tcrit	No DHv,b	NDEP (2023)
Hexachlorobutadiene	260.76	8.45E+02	2.67E-02	7.03E-06	3.20E+00	1.03E-02	488.15	732.23	10206.00	NDEP (2023)
n-Hexane	86.18	1.32E+02	7.31E-02	8.17E-06	9.50E+00	1.80E+00	341.70	508.00	6895.15	NDEP (2023)
2-Hexanone	100.16	1.50E+01	7.04E-02	8.44E-06	1.72E+04	9.32E-05	400.60	600.90	8610.39	NDEP (2023)
alpha-Methyl styrene	118.18	6.98E+02	6.29E-02	8.19E-06	1.16E+02	2.55E-03	438.40	657.00	11419.16	NDEP (2023)
Methyl tert-butyl ether	88.15	1.16E+01	7.53E-02	8.59E-06	5.10E+04	5.87E-04	328.20	497.10	6677.66	NDEP (2023)
4-Methyl-2-pentanone	100.16	1.26E+01	6.98E-02	8.35E-06	1.90E+04	1.38E-04	389.50	571.00	8243.11	NDEP (2023)
Methylene Chloride	84.93	2.17E+01	9.99E-02	1.25E-05	1.30E+04	3.25E-03	313.00	510.00	6706.00	NDEP (2023)
Methylmethacrylate	100.12	9.14E+00	7.50E-02	9.21E-06	1.50E+04	3.19E-04	373.50	567.00	8974.90	NDEP (2023)
Naphthalene	128.18	1.54E+03	6.05E-02	8.38E-06	3.10E+01	4.40E-04	490.90	748.40	10373.00	NDEP (2023)
n-Octane	114.23	4.37E+02	6.16E-02	6.45E-06	6.60E-01	3.21E+00	398.75	--	--	EPISuite (USEPA 2012) + n-Heptane for diffusivities
n-Propylbenzene	120.20	8.13E+02	6.02E-02	7.83E-06	5.22E+01	1.05E-02	432.20	630.00	9123.00	NDEP (2023)
Styrene	104.15	4.46E+02	7.11E-02	8.78E-06	3.10E+02	2.75E-03	418.00	636.00	8737.00	NDEP (2023)
1,1,1,2-Tetrachloroethane	167.85	8.60E+01	4.82E-02	9.10E-06	1.07E+03	2.50E-03	403.50	624.00	9768.28	NDEP (2023)
1,1,2,2-Tetrachloroethane	167.85	9.49E+01	4.89E-02	9.29E-06	2.83E+03	3.67E-04	419.50	661.15	8996.00	NDEP (2023)
Tetrachloroethene	165.83	9.49E+01	5.05E-02	9.46E-06	2.06E+02	1.77E-02	394.30	620.20	8288.00	NDEP (2023)
Tetrahydrofuran	72.11	1.08E+01	9.94E-02	1.08E-05	1.00E+06	7.05E-05	339.00	541.15	7073.99	NDEP (2023)
Toluene	92.14	2.34E+02	7.78E-02	9.20E-06	5.26E+02	6.64E-03	383.60	591.79	7930.00	NDEP (2023)
1,2,3-Trichlorobenzene	181.45	1.38E+03	3.95E-02	8.38E-06	1.80E+01	1.25E-03	491.50	762.50	12611.53	NDEP (2023)
1,2,4-Trichlorobenzene	181.45	1.36E+03	3.96E-02	8.40E-06	4.90E+01	1.42E-03	486.50	725.00	10471.00	NDEP (2023)
1,1,1-Trichloroethane	133.41	4.39E+01	6.48E-02	9.60E-06	1.29E+03	1.72E-02	347.00	545.00	7136.00	NDEP (2023)
1,1,2-Trichloroethane	133.41	6.07E+01	6.69E-02	1.00E-05	4.59E+03	8.24E-04	386.80	602.00	8322.00	NDEP (2023)
Trichloroethene	131.39	6.07E+01	6.87E-02	1.02E-05	1.28E+03	9.85E-03	360.20	544.20	7505.00	NDEP (2023)
Trichlorofluoromethane	137.37	4.39E+01	6.54E-02	1.00E-05	1.10E+03	9.70E-02	296.70	471.00	5998.90	NDEP (2023)
1,2,3-Trichloropropane	147.43	1.16E+02	5.75E-02	9.24E-06	1.75E+03	3.43E-04	430.00	652.00	9171.00	NDEP (2023)
1,1,2-Trichloro-1,2,2-trifluoroethane	187.38	1.97E+02	3.76E-02	8.59E-06	1.70E+02	5.26E-01	320.70	487.30	6462.56	NDEP (2023)
1,2,4-Trimethylbenzene	120.20	6.14E+02	6.07E-02	7.92E-06	5.70E+01	6.16E-03	442.30	649.17	9368.80	NDEP (2023)
1,3,5-Trimethylbenzene	120.20	6.02E+02	6.02E-02	7.84E-06	4.82E+01	8.77E-03	437.70	637.25	9321.00	NDEP (2023)

TABLE 5-7. Physical and Chemical Properties for Soil Gas and Shallow Groundwater Analytes

GMC - Linden, New Jersey
Henderson, Nevada

Chemical [1]	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient K_{oc} (cm^3/g)	Diffusivity in Air D_a (cm^2/s)	Diffusivity in Water D_w (cm^2/s)	Pure Component Water Solubility S (mg/L)	Henry's Law Constant at 25° C H ($atm\text{-}m^3/mol$)	Normal Boiling Point T_B (°K)	Critical Temperature T_C (°K)	Enthalpy of Vaporization at the Normal Boiling Point ΔHv (cal/mol)	Source
Vinyl acetate	86.09	5.58E+00	8.49E-02	1.00E-05	2.00E+04	5.11E-04	345.50	519.13	7800.00	NDEP (2023)
Vinyl chloride	62.50	2.17E+01	1.07E-01	1.20E-05	8.80E+03	2.78E-02	259.70	432.00	5250.00	NDEP (2023)
Xylenes (total)	106.17	3.83E+02	6.85E-02	8.46E-06	1.06E+02	6.63E-03	411.30	616.20	8523.00	NDEP (2023)

Notes:

-- = Not available
$atm\text{-}m^3/mol$ = atmosphere-cubic meter per mole
cal/mol = calorie per mole
cm^3/g = cubic centimeter per gram
cm^2/s = square centimeter per second
g/mol = gram per mole
°K = degrees Kelvin
mg/L = milligram per liter
NDEP = Nevada Division of Environmental Protection
USEPA = United States Environmental Protection Agency

[1] Volatile compounds defined by USEPA (2023) as chemicals with vapor pressure greater than 1 millimeter (mm) Hg or Henry's Law constant greater than 0.00001 atm-m3/mole.

Sources:

NDEP. 2023. User’s Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas, Revision 16. June.
USEPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. Washington, DC, USA.
USEPA. 2023. Regional Screening Levels User's Guide. May.

TABLE 5-8. Soil Properties Data

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Sample ID [1]	Depth (ft)	Water-filled Porosity [2] (%Vb)	Dry Bulk Density [3] (g/cm^3)	Grain Density [4] (g/cm^3)	Soil Total Porosity [5] (%Vb)	Soil Type
SA56-10BSPLP	10	0.134	1.689	2.719	0.379	Loamy Sand
RSAM3-10BSPLP	10	0.145	1.593	2.674	0.404	Loamy Sand
SA166-10BSPLP	10	0.100	1.721	2.681	0.358	Loamy Sand
SA182-10BSPLP	10	0.182	1.740	2.601	0.331	Sandy Loam
RSAJ3-10BSPLP	10	0.154	1.770	2.682	0.340	Loamy Sand
RSAI7-10B	10	0.138	1.661	2.682	0.381	Sand
SA34-10BSPLP	10	0.169	1.738	2.696	0.355	Loamy Sand
SA52-15BSPLP [6]	15	0.239	1.405	2.710	0.481	Sand
RSAQ8-10BSPLP	10	0.148	1.697	2.695	0.370	Sand
RSAN8-10BSPLP	10	0.189	1.679	2.683	0.374	Loamy Sand
RSAQ4-10BSPLP	10	0.141	1.841	2.705	0.319	Sand
SA148-10BSPLP	10	0.119	1.762	2.732	0.355	Sand
SA30-9BSPLP	9	0.160	1.805	2.711	0.334	Sand
SA128-10BSPLP	10	0.156	1.654	2.654	0.377	Loamy Sand
SA102-10BSPLP	10	0.135	1.769	2.696	0.344	Sand
SA64-10BSPLP	10	0.148	1.717	2.651	0.352	Sand
Mean	9.93	0.148	1.722	2.684	0.358	Loamy Sand
Minimum	9	0.100	1.593	2.601	0.319	NA
Maximum	10	0.189	1.841	2.732	0.404	NA
Median	10	0.148	1.721	2.683	0.355	NA

Notes:

ft = feet
g/cm^3 = grams per cubic centimeter
ASTM = American Society for Testing and Materials
NA = not applicable
OU = Operable unit
Vb = Bulk volume

[1] The soil properties were reported in Northgate and Exponent (2010).
[2] As measured according to ASTM D 2216 and converted from mass-based water moisture to volumetric water content.
[3] As measured according to ASTM D 2937.
[4] As measured according to ASTM D 854.
[5] Calculated from dry bulk density and grain density.
[6] Sample not included in the evaluation because it represents wetter than average conditions in OU-1.

Sources:

Northgate and Exponent. 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada, November 22.

TABLE 5-9a. Transfer Factors for Volatile Compounds Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	TF for Soil Gas Migrating to Indoor Air ($\mu g/m^3$ per $\mu g/m^3$)		TF for Soil Gas Migrating to Outdoor Air ($\mu g/m^3$ per $\mu g/m^3$)		TF for Soil Gas Migrating to Trench Air ($\mu g/m^3$ per $\mu g/m^3$)
	5 ft bgs	15 ft bgs	5 ft bgs	15 ft bgs	5 ft below Trench
Acetone	2.7E-04	8.6E-05	5.6E-06	1.9E-06	5.2E-05
Acrylonitrile	2.8E-04	9.0E-05	1.6E-06	5.3E-07	1.5E-05
tert-Amyl methyl ether	1.6E-04	5.2E-05	6.5E-08	2.2E-08	6.0E-07
Benzene	9.0E-18	3.9E-19	1.2E-21	5.4E-23	1.1E-20
Benzyl chloride	1.6E-04	5.0E-05	3.2E-07	1.1E-07	3.0E-06
Bromodichloromethane	1.4E-04	4.5E-05	5.0E-08	1.7E-08	4.7E-07
Bromoform	9.3E-05	2.9E-05	1.5E-07	4.8E-08	1.4E-06
Bromomethane	2.5E-04	7.9E-05	2.3E-08	7.5E-09	2.1E-07
2-Butanone	2.3E-04	7.3E-05	3.1E-06	1.0E-06	2.9E-05
tert-Butyl alcohol	2.4E-04	7.7E-05	1.4E-05	4.7E-06	1.3E-04
n-Butylbenzene	1.3E-04	4.2E-05	8.3E-09	2.8E-09	7.8E-08
sec-Butylbenzene	1.3E-04	4.2E-05	7.3E-09	2.4E-09	6.8E-08
tert-Butylbenzene	1.3E-04	4.2E-05	9.7E-09	3.2E-09	9.1E-08
Carbon disulfide	2.6E-04	8.3E-05	1.3E-08	4.3E-09	1.2E-07
Carbon tetrachloride	1.4E-04	4.5E-05	3.8E-09	1.3E-09	3.5E-08
3-Chloro-1-propene	2.3E-04	7.4E-05	1.5E-08	5.1E-09	1.4E-07
Chlorobenzene	1.8E-04	5.7E-05	4.6E-08	1.5E-08	4.3E-07
Chloroethane	2.5E-04	8.1E-05	1.6E-08	5.2E-09	1.5E-07
Chloroform	1.9E-04	6.1E-05	3.8E-08	1.3E-08	3.5E-07
Chloromethane	3.0E-04	9.7E-05	2.2E-08	7.4E-09	2.1E-07
Cumene	1.5E-04	4.8E-05	1.2E-08	4.0E-09	1.1E-07
Cyclohexane	2.0E-04	6.3E-05	9.8E-10	3.3E-10	9.1E-09
p-Cymene	1.9E-04	5.9E-05	8.2E-11	2.7E-11	7.6E-10
1,2-Dibromo-3-chloropropane	8.5E-05	2.6E-05	5.1E-07	1.7E-07	4.7E-06
Dibromochloromethane	9.5E-05	2.9E-05	8.1E-08	2.7E-08	7.5E-07
1,2-Dibromoethane	1.1E-04	3.4E-05	1.4E-07	4.5E-08	1.3E-06
1,2-Dichlorobenzene	1.4E-04	4.5E-05	6.4E-08	2.1E-08	6.0E-07
1,3-Dichlorobenzene	1.7E-04	5.5E-05	4.7E-08	1.6E-08	4.4E-07
1,4-Dichlorobenzene	1.4E-04	4.4E-05	4.9E-08	1.6E-08	4.6E-07
Dichlorodifluoromethane	1.9E-04	6.0E-05	4.1E-10	1.4E-10	3.8E-09
1,1-Dichloroethane	2.1E-04	6.6E-05	2.7E-08	8.9E-09	2.5E-07
1,2-Dichloroethane	2.1E-04	6.8E-05	1.4E-07	4.6E-08	1.3E-06
1,1-Dichloroethene	2.1E-04	6.8E-05	5.7E-09	1.9E-09	5.3E-08
cis-1,2-Dichloroethene	2.2E-04	7.0E-05	3.9E-08	1.3E-08	3.7E-07
trans-1,2-Dichloroethene	2.2E-04	6.9E-05	1.7E-08	5.5E-09	1.5E-07
1,2-Dichloropropane	1.8E-04	5.8E-05	4.9E-08	1.6E-08	4.6E-07
1,3-Dichloropropene	1.9E-04	6.0E-05	4.2E-08	1.4E-08	3.9E-07
Diisopropyl ether	1.6E-04	5.2E-05	3.3E-08	1.1E-08	3.0E-07
1,4-Dioxane	2.7E-04	8.8E-05	4.7E-05	1.6E-05	4.4E-04
Ethanol	3.4E-04	1.1E-04	3.8E-05	1.3E-05	3.5E-04
Ethyl tert-butyl ether	1.6E-04	5.2E-05	5.2E-08	1.7E-08	4.9E-07
Ethyl acetate	2.1E-04	6.6E-05	1.2E-06	3.9E-07	1.1E-05
Ethylbenzene	1.7E-04	5.4E-05	1.8E-08	5.9E-09	1.6E-07
4-Ethyltoluene	1.9E-04	5.9E-05	8.2E-11	2.7E-11	7.6E-10
1,2-Dichlorotetrafluoroethane	9.7E-05	3.0E-05	1.8E-11	5.8E-12	1.6E-10
n-Heptane	1.6E-04	4.9E-05	4.0E-11	1.3E-11	3.7E-10
Hexachlorobutadiene	7.0E-05	2.1E-05	6.0E-09	2.0E-09	5.6E-08
n-Hexane	1.8E-04	5.8E-05	7.4E-11	2.5E-11	6.9E-10
2-Hexanone	1.8E-04	5.7E-05	1.6E-06	5.2E-07	1.5E-05
alpha-Methyl styrene	1.6E-04	5.0E-05	6.0E-08	2.0E-08	5.6E-07
Methyl tert-butyl ether	1.9E-04	6.0E-05	2.3E-07	7.6E-08	2.1E-06
4-Methyl-2-pentanone	1.8E-04	5.6E-05	1.0E-06	3.4E-07	9.5E-06

TABLE 5-9a. Transfer Factors for Volatile Compounds Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	TF for Soil Gas Migrating to Indoor Air ($\mu g/m^3$ per $\mu g/m^3$)		TF for Soil Gas Migrating to Outdoor Air ($\mu g/m^3$ per $\mu g/m^3$)		TF for Soil Gas Migrating to Trench Air ($\mu g/m^3$ per $\mu g/m^3$)
	5 ft bgs	**15 ft bgs**	**5 ft bgs**	**15 ft bgs**	**5 ft below Trench**
Methylene Chloride	2.4E-04	7.9E-05	5.4E-08	1.8E-08	5.0E-07
Methylmethacrylate	1.9E-04	6.0E-05	4.8E-07	1.6E-07	4.5E-06
Naphthalene	1.5E-04	4.8E-05	3.2E-07	1.1E-07	3.0E-06
n-Octane	1.6E-04	4.9E-05	2.5E-11	8.4E-12	2.3E-10
n-Propylbenzene	1.5E-04	4.8E-05	1.2E-08	4.1E-09	1.1E-07
Styrene	1.8E-04	5.6E-05	5.3E-08	1.8E-08	5.0E-07
1,1,1,2-Tetrachloroethane	1.2E-04	3.8E-05	4.2E-08	1.4E-08	3.9E-07
1,1,2,2-Tetrachloroethane	1.3E-04	3.9E-05	2.8E-07	9.3E-08	2.6E-06
Tetrachloroethene	1.3E-04	4.0E-05	5.6E-09	1.9E-09	5.3E-08
Tetrahydrofuran	2.5E-04	7.9E-05	2.6E-06	8.7E-07	2.4E-05
Toluene	1.9E-04	6.1E-05	2.3E-08	7.6E-09	2.1E-07
1,2,4-Trichlorobenzene	1.0E-04	3.2E-05	6.6E-08	2.2E-08	6.1E-07
1,1,1-Trichloroethane	1.6E-04	5.1E-05	6.9E-09	2.3E-09	6.4E-08
1,1,2-Trichloroethane	1.7E-04	5.3E-05	1.6E-07	5.4E-08	1.5E-06
Trichloroethene	1.7E-04	5.4E-05	1.3E-08	4.4E-09	1.2E-07
Trichlorofluoromethane	1.6E-04	5.2E-05	1.1E-09	3.8E-10	1.1E-08
1,2,3-Trichloropropane	1.5E-04	4.6E-05	3.6E-07	1.2E-07	3.3E-06
1,1,2-Trichloro-1,2,2-trifluoroethane	9.7E-05	3.0E-05	1.3E-10	4.2E-11	1.2E-09
1,2,4-Trimethylbenzene	1.5E-04	4.8E-05	2.2E-08	7.2E-09	2.0E-07
1,3,5-Trimethylbenzene	1.5E-04	4.8E-05	1.5E-08	5.0E-09	1.4E-07
Vinyl acetate	2.1E-04	6.7E-05	3.2E-07	1.1E-07	3.0E-06
Vinyl chloride	2.6E-04	8.4E-05	6.2E-09	2.1E-09	5.7E-08
Xylenes (total)	1.7E-04	5.4E-05	2.1E-08	7.0E-09	2.0E-07

