Prepared for
**Nevada Environmental Response Trust**

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

Date
**September 15, 2023**

# BASELINE HEALTH RISK ASSESSMENT REPORT FOR OU-2 SOIL GAS AND GROUNDWATER, REVISION 1

## NEVADA ENVIRONMENTAL RESPONSE TRUST SITE HENDERSON, NEVADA

RAMBOLL

# Baseline Health Risk Assessment Report for OU-2 Soil Gas and Groundwater, Revision 1

**Nevada Environmental Response Trust**
**(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

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**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:** 9/13/23

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# Baseline Health Risk Assessment Report for OU-2 Soil Gas and Groundwater, 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

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

September 15, 2023

**Date**

Certified Environmental Manager
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Baseline Health Risk Assessment Report for OU-2 Soil Gas and Groundwater, Revision 1
Nevada Environmental Response Trust
Henderson, Nevada

Date **September 15, 2023**
Prepared by **Ramboll Americas Engineering Solutions, Inc.**
Description **Baseline Health Risk Assessment Report for OU-2 Soil Gas and Groundwater, Revision 1**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| API | American Petroleum Institute |
| ATSDR | Agency for Toxic Substances & Disease Registry |
| BCL | Basic Comparison Level |
| bgs | below ground surface |
| BMI | Black Mountain Industrial |
| BRC | Basic Remediation Company |
| Cal/EPA | California Environmental Protection Agency |
| CAS | Chemical Abstract Service |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COH | City of Henderson |
| CSM | conceptual site model |
| DNAPL | dense non-aqueous phase liquid |
| DQI | data quality indicator |
| DUE | data usability evaluation |
| DVSR | data validation summary report |
| EDA | exploratory data analysis |
| EDD | electronic data deliverable |
| ENSR | ENSR Corporation |
| ENVIRON | ENVIRON International Corporation |
| EPC | exposure point concentration |
| Exponent | Exponent, Inc. |
| fg1 | first fine-grained facies |
| GC/MS | gas chromatography/mass spectroscopy |
| HEAST | Health Effects Assessment Summary Tables |
| HI | hazard index |
| HQ | hazard quotient |
| HRA | health risk assessment |
| IAQ | Indoor Air Quality |
| IQR | interquartile range |
| IRIS | Integrated Risk Information System |

| | |
|---|---|
| ITRC | Interstate Technology Regulatory Council |
| IUR | inhalation unit risk |
| IWF | interceptor well field |
| L | Liter |
| LOAEL | lowest-observed-adverse-effect level |
| LOU | Letter of Understanding |
| mm Hg | millimeter of mercury |
| mol | mole |
| mph | mile per hour |
| MRL | Minimal Risk Level |
| NCP | National Contingency Plan |
| NDEP | Nevada Division of Environmental Protection |
| NERT | Nevada Environmental Response Trust |
| NFA | no further action |
| Northgate | Northgate Environmental Management, Inc. |
| NRC | National Research Council |
| OSSM | Olin Chlor-Alkali/Stauffer/Syngenta/Montrose |
| OSWER | Office of Solid Waste and Emergency Response |
| PPRTV | Provisional Peer Reviewed Toxicity Values |
| PQL | practical quantitation limit |
| Qal | quaternary alluvial deposit |
| QAPP | Quality Assurance Project Plan |
| Ramboll | Ramboll Americas Engineering Solutions, Inc. |
| Ramboll Environ | Ramboll Environ US Corporation |
| RAO | Remedial Action Objectives |
| RBTC | risk-based target concentration |
| RfC | reference concentration |
| RfD | reference dose |
| RI/FS | remedial investigation/feasibility study |
| RME | reasonable maximum exposure |
| RPD | relative percent difference |
| RSL | regional screening level |
| SIM | selective ion monitoring |

| | |
|---|---|
| Site | Nevada Environmental Response Trust Site |
| SOP | standard operating procedure |
| SQL | sample quantitation limit |
| TDS | Total Dissolved Solids |
| TIMET | Titanium Metals Corporation |
| Tronox | Tronox, LLC |
| Trust | Nevada Environmental Response Trust |
| UCL | upper confidence limit |
| µg | microgram |
| UMCf | Upper Muddy Creek Formation |
| USEPA | United States Environmental Protection Agency |
| VDEQ | Virginia Department of Environmental Quality |
| VOC | volatile organic compound |
| WBZ | Water Bearing Zone |

# EXECUTIVE SUMMARY

This Baseline Health Risk Assessment (BHRA) Report for OU-2 Soil Gas and Groundwater, Revision 1 ("BHRA Report") was prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) and presents the BHRA for soil gas and groundwater in Operable Unit 2 (OU-2) of the NERT RI Study Area in Henderson, Nevada. The BHRA was conducted to evaluate potential health risks to current and future residents and workers from exposures to residual levels of volatile organic compounds (VOCs) released from soil gas and groundwater to indoor, outdoor, and trench air. This BHRA report has been prepared according to the methodology described in the BHRA Work Plan for OU-1[1] and OU-2 Soil Gas and Groundwater, Revision 1 (Ramboll 2018a), submitted to the Nevada Division of Environmental Protection (NDEP) on December 18, 2018 and approved by NDEP on January 24, 2019.

OU-2 is approximately 2,645 acres, is located immediately north of Operable Unit 1 (OU-1) of the NERT RI Study Area and extends to the east. It is generally divided into two areas: 1) the NERT Off-Site Study Area component of OU-2 located west of Pabco Road; and 2) the Eastside Sub-Area component of OU-2 located east of Pabco Road, as shown in Figure ES-1. Pabco Road serves as a boundary demarcating differing historical land use within OU-2 and is also used to identify NERT's obligations related to the remedial investigation and feasibility study (RI/FS). NERT's obligations in OU-2 are different than in OU-1 in that in the Eastside Sub-Area, located east of Pabco Road, NERT is only responsible for evaluating the nature and extent of perchlorate and chlorate in the environment.

The BHRA Report for OU-2 Soil Gas and Groundwater was submitted to NDEP on July 23, 2021 (Ramboll 2021a), and NDEP comments were received on October 13, 2022. As requested by NDEP, this version was prepared to address NDEP comments and to incorporate the data collected during the Indoor Air Quality (IAQ) investigation as summarized in the OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum submitted to NDEP on August 29, 2022 (Ramboll 2022a). The purpose of the IAQ investigation was to confirm that chloroform indoor air levels remain below a long-term, health-based threshold of 12 µg/m$^3$ and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements. Furthermore, and as directed by NDEP, this revised BHRA includes spatial plots consistent with Neptune's draft technical memorandum "NERT Spatial Plot Recommendations" dated February 18, 2022 (Neptune 2022).

Subsequent to the initial version of the BHRA submitted in 2021, NDEP released updated Basic Comparison Level (BCL) tables (NDEP 2020a, 2023a) and User's Guide and Background Technical Documents (NDEP 2020b, 2023b), with the latest updates issued in June 2023. In the update, 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

[1] A separate BHRA report for OU-1 soil gas and groundwater was submitted on September 29, 2021 (Ramboll 2021b) and is currently being revised to address the NDEP comments.

relevant updates from NDEP and USEPA as described above have been incorporated into this revised BHRA Report.

In accordance with the NDEP-approved BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1 (Ramboll 2018a), the potential risks associated with the vapor intrusion pathway from soil gas and groundwater is only being evaluated west of Pabco Road since NERT is only obligated to address risk associated with perchlorate and chlorate (which are not volatile organic compounds) east of Pabco Road. Although perchlorate and chlorate are present in groundwater in the Eastside Sub-Area, there are no complete pathways for human exposures to these non-volatile chemicals due to depth to groundwater being greater than 10 feet below ground surface (bgs) in the Eastside Sub-Area. In addition, groundwater within the entire NERT RI Study Area is not used as drinking water. Therefore, consistent with the 2018 NDEP-approved BHRA Work Plan, the scope of this BHRA, and thus NERT's health risk assessments in OU-2, is limited to the portion of OU-2 located west of Pabco Road.

The NERT Off-Site Study Area component of OU-2 located west of Pabco Road has been the subject of subsurface investigations related to the downgradient migration of chemicals in groundwater originating from upgradient sources, including the NERT Site (or "Site"). It is bordered to the south by Warm Springs Road, to the north by the OU-2/OU-3 boundary, to the east by Pabco Road, and to the west by the western border of the NERT RI Study Area, including areas previously owned by Tronox, LLC (Tronox) or the Trust, referred to as Parcels A, B, I, and J in the southwestern portion of OU-2 (Figure ES-2).

NDEP has determined no further action or remediation is required for both soil direct contact pathways for former Parcels A and B (NDEP 2008a) and the vapor intrusion pathway for former Parcel A and the western portion of former Parcel B (NDEP 2013). Former Parcel I has received a No Further Action (NFA) determination for the top 10 feet of soil for the direct contact pathway but not for the vapor intrusion pathway through soil gas or groundwater (NDEP 2009). Former Parcel J has not received any NFA determination to date.[2] As a result, the NERT Off-Site Study Area in OU-2, excluding former Parcel A and the western portion of Parcel B, is referred to as the OU-2 BHRA Area and is the subject of this report (Figure ES-2).

Performing this BHRA is one step of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The BHRA was conducted using the data collected from the Remedial Investigation (RI) and Groundwater Monitoring and Groundwater Extraction and Treatment System (GWETS) Remedial Performance reporting program for OU-1 and OU-2 (Ramboll 2023). The results and conclusions from the BHRA will then be evaluated in the upcoming Feasibility Study (FS) to determine if remediation is necessary in the OU-2 BHRA Area to satisfy the remedial action objectives and which remedial action alternative(s) will be implemented to mitigate the potential health risks to acceptable levels.

[2] Parcel J was never owned by the Trust. Based on email communication with NDEP on May 15, 2018 (NDEP 2018a), Parcel J was sold but NDEP does not have additional information about it. Assuming Parcel J has not received its NFA determination to date, this parcel is included in the soil gas and groundwater evaluations for the vapor intrusion pathways in this BHRA.

Separate BHRA reports were prepared or are being prepared for OU-1 and OU-3. The BHRAs for OU-1 address the potential health risks associated with the vapor intrusion pathway for VOCs released from soil gas and groundwater and direct contact with surface soil in OU-1. *The OU-1 Soil BHRA Report, Revision 2* (Ramboll 2022b) was submitted to NDEP on May 6, 2022 and approved by NDEP on June 2, 2022. The *OU-1 BHRA Report for Soil Gas and Groundwater* was submitted to NDEP on September 29, 2021 (Ramboll 2021b), and NDEP comments on that report were received on March 9, 2022; the annotated response to the NDEP comment letter on that report was submitted to NDEP on June 24, 2022; NDEP's responses on the annotated response to comment letter were received on November 3, 2022; the revised report and annotated response to the NDEP comment letter is currently under preparation. The forthcoming BHRA for OU-3 will address the potential health risks due to exposures to contaminants migrating from OU-1, through OU-2, and into OU-3. The BHRA Work Plan for OU-3, Revision 1 was submitted to NDEP on December 5, 2022 (Ramboll 2022c) and approved by NDEP on February 1, 2023. The BHRA Report for OU-3 is currently under preparation.

This BHRA followed the procedures outlined in the USEPA risk assessment guidance and applicable NDEP guidance. The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for the 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 ($1 \times 10^{-6}$) to one hundred in a million ($1 \times 10^{-4}$). 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 BHRA do not represent absolute estimates, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks.

Consistent with the NDEP-approved BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1 (Ramboll 2018a) and agency guidance from USEPA (USEPA 2015), multiple lines of evidence were utilized in the BHRA. Specifically, soil gas collected since 2008 and shallow groundwater (i.e., at monitoring wells with top of well screens less than 60 feet bgs) collected between 2016 and 2020 within the OU-2 BHRA Area were used to evaluate potential exposure for current and future residents and workers via inhalation of vapors migrating from the subsurface to indoor air, outdoor air, and trench air to provide multiple lines of evidence. The soil gas data used in this BHRA was specifically collected to evaluate the vapor intrusion pathway. Soil gas data is the preferred 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 solely 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 BHRA considers the soil gas data as the primary line of evidence for evaluation of the vapor intrusion pathway; groundwater data were evaluated to provide a secondary line of evidence and to check the consistency between soil gas and groundwater results.

In this BHRA report, the preliminary soil gas and shallow groundwater BHRA data sets presented in the OU-1 and OU-2 Soil Gas and Groundwater BHRA Work Plan (Ramboll 2018a) have been updated by incorporating additional soil gas and shallow groundwater data from the most recent investigations. Potential health risks associated with exposure to

VOCs in air migrating from soil gas and groundwater in the OU-2 BHRA Area were evaluated.

The OU-2 BHRA Area has been the subject of extensive environmental investigations. The primary field investigations for soil gas since the 2005 conceptual site model (CSM) report (ENSR Corporation [ENSR] 2005) have included the following[3]:

- Phase B Soil Gas Investigation in 2008;
- Phase 1 RI in 2015;
- Phase 2 RI Modification No. 11 in 2019; and
- Phase 3 RI Modification No. 9 in 2019-2020.

The primary field investigations for shallow groundwater (i.e., at monitoring wells with top of well screens less than 60 feet bgs) conducted by the Trust since 2015 have included the following:

- Phase 1 RI in 2015;
- Phase 2 RI in 2017-2018;
- Phase 3 RI in 2018; and
- Groundwater Monitoring and GWETS Remedial Performance reporting in 2016-2020.