Notes:

bgs = below ground surface

ft = feet

$\mu g/m^3$ = microgram per cubic meter

TF = Transfer Factor

TABLE 5-9b.Transfer Factors for Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	TF for Groundwater Vapor Migrating to Indoor Air (µg/m^3 per µg/L)	TF for Groundwater Vapor Migrating to Outdoor Air (µg/m^3 per µg/L)	TF for Groundwater Vapor Migrating to Trench Air (µg/m^3 per µg/L)
Benzene	1.8E-17	4.0E-19	5.4E-18
Bromobenzene	8.9E-04	2.0E-05	2.5E-04
Bromochloromethane	9.7E-04	2.2E-05	2.7E-04
Bromodichloromethane	9.7E-04	2.2E-05	2.7E-04
Bromoform	1.6E-04	3.6E-06	4.7E-05
Bromomethane	6.6E-03	1.5E-04	1.8E-03
2-Butanone	5.5E-05	1.3E-06	1.7E-05
n-Butylbenzene	4.9E-03	1.1E-04	1.4E-03
sec-Butylbenzene	5.6E-03	1.3E-04	1.5E-03
tert-Butylbenzene	4.2E-03	9.7E-05	1.2E-03
Carbon tetrachloride	1.3E-02	2.9E-04	3.5E-03
Chlorobenzene	1.7E-03	3.8E-05	4.7E-04
Chloroethane	1.0E-02	2.3E-04	2.8E-03
Chloroform	2.3E-03	5.3E-05	6.5E-04
Chloromethane	1.0E-02	2.3E-04	2.8E-03
2-Chlorotoluene	1.5E-03	3.5E-05	4.2E-04
4-Chlorotoluene	1.8E-03	4.2E-05	5.1E-04
Cumene	4.5E-03	1.0E-04	1.2E-03
p-Cymene	1.0E+00	2.3E-02	2.8E-01
1,2-Dibromo-3-chloropropane	4.2E-05	9.6E-07	1.3E-05
Dibromochloromethane	2.8E-04	6.4E-06	8.2E-05
1,2-Dibromoethane	2.4E-04	5.4E-06	6.9E-05
Dibromomethane	3.9E-04	8.9E-06	1.1E-04
1,2-Dichlorobenzene	7.6E-04	1.7E-05	2.2E-04
1,3-Dichlorobenzene	1.5E-03	3.4E-05	4.2E-04
1,4-Dichlorobenzene	9.5E-04	2.2E-05	2.7E-04
Dichlorodifluoromethane	2.0E-01	4.7E-03	5.7E-02
1,1-Dichloroethane	3.9E-03	8.9E-05	1.1E-03
1,2-Dichloroethane	8.3E-04	1.9E-05	2.4E-04
1,1-Dichloroethene	1.9E-02	4.4E-04	5.3E-03
cis-1,2-Dichloroethene	2.9E-03	6.8E-05	8.3E-04
trans-1,2-Dichloroethene	6.8E-03	1.6E-04	1.9E-03
1,2-Dichloropropane	1.6E-03	3.7E-05	4.6E-04
1,3-Dichloropropane	5.7E-04	1.3E-05	1.6E-04
2,2-Dichloropropane	1.3E-02	3.0E-04	3.7E-03
1,1-Dichloropropene	4.2E-02	9.7E-04	1.2E-02
1,3-Dichloropropene	2.1E-03	4.8E-05	5.8E-04
1,4-Dioxane	5.7E-06	1.3E-07	1.8E-06
Ethyl tert-butyl ether	1.2E-03	2.8E-05	3.5E-04
Ethylbenzene	3.9E-03	8.9E-05	1.1E-03
Hexachlorobutadiene	1.8E-03	4.1E-05	5.0E-04
Methylene Chloride	2.7E-03	6.3E-05	7.7E-04
Naphthalene	2.0E-04	4.5E-06	5.8E-05
n-Propylbenzene	4.3E-03	9.9E-05	1.2E-03
Styrene	1.4E-03	3.3E-05	4.0E-04
1,1,1,2-Tetrachloroethane	8.6E-04	2.0E-05	2.4E-04
1,1,2,2-Tetrachloroethane	1.5E-04	3.5E-06	4.6E-05
Tetrachloroethene	6.6E-03	1.5E-04	1.8E-03
Toluene	3.9E-03	9.0E-05	1.1E-03
1,2,3-Trichlorobenzene	3.1E-04	7.1E-06	8.9E-05
1,2,4-Trichlorobenzene	3.9E-04	8.8E-06	1.1E-04
1,1,1-Trichloroethane	8.9E-03	2.0E-04	2.5E-03
1,1,2-Trichloroethane	4.5E-04	1.0E-05	1.3E-04
Trichloroethene	5.3E-03	1.2E-04	1.5E-03
Trichlorofluoromethane	5.5E-02	1.3E-03	1.5E-02
1,2,3-Trichloropropane	1.6E-04	3.7E-06	4.8E-05
1,2,4-Trimethylbenzene	2.5E-03	5.8E-05	7.1E-04
1,3,5-Trimethylbenzene	3.6E-03	8.2E-05	9.9E-04

TABLE 5-9b.Transfer Factors for Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	TF for Groundwater Vapor Migrating to Indoor Air ($\mu g/m^3$ per µg/L)	TF for Groundwater Vapor Migrating to Outdoor Air ($\mu g/m^3$ per µg/L)	TF for Groundwater Vapor Migrating to Trench Air ($\mu g/m^3$ per µg/L)
Vinyl chloride	2.7E-02	6.2E-04	7.5E-03
Xylenes (total)	3.3E-03	7.5E-05	9.2E-04

Notes:
µg/L = microgram per liter
$\mu g/m^3$ = microgram per cubic meter
TF = Transfer Factor

TABLE 5-10a. Air EPCs Due to Volatile Compounds Migrating from 5 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air

GMC - Linden, New Jersey
Henderson, Nevada

Chemical	5 ft bgs Maximum Soil Gas Concentration	Predicted Indoor Air Concentration	Predicted Outdoor Concentration	Predicted Trench Air Concentration
	µg/m^3			
Acetone	19	5.0E-03	1.1E-04	1.0E-03
Acrylonitrile	0.15	4.2E-05	2.4E-07	2.2E-06
Benzene	1.6	1.4E-17	1.9E-21	1.8E-20
2-Butanone	5.5	1.3E-03	1.7E-05	1.6E-04
tert-Butyl alcohol	0.62	1.5E-04	8.8E-06	8.2E-05
n-Butylbenzene	0.22	3.0E-05	1.8E-09	1.7E-08
Carbon disulfide	14	3.6E-03	1.8E-07	1.7E-06
Carbon tetrachloride	0.51	7.4E-05	1.9E-09	1.8E-08
Chlorobenzene	2.5	4.5E-04	1.2E-07	1.1E-06
Chloroethane	57	1.4E-02	8.9E-07	8.3E-06
Chloroform	1000	1.9E-01	3.8E-05	3.5E-04
Chloromethane	0.19	5.7E-05	4.2E-09	3.9E-08
Cyclohexane	9.0	1.8E-03	8.8E-09	8.2E-08
p-Cymene	0.19	3.6E-05	1.6E-11	1.4E-10
1,2-Dichlorobenzene	4.9	7.0E-04	3.1E-07	2.9E-06
1,3-Dichlorobenzene	12	2.1E-03	5.7E-07	5.3E-06
1,4-Dichlorobenzene	2.0	2.8E-04	9.8E-08	9.1E-07
Dichlorodifluoromethane	4.2	8.0E-04	1.7E-09	1.6E-08
1,1-Dichloroethane	170	3.5E-02	4.5E-06	4.2E-05
1,2-Dichloroethane	17	3.6E-03	2.3E-06	2.2E-05
1,1-Dichloroethene	1.8	3.8E-04	1.0E-08	9.5E-08
cis-1,2-Dichloroethene	2.2	4.8E-04	8.6E-08	8.0E-07
trans-1,2-Dichloroethene	0.44	9.5E-05	7.3E-09	6.8E-08
1,4-Dioxane	0.51	1.4E-04	2.4E-05	2.2E-04
Ethanol	7.3	2.5E-03	2.8E-04	2.6E-03
Ethylbenzene	0.16	2.8E-05	2.8E-09	2.6E-08
4-Ethyltoluene	0.11	2.1E-05	9.0E-12	8.4E-11
1,2-Dichlorotetrafluoroethane	0.10	9.5E-06	1.7E-12	1.6E-11
n-Heptane	0.51	7.9E-05	2.1E-11	1.9E-10
Hexachlorobutadiene	12	8.3E-04	7.2E-08	6.7E-07
2-Hexanone	0.83	1.5E-04	1.3E-06	1.2E-05
alpha-Methyl styrene	0.19	3.0E-05	1.1E-08	1.1E-07
4-Methyl-2-pentanone	0.37	6.5E-05	3.8E-07	3.5E-06
Methylene Chloride	35	8.6E-03	1.9E-06	1.8E-05
Naphthalene	0.92	1.4E-04	2.9E-07	2.7E-06
n-Octane	0.36	5.6E-05	9.0E-12	8.4E-11
n-Propylbenzene	0.088	1.3E-05	1.1E-09	1.0E-08
Styrene	0.46	8.2E-05	2.5E-08	2.3E-07
Tetrachloroethene	200	2.6E-02	1.1E-06	1.1E-05
Tetrahydrofuran	0.40	9.9E-05	1.0E-06	9.7E-06
Toluene	2.2	4.3E-04	5.0E-08	4.7E-07
1,2,4-Trichlorobenzene	21	2.1E-03	1.4E-06	1.3E-05
1,1,2-Trichloroethane	3.5	5.9E-04	5.6E-07	5.2E-06
Trichloroethene	71	1.2E-02	9.3E-07	8.7E-06
Trichlorofluoromethane	1.3	2.1E-04	1.5E-09	1.4E-08

TABLE 5-10a. Air EPCs Due to Volatile Compounds Migrating from 5 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air

GMC - Linden, New Jersey
Henderson, Nevada

Chemical	5 ft bgs Maximum Soil Gas Concentration	Predicted Indoor Air Concentration	Predicted Outdoor Concentration	Predicted Trench Air Concentration
	$\mu g/m^3$			
1,1,2-Trichloro-1,2,2-trifluoroethane	0.56	5.4E-05	7.0E-11	6.5E-10
1,2,4-Trimethylbenzene	0.35	5.4E-05	7.5E-09	7.0E-08
Vinyl acetate	5.1	1.1E-03	1.6E-06	1.5E-05
Vinyl chloride	0.19	4.9E-05	1.2E-09	1.1E-08
Xylenes (total)	5.1	8.8E-04	1.1E-07	1.0E-06

Notes:
bgs = below ground surface
ft = feet
$\mu g/m^3$ = microgram per cubic meter
EPC = Exposure point concentration

TABLE 5-10b. Air EPCs Due to Volatile Compounds Migrating from 15 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	15 ft bgs Maximum Soil Gas Concentration	Predicted Indoor Air Concentration	Predicted Outdoor Concentration	Predicted Trench Air Concentration
	μg/m^3			
Acetone	20	1.7E-03	3.7E-05	1.0E-03
Benzene	17	6.6E-18	9.2E-22	1.9E-19
Bromodichloromethane	0.48	2.1E-05	8.1E-09	2.3E-07
2-Butanone	2.0	1.5E-04	2.1E-06	5.7E-05
Carbon disulfide	7.2	6.0E-04	3.1E-08	8.6E-07
Carbon tetrachloride	0.55	2.5E-05	6.9E-10	1.9E-08
Chlorobenzene	32	1.8E-03	5.0E-07	1.4E-05
Chloroethane	200	1.6E-02	1.0E-06	2.9E-05
Chloroform	2900	1.8E-01	3.7E-05	1.0E-03
Chloromethane	0.29	2.8E-05	2.1E-09	6.0E-08
Cyclohexane	38	2.4E-03	1.2E-08	3.5E-07
1,2-Dichlorobenzene	27	1.2E-03	5.8E-07	1.6E-05
1,3-Dichlorobenzene	130	7.1E-03	2.1E-06	5.7E-05
1,4-Dichlorobenzene	28	1.2E-03	4.6E-07	1.3E-05
Dichlorodifluoromethane	4.1	2.5E-04	5.6E-10	1.6E-08
1,1-Dichloroethane	660	4.4E-02	5.9E-06	1.6E-04
1,2-Dichloroethane	98	6.6E-03	4.5E-06	1.3E-04
1,1-Dichloroethene	5.6	3.8E-04	1.1E-08	2.9E-07
cis-1,2-Dichloroethene	0.19	1.3E-05	2.5E-09	6.9E-08
trans-1,2-Dichloroethene	1.7	1.2E-04	9.4E-09	2.6E-07
1,2-Dichloropropane	1.9	1.1E-04	3.1E-08	8.7E-07
Ethanol	1.5	1.7E-04	1.9E-05	5.3E-04
Ethylbenzene	0.084	4.6E-06	4.9E-10	1.4E-08
Hexachlorobutadiene	54	1.2E-03	1.1E-07	3.0E-06
Methylene Chloride	24	1.9E-03	4.3E-07	1.2E-05
Tetrachloroethene	530	2.1E-02	1.0E-06	2.8E-05
Tetrahydrofuran	0.65	5.2E-05	5.6E-07	1.6E-05
Toluene	1.0	6.1E-05	7.6E-09	2.1E-07
1,2,4-Trichlorobenzene	130	4.1E-03	2.8E-06	7.9E-05
1,1,2-Trichloroethane	2.5	1.3E-04	1.3E-07	3.7E-06
Trichloroethene	240	1.3E-02	1.1E-06	2.9E-05
Trichlorofluoromethane	1.3	6.7E-05	4.9E-10	1.4E-08
1,1,2-Trichloro-1,2,2-trifluoroethane	0.52	1.6E-05	2.2E-11	6.1E-10
1,2,4-Trimethylbenzene	0.14	6.7E-06	1.0E-09	2.8E-08
Vinyl chloride	1.2	1.0E-04	2.5E-09	6.9E-08
Xylenes (total)	1.4	7.4E-05	9.6E-09	2.7E-07

Notes:

bgs = below ground surface
ft = feet
μg/m^3 = microgram per cubic meter
EPC = Exposure point concentration

TABLE 5-11. Air EPCs Due to Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	Maximum Groundwater Concentration	Predicted Indoor Air Concentration	Predicted Outdoor Concentration	Predicted Trench Air Concentration
	μg/L	μg/m^3		
Benzene	58,000	1.0E-12	2.3E-14	3.1E-13
Bromodichloromethane	0.29	2.8E-04	6.4E-06	7.9E-05
Carbon tetrachloride	0.32	4.0E-03	9.2E-05	1.1E-03
Chlorobenzene	50,000	8.4E+01	1.9E+00	2.4E+01
Chloroethane	0.44	4.4E-03	1.0E-04	1.2E-03
Chloroform	710	1.7E+00	3.8E-02	4.6E-01
Chloromethane	0.25	2.5E-03	5.8E-05	7.1E-04
1,2-Dichlorobenzene	1,000	7.6E-01	1.7E-02	2.2E-01
1,3-Dichlorobenzene	54	8.1E-02	1.9E-03	2.3E-02
1,4-Dichlorobenzene	1,800	1.7E+00	3.9E-02	4.8E-01
1,1-Dichloroethane	60	2.3E-01	5.3E-03	6.5E-02
1,2-Dichloroethane	1.1	9.1E-04	2.1E-05	2.6E-04
1,4-Dioxane	3.6	2.0E-05	4.7E-07	6.6E-06
Tetrachloroethene	64	4.2E-01	9.7E-03	1.2E-01
1,2,3-Trichlorobenzene	0.50	1.6E-04	3.5E-06	4.5E-05
1,2,4-Trichlorobenzene	120	4.6E-02	1.1E-03	1.3E-02
Trichloroethene	0.33	1.7E-03	4.0E-05	4.8E-04
1,2,3-Trichloropropane	0.012	2.0E-06	4.5E-08	5.8E-07

Notes:
μg/L = microgram per liter
μg/m^3 = microgram per cubic meter
EPC = Exposure point concentration

TABLE 5-12. Exposure Assumptions
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Exposure Factors	Units	Symbol	Indoor Commercial/ Industrial Worker		Outdoor Commercial/ Industrial Worker		Construction Worker	
			Value	Source	Value	Source	Value	Source
Population-Specific Exposure Assumptions								
Exposure Time	hours/day	ET	8	NDEP 2023	8	NDEP 2023	4	VDEQ 2019
Exposure Frequency	days/year	EF	250	NDEP 2023	225	NDEP 2023	30	[1]
Exposure Duration	years	ED	25	NDEP 2023	25	NDEP 2023	1	USEPA 2023
Averaging Time for Carcinogens	days	AT_c	25,550	NDEP 2023	25,550	NDEP 2023	25,550	USEPA 2023
Averaging Time for Noncarcinogens	days	AT_{nc}	9,125	NDEP 2023	9,125	NDEP 2023	365	USEPA 2023
Inhalation of Vapor Migrating from Soil Gas or Groundwater to Indoor, Outdoor Air, or Trench Air								
Conversion Factor	hour/day	CF	24	--	24	--	24	--
Intake Factor for Vapor Inhalation, cancer	unitless	$IF_{vapor.inh\_c}$	8.2E-02	USEPA 2009	7.3E-02	USEPA 2009	2.0E-04	USEPA 2009
Intake Factor for Vapor Inhalation, noncancer	unitless	$IF_{vapor.inh\_nc}$	2.3E-01	USEPA 2009	2.1E-01	USEPA 2009	1.4E-02	USEPA 2009

Notes:

-- = Not applicable
NDEP = Nevada Division of Environmental Protection
USEPA = United States Environmental Protection Agency
VDEQ = Virginia Department of Environmental Quality

[1] Recommended exposure frequency in NDEP's January 12, 2017 comment letter (NDEP 2017).