Analytical results of soil gas and shallow groundwater samples collected within the OU-2 BHRA Area were assessed through the data processing and data usability evaluation (DUE) steps (see Section 4.1), and data representative of current conditions were selected for purposes of the BHRA. The VOCs selected for evaluation, the CSM and the estimated excess lifetime cancer risks and chronic HIs are summarized as follows:

- All VOCs detected in one or more soil gas or shallow groundwater samples in the BHRA data sets were evaluated in the risk assessment. As summarized in Table ES-1, a total of 71 VOCs were detected in soil gas and a total of 23 VOCs were detected in shallow groundwater.
- Based on the CSM for the OU-2 BHRA Area, potential exposure to soil gas and shallow groundwater was evaluated for residents, indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers via inhalation of vapors migrating from soil gas and shallow groundwater to indoor air, outdoor air, and trench air. In addition, a trailer scenario was evaluated for residents living in residential trailers in a limited area in the OU-2 BHRA Area. To be conservative, construction workers were assumed to be exposed to vapors migrating from soil gas/shallow groundwater while standing in a 10-foot trench in the unsaturated zone, placing them closer to the potential sources.
- Excess lifetime cancer risks and noncancer HIs associated with inhalation of vapors migrating from soil gas and shallow groundwater were estimated for detected VOCs

[3] The soil gas investigations were conducted historically by other parties in 2008, and more recently by the Trust in 2019 and 2020.

in soil gas and shallow groundwater for each sample for indoor air and trench air scenarios, and based on the 95% upper confidence limits (UCLs) on the mean concentrations over the entire OU-2 BHRA Area (or the maximum outdoor air concentrations predicted over the entire OU-2 BHRA Area if 95% UCLs could not be calculated due to limited detections or higher than the maximum outdoor concentrations) for outdoor air scenarios. The risk results based on the soil gas data evaluation are presented in Table ES-2 and summarized below.

- For the residential slab-on-grade scenario, the estimated excess lifetime cancer risk ranged from $6 \times 10^{-8}$ to $2 \times 10^{-5}$ and $2 \times 10^{-7}$ to $2 \times 10^{-5}$ for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. As shown on Figures ES-3 and ES-4, the highest risk estimates for both depth intervals correspond to sample location RISG-1. For the residential trailer scenario, the estimated excess lifetime cancer risks ranged from $5 \times 10^{-7}$ to $1 \times 10^{-5}$ and $3 \times 10^{-7}$ to $7 \times 10^{-6}$ for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. As shown on Figures ES-3 and ES-4, the highest risk estimates at both depth intervals correspond to sample location RISG-77. All of these excess lifetime cancer risk estimates are within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cancer risk driver for the soil gas samples was chloroform, contributing to over 97% of the total cancer risk for the location with the highest estimated cancer risks for residents. Soil gas sample locations with cancer risks above $10^{-6}$ for residential indoor air scenarios were located over the area of higher chloroform concentrations in groundwater in the residential area in the OU-2 BHRA Area. This confirms that chloroform in groundwater is the source of chloroform in soil gas.
- For indoor commercial/industrial workers, the estimated excess lifetime cancer risks ranged from $5 \times 10^{-9}$ to $3 \times 10^{-6}$ and $4 \times 10^{-9}$ to $2 \times 10^{-6}$ for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. As shown on Figures ES-5 and ES-6, the highest risk estimates correspond to sample location RISG-6. All of these excess lifetime cancer risk estimates were within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cancer risk driver for the soil gas samples was chloroform, contributing to over 99% of the total cancer risk at the location with the highest estimated cancer risk for indoor commercial/industrial workers. Soil gas sample locations with cancer risks above $10^{-6}$ for commercial/industrial indoor air scenarios were located over the area of higher chloroform concentrations in groundwater confirming that groundwater contamination is the source of constituents detected in soil gas.
- The estimated excess lifetime cancer risks for outdoor commercial/industrial workers and construction workers exposed to soil gas at 5 feet bgs and at 10-15 feet bgs were below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.
- The estimated total noncancer HIs for all the soil gas scenarios were below the NDEP and USEPA target HI of greater than one.

As discussed above, this BHRA 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 the consistency between soil gas and groundwater results. Groundwater results for VOCs from shallow monitoring wells (with top

of well screens less than 60 feet bgs) collected from 2015 to 2020 within the OU-2 BHRA Area were included in this BHRA analysis. Similar to soil gas, the estimated excess lifetime cancer risks for vapor intrusion from shallow groundwater were estimated within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and chloroform was the primary chemical contributor to the estimated total cancer risk. All estimated total noncancer HIs for all the groundwater scenarios were below the NDEP and USEPA target HI of greater than one.

The spatial distribution of locations with cancer risk above $10^{-6}$ for shallow groundwater is also generally consistent with those for soil gas in the OU-2 BHRA Area. The soil gas location with the highest cancer risk estimates (i.e., RISG-1 in the residential area) is co-located with the shallow groundwater well with the highest residential cancer risk estimate (i.e., PC-67). The soil gas location with the highest cancer risk estimates for indoor commercial/industrial workers (i.e., RISG-6 in the commercial area) is also co-located with a shallow groundwater well that is among the wells with the highest cancer risk estimate (i.e., PC-122). The results and conclusions of the groundwater risk evaluation are generally consistent with the results and conclusions of the soil gas risk evaluations for the OU-2 BHRA Area, supporting the OU-2 CSM developed in the RI Report for OU-1 and OU-2 (Ramboll 2023) which identified that chloroform in groundwater is the main source of chloroform detected in soil gas in this area. The highest cancer risk estimates occur at locations where the highest chloroform concentrations were detected in groundwater within the OU-2 BHRA Area and are located generally downgradient of the upgradient sources (Figure ES-7).

Exposure via domestic use of groundwater was not evaluated because groundwater is not currently used as a domestic water supply consistent with the approved 2018 BHRA Work Plan (Ramboll 2018a).[4] Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities is possible in very limited areas near PC-161 and PC-162, where the depth to groundwater is less than 10 feet bgs. Due to the limited number of monitoring wells and the low concentrations detected at these wells, significant health risks during short-term construction activities are not expected to occur through the groundwater direct contact pathway in this area. This potential pathway is discussed as part of the uncertainty analysis of this BHRA.

In addition, the IAQ data collected in the eastern portion of the Pittman Neighborhood in OU-2 between March and May 2022 were used to confirm the site-specific vapor intrusion modeling conducted in the BHRA for OU-2. The indoor air results for chloroform were compared to the health-based screening level threshold of 12 micrograms per cubic meter ($\mu g/m^3$) to confirm that the vapor intrusion risk to residents does not exceed the NDEP and USEPA risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ for carcinogenic impacts. The IAQ data confirms the validity of modeled results as presented in the BHRA Report.

In summary, potential human health risks to residents, indoor and outdoor commercial/industrial workers, and construction workers due to exposure to VOCs in soil gas and shallow groundwater in the OU-2 BHRA Area do not exceed the NDEP and USEPA

[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

risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ for carcinogenic impacts and the target HI of greater than one for noncarcinogenic impacts, under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the risk characterization results for the OU-2 BHRA Area.

# 1. INTRODUCTION

This Baseline Health Risk Assessment (BHRA) Report for OU-2 Soil Gas and Groundwater, Revision 1 ("BHRA Report") has been prepared by Ramboll Americas Engineering Solutions, Inc. (Ramboll) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) and presents the BHRA for soil gas and groundwater in the western portion of Operable Unit 2 (OU-2) in the NERT Remedial Investigation (RI) Study Area in Henderson, Nevada. The potential health risks to future residents and workers in OU-2 associated with inhalation of volatile organic compounds (VOCs) released from soil gas and groundwater to indoor, outdoor, and trench air were evaluated and are presented herein. The risk to construction workers from direct contact to groundwater is very limited and is addressed in the uncertainty analysis of this BHRA.

NERT is implementing a RI consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The NERT RI Study Area occupies approximately 5,200 acres (8.1 square miles) within the City of Henderson (COH) and Clark County, Nevada (Figure 1-1). The southern-most portion of the NERT RI Study Area is located within a portion of the Black Mountain Industrial (BMI) Complex. The NERT RI Study Area then extends north towards the Las Vegas Wash and east towards Lake Mead Parkway, as depicted in Figures 1-2 and 1-3. The BMI Complex was initially developed for industrial purposes in the early 1940s and continues to house several industrial manufacturing operations. As depicted in Figure 1-3, currently, the NERT RI Study Area collectively consists of four study areas. These are the NERT Site Study Area[5] and the NERT Off-Site Study Area (established in 2012 as the original NERT RI Study Area), the Downgradient Study Area (added in 2015), and the Eastside Study Area (added in 2016 and comprised of the Eastside Sub-Area and the Northeast Sub-Area). The NERT RI Study Area has been divided into three Operable Units (OUs). Operable Unit 1 (OU-1) is approximately 346 acres and includes the NERT Site. OU-2 is approximately 2,645 acres and is located immediately north of OU-1 and extends to the east; it comprises the southern portion of the NERT Off-Site Study Area and the Eastside Sub-Area. Operable Unit 3 (OU-3) is approximately 2,100 acres and is located north of OU-2; it encompasses the Downgradient Study Area, the Northeast Sub-Area, and the northern portion of the NERT Off-Site Study Area.

From an investigative and risk assessment standpoint, OU-2 is divided into two areas: 1) the NERT Off-Site Study Area component of OU-2 located west of Pabco Road; and 2) the Eastside Sub-Area component of OU-2 located east of Pabco Road, as shown in Figure ES-1. Pabco Road serves as a boundary demarcating differing historical land use within OU-2 and is also used to identify NERT's obligations related to the remedial investigation and feasibility study (RI/FS). NERT's obligations in OU-2 are different than in OU-1 in that in the Eastside Sub-Area, located east of Pabco Road, NERT is only responsible for evaluating the nature and extent of perchlorate and chlorate in the environment.

In accordance with the NDEP-approved BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1 (Ramboll 2018a), the potential risks associated with the vapor intrusion pathway from soil gas and groundwater are only being evaluated west of Pabco

[5] 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.

Road since NERT is only obligated to address risk associated with perchlorate and chlorate (which are not volatile organic compounds) east of Pabco Road. Although perchlorate and chlorate are present in groundwater in the Eastside Sub-Area, there are no complete pathways for human exposures to these non-volatile chemicals due to depth to groundwater being greater than 10 feet below ground surface (bgs) in the Eastside Sub-Area. In addition, groundwater within the entire NERT RI Study Area is not used as drinking water. Therefore, consistent with the NDEP-approved BHRA Work Plan, the portion of OU-2 east of Pabco Road is not included in this BHRA.

The NERT Off-Site Study Area in OU-2 has been the subject of subsurface investigations related to the downgradient migration of groundwater contaminants originating from upgradient sources including the NERT Site. It is bordered to the south by Warm Springs Road, to the north by the OU-2/OU-3 boundary,[6] to the east by Pabco Road, and to the west by the western border of the NERT RI Study Area, including areas previously owned by Tronox, LLC (Tronox) or the Trust, referred to as Parcels A, B, I, and J in the southwestern portion of OU-2 (Figure 1-4). This area is primarily residential housing, known as the Pittman Neighborhood, with commercial operations adjacent to major roadways. The central and eastern portions of former Parcel B, Parcel I, and Parcel J were sold by Tronox in 2008; former Parcel A and the western portion of former Parcel B were sold by NERT in 2013.[7] These parcels now represent neighboring properties to the north of the NERT Site (Figure 1-4). NDEP has determined no further action (NFA) or remediation is required for the soil direct contact pathways for former Parcels A and B (NDEP 2008a) and the vapor intrusion pathway for former Parcel A and the western portion of Parcel B (NDEP 2013). Former Parcel I has also received an NFA determination for the top 10 feet of soil for the direct contact pathway but not for the vapor intrusion pathway through groundwater or soil gas (NDEP 2009). Parcel J has not received an NFA determination to date.[8] Former Parcel A and the western portion of former Parcel B are excluded from this BHRA. For purposes of this BHRA, the NERT Off-Site Study Area in OU-2 excluding former Parcel A and the western portion of Parcel B is referred to as the OU-2 BHRA Area (Figure 1-4). However, soil gas and shallow groundwater data collected in the entire former Parcel B were used to obtain better spatial coverage in the evaluation of the health risks for the vapor intrusion pathway in the neighboring Parcels I and J.

As noted in the Remedial Investigation and Feasibility Study Work Plan (RI/FS Work Plan) (ENVIRON 2014a), businesses and residences located within or downgradient of the Site are connected to a municipal water supply. NDEP has conducted a survey of identified private well owners in the area downgradient of the Site to confirm that the wells are no longer present, and none were identified. Based on the available information, shallow groundwater

[6] The mid-plume containment boundary line is the boundary between OU-2 and OU-3 and represents the RAO for OU-2 of mid-plume containment and mass removal.

[7] According to assessor's office records from Clark County, Parcels A and the western portion of Parcel B were sold by the Trust to Treco LLC on December 4, 2013; Parcel I was sold by Tronox to Rolly Properties LLC on June 27, 2008; Parcel J was sold by Tronox to Ellis Living Trust on January 31, 2008 (Clark County Assessor's Office Open Web Mapping Applications; Accessed May 9, 2018). http://www.clarkcountynv.gov/gis/services/Pages/OpenWeb.aspx.

[8] Parcel J was never owned by NERT. Based on email communication with NDEP on May 15, 2018 (NDEP 2018a), Parcel J was sold but NDEP does not have additional information about it. Assuming Parcel J has not received its NFA determination to date, this parcel will be included in the soil gas and groundwater evaluations for the vapor intrusion pathways in the BHRA for OU-2.

is not currently used as a source of drinking water and given the high concentrations of total dissolved solids (TDS),[9] is not anticipated to be used in the future as a drinking water source in the OU-2 BHRA Area.

The BHRA is one step of the CERCLA process. The BHRA was conducted using the data collected from the RI. The results and conclusions from the BHRA will then be evaluated in the upcoming FS to determine if remediation is necessary in the OU-2 BHRA Area to satisfy the remedial action objectives and, if needed, which remedial action alternative will be implemented to mitigate the potential health risks to acceptable levels.

The initial BHRA for OU-2 Soil Gas and Groundwater was submitted to NDEP on July 23, 2021 (Ramboll 2021a), and NDEP comments were received on October 13, 2022. As requested by NDEP, this version (i.e., Revision 1) was prepared to address NDEP comments and to incorporate the data collected during the Indoor Air Quality (IAQ) investigation as summarized in the OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum submitted to NDEP on August 29, 2022 (Ramboll 2022a). The purpose of the IAQ investigation was to confirm that chloroform indoor air levels remain below a long-term, health-based threshold of 12 $\mu g/m^3$ and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements. Furthermore, and as directed by NDEP, this revised BHRA includes spatial plots consistent with Neptune's draft technical memorandum "NERT Spatial Plot Recommendations" dated February 18, 2022 (Neptune 2022).

Subsequent to the initial version of the BHRA Report was submitted in 2021, NDEP released an updated Basic Comparison Level (BCL) tables (NDEP 2020a, 2023a) and User's Guide and Background Technical Documents (NDEP 2020b, 2023b), with the latest updates issued in June 2023. 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 BHRA Report.