Sources:

NDEP. 2017. Response to: Soil Gas Investigation and Health Risk Assessment for Parcels C, D, F, G, and H, Revision 1. January 12.
NDEP. 2023. User’s Guide and Background Technical Document for the NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas, Revision 16. June.
VDEQ. 2019. Virginia Unified Risk Assessment Model - VURAM User's Guide. July.
USEPA. 2009. Risk Assessment Guidance for Superfund. Vol. 1: Part F, Supplemental Guidance for Inhalation Risk Assessment. Final. January.
USEPA. 2023. Regional Screening Levels User's Guide. May.

TABLE 5-13. Chronic and Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater Analytes
GMC - Linden, New Jersey
Henderson, Nevada

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$		USEPA Weight-of-Evidence Carcinogen Classification		Inhalation Chronic RfC $(\mu g/m^3)$		Inhalation Subchronic RfC $(\mu g/m^3)$	
Acetone	--	--	D	IRIS	31,000	NDEP	31,000	NDEP [1]
Acrylonitrile	0.000068	IRIS	B1	IRIS	2.0	IRIS	2.0	IRIS [1]
tert-Amyl methyl ether	--	--	--	--	3,000	IRIS [2]	3,000	IRIS [1, 2]
Benzene	0.0000078	IRIS	A	IRIS	30	IRIS	80	PPRTV
Benzyl chloride	0.000049	Cal/EPA	B2	IRIS	1.0	PPRTV	4.0	PPRTV
Bromobenzene	--	--	D	IRIS	60	IRIS	200	IRIS
Bromochloromethane	--	--	D	IRIS	40	PPRTV Appendix	100	PPRTV
Bromodichloromethane	0.000037	Cal/EPA	B2	IRIS	600	IRIS [3]	20	PPRTV
Bromoform	0.0000011	IRIS	B2	IRIS	--	--	--	--
Bromomethane	--	--	D	IRIS	5.0	IRIS	100	PPRTV
2-Butanone	--	--	D	IRIS	5,000	IRIS	1,000	HEAST
tert-Butyl alcohol	--	--	--	--	5,000	IRIS	5,000	IRIS [1]
n-Butylbenzene	--	--	--	--	400	IRIS [4]	90	HEAST [4]
sec-Butylbenzene	--	--	--	--	400	IRIS [4]	90	HEAST [4]
tert-Butylbenzene	--	--	--	--	400	IRIS [4]	90	HEAST [4]
Carbon disulfide	--	--	--	--	700	IRIS	700	HEAST
Carbon tetrachloride	0.0000060	IRIS	B2	IRIS	100	IRIS	190	ATSDR
3-Chloro-1-propene	0.0000060	Cal/EPA	C	IRIS	1.0	IRIS	10	HEAST
Chlorobenzene	--	--	D	IRIS	50	PPRTV	500	PPRTV
Chloroethane	--	--	B2	PPRTV	10,000	IRIS	4,000	PPRTV
Chloroform	0.000023	IRIS	B2	IRIS	98	ATSDR	240	ATSDR
Chloromethane	--	--	D	IRIS	90	IRIS	3,000	PPRTV
2-Chlorotoluene	--	--	D	PPRTV	50	PPRTV [5]	800	PPRTV Appendix
4-Chlorotoluene	--	--	D	PPRTV	50	PPRTV [5]	500	PPRTV [5]
Cumene	--	--	D	IRIS	400	IRIS	90	HEAST
Cyclohexane	--	--	D	IRIS	6,000	IRIS	18,000	PPRTV
p-Cymene	--	--	--	--	400	IRIS [4]	90	HEAST [4]
1,2-Dibromo-3-chloropropane	0.0060	PPRTV	B2	PPRTV	0.20	IRIS	2.0	PPRTV

TABLE 5-13. Chronic and Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater Analytes

GMC - Linden, New Jersey
Henderson, Nevada

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$		USEPA Weight-of-Evidence Carcinogen Classification		Inhalation Chronic RfC $(\mu g/m^3)$		Inhalation Subchronic RfC $(\mu g/m^3)$	
Dibromochloromethane	--	--	C	IRIS	--	--	--	--
1,2-Dibromoethane	0.00060	IRIS	B2	IRIS	9.0	IRIS	2.0	HEAST
Dibromomethane	--	--	D	PPRTV	4.0	PPRTV Appendix	40	PPRTV Appendix
1,2-Dichlorobenzene	--	--	D	IRIS	200	HEAST	2,000	HEAST
1,3-Dichlorobenzene	--	--	D	IRIS	200	HEAST [6]	2,000	HEAST [6]
1,4-Dichlorobenzene	0.000011	Cal/EPA	C	USEPA 2018	800	IRIS	1,200	ATSDR
Dichlorodifluoromethane	--	--	D	PPRTV	100	PPRTV Appendix	1,000	PPRTV
1,1-Dichloroethane	0.0000016	Cal/EPA	C	IRIS	--	--	--	--
1,2-Dichloroethane	0.000026	IRIS	B2	IRIS	7.0	PPRTV	70	PPRTV
1,1-Dichloroethene	--	--	C	IRIS	200	IRIS	4.0	ATSDR
cis-1,2-Dichloroethene	--	--	D	IRIS	40	Cal/EPA	400	PPRTV Appendix
trans-1,2-Dichloroethene	--	--	D	IRIS	40	Cal/EPA	790	ATSDR
1,2-Dichloropropane	0.0000037	PPRTV	B2	USEPA 2018	4.0	IRIS	9.2	ATSDR
1,3-Dichloropropane	--	--	--	--	4.0	IRIS [8]	9.2	ATSDR [8]
2,2-Dichloropropane	--	--	--	--	4.0	IRIS [8]	9.2	ATSDR [8]
1,1-Dichloropropene	--	--	--	--	20	IRIS [9]	36	ATSDR [9]
1,3-Dichloropropene	0.0000040	IRIS	B2	IRIS	20	IRIS	36	ATSDR
Diisopropyl ether	--	--	--	--	700	PPRTV	700	PPRTV
1,4-Dioxane	0.0000050	IRIS	B2	IRIS	30	IRIS	720	ATSDR
Ethanol	--	--	--	--	100,000	NDEP	100,000	NDEP [1]
Ethyl tert-butyl ether	0.000000080	IRIS	--	--	40,000	IRIS	40,000	IRIS [1]
Ethyl acetate	--	--	D	PPRTV	70	PPRTV	700	PPRTV
Ethylbenzene	0.0000025	Cal/EPA	D	IRIS	1,000	IRIS	9,000	PPRTV
4-Ethyltoluene	--	--	--	--	400	IRIS [4]	90	HEAST [4]
1,2-Dichlorotetrafluoroethane	--	--	--	--	5000	PPRTV [10]	50000	PPRTV [10]
n-Heptane	--	--	D	IRIS	400	PPRTV	4,000	PPRTV
Hexachlorobutadiene	0.000022	IRIS	C	IRIS	--	--	--	--
n-Hexane	--	--	D	IRIS	700	IRIS	2,000	PPRTV

TABLE 5-13. Chronic and Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater Analytes

GMC - Linden, New Jersey
Henderson, Nevada

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$		USEPA Weight-of-Evidence Carcinogen Classification		Inhalation Chronic RfC $(\mu g/m^3)$		Inhalation Subchronic RfC $(\mu g/m^3)$	
2-Hexanone	--	--	D	IRIS	30	IRIS	30	IRIS [1]
alpha-Methyl styrene	--	--	--	--	1,000	IRIS [11]	3,000	HEAST [11]
Methyl tert-butyl ether	0.00000026	Cal/EPA	--	--	3,000	IRIS	3,000	IRIS [1]
4-Methyl-2-pentanone	--	--	D	IRIS	3,000	IRIS	800	HEAST
Methylene Chloride	0.000000010	IRIS	B2	IRIS	600	IRIS	1,040	ATSDR
Methylmethacrylate	--	--	E	IRIS	700	IRIS	700	IRIS [1]
Naphthalene	0.000034	Cal/EPA	C	IRIS	3.0	IRIS	3.0	IRIS [1]
n-Octane	--	--	--	--	20	PPRTV [12]	200	PPRTV [12]
n-Propylbenzene	--	--	D	PPRTV	1,000	PPRTV Appendix	1,000	PPRTV Appendix
Styrene	--	--	--	--	1,000	IRIS	3,000	HEAST
1,1,1,2-Tetrachloroethane	0.0000074	IRIS	C	IRIS	--	--	--	--
1,1,2,2-Tetrachloroethane	0.000058	Cal/EPA	B2	IRIS	--	--	--	--
Tetrachloroethene	0.00000026	IRIS	B1	IRIS	40	IRIS	41	ATSDR
Tetrahydrofuran	--	--	C	IRIS	2,000	IRIS	2,000	IRIS [1]
Toluene	--	--	D	IRIS	5,000	IRIS	5,000	PPRTV
1,2,3-Trichlorobenzene	--	--	D	PPRTV	2.0	PPRTV [13]	20	PPRTV [13]
1,2,4-Trichlorobenzene	--	--	D	IRIS	2.0	PPRTV	20	PPRTV
1,1,1-Trichloroethane	--	--	D	IRIS	5,000	IRIS	5,000	IRIS
1,1,2-Trichloroethane	0.000016	IRIS	C	IRIS	0.20	PPRTV Appendix	11	ATSDR
Trichloroethene	0.0000041	IRIS	A	IRIS	2.0	IRIS	2.2	ATSDR
Trichlorofluoromethane	--	--	D	PPRTV	--	--	1,000	PPRTV
1,2,3-Trichloropropane	--	--	B2	IRIS	0.30	IRIS	0.30	IRIS [1]
1,1,2-Trichloro-1,2,2-trifluoroethane	--	--	D	PPRTV	5,000	PPRTV	50,000	PPRTV
1,2,4-Trimethylbenzene	--	--	D	IRIS	60	IRIS	200	IRIS
1,3,5-Trimethylbenzene	--	--	D	IRIS	60	IRIS	200	IRIS
Vinyl acetate	--	--	--	--	200	IRIS	35	ATSDR
Vinyl chloride	0.0000044	IRIS	A	IRIS	100	IRIS	100	IRIS[1]

TABLE 5-13. Chronic and Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater Analytes
GMC - Linden, New Jersey
Henderson, Nevada

Chemical	Inhalation Unit Risk ($\mu g/m^3$)$^{-1}$		USEPA Weight-of-Evidence Carcinogen Classification		Inhalation Chronic RfC ($\mu g/m^3$)		Inhalation Subchronic RfC ($\mu g/m^3$)	
Xylenes (total)	--	--	D	IRIS	100	IRIS	400	PPRTV

Notes:
-- = Not available
$\mu g/m^3$ = microgram per cubic meter
ATSDR = Agency for Toxic Substances and Disease Registry (values as cited in USEPA 2023a)
Cal/EPA = California Environmental Protection Agency (values as cited in USEPA 2023a)
HEAST = Health Effects Assessment Summary Tables (values as cited in USEPA 2023a)
IRIS = Integrated Risk Information System (USEPA 2023b)
NDEP = Nevada Division of Environmental Protection (NDEP 2023)
OEHHA = Cal/EPA's Office of Environmental Health Hazard Assessment
PPRTV = Provisional Peer Reviewed Toxicity Values for Superfund (values as cited in USEPA 2023a)
RfC = Reference concentration
USEPA = United States Environmental Protection Agency

USEPA Weight-of-Evidence Carcinogen Classification:
A = Human carcinogen
B1 = Probable carcinogen, limited human evidence
B2 = Probable carcinogen, sufficient evidence in animals
C = Possible human carcinogen
D = Not classifiable
E = Evidence of noncarcinogenicity

[1] Use chronic RfC as surrogate.
[2] Use methyl tert-butyl ether as surrogate.
[3] Use dichloromethane (methylene chloride) as surrogate.
[4] Use cumene as surrogate.
[5] Use chlorobenzene as surrogate.
[6] Use 1,2-dichlorobenzene as surrogate.
[7] Use trans-1,2-dichloroethene as surrogate.
[8] Use 1,2-dichloropropane as surrogate.
[9] Use 1,3-dichloropropene as surrogate.
[10] Use 1,1,2-trichloro-1,2,2-trifluoroethane as surrogate.
[11] Use styrene as surrogate.
[12] Use n-nonane as surrogate.
[13] Use 1,2,4-trichlorobenzene as surrogate.

Sources:
NDEP. 2023. Basic Comparison Level (BCL) Table. June.
USEPA. 2018. Prioritized Chronic Dose-Response Values for Screening Risk Assessments. June.
USEPA. 2023a. Regional Screening Levels. May.
USEPA. 2023b. Integrated Risk Information System (IRIS). Available online at https://www.epa.gov/iris. Accessed on May 31, 2023.

TABLE 5-14. Estimated Asbestos Cancer Risks

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Risk Type	Indoor Commercial/Industrial Worker			Outdoor Commercial/Industrial Worker			Construction Worker		
	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk
Best Estimate	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
Upper-Bound Estimate	2E-07	1E-09	2E-07	4E-07	3E-09	4E-07	4E-06	3E-08	4E-06

Notes:

Best Estimate = Calculated based on the number of long fibers observed in soil samples.

Upper-Bound Estimate = Calculated based on the 95% upper confidence limit (UCL) of the number of long fibers observed in soil samples from a Poisson distribution.

TABLE 5-15a. Estimated Soil Gas Cancer Risks and Non-Cancer Hazard Indices (5 ft bgs)

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	5 ft bgs Soil Gas EPC [1] (µg/m^3)	5 ft bgs					
		Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
		Cancer Risk	HQ	Cancer Risk	HQ	Cancer Risk	HQ
Acetone	19	--	3.7E-08	--	7.1E-10	--	4.4E-10
Acrylonitrile	0.15	2.3E-10	4.7E-06	1.2E-12	2.4E-08	3.0E-14	1.5E-08
Benzene	1.6	9.1E-24	1.1E-19	1.1E-27	1.3E-23	2.8E-29	3.1E-24
2-Butanone	5.5	--	5.8E-08	--	7.0E-10	--	2.2E-09
tert-Butyl alcohol	0.62	--	6.8E-09	--	3.6E-10	--	2.2E-10
n-Butylbenzene	0.22	--	1.7E-08	--	9.4E-13	--	2.6E-12
Carbon disulfide	14	--	1.2E-06	--	5.3E-11	--	3.3E-11
Carbon tetrachloride	0.51	3.6E-11	1.7E-07	8.5E-16	4.0E-12	2.1E-17	1.3E-12
Chlorobenzene	2.5	--	2.1E-06	--	4.8E-10	--	3.0E-11
Chloroethane	57	--	3.3E-07	--	1.8E-11	--	2.8E-11
Chloroform	1000	3.6E-07	4.5E-04	6.4E-11	7.9E-08	1.6E-12	2.0E-08
Chloromethane	0.19	--	1.4E-07	--	9.6E-12	--	1.8E-13
Cyclohexane	9.0	--	6.8E-08	--	3.0E-13	--	6.2E-14
p-Cymene	0.19	--	2.0E-08	--	8.0E-15	--	2.2E-14
1,2-Dichlorobenzene	4.9	--	8.0E-07	--	3.2E-10	--	2.0E-11
1,3-Dichlorobenzene	12	--	2.4E-06	--	5.9E-10	--	3.6E-11
1,4-Dichlorobenzene	2.0	2.5E-10	8.0E-08	7.9E-14	2.5E-11	2.0E-15	1.0E-11
Dichlorodifluoromethane	4.2	--	1.8E-06	--	3.6E-12	--	2.2E-13
1,1-Dichloroethane	170	4.6E-09	--	5.3E-13	--	1.3E-14	--
1,2-Dichloroethane	17	7.7E-09	1.2E-04	4.4E-12	6.8E-08	1.1E-13	4.2E-09
1,1-Dichloroethene	1.8	--	4.4E-07	--	1.0E-11	--	3.3E-10
cis-1,2-Dichloroethene	2.2	--	2.7E-06	--	4.4E-10	--	2.8E-11
trans-1,2-Dichloroethene	0.44	--	5.4E-07	--	3.7E-11	--	1.2E-12
1,4-Dioxane	0.51	5.7E-11	1.1E-06	8.8E-12	1.7E-07	2.2E-13	4.3E-09
Ethanol	7.3	--	5.7E-09	--	5.7E-10	--	3.5E-10
Ethylbenzene	0.16	5.6E-12	6.3E-09	5.2E-16	5.8E-13	1.3E-17	4.0E-14
4-Ethyltoluene	0.11	--	1.2E-08	--	4.6E-15	--	1.3E-14
1,2-Dichlorotetrafluoroethane	0.098	--	4.3E-10	--	7.1E-17	--	4.4E-18
n-Heptane	0.51	--	4.5E-08	--	1.1E-14	--	6.5E-16
Hexachlorobutadiene	12	1.5E-09	--	1.2E-13	--	2.9E-15	--
2-Hexanone	0.83	--	1.1E-06	--	8.9E-09	--	5.5E-09
alpha-Methyl styrene	0.19	--	6.9E-09	--	2.3E-12	--	4.8E-13
4-Methyl-2-pentanone	0.37	--	5.0E-09	--	2.6E-11	--	6.0E-11
Methylene Chloride	35	7.0E-12	3.3E-06	1.4E-15	6.5E-10	3.4E-17	2.3E-10
Naphthalene	0.92	3.9E-10	1.1E-05	7.3E-13	2.0E-08	1.8E-14	1.2E-08
n-Octane	0.36	--	6.4E-07	--	9.3E-14	--	5.8E-15
n-Propylbenzene	0.088	--	3.1E-09	--	2.2E-13	--	1.4E-13
Styrene	0.46	--	1.9E-08	--	5.0E-12	--	1.0E-12
Tetrachloroethene	200	5.5E-10	1.5E-04	2.2E-14	5.8E-09	5.3E-16	3.5E-09
Tetrahydrofuran	0.40	--	1.1E-08	--	1.1E-10	--	6.6E-11
Toluene	2.2	--	1.9E-08	--	2.1E-12	--	1.3E-12
1,2,4-Trichlorobenzene	21	--	2.4E-04	--	1.4E-07	--	8.8E-09
1,1,2-Trichloroethane	3.5	7.7E-10	6.7E-04	6.6E-13	5.8E-07	1.6E-14	6.6E-09
Trichloroethene	71	4.1E-09	1.4E-03	2.8E-13	9.6E-08	7.0E-15	5.5E-08

TABLE 5-15a. Estimated Soil Gas Cancer Risks and Non-Cancer Hazard Indices (5 ft bgs)
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	5 ft bgs Soil Gas EPC [1] (μg/m³)	5 ft bgs					
		Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
		Cancer Risk	HQ	Cancer Risk	HQ	Cancer Risk	HQ
Trichlorofluoromethane	1.3	--	--	--	--	--	1.9E-13
1,1,2-Trichloro-1,2,2-trifluoroethane	0.56	--	2.5E-09	--	2.9E-15	--	1.8E-16
1,2,4-Trimethylbenzene	0.35	--	2.0E-07	--	2.6E-11	--	4.8E-12
Vinyl acetate	5.1	--	1.2E-06	--	1.7E-09	--	5.9E-09
Vinyl chloride	0.19	1.8E-11	1.1E-07	3.8E-16	2.4E-12	9.4E-18	1.5E-12
Xylenes (total)	5.1	--	2.0E-06	--	2.2E-10	--	3.4E-11
Total Cancer Risk/Non-Cancer HI		**4E-07**	**0.003**	**8E-11**	**0.000001**	**2E-12**	**0.0000001**

Notes:

-- Not calculated

bgs = below ground surface

ft = feet

μg/m³ = microgram per cubic meter

EPC = Exposure point concentration

HI = Hazard index

HQ = Hazard quotient

[1] Conservatively used the maximum detected concentrations in the 5 ft bgs soil gas samples collected in Parcel E.