Separate BHRA reports were prepared or are being prepared for OU-1 and OU-3. The BHRAs for OU-1 address the potential health risks associated with the vapor intrusion pathway for VOCs released from soil gas and groundwater and direct contact with surface soil in OU-1. *The OU-1 Soil BHRA Report, Revision 2* (Ramboll 2022b) was submitted to NDEP on May 6, 2022 and approved by NDEP on June 2, 2022. The *OU-1 BHRA Report for Soil Gas and Groundwater* was submitted to NDEP on September 29, 2021 (Ramboll 2021b), and NDEP comments on this report were received on March 9, 2022; the annotated response to the NDEP comment letter on this report was submitted to NDEP on June 24, 2022; NDEP's responses on the annotated response to comment letter were received on November 3, 2022; the revised report and annotated response to the NDEP comment letter are currently under preparation. The forthcoming BHRA for OU-3 will address the potential health risks

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

due to exposures to contaminants migrating from OU-1 to OU-3. The BHRA Work Plan for OU-3, revision 1 was submitted to NDEP on December 5, 2022 (Ramboll 2022c) and approved by NDEP on February 1, 2023. The BHRA Report for OU-3 is currently under preparation. Finally, and as discussed with NDEP, NERT will not be assessing risk in the Eastside Sub-Area component of OU-2 east of Pabco Road.

## 1.1 Scope of BHRA

OU-1, and specifically the NERT Site, has been the subject of extensive environmental investigations since the 1970s, during which time health risk assessments (HRAs) have been prepared for specific subareas of the NERT Site to evaluate potential risks associated with soil and soil gas exposure pathways. In 2010, prior to the inception of NERT and thus NERT's ownership of the Site, Northgate Environmental Management, Inc. (Northgate) and Exponent, Inc. (Exponent) prepared a HRA Work Plan (the 2010 HRA Work Plan) that described the risk assessment methodology for evaluating soil and soil gas exposure pathways in future HRAs prepared for the NERT Site (Northgate and Exponent 2010a). The 2010 HRA Work Plan was approved by NDEP on March 16, 2010 (NDEP 2010a).

Northgate and Exponent (2010b) conducted a Site-Wide Soil Gas Human Health Risk Assessment (2010 Site-Wide Soil Gas HRA), which evaluated the soil gas samples collected in May 2008 during the Phase B soil gas investigation (ENSR Corporation [ENSR] 2008a), but this HRA was not reviewed by NDEP.[10]

In 2014, a new BHRA work plan (2014 BHRA Work Plan), the first BHRA work plan prepared by the Trust as part of the RI/FS Work Plan, was prepared (ENVIRON 2014b). The 2014 BHRA Work Plan incorporated relevant elements from the 2010 HRA Work Plan, updated background information at the Site, and presented preliminary summary statistics for the soil and soil gas data sets representative of current conditions and available for the BHRA. The 2014 BHRA Work Plan was submitted to NDEP on February 28, 2014 and approved by NDEP on May 20, 2014. In addition, the conceptual site model (CSM) (ENSR 2005) was significantly revised in the 2014 BHRA Work Plan to identify additional transport pathways, evaluate off-Site populations in the downgradient groundwater Study Area (not previously included in the 2010 HRA Work Plan), and consider soil removal actions that have been completed since 2010.

A BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, which focused on the vapor intrusion pathways, was submitted to NDEP on December 18, 2018, and approved by NDEP on January 24, 2019 (Ramboll 2018a). This BHRA report for OU-2 soil gas and groundwater has been prepared according to the methodology as described in the 2018 BHRA Work Plan. In this BHRA report, the preliminary soil gas and shallow groundwater BHRA data sets presented in the 2018 BHRA Work Plan (Ramboll 2018a) have been updated by incorporating additional soil gas and shallow groundwater data from recent investigations. Potential health risks associated with exposure to VOCs in air migrating from soil gas and groundwater to indoor air, outdoor air, or trench air in the OU-2 BHRA Area were evaluated. Because groundwater in OU-2 is not used as a drinking water source, direct contact with groundwater is not a complete exposure pathway for current and future

[10] The Draft Soil Gas HRA was submitted in 2010, but not approved by NDEP since upon establishment of NERT in February 2011, it was recognized that NERT would be performing health risk assessments as part of the RI being planned at the time.

populations. Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities is possible in the very limited areas where depth to groundwater is less than 10 feet bgs. Due to the limited number of wells and the low concentrations detected at these wells, significant health risks are not expected to occur through the groundwater direct contact pathway in this area. This potential pathway is discussed as part of the uncertainty analysis in Section 6.2.4 of this BHRA. Accordingly, this risk assessment will only quantitatively evaluate the risk associated with VOCs in soil gas and groundwater within the OU-2 BHRA Area. The findings of this BHRA will be used in the forthcoming FS for OU-2 to determine which areas (if any) may require remediation to address unacceptable risk to the current and future residents and workers.

In addition, consistent with the NDEP's direction, the results of the IAQ investigation as discussed in the OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum (Ramboll 2022a) have been integrated into this report.

Leaching of soil contaminants to groundwater is being addressed as a separate evaluation within the RI/FS process, i.e., in the RI Report for OU-1 and OU-2 (Ramboll 2023). The Remedial Action Objectives (RAOs) were established within the approved Phase 3 RI Work Plan (Ramboll Environ 2017a). Generally speaking, the RAOs focus on achieving the Trust's overarching objective of protecting the Las Vegas Wash and downstream interests over a long-term time frame (i.e., greater than five years). For OU-2, the migration of chemicals present in off-site groundwater within OU-2 will be mitigated through a combination of plume containment and (where feasible) contaminant mass removal.

## 1.2 Report Organization

The remainder of this report is organized as follows:

- Section 2 provides an overview of OU-2, including background, climate, and geologic and hydrogeologic settings.
- Section 3 summarizes the environmental investigations of soil gas and groundwater conducted within the OU-2 BHRA Area.
- Section 4 identifies the sources of soil gas and shallow groundwater data available for this BHRA and 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 chemicals to be evaluated in the BHRA, 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 BHRA on the risk results.
- Section 7 provides the data quality assessment.
- Section 8 provides a summary of the BHRA and presents conclusions regarding current conditions within the OU-2 BHRA Area.
- Section 9 lists the references cited in this report.
- Supporting tables, figures, and appendices follow the text of the report.

# 2. OVERVIEW

## 2.1 Background

OU-2 comprises approximately 2,645 acres and mostly consists of developed and undeveloped residential and commercial property (Figures 1-2 and 1-3), and it is generally divided into two areas: 1) the NERT Off-Site Study Area component of OU-2 located west of Pabco Road; and 2) the Eastside Sub Area component of OU-2 located east of Pabco Road. (see Figure 1-3). The following presents a summary of relevant information previously provided in the NERT RI Report for OU-1 and OU-2.

The majority of the Eastside Sub-Area was historically operated by BMI for general facility and utility operations in areas referred to as the BMI Common Areas, which included the Upper BMI Ponds and much of the area south of the Beta Ditch within the Eastside Study Area. Much of this area is being redeveloped, primarily for residential use, as part of a Master-Planned Community. Based on a review of aerial imagery as of the date of this report, approximately 50% of the Master-Planned Community has been redeveloped, with the future pace of development to be driven by real estate market conditions.