TABLE 5-15b. Estimated Soil Gas Cancer Risks and Non-Cancer Hazard Indices (15 ft bgs)

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical	15 ft bgs Soil Gas EPC [1] ($\mu g/m^3$)	15 ft bgs					
		Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
		Cancer Risk	HQ	Cancer Risk	HQ	Cancer Risk	HQ
Acetone	20	--	1.3E-08	--	2.5E-10	--	4.6E-10
Benzene	17	4.2E-24	5.0E-20	5.3E-28	6.3E-24	2.9E-28	3.3E-23
Bromodichloromethane	0.48	6.5E-11	8.2E-09	2.2E-14	2.8E-12	1.6E-15	1.5E-10
2-Butanone	2.0	--	6.7E-09	--	8.4E-11	--	7.9E-10
Carbon disulfide	7.2	--	2.0E-07	--	9.0E-12	--	1.7E-11
Carbon tetrachloride	0.55	1.2E-11	5.7E-08	3.1E-16	1.4E-12	2.3E-17	1.4E-12
Chlorobenzene	32	--	8.3E-06	--	2.0E-09	--	3.8E-10
Chloroethane	200	--	3.7E-07	--	2.1E-11	--	9.9E-11
Chloroform	2900	3.3E-07	4.1E-04	6.2E-11	7.7E-08	4.6E-12	5.8E-08
Chloromethane	0.29	--	7.1E-08	--	4.9E-12	--	2.7E-13
Cyclohexane	38	--	9.1E-08	--	4.2E-13	--	2.6E-13
1,2-Dichlorobenzene	27	--	1.4E-06	--	5.9E-10	--	1.1E-10
1,3-Dichlorobenzene	130	--	8.1E-06	--	2.1E-09	--	3.9E-10
1,4-Dichlorobenzene	28	1.1E-09	3.5E-07	3.7E-13	1.2E-10	2.7E-14	1.5E-10
Dichlorodifluoromethane	4.1	--	5.6E-07	--	1.2E-12	--	2.2E-13
1,1-Dichloroethane	660	5.7E-09	--	6.9E-13	--	5.1E-14	--
1,2-Dichloroethane	98	1.4E-08	2.2E-04	8.5E-12	1.3E-07	6.4E-13	2.4E-08
1,1-Dichloroethene	5.6	--	4.3E-07	--	1.1E-11	--	5.1E-11
cis-1,2-Dichloroethene	0.19	--	--	--	--	--	1.2E-12
trans-1,2-Dichloroethene	1.7	--	--	--	--	--	4.6E-12
1,2-Dichloropropane	1.9	3.3E-11	6.3E-06	8.5E-15	1.6E-09	6.3E-16	1.3E-09
Ethanol	1.5	--	3.9E-10	--	3.9E-11	--	7.2E-11
Ethylbenzene	0.084	9.3E-13	1.0E-09	9.1E-17	1.0E-13	6.8E-18	2.1E-14
Hexachlorobutadiene	54	2.1E-09	--	1.7E-13	--	1.3E-14	--
Methylene Chloride	24	1.5E-12	7.2E-07	3.2E-16	1.5E-10	2.4E-17	1.6E-10
Tetrachloroethene	530	4.5E-10	1.2E-04	1.9E-14	5.1E-09	1.4E-15	9.4E-09
Tetrahydrofuran	0.65	--	5.9E-09	--	5.8E-11	--	1.1E-10
Toluene	1.0	--	2.8E-09	--	3.1E-13	--	5.8E-13
1,2,4-Trichlorobenzene	130	--	4.7E-04	--	2.9E-07	--	5.4E-08
1,1,2-Trichloroethane	2.5	1.7E-10	1.5E-04	1.6E-13	1.4E-07	1.2E-14	4.7E-09
Trichloroethene	240	4.4E-09	1.5E-03	3.2E-13	1.1E-07	2.4E-14	1.9E-07
Trichlorofluoromethane	1.3	--	--	--	--	--	1.9E-13
1,1,2-Trichloro-1,2,2-trifluoroethane	0.52	--	7.1E-10	--	8.9E-16	--	1.7E-16
1,2,4-Trimethylbenzene	0.14	--	2.6E-08	--	3.4E-12	--	1.9E-12
Vinyl chloride	1.2	3.6E-11	2.3E-07	8.0E-16	5.1E-12	5.9E-17	1.2E-11
Xylenes (total)	1.4	--	1.7E-07	--	2.0E-11	--	9.1E-12
Total Cancer Risk/Non-Cancer HI		**4E-07**	**0.003**	**7E-11**	**0.0000008**	**5E-12**	**0.0000003**

Notes:

-- Not calculated

bgs = below ground surface

ft = feet

$\mu g/m^3$ = microgram per cubic meter

EPC = Exposure point concentration

HI = Hazard index

HQ = Hazard quotient

[1] Conservatively used the maximum detected concentrations in the 15 ft bgs soil gas samples collected in Parcel E.

TABLE 5-16. Estimated Shallow Groundwater Cancer Risks and Non-Cancer Hazard Indices

Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical	Shallow Groundwater EPC [1] (µg/L)	Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
		Cancer Risk	HQ	Cancer Risk	HQ	Cancer Risk	HQ
Benzene	58,000	6.5E-19	7.7E-15	1.3E-20	1.6E-16	4.8E-22	5.4E-17
Bromodichloromethane	0.29	8.5E-10	1.1E-07	1.7E-11	2.2E-09	5.7E-13	5.4E-08
Carbon tetrachloride	0.32	2.0E-09	9.2E-06	4.1E-11	1.9E-07	1.3E-12	8.1E-08
Chlorobenzene	50,000	--	3.8E-01	--	7.9E-03	--	6.4E-04
Chloroethane	0.44	--	1.0E-07	--	2.1E-09	--	4.2E-09
Chloroform	710	3.1E-06	3.9E-03	6.4E-08	8.0E-05	2.1E-09	2.6E-05
Chloromethane	0.25	--	6.4E-06	--	1.3E-07	--	3.2E-09
1,2-Dichlorobenzene	1,000	--	8.7E-04	--	1.8E-05	--	1.5E-06
1,3-Dichlorobenzene	54	--	9.2E-05	--	1.9E-06	--	1.6E-07
1,4-Dichlorobenzene	1,800	1.5E-06	4.9E-04	3.1E-08	1.0E-05	1.0E-09	5.5E-06
1,1-Dichloroethane	60	3.0E-08	--	6.2E-10	--	2.0E-11	--
1,2-Dichloroethane	1.1	1.9E-09	3.0E-05	4.0E-11	6.1E-07	1.3E-12	5.1E-08
1,4-Dioxane	3.6	8.3E-12	1.6E-07	1.7E-13	3.2E-09	6.4E-15	1.3E-10
Tetrachloroethene	64	9.0E-09	2.4E-03	1.8E-10	5.0E-05	6.0E-12	4.0E-05
1,2,3-Trichlorobenzene	0.50	--	1.8E-05	--	3.6E-07	--	3.1E-08
1,2,4-Trichlorobenzene	120	--	5.3E-03	--	1.1E-04	--	9.0E-06
Trichloroethene	0.33	5.8E-10	2.0E-04	1.2E-11	4.1E-06	3.9E-13	3.3E-06
1,2,3-Trichloropropane	0.012	--	1.5E-06	--	3.1E-08	--	2.7E-08
Total Cancer Risk/Non-Cancer HI		5E-06	0.4	1E-07	0.008	3E-09	0.0007

Notes:

-- Not calculated
µg/L = microgram per liter
EPC = Exposure point concentration
HI = Hazard index
HQ = Hazard quotient
[1] Conservatively used the maximum detected concentrations in the shallow groundwater samples collected in Parcel E.

TABLE 7-1. Soil Gas Data Quality Assessment

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Medium	**Soil Gas (5 ft bgs)**		**Soil Gas (15 ft bgs)**	
Parcel	**E**		**E**	
Number of Samples	10		6	
P_1 [1]	0		0	
Sample count for effect size	1	2	1	2
Effect size [2]	0.100	0.200	0.167	0.333
P_2 [3]	0.100	0.200	0.167	0.333
	Number of samples required [4]			
β=15%	19	9	11	5
β=20%	16	8	9	4
β=25%	14	7	8	4

Notes:

bgs = below ground surface

ft = feet

[1] P_1 is the theoretical proportion of concentrations exceeding a threshold as specified in the null hypothesis. Input 0.000001 in G*Power, because the minimum input is 0.000001 in Gpower.

[2] Effect size is population proportion, set to defined number of samples over total number of samples.

[3] P_2 is P_1 plus effect size.

[4] Calculations were done using the Exact – Generic binomial test in the software program G*Power.

TABLE 7-2. Shallow Groundwater Data Quality Assessment
Parcel E, Nevada Environmental Response Trust Site
Henderson, Nevada

Medium	Groundwater	
Parcel	E	
Number of Samples	11	
P_1 [1]	0	0
Sample count for effect size	1	2
Effect size [2]	0.091	0.182
P_2 [3]	0.091	0.182
	Number of samples required [4]	
β=15%	20	10
β=20%	17	9
β=25%	15	7

Notes:

[1] P_1 is the theoretical proportion of concentrations exceeding a threshold as specified in the null hypothesis. Input 0.000001 in G*Power, because the minimum input is 0.000001 in Gpower.

[2] Effect size is population proportion, set to defined number of samples over total number of samples.

[3] P_2 is P_1 plus effect size.

[4] Calculations were done using the Exact – Generic binomial test in the software program G*Power.

TABLE 8-1. Summary of Cumulative Estimated Risks for Soil and Soil Gas

Parcel E, Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure [1]	Indoor Commercial/Industrial Worker		Outdoor Commercial/Industrial Worker		Construction Worker	
	Cancer Risk	Non-Cancer HI	Cancer Risk	Non-Cancer HI	Cancer Risk	Non-Cancer HI
Cumulative Risk for Soil and Soil Gas (5 ft) [2]	4E-07	0.003	8E-11	0.000001	2E-12	0.0000001
Cumulative Risk for Soil and Soil Gas (15 ft) [2]	4E-07	0.003	7E-11	0.0000008	5E-12	0.0000003
Asbestos - Best Estimate	0E+00	--	0E+00	--	0E+00	--
Asbestos - Upper-Bound Estimate [3]	2E-07	--	4E-07	--	4E-06	--

Notes:

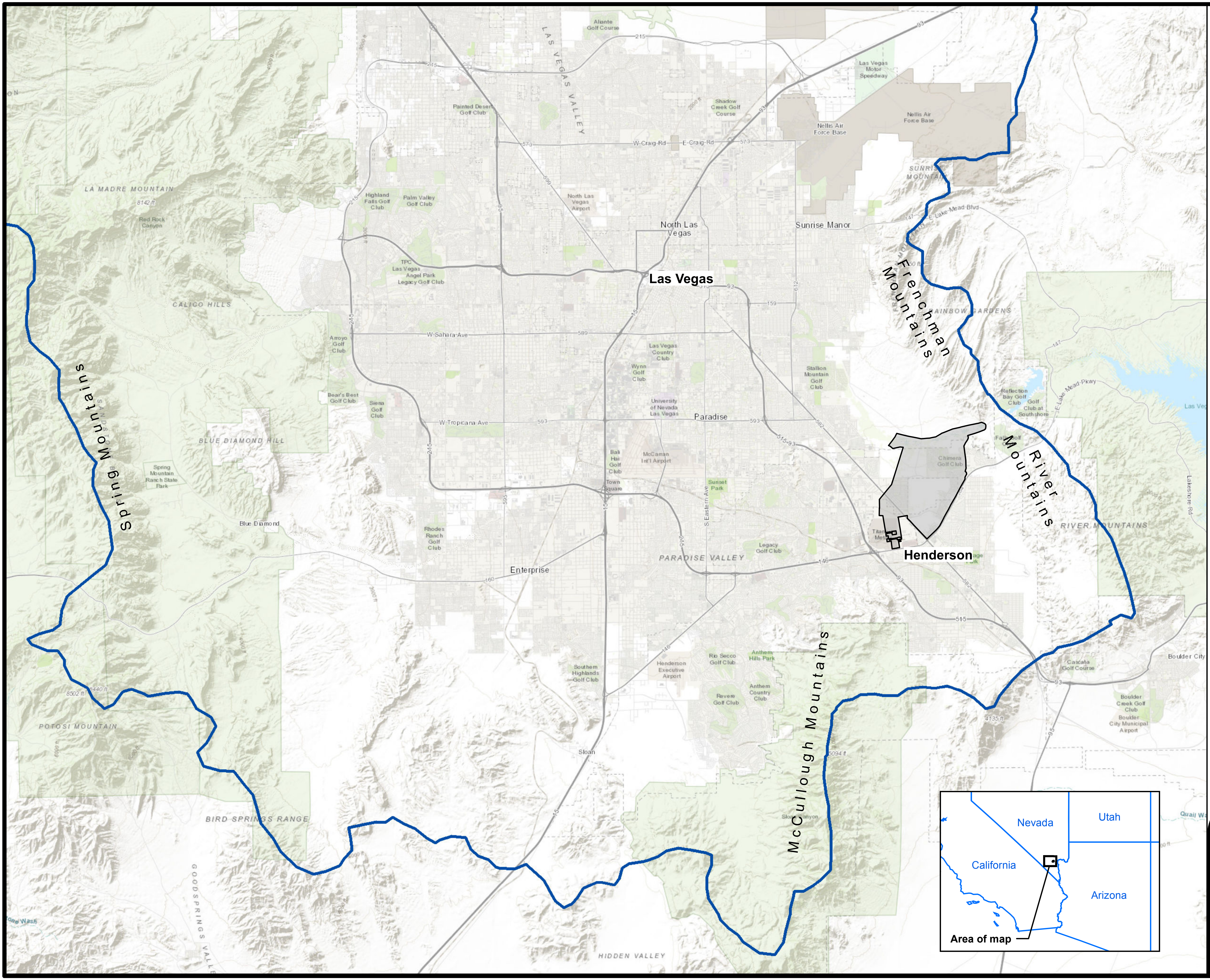
-- = Not applicable
ft = feet
COPC = Chemical of potential concern
HI = Hazard index
VOC = Volatile organic compound

[1] Asbestos cancer risk was not included in the cumulative risk calculation.

[2] No analytes except asbestos were identified as soil COPCs. Therefore, the cumulative cancer risk and non-cancer HI were equal to the cancer risk and non-cancer HI for VOCs via inhalation of soil gas migrating to air.

[3] Although fiber counts were zero (0), upper-bound fiber concentrations in soil are estimated assuming a Poisson distribution, which yields an upper-bound risk estimate that is greater than 0.

FIGURES



LEGEND:

- ▭ Las Vegas Valley Hydrologic Basin
- ▨ NERT RI Study Area

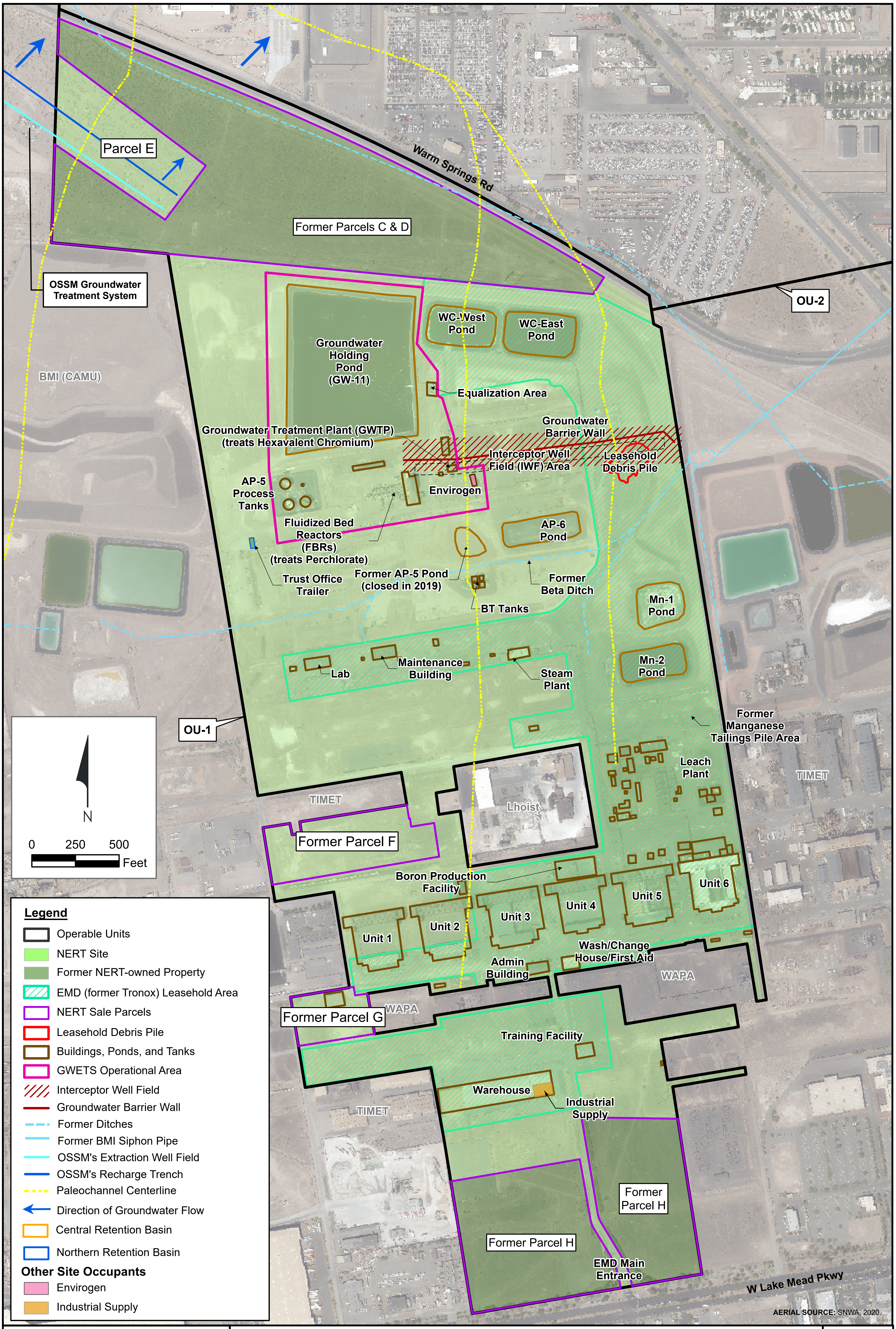
Note:
See Figure 1-2 for NERT RI Study Area details.

RAMBOLL

NERT RI Study Area Location Map
Nevada Environmental Response Trust Site
Henderson, Nevada

Date:	Contract Number:		Figure
9/26/2023	1690029369-012		**ES-1**
Drafter: RS	Approved:	Revised:	

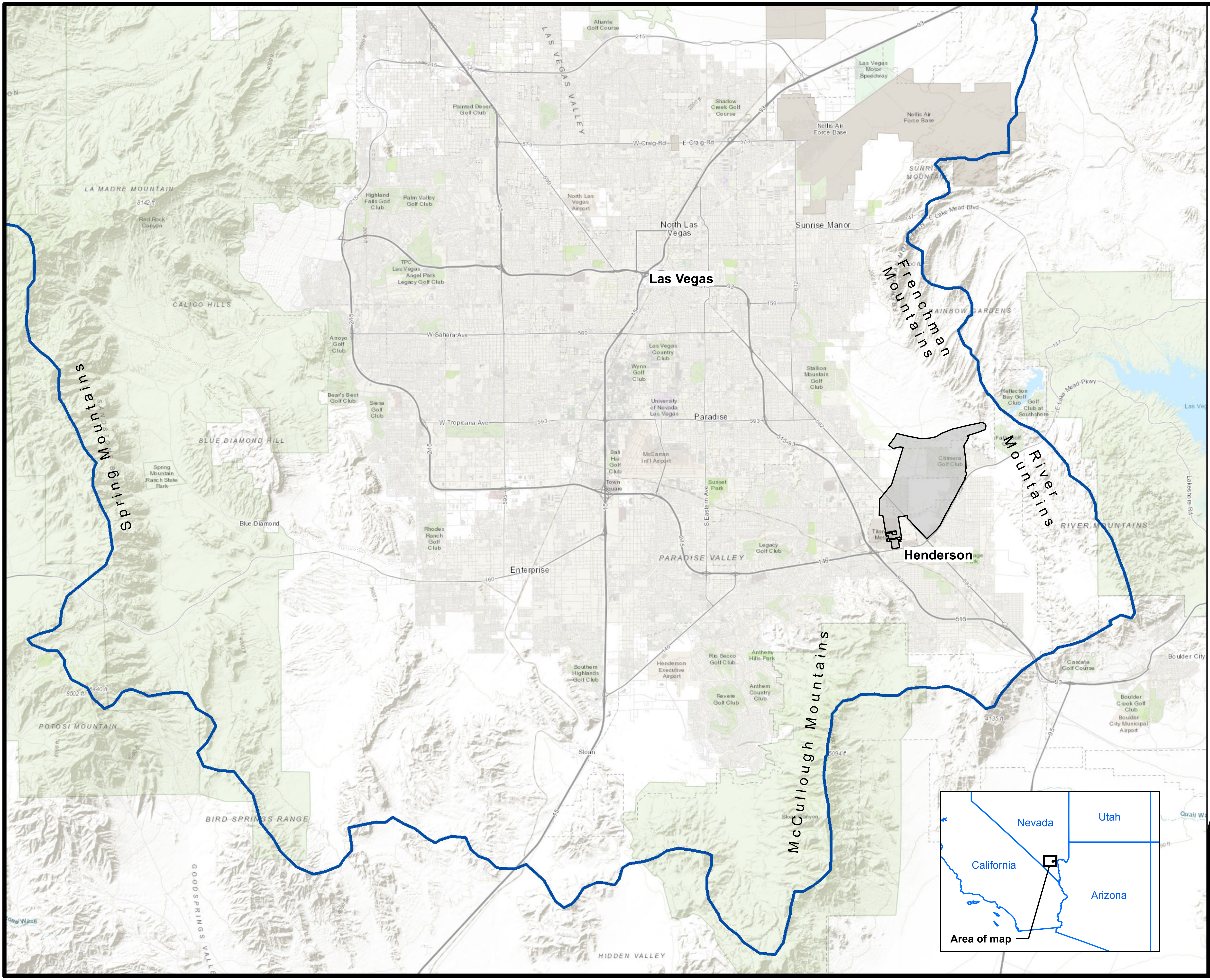
Path: H:\LePetomane\NERT\RI OU-1_OU-2 RI Report\Sections\Section 1 - Introduction\GIS\Fig 1-1 RI Location Map.mxd



Site Features
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
ES-2

Drafter: RS/JC | Date: 11/07/2023. | Contract Number: 1690029369-012 | Approved by: | Revised:



LEGEND:

▭	Las Vegas Valley Hydrologic Basin
▨	NERT RI Study Area

Note:
See Figure 1-2 for NERT RI Study Area details.

N

0 2.5 5 Miles

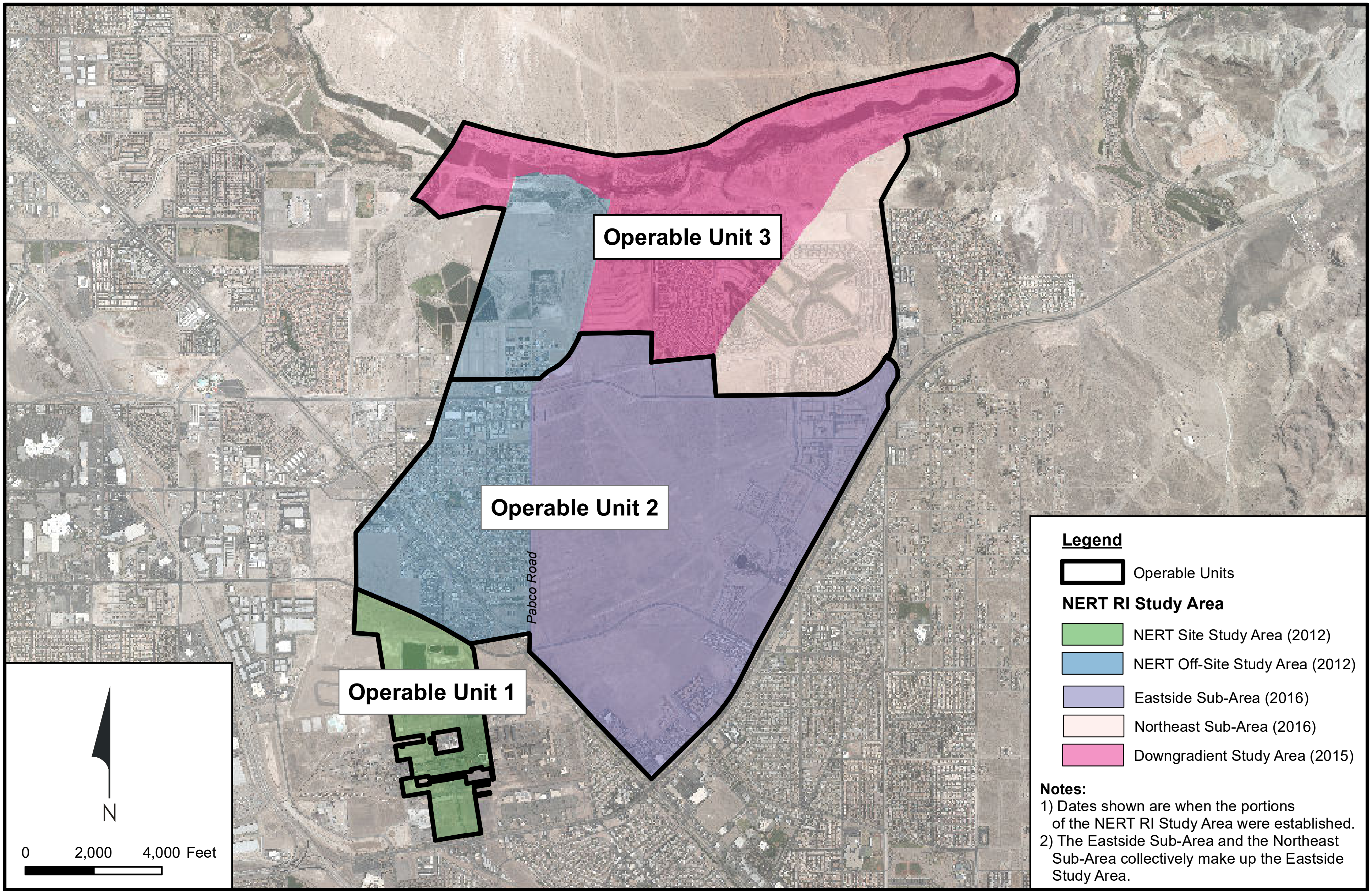
RAMBOLL

NERT RI Study Area Location Map

Nevada Environmental Response Trust Site
Henderson, Nevada

Date: 9/26/2023	Contract Number: 1690029369-012		Figure 1-1
Drafter: RS	Approved:	Revised:	

Path: H:\LePetomane\NERT\RI OU-1_OU-2 RI Report\Sections\Section 1 - Introduction\GIS\Fig 1-1 RI Location Map.mxd



Legend

▭ Operable Units

NERT RI Study Area

🟩 NERT Site Study Area (2012)

🟦 NERT Off-Site Study Area (2012)

🟪 Eastside Sub-Area (2016)

▭ Northeast Sub-Area (2016)

🟥 Downgradient Study Area (2015)

Notes:
1) Dates shown are when the portions of the NERT RI Study Area were established.
2) The Eastside Sub-Area and the Northeast Sub-Area collectively make up the Eastside Study Area.

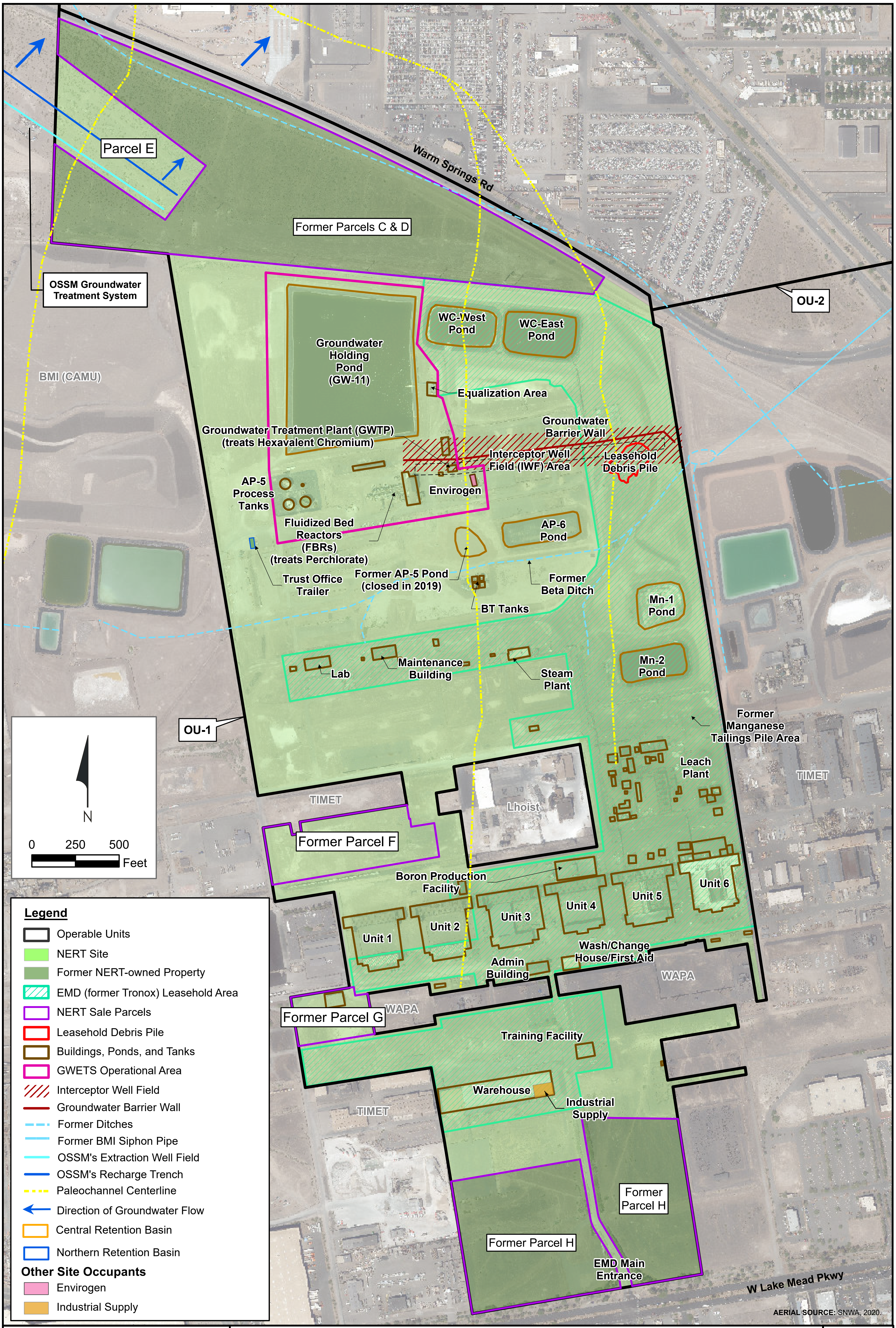
RAMBOLL

NERT RI Study Area Operable Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
1-2

Drafter: RS Date: 9/26/2023 Contract Number: 1690029369-012 Approved: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Fig 1-2 RI Study Area Operable Units.mxd



Path: \\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 1-3 Site Features.aprx

RAMBOLL

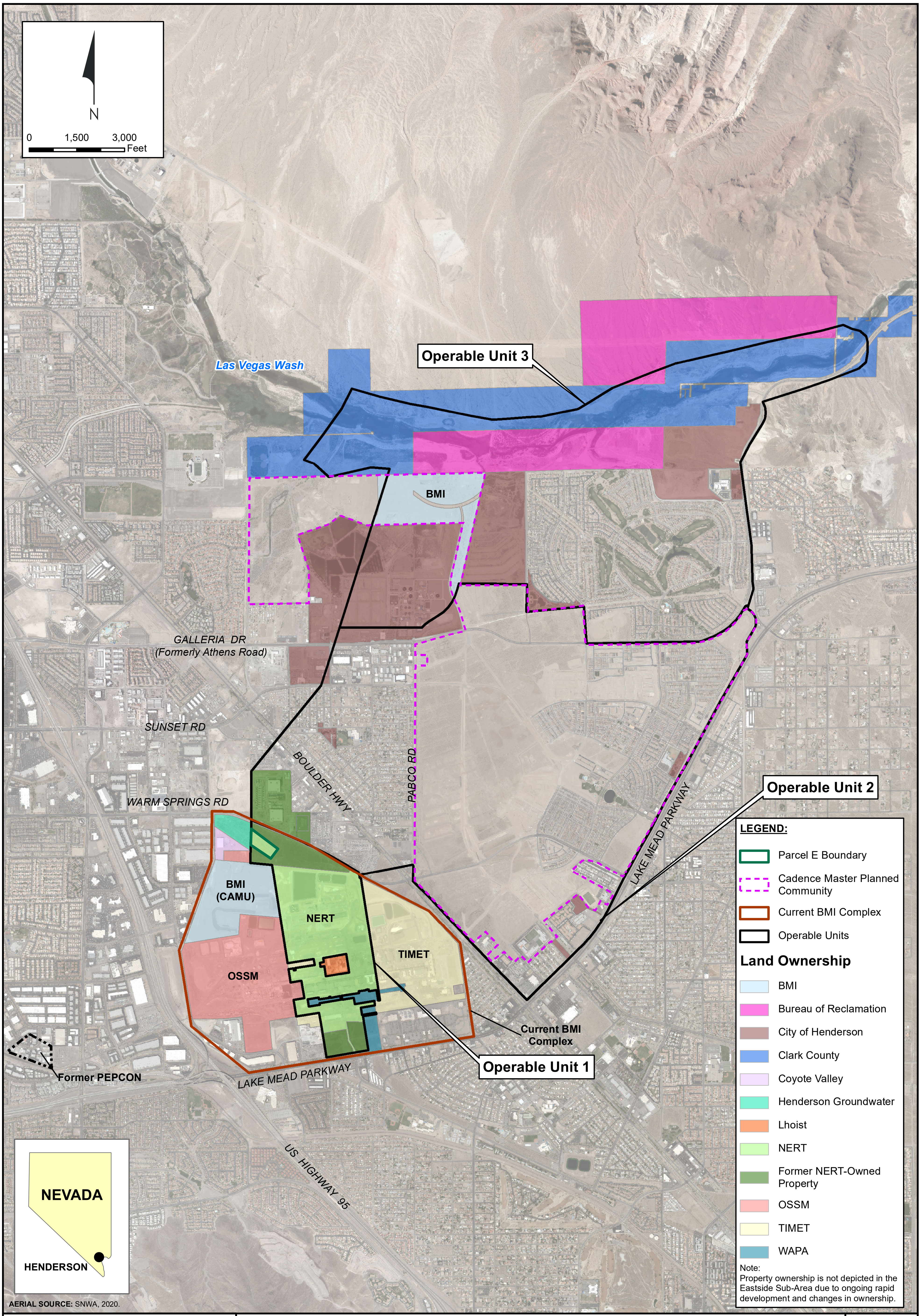
Site Features

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

1-3

Drafter: RS/JC	Date: 11/07/2023.	Contract Number: 1690029369-012	Approved by:	Revised:



AERIAL SOURCE: SNWA, 2020.