Unlike that of the Eastside Sub-Area, the Off-Site Study Area of OU-2 was mostly vacant in the early 1950s with scattered structures located north and south of what is now North Boulder Highway. By 1950, the Northwest Ditch and Alpha Ditch, which conveyed primarily storm water and non-contact cooling water, were located along the southern and eastern boundaries of the Off-Site Study Area of OU-2, respectively. By the early 1980s, much of the Off-Site Study Area of OU-2 had been developed with a combination of commercial and residential structures, including the Pittman Neighborhood. The portion of OU-2 located west of Pabco Road continues to be used primarily for residential housing (generally northeast of Boulder Highway, west of Pabco Road, and south of Sunset Road) with commercial and light industrial operations to the north (between Sunset Road and Galleria Drive) and the southwest (along Boulder Highway and between Boulder Highway and Warm Springs Road). The residential community in this area, which is known as the Pittman Neighborhood, currently includes approximately 1,500 single-family dwellings, 30 multi-family dwellings, and two mobile home parks. The Athens Road Well Field (AWF) extraction wells, a component of the NERT groundwater extraction and treatment system (GWETS), are located immediately north of Galleria Drive near the OU-2/OU-3 boundary (Figure 1-4).

## 2.2 Climate

The climate of the Las Vegas Valley is arid with mild winters and dry hot summers. Average annual precipitation as measured in Las Vegas between 1980 and 2020 was 4.20 inches (National Oceanic and Atmospheric Administration 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 rainfalls over a smaller area for a short duration. These 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 9 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°F in the summer, and the average relative humidity is approximately 20%. The

mean annual evaporation from lake and reservoir surfaces ranges from 60 to 82 inches per year (Shevenell 1996).

## 2.3 Geologic and Hydrological Setting

OU-2, as part of the NERT RI Study Area, is located within Las Vegas Valley, which 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 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 (basalts, rhyolites, andesites, and related rocks) that overlie Precambrian metamorphic and granitic rocks (ENSR 2007).

OU-2 is located on Quaternary alluvial deposits (Qal) that slope north toward Las Vegas Wash. The portion of the NERT Off-Site Study Area within OU-2 is located north of the NERT Site between Warm Springs Road and just north of Galleria Drive. Topographic elevations in this area range from 1,605 to 1,701 feet msl. The topographic surface continues to decrease from south to north at approximately the same gradient as within the NERT Site, extending to approximately Sunset Road, at which point it flattens to a gradient of approximately 0.01 feet/foot to the Las Vegas Wash.

A major feature of the alluvial deposits in OU-2 is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the Upper Muddy Creek Formation (UMCf) that underlies the Qal deposits. 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, Ramboll 2023). Within OU-2, the UMCf-first fine-grained facies (fg1) deposits become very fine-grained with abundant gypsum deposits, reflecting the saline mudflat depositional environment characteristic of the basin interior. The lower permeability UMCf is the unit in which most of the contaminant mass is stored and chemicals present in the UMCf would slowly migrate upwards into the overlying alluvium, where it is saturated. Additional details on the regional and local geology and hydrogeology, including information on the water-bearing zones, are provided in the RI Report for OU-1 and OU-2 (Ramboll 2023).

Within OU-2, groundwater is generally encountered between 20 and 60 feet bgs, becoming shallower to the north because of surface topography. The depths to groundwater in a very limited area near PC-161 and PC-162 are shallower than 10 feet bgs. The groundwater flow direction within OU-2 is generally north-northeast toward Las Vegas Wash, which is the major drainage outlet for the Las Vegas basin (Ramboll 2023).

# 3. ENVIRONMENTAL INVESTIGATIONS

As previously indicated, the OU-2 BHRA Area is limited to the NERT Off-Site Study Area component of OU-2 located west of Pabco Road. The following sections summarize soil gas investigations conducted within this area since 2008 and groundwater sampling for VOCs conducted from shallow monitoring wells (with top of well screens less than 60 feet bgs) since the 2015 Phase 1 RI.[11] The data from the soil gas and groundwater samples collected during these investigations are used as multiple lines of evidence to support the vapor intrusion analysis of this BHRA.

## 3.1 Soil Gas Investigations

The following sections present the soil gas investigations conducted in the OU-2 BHRA Area, which were used as the data sources for this BHRA.

### 3.1.1 Phase B Soil Gas Investigation

The Phase B soil gas investigation was conducted in May 2008 prior to inception of the Trust. Details of the soil gas sampling are provided in the *Phase B Source Area Investigation Soil Gas Survey Work Plan* (ENSR 2008a) and summarized in the draft 2010 *Site-Wide Soil Gas Human Health Risk Assessment* (Northgate and Exponent 2010b).[12] The majority of the Phase B soil gas samples were located in OU-1 with some of the soil gas samples located in the former sale parcels including former Parcels A and B in OU-2. These locations were selected 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 NERT Site; 2) historic groundwater data collected during investigations prior to 2006; and 3) an assessment of former chemical usage at the individual Letter of Understanding (LOU) potential source areas.[13]

A total of 11 soil gas samples were collected in 2008 at 10 locations within the OU-2 BHRA Area, all of which were collected at 5 feet bgs in Parcel B.

Analytical results for samples collected during the Phase B soil gas investigation were presented in a data validation summary report (DVSR) (ENSR 2008b) that was submitted to NDEP on October 13, 2008, and approved by NDEP on October 20, 2008.

### 3.1.2 Phase 1 RI

In accordance with the 2011 Interim Consent Agreement between the Trust and NDEP, the Trust is in the process of conducting a RI/FS. Per the RI/FS Work Plan (ENVIRON 2014a), Ramboll Environ collected soil gas samples as part of a Phase 1 RI data gap investigation (Phase 1 RI) in March 2015. As described in the Phase 1 RI Field Sampling Plan (ENVIRON 2014c) and the Technical Memorandum, Remedial Investigation Data Evaluation (the "RI Data Evaluation Technical Memorandum", Ramboll Environ 2016a), soil gas samples were

[11] Shallow groundwater data since the Phase 1 RI are considered to provide an adequate spatial coverage and reflect the current conditions within the OU-2 BHRA Area.

[12] The Draft Soil Gas HRA was submitted in 2010, but not approved by NDEP since upon establishment of NERT in February 2011, it was recognized that NERT would be performing health risk assessments as part of the RI being planned at the time.

[13] In 1994, in a Letter of Understanding (LOU), NDEP identified 69 LOU Potential Source Areas (NDEP 1994) (referred to in this and other reports as LOUs).

collected adjacent to the three monitoring wells in the OU-2 BHRA Area with the highest chloroform concentrations in groundwater. Soil gas samples were collected from depths of 5 feet and 13 feet at RISG-1 and from depths of 5 feet and 15 feet at RISG-2 and RISG-3 using temporary soil gas probes.

Analytical results for soil gas samples collected during the Phase 1 RI were presented in a DVSR (Ramboll Environ 2017b) that was submitted to NDEP on November 3, 2017, and approved by NDEP on January 25, 2018.