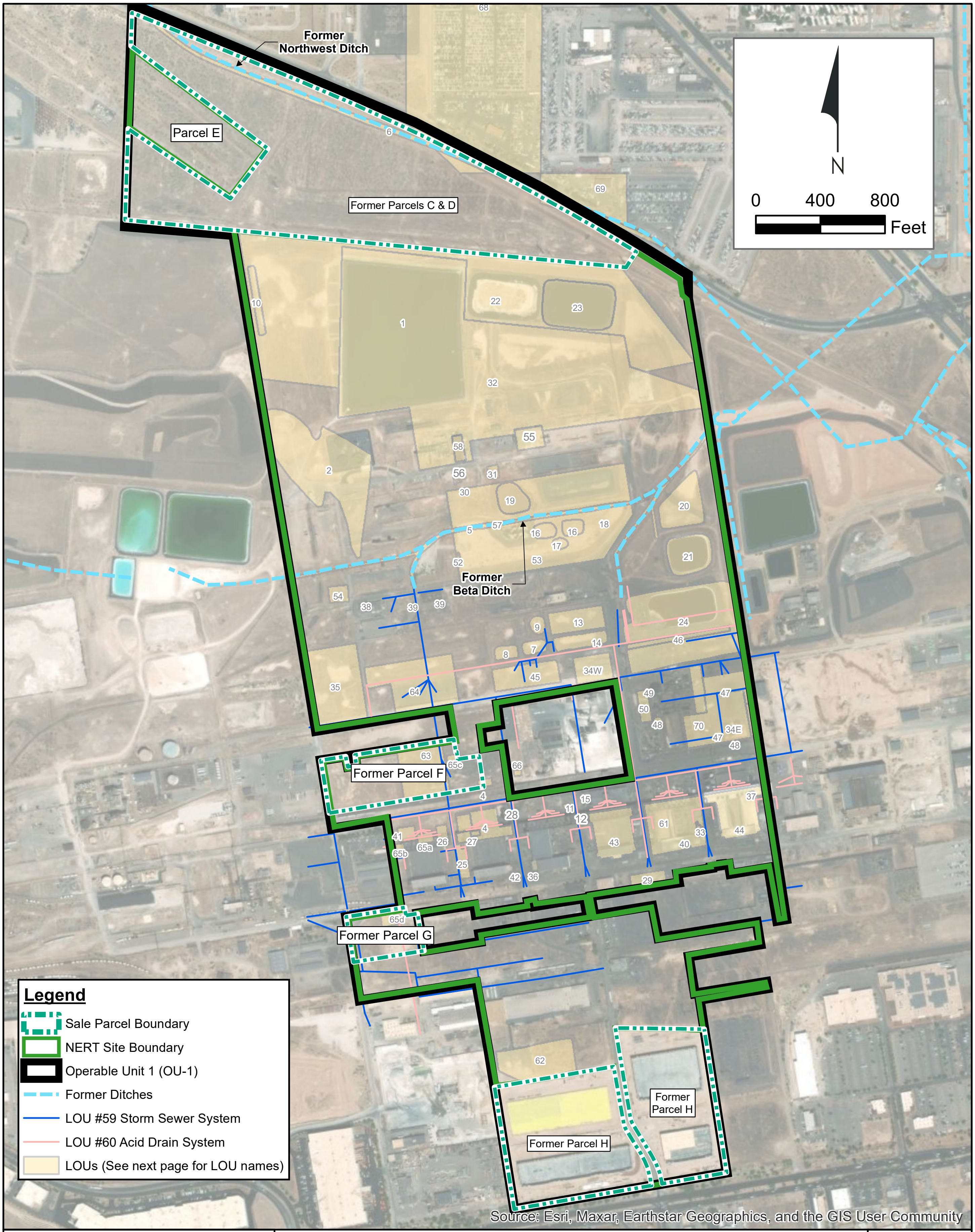
Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Fig 1-3a BMI Complex Land Ownership and Surrounding Area.mxd

RAMBOLL

Major Land Ownership in the RI Study Area
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
1-4

Drafter: RS/JC | Date: 09/26/2023 | Contract Number: 1690029369-012 | Approved by: | Revised:



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

RAMBOLL

Letter of Understanding (LOU) Map

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
2-1

Drafter: RS Date: 9/6/2023 Contract Number: 1690029369-012 Approved by: Revised:

Path: \\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil Gas and Groundwater BHRA\GIS\Figure 2-2.mxd

LOU Identification

LOU #	Name	LOU #	Name
1	Trade Effluent Settling Ponds	36	Former satellite accumulation point - Maintenance Shop
2	Open area south of Trade Effluent Settling Ponds area	37	Former satellite accumulation point - Unit 6 Maintenance Shop
3	Air emissions associated with industrial processes	38	Former satellite accumulation point - AP Change House & Laboratory
4	Hardesty Chemical Company Site	39	Satellite accumulation point - AP maintenance shop
5	On-Site portion of Beta Ditch + diversion ditch north of Pond C-1	40	PCB transformer spill
6	Unnamed drainage ditch segment	41	Unit 1 tenant stains
7	Old Pond P-2 and associated conveyance facilities	42	Unit 2 salt conveyor
8	Old P-3 Pond and associated conveyance facilities	43	Unit 4 and old Sodium Chlorate Plant decommissioning
9	New P-2 and associated piping	44	Unit 6 basement
10	On-Site Hazardous Waste Landfill	45	Diesel storage tanks
11	Sodium chlorate filter cake holding area	46	Former old main cooling tower and recirculation lines
12	Hazardous Waste Storage Area	47	Leach Plant area Mn ore piles (current & historic)
13	Pond S-1	48	Leach Plant analyte tanks
14	Pond P-1 and associated conveyance piping	49	Leach Plant area sulfuric acid storage tanks
15	Platinum drying unit	50	Leach Plant area leach lines
16/17	Ponds AP-1, AP-2, and AP-3 and associated transfer lines	51	Leach Plant area transfer lines
18	Pond AP-4	52	AP Plant area Screening Building, Dryer Building, and associated sump
19	Ponds AP-5 & AP-6	53	AP Plant area Tank Farm
20	Pond C-1 and associated piping	54	AP Plant area Change House / laboratory septic tank
21	Pond Mn-1 and associated piping	55	Area affected by July 1990 fire
22	Pond WC-W and associated piping	56	AP Plant area old building D-1 washdown
23	Pond WC-E and associated piping	57	AP Plant area transfer lines to sodium chlorate process
24	Leach beds, associated conveyance facilities and Mn tailings area	58	AP Plant area New D-1 Building washdown
25	Process hardware storage area	59	Storm sewer system
26	Trash storage area	60	Acid drain system
27	PCB storage area	61	Unit 5 basement & old Sodium Chlorate Plant decommission
28	Hazardous Waste Storage Area	62	State Industries, Inc site
29	Solid waste dumpsters	63	J.B. Kelley Trucking Inc. site
30	AP Plant area - Pad 35	64	Koch Materials Company site
31	Drum recycling area	65	Nevada precast concrete products, Green Ventures International, Buckles Construction Company, and Ebony Construction sites
32	Groundwater remediation unit	66	Above-ground diesel storage tank leased by Flintkote Company on Chemstar property
33	Sodium perchlorate platinum by-product filter	67	Delbert Madsen and estate of Delbert Madsen site
34	Former Mn tailings area	68	Southern Nevada Auto Parts site
35	Truck emptying/dumping site	69	Dillon Potter site
36	Former satellite accumulation point - Maintenance Shop	70	US Vanadium Leasehold

RAMBOLL

Letter of Understanding (LOU) Map

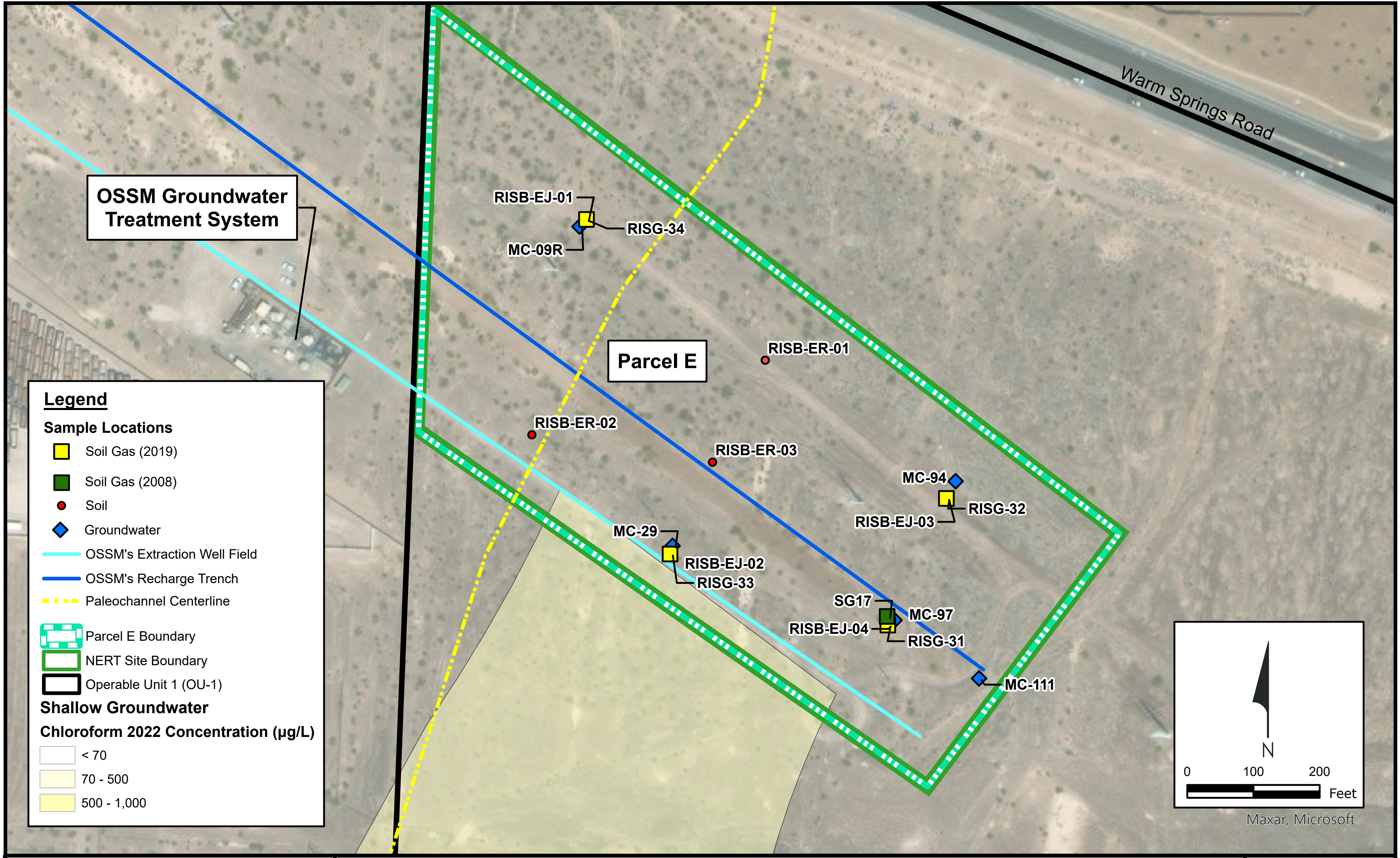
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

2-1

Drafter: Date: 9/26/2023 Contract Number: 1690029369-012 Approved by: Revised:

H:\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 3-1 Sampling_Figure.aprx



RAMBOLL

Soil, Soil Gas and Shallow Groundwater Sample Locations (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
3-1

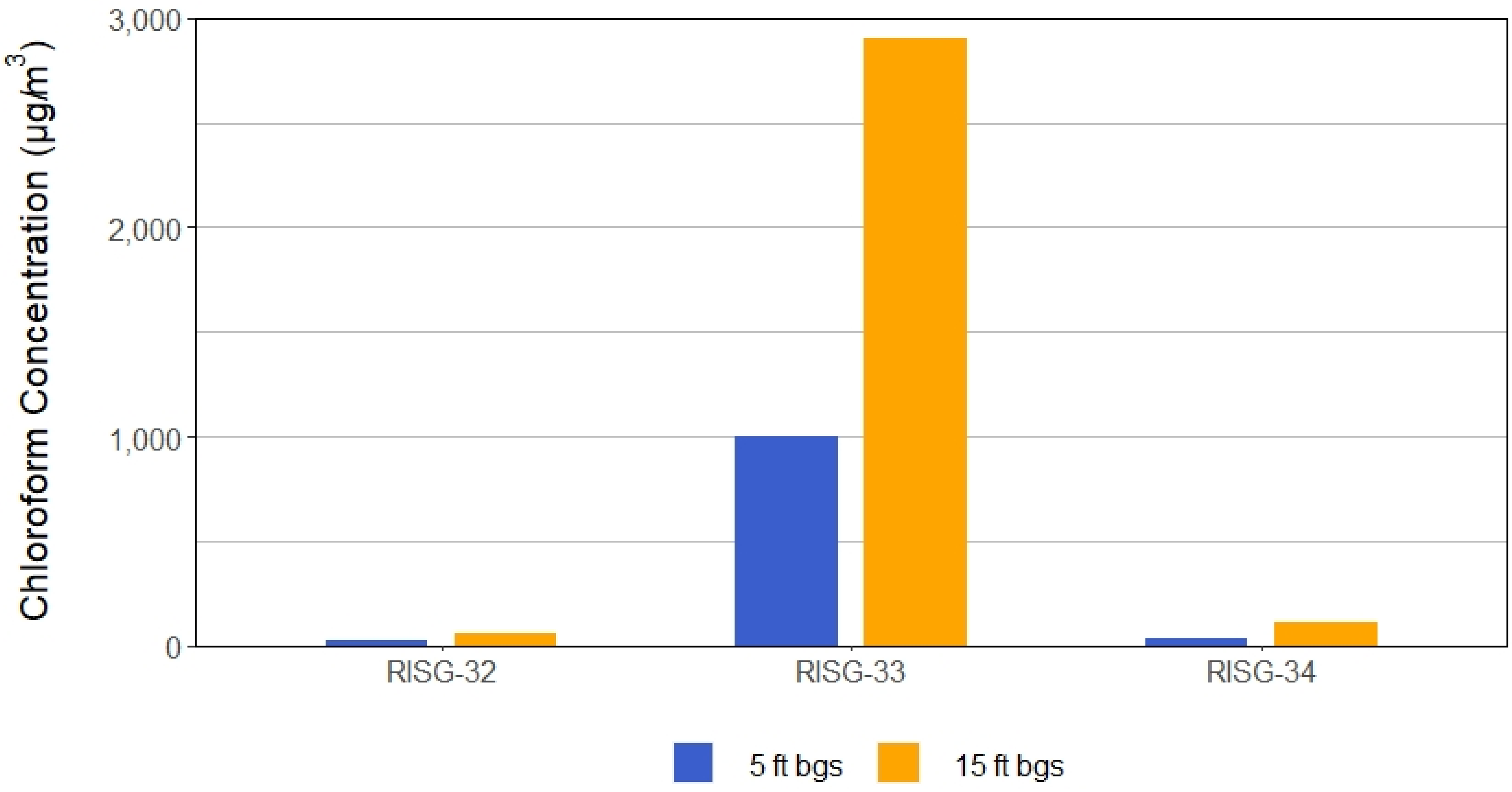
Drafter: JA Date: 11/7/2023 Contract Number: 1690029369-012 Approved by: Revised:

Maximum Chloroform Concentrations (µg/m³) in 2019		
Boring ID	**5 ft bgs**	**15 ft bgs**
RISG-32	24	58
RISG-33	1,000	2,900
RISG-34	36	110

Notes:

µg/m³ = microgram per cubic meter

ft bgs = feet below ground surface



RAMBOLL

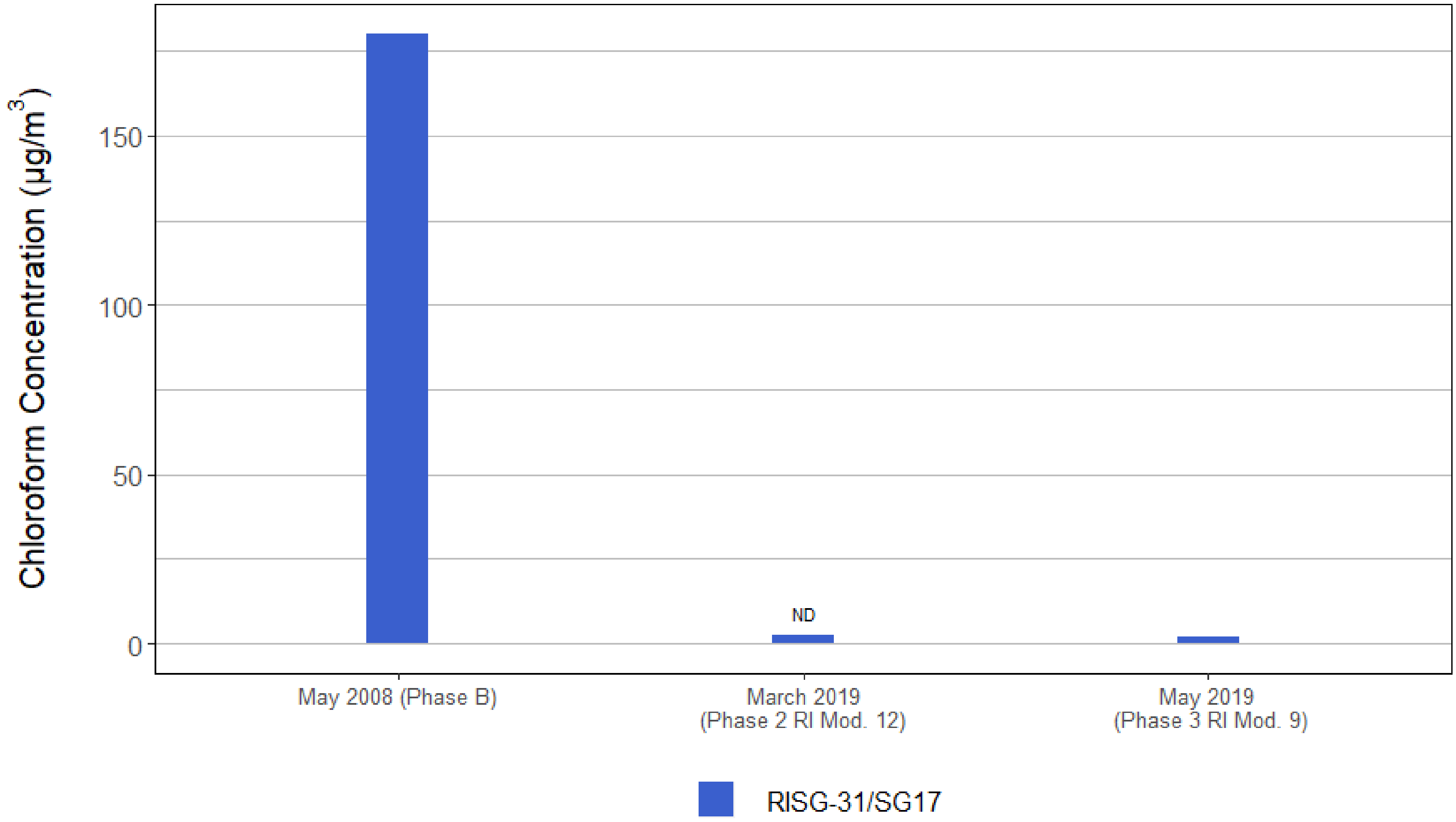
Comparison of Chloroform Concentrations in Soil Gas at 5 and 15 feet bgs

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

4-1

Drafter: JA Date: 9/26/2023 Contract Number: 1690029369-012 Approved by: Revised:



Note: The detection limit values are used to plot non-detected (ND) analytical results.

RAMBOLL

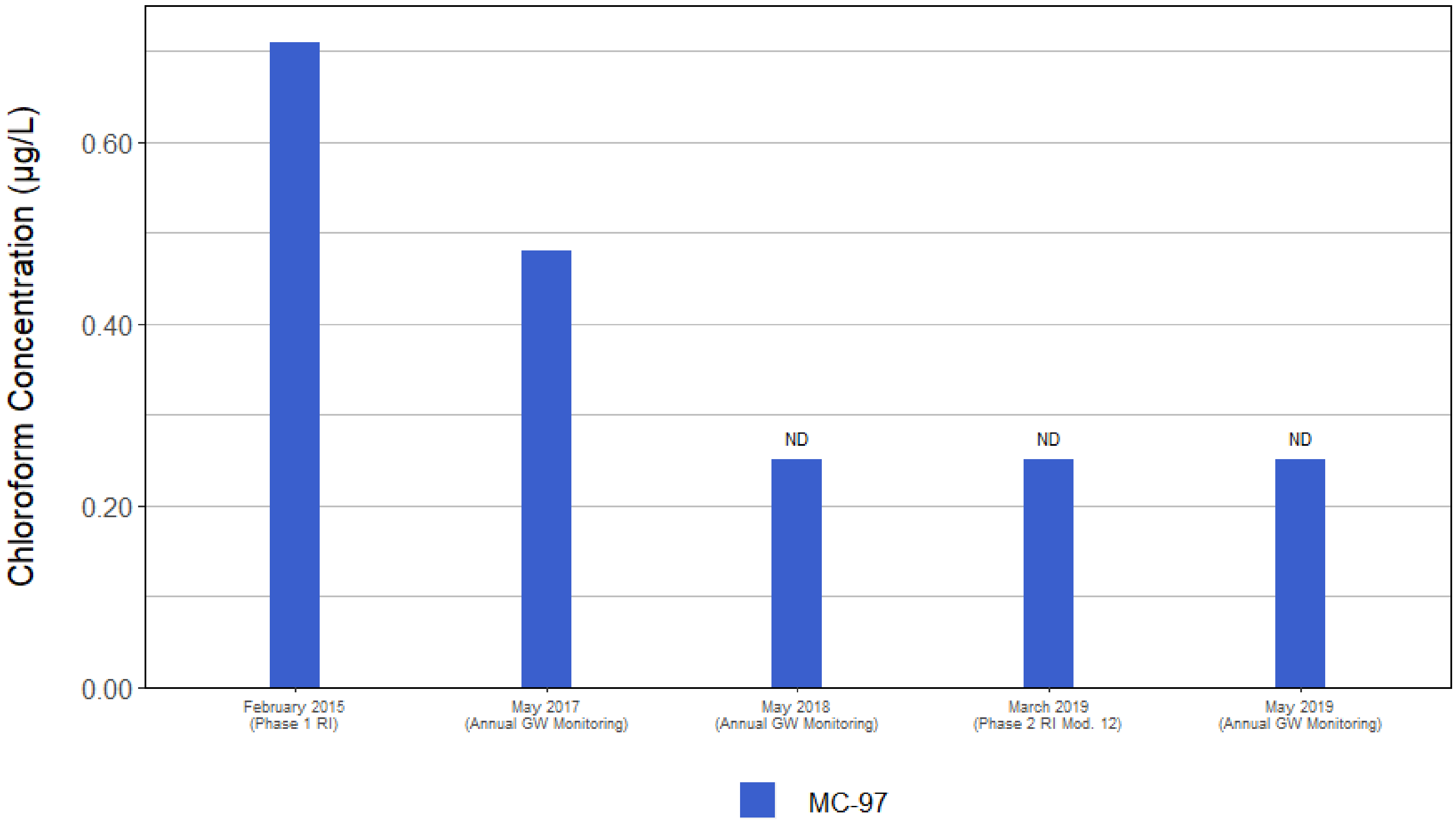
Temporal Distribution of Chloroform Concentrations in 5 feet bgs Soil Gas

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

4-2

Drafter: JA Date: 9/26/2023 Contract Number: 1690029369-012 Approved by: Revised:



Note: The detection limit values are used to plot non-detected (ND) analytical results.

Temporal Distribution of Chloroform Concentrations in Shallow Groundwater

Nevada Environmental Response Trust Site, Henderson, Nevada

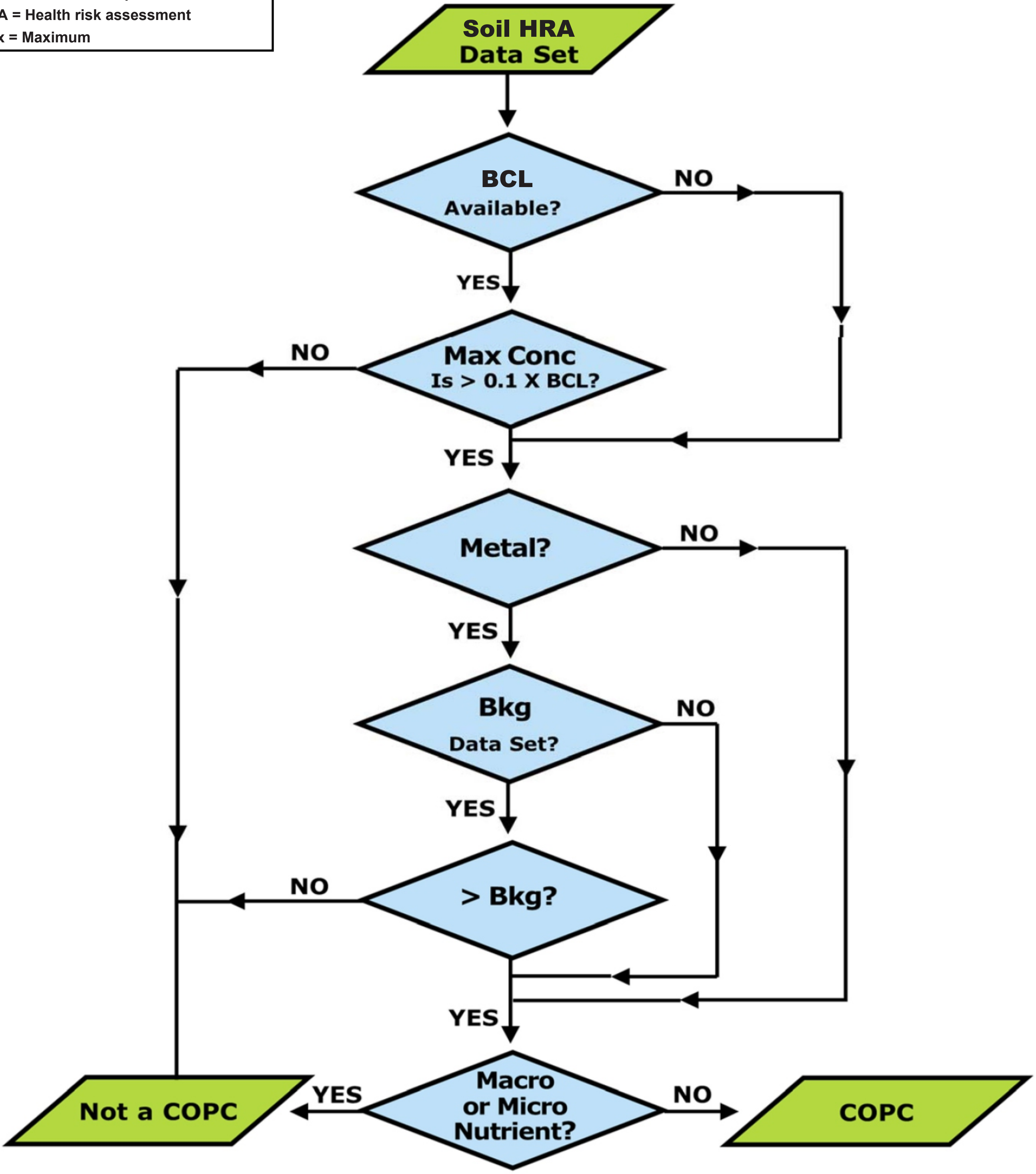
Figure

4-3

Drafter: JA Date: 9/26/2023 Contract Number: 1690029369-012 Approved by: Revised:

Acronym

BCL = Basic comparison level
Bkg = Background
Conc = Concentration
COPC = Chemical of potential concern
HRA = Health risk assessment
Max = Maximum



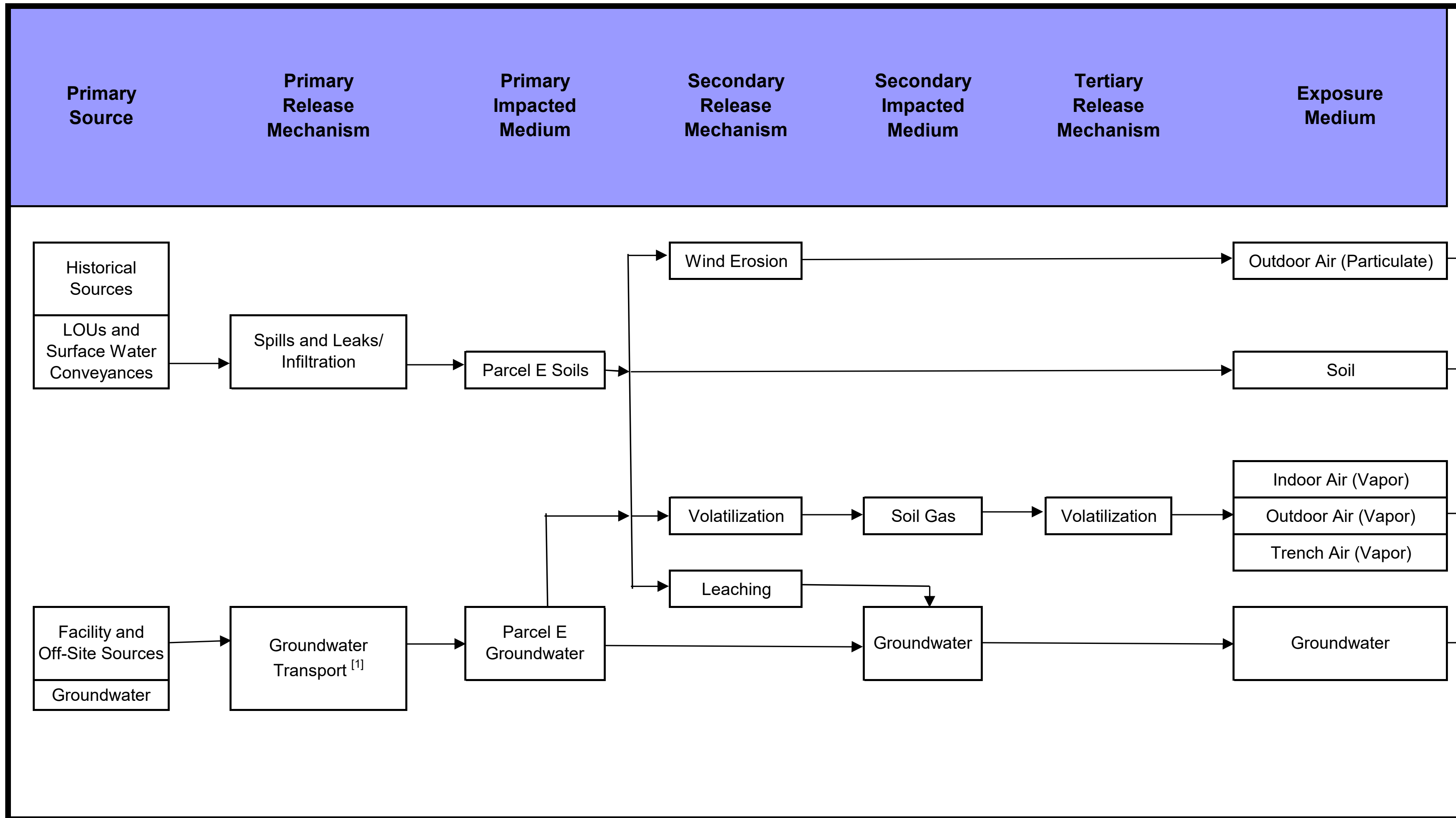
Soil COPC Identification Flowchart

Parcel E, Nevada Environmental Response Trust Site,
Henderson, Nevada

Figure
5-1

Drafter: RS Date: 9/26/2023 Contract Number: 1690029369-012 Approved by: Revised:

Q:\DRAWINGS\NERT



Exposure Route	Current/Future Receptor						
	On-Parcel				Off-Site		
	Construction Worker	Indoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Visitor and Trespasser	Indoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Resident
Inhalation [2], [3]	X	X	X	O [10]	O [11]	O [11]	O [11]
Ingestion [2]	X	X	X	O [10]	--	--	--
Dermal Contact	X	--	X	O [10]	--	--	--
External [4]	X	X	X	O [10]	--	--	--
Inhalation	--	X	--	--	O [12]	--	O [12]
Inhalation	O [5]	O [8]	X	O [10]	O [12]	O [12]	O [12]
Inhalation	X [6]	--	--	--	--	--	--
Ingestion	-- [7]	-- [9]	-- [9]	-- [9]	-- [9]	-- [9]	-- [9]
Dermal Contact	-- [7]	-- [9]	-- [9]	-- [9]	-- [9]	-- [9]	-- [9]

Notes:

X = Complete or potentially complete exposure pathway
O = Complete, but negligible exposure pathway; discussed qualitatively
-- = Incomplete exposure pathway
EPC = Exposure point concentration
LOU = Letter of Understanding
OSSM = Olin Chlor-Alkali/Stauffer/Syngenta/Montrose
PEF = Particulate emission factor
VOC = Volatile organic compound

[1] The OSSM groundwater treatment system, a portion of which is located in Parcel E, treats for VOCs.
[2] Includes radionuclide exposures.
[3] Includes asbestos exposures.
[4] Only radionuclide exposures.
[5] The exposure to VOCs in outdoor air is not quantitatively evaluated for construction workers because it is expected to be much lower than the exposure to VOCs in trench air.
[6] To be conservative, construction workers are assumed to be exposed to vapors migrating from soil gas/groundwater while standing in a 10-foot trench in the unsaturated zone, placing them closer to the potential sources.
[7] Incidental ingestion and dermal contact with groundwater by construction workers are not considered complete exposure pathways because depth to groundwater is greater than 10 feet below ground surface.
[8] The exposure to VOCs in outdoor air is not quantitatively evaluated for indoor commercial/industrial workers because it is expected to be much lower than the exposure to VOCs in indoor air.
[9] Exposure via domestic use of groundwater is not evaluated because Site groundwater is not used as a domestic water supply.
[10] Visitors and trespassers are not quantitatively evaluated because 1) public access is generally restricted at industrial sites, and 2) while the public may have access to commercial sites, on-site workers have a much higher exposure potential because they spend substantially more time at the site.
[11] For inhalation of soil particulates, the PEF for on-parcel construction workers is much higher than the PEF during construction for off-site receptors (see discussion in text Section 6.2.2.1). Therefore, as compared with other exposure factors that may be higher for the off-site receptors, the exposures through inhalation of soil particulates by off-site receptors are expected to be lower than the exposures by on-parcel construction workers, and are not quantitatively evaluated.
[12] For inhalation of vapors migrating from soil gas or groundwater, the EPCs in air for off-site receptors are expected to be much lower than those for on-site receptors due to air dispersion given the distances to parcel boundaries (see discussion in text Section 6.2.2.1). Therefore, the off-site receptors are not quantitatively evaluated.