### 3.1.3 Phase 2 RI

Because groundwater is considered to be the primary source of VOCs in soil gas, review and identification of data gaps in the existing soil gas data sets was completed following further evaluation of VOC data in shallow groundwater in the OU-2 BHRA Area. In the *Phase 2 RI Modification No. 11* (Ramboll 2018b), which was submitted on May 23, 2018, and approved by NDEP on June 21, 2018 (NDEP 2018b), Ramboll proposed soil gas sampling for VOCs at 17 locations in OU-1 and 13 locations in the OU-2 BHRA Area.

In accordance with the *Phase 2 RI Modification No. 11,* soil gas samples were collected from 13 locations in the OU-2 BHRA Area in March 2019 to evaluate areas where high chloroform concentrations were detected in the previous soil gas and/or groundwater sampling, and to obtain data at a deeper depth (either 10 or 15 feet bgs, depending on depth to groundwater) consistent with current vapor intrusion guidance (United States Environmental Protection Agency [USEPA] 2015) recommending samples closer to the source (i.e., VOCs in groundwater). The results of the soil gas samples collected during this investigation were summarized in the Technical Memorandum, Soil Gas Sampling Results for OU-1 and OU-2 (Ramboll 2020a; with comments on the submittal provided by NDEP on January 28, 2021) and the RI report for OU-1 and OU-2 (Ramboll 2023). The 13 soil gas sample locations are summarized as below:

- Seven locations are within the chloroform groundwater plume with relatively higher concentrations which were sampled at both 5 and 15 feet bgs; and
- Six locations were sampled to better understand the lateral extent of VOCs in soil gas where chloroform concentrations in groundwater are lower, which were sampled at 5 and either 10 or 15 feet bgs, depending on the depth to groundwater.

Based on the recommendations in the USEPA Vapor Intrusion Guidance (USEPA 2015), Ramboll has utilized 100 feet to define an initial lateral inclusion zone for vapor intrusion assessment (i.e., for identifying buildings or infrastructure that are 'near' a subsurface vapor source and generally warrant assessment, defined as "zone of influence") for purposes of a preliminary analysis. The buildings, infrastructure, and soil cover within 100 feet of each 5-foot Phase 2 RI soil gas sample location in OU-2 are documented in Appendix A-1, which indicates that the soil gas data collected are representative of the OU-2 BHRA Area and are used for the vapor intrusion evaluation. All soil gas data collected in the OU-2 BHRA Area are considered in this BHRA.

In addition, to perform a more representative site-specific vapor intrusion modeling, soil physical properties, including soil classification (grain size distribution/Atterberg Limits), total organic carbon, bulk density, water content, and total porosity were collected at 5 feet

bgs, 10 feet bgs, and 15 feet bgs at nine soil gas sample locations (RISG-1 through RISG-9) in the OU-2 BHRA Area where soil properties had not been collected previously (Ramboll 2018b).[14]

VOCs in the soil gas samples were analyzed using USEPA Method TO-15, as described in the RI/FS Work Plan (ENVIRON 2014a) and the *NERT RI Quality Assurance Project Plan* (QAPP) (Ramboll Environ 2017c). Analytical results for soil gas samples collected during the Phase 2 RI Modification No. 11 were presented in a DVSR (Ramboll 2020b) that was submitted to NDEP on February 12, 2020 and approved by NDEP on April 9, 2020. All soil gas data collected in the OU-2 BHRA Area from the Phase 2 RI Modification No. 11 investigation are considered in this BHRA.

### 3.1.4 Phase 3 RI

Upon evaluation of the 2019 soil gas sampling results from Phase 2 RI Modification No. 11, it was determined that additional soil gas samples were necessary to delineate the horizontal and vertical extent of VOCs in soil gas as required for completion of the OU-1 and OU-2 RI and to assess potential vapor intrusion risks as part of the OU-1 and OU-2 BHRAs. In accordance with the Phase 3 RI Modification No. 9 (Ramboll 2019a), which was submitted on October 7, 2019, and approved by NDEP on October 14, 2019, soil gas sampling for VOCs was conducted at 5 and 10-15 feet bgs at 40 locations identified in the OU-2 BHRA Area in November 2019 to January 2020. Twenty-eight of the sample locations were within the residential area northeast of Boulder Highway. Eight were within commercial areas north of Sunset Road and four were within the commercial area southwest of Boulder Highway. Among these soil gas sample locations, the original 13 locations in OU-2 sampled during the Phase 2 RI Modification No. 11 were resampled for soil gas at 5 and 10-15 feet bgs, depending on the depth to groundwater. The results of the soil gas samples collected during this RI modification were summarized in the *Technical Memorandum, Soil Gas Sampling Results for OU-1 and OU-2* (Ramboll 2020a; with comments on the submittal provided by NDEP on January 28, 2021) and the RI report for OU-1 and OU-2 (Ramboll 2023).

The infrastructure and soil cover within the 100-foot zone of influence of each 5-foot Phase 3 RI Modification No. 9 soil gas sample location collected in OU-2 is documented in Appendix A-2, which indicates that the soil gas data collected are representative for use in the vapor intrusion evaluation.

VOCs in the soil gas samples were analyzed using USEPA Method TO-15, as described in the RI/FS Work Plan (ENVIRON 2014a) and the NERT RI QAPP (Ramboll Environ 2017c). Analytical results for soil gas samples collected during the Phase 3 RI Modification No. 9 were presented in a DVSR (Ramboll 2021c) that was submitted to NDEP on January 13, 2021, and approved by NDEP on January 27, 2021. All soil gas data collected within the OU-2 BHRA Area from the Phase 3 RI Modification No. 9 investigation are considered in this BHRA.

[14] Soil classification (grain size distribution/Atterberg Limits) and total organic carbon were previously collected at PC-172 (co-located with RISG-4, at 13.5 feet bgs), PC-167 (co-located with RISG-7, at 11.0 feet bgs), and PC-166 (co-located with RISG-9, at 11.5 feet bgs) during the Phase 2 RI.

The DVSRs for the soil gas investigations conducted in the OU-2 BHRA Area, as summarized in Section 3.1, are provided in Appendix B.

## 3.2 Groundwater Investigations

The following sections present the groundwater investigations conducted in the OU-2 BHRA Area, which were used as the data sources for the BHRAs.

### 3.2.1 Phase 1 RI

Per the RI/FS Work Plan (ENVIRON 2014c), field work for the Phase 1 RI was conducted between October 2014 and May 2015. The purpose of the Phase 1 RI was to determine the nature and extent of chemicals in soil and groundwater at the NERT Site (OU-1) and in the NERT Off-Site Study Area (including what is now parts of OU-2 and OU-3).

The Phase 1 RI included installation of new monitoring wells, collection of grab groundwater samples, performance of slug tests, and sampling of existing groundwater monitoring wells.

The results of the Phase 1 RI were summarized in the RI Data Evaluation Technical Memorandum (Ramboll Environ 2016a). Data gaps to be addressed in the Phase 2 RI were identified in the same submittal. Analytical results for groundwater samples collected during the Phase 1 RI were presented in the DVSR (Ramboll 2018c) that was submitted on June 22, 2018, and approved by NDEP on August 13, 2018.

In the OU-2 BHRA Area, 13 groundwater samples (including two field duplicate samples) were collected at 11 shallow groundwater well locations with the top of well screens less than 60 feet bgs during the Phase 1 RI, and the VOC data from these shallow groundwater samples are considered in this BHRA.