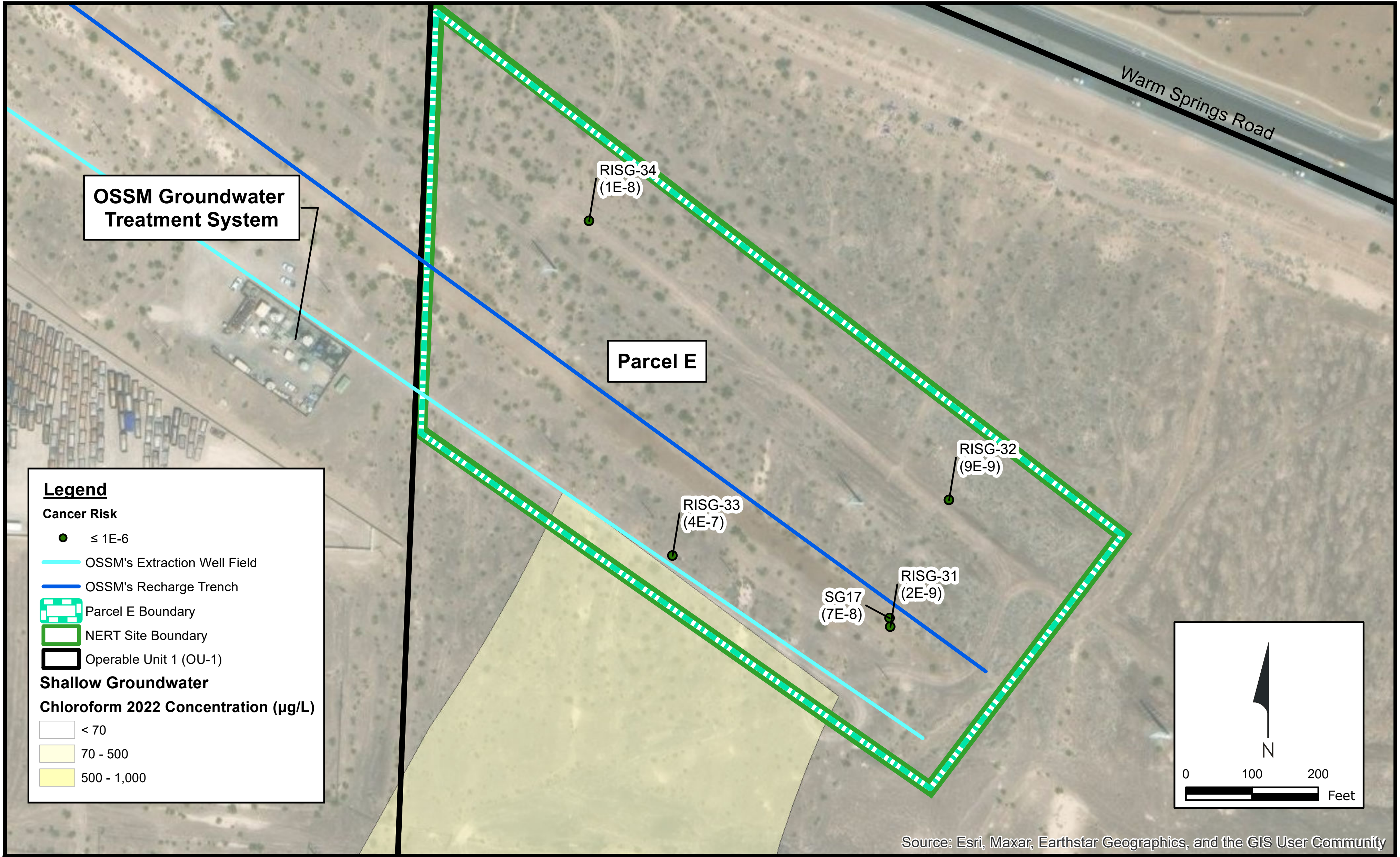
RAMBOLL

Conceptual Site Model for Potential Human Exposures in Parcel E
Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
5-2

Drafter:
Date:9/26/2023
Contract Number: 1690029369-012
Approved by:
Revised:

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 5-3 Estimated Total Cancer Risk Future Indoor Worker for SG 5 ft bgs.mxd



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

RAMBOLL

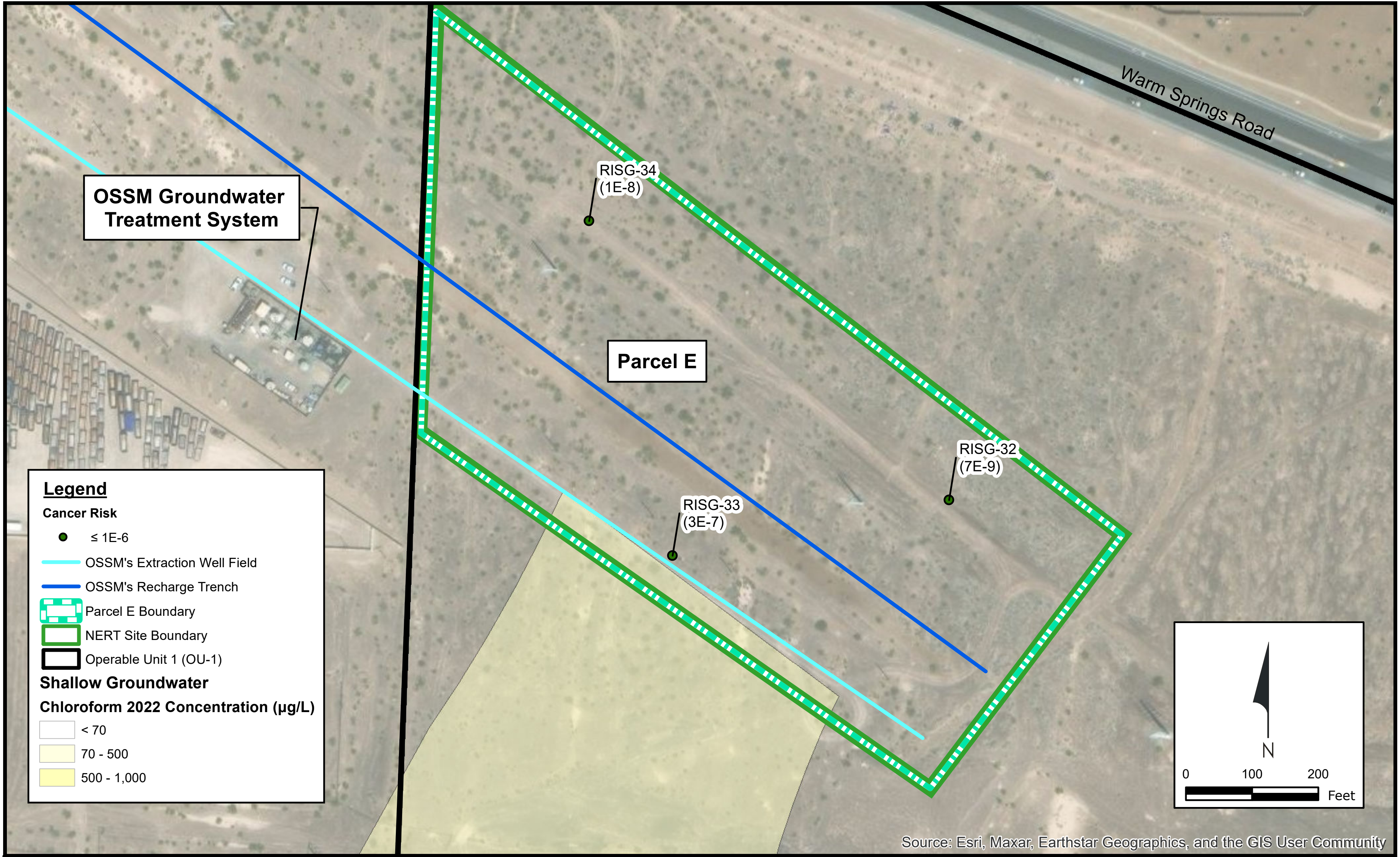
Estimated Total Cancer Risk for Future Indoor Worker for Soil Gas (5 feet bgs) (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
5-3

Drafter: JA
Date: 10/5/2023
Contract Number: 1690029369-012
Approved by:
Revised:

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 5-4 Estimated Total Cancer Risk Future Indoor Worker for SG 15 ft bgs.mxd



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

RAMBOLL

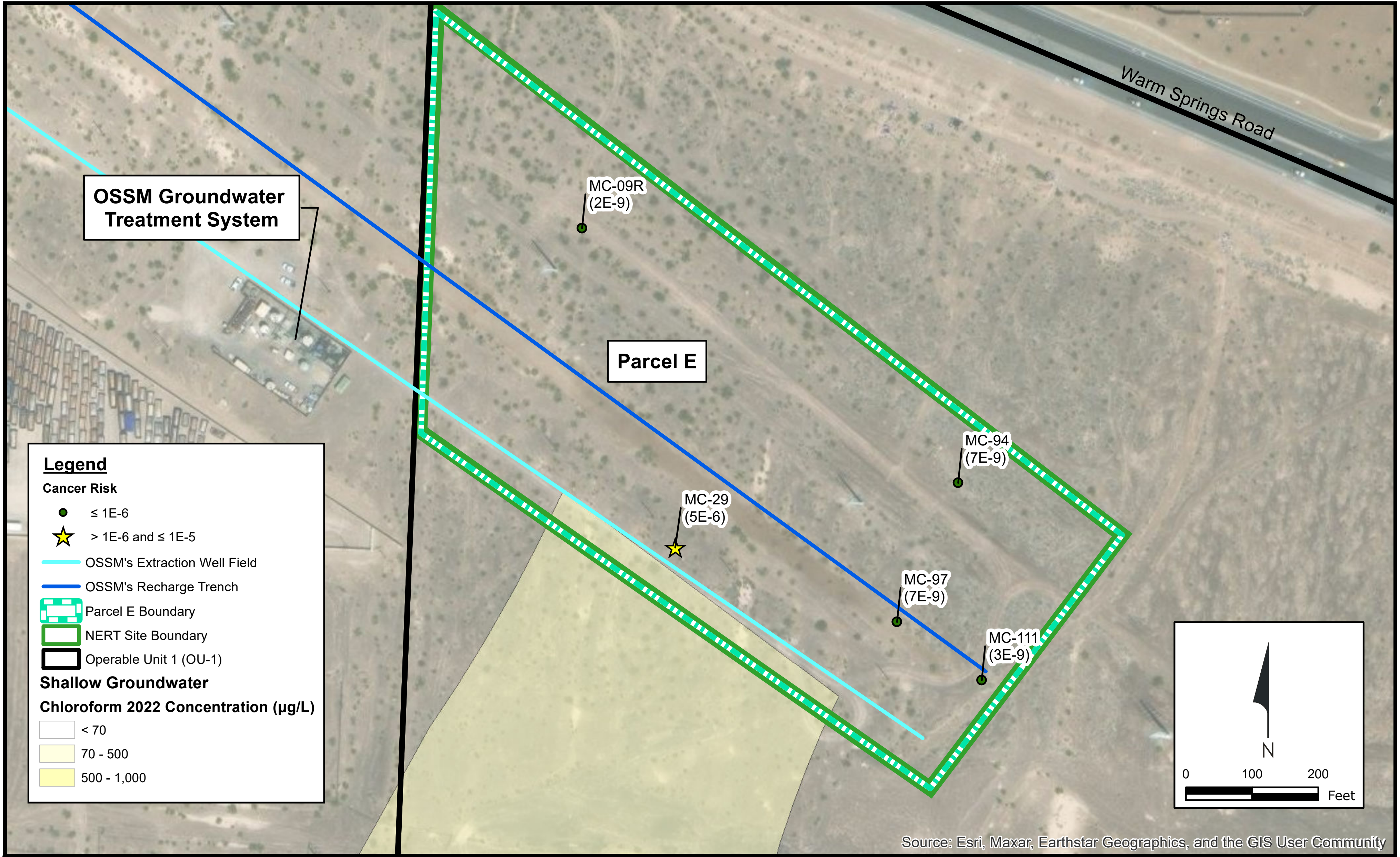
Estimated Total Cancer Risk for Future Indoor Worker for Soil Gas (15 feet bgs) (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
5-4

Drafter: JA	Date: 10/5/2023	Contract Number: 1690029369-012	Approved by:	Revised:

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 5-5 Estimated Total Cancer Risk Future Indoor Worker for Shallow GW.mxd



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

RAMBOLL

Estimated Total Cancer Risk for Future Indoor Worker for Shallow Groundwater (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)

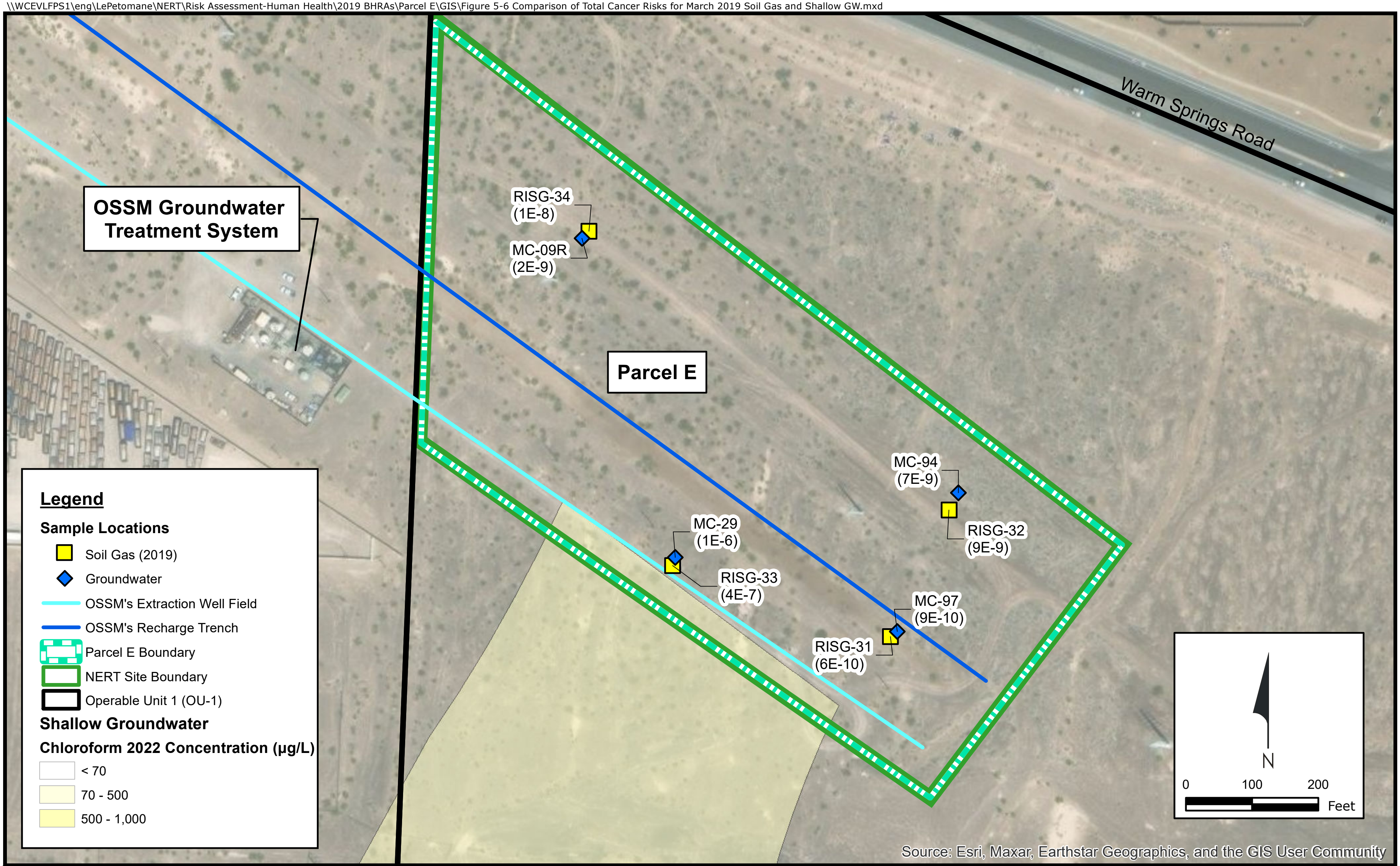
Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-5

Drafter: JA Date: 10/5/2023 Contract Number: 1690029369-012 Approved by: Revised:

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2019 BHRAs\Parcel E\GIS\Figure 5-6 Comparison of Total Cancer Risks for March 2019 Soil Gas and Shallow GW.mxd



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

RAMBOLL

Comparison of Cancer Risks for March 2019 Soil Gas and Shallow Groundwater (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)

Parcel E, Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
5-6

Drafter: SS Date: 10/5/2023 Contract Number: 1690029369-012 Approved by: Revised:

APPENDIX A
DATA VALIDATION SUMMARY REPORTS AND TABLES
(PROVIDED ELECTRONICALLY)

APPENDIX B
SOIL HRA DATA SET FOR PARCEL E
(PROVIDED ELECTRONICALLY)

APPENDIX C
SOIL SUMMARY STATISTICS FOR PARCEL E
(PROVIDED ELECTRONICALLY)

APPENDIX D
BRC/TIMET SOIL BACKGROUND DATA SET
(PROVIDED ELECTRONICALLY)

APPENDIX E
BACKGROUND EVALUATION FOR METALS AND RADIONUCLIDES IN SOIL FOR PARCEL E
(PROVIDED ELECTRONICALLY)

APPENDIX F
SPATIAL QUARTILE PLOTS AND SPATIAL CONCENTRATION PLOTS FOR PARCEL E SOIL, SOIL GAS, AND SHALLOW GROUNDWATER SAMPLES

APPENDIX G
SOIL GAS FIELD SAMPLING DATA FOR PARCEL E
(PROVIDED ELECTRONICALLY)

APPENDIX H
GROUNDWATER FIELD SAMPLING DATA FOR PARCEL E
(PROVIDED ELECTRONICALLY)

APPENDIX I
NDEP FLOWCHART FOR RADIONUCLIDE DATA USABILITY

APPENDIX J
UCL INPUT AND OUTPUT FILES
(PROVIDED ELECTRONICALLY)

APPENDIX K
RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION
(PROVIDED ELECTRONICALLY)

APPENDIX K-1
RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION – SOIL

APPENDIX K-2
RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION - SOIL GAS

APPENDIX K-3

RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION – GROUNDWATER

APPENDIX L
SOIL PROPERTY SAMPLING LOCATIONS AND BORING LOGS
(PROVIDED ELECTRONICALLY)

APPENDIX M
VAPOR INTRUSION MODELING FILES
(PROVIDED ELECTRONICALLY)

APPENDIX N
SOIL GAS SAMPLE LOCATION LOGS
(PROVIDED ELECTRONICALLY)