### 3.2.2 Phase 2 RI

In accordance with the RI Data Evaluation Technical Memorandum (Ramboll Environ 2016a), the Trust implemented a second phase of remedial investigation (Phase 2 RI) from February to November 2017. In addition, 15 Phase 2 RI Modifications were also conducted from April 2017 to April 2019, and VOC data were collected at shallow groundwater monitoring wells within the NERT Off-Site Study Area (including part of OU-2 and OU-3). The primary purposes of the Phase 2 RI were to obtain data necessary to further understand the nature and extent of impacts to soil and groundwater and support feasibility study evaluations for the selection of the final remedy.

In the OU-2 BHRA Area, new monitoring wells were installed as part of the Phase 2 RI to further characterize the lateral and vertical extent of chemicals in groundwater within the alluvium and underlying UMCf.

Groundwater at each newly installed monitoring well was sampled twice, including during the initial round immediately following well development and during the second round a few months after well development when groundwater conditions had stabilized. In addition, existing monitoring wells were sampled once during the Phase 2 RI.

Analytical results for groundwater samples collected during the Phase 2 RI were presented in three DVSRs, including the Data Validation Summary Report, Revision 1, Soil and

Groundwater Remedial Investigation Phase 2, February through June 2017 (Ramboll 2019b), submitted on June 26, 2019, and approved by NDEP on July 10, 2019; the Data Validation Summary Report, Revision 1, Soil and Groundwater Remedial Investigation Phase 2, July through November 2017 (Ramboll 2019c), submitted on May 29, 2019, and approved by NDEP on June 3, 2019; and the Data Validation Summary Report, Remedial Investigation Sampling Phase 2, March 2018 through March 2019, Revision 1 (Ramboll 2020b), submitted on February 14, 2020, and approved by NDEP on April 9, 2020.

In the OU-2 BHRA Area, 70 shallow groundwater samples (including eight field duplicate samples) were collected at 33 monitoring wells with the top of the well screen less than 60 feet bgs during the Phase 2 RI, and the VOC data from these groundwater samples are considered in this BHRA.

### 3.2.3 Phase 3 RI

As discussed in the RI/FS Work Plan Addendum: Phase 3 Remedial Investigation, Revision 1 (Ramboll Environ 2017a), submitted to NDEP on October 27, 2017, and approved by NDEP on November 8, 2017, the Trust implemented a third phase of remedial investigation (Phase 3 RI) within the Eastside Study Area (including the Eastside Sub-Area in OU-2 and Northeast Sub-Area in OU-3), located immediately east of the NERT Site and NERT Off-Site Study Area. The investigation was designed to determine the extent of contamination that migrated from the NERT Site to the Eastside Study Area via the Beta Ditch and to obtain data to support future feasibility study evaluations to address these constituents. In addition to the sampling in the RI Eastside Study Area, the Phase 3 RI also included samples collected from three locations in the OU-2 BHRA Area that were part of the proposed Phase 2 RI sampling as described the RI Data Evaluation Technical Memorandum (Ramboll Environ 2016a) but could not be installed during the Phase 2 RI field effort. Two shallow groundwater samples were collected from wells PC-168 and PC-172D located in the OU-2 BHRA Area during the Phase 3 RI, and the VOC data from these two groundwater samples are considered in this BHRA. Analytical results for these two groundwater samples collected during the Phase 3 RI were presented in the Phase 3 Remedial investigation Data Validation Summary Report for December 2017 through November 2018 Data (Ramboll 2019d) submitted on September 26, 2019, and approved by NDEP on October 28, 2019.

### 3.2.4 Groundwater Monitoring and GWETS Performance Reporting

Monitoring for VOCs was 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 (Ramboll Environ 2016a). The 2016 Annual Remedial Performance Report for Chromium and Perchlorate (Ramboll Environ 2016c) detailed the results of groundwater sampling from the second half of 2015 through the first half of 2016, which was submitted to NDEP on October 31, 2016, and approved by NDEP on December 6, 2016. The analytical results for groundwater samples were also presented in the DVSR (Ramboll 2018d) submitted on June 20, 2018, and approved by NDEP on July 10, 2018. Groundwater samples collected in February and June 2016 were analyzed for VOCs.

Subsequent to the above sampling, additional groundwater sampling for VOCs was conducted in the third quarter of 2016 as part of the Phase 1 RI. The analytical results for

groundwater samples collected during this sampling event were detailed in the 2017 Annual Remedial Performance Report for Chromium and Perchlorate (Ramboll Environ 2017d) submitted on December 8, 2017 and approved by NDEP on February 6, 2018, and were also presented in the DVSR (Ramboll Environ 2017e) submitted on July 26, 2017, and approved by NDEP on August 17, 2017.

Comprehensive groundwater sampling for VOCs has been conducted on an annual basis (usually in May every year) as part of the groundwater monitoring program since 2017. The results of groundwater sampling for VOCs conducted in May-June 2017, May 2018, May 2019, and May 2020 were presented in the Annual Remedial Performance Report for Chromium and Perchlorate for 2017 (Ramboll Environ 2017d), 2018 (Ramboll 2018e), 2019 (Ramboll 2019e), and the Annual Groundwater Monitoring and GWETS Performance Report, July 2019 - June 2020 (Ramboll 2021d), respectively.

In summary, in the OU-2 BHRA Area, 225 groundwater samples (including 12 field duplicate samples) were collected at 57 monitoring wells with the top of the well screen less than 60 feet bgs during the February 2016 – May 2020 groundwater remedial performance monitoring sampling events. The VOC data from these groundwater samples are included in this BHRA.

The DVSRs for the groundwater investigations conducted in the OU-2 BHRA Area, as summarized in Section 3.2, are provided in Appendix C.

## 3.3 Indoor Air Investigations

This section presents the IAQ sampling program that was conducted in the OU-2 BHRA Area to confirm the site-specific vapor intrusion modeling and risk assessment findings for the Pittman neighborhood (as discussed in further detail in Sections 5.2.2 and 5.4).

On September 8, 2021, NERT received a letter from NDEP (the "NDEP Letter"; NDEP 2021) requiring NERT to modify the approved BHRA Work Plan (Ramboll 2018) to include a targeted indoor air sampling investigation of chloroform in areas of OU-2 with elevated soil gas and groundwater concentrations within the eastern portion of the Pittman Neighborhood. In the NDEP Letter, NERT was required to "confirm that chloroform indoor air levels remain below long-term, health-based thresholds and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements". The health-based screening level threshold of 12 $\mu g/m^3$ was based on the USEPA letter (the "USEPA Letter") attached to the NDEP Letter to confirm that the vapor intrusion risk to residents is below or within the NDEP and USEPA's cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.

In response to the NDEP Letter, NERT prepared Modification No. 1 to the BHRA Work Plan Revision 1 ("BHRA Modification"), dated October 29, 2021 (Ramboll 2021e), which was approved by NDEP on November 10, 2021. Implementation of the BHRA Modification began immediately following the "Pittman Indoor Air Sampling Virtual Community Information Meeting" hosted by NDEP on December 9, 2021. Indoor air sampling was implemented in accordance with the BHRA Modification between March and May 2022. Two "Target Indoor Air Sampling Areas" were selected based on the residential locations where chloroform concentrations in soil gas at depths of 10 to 15 feet bgs exceeded 4,000 $\mu g/m^3$. The two

areas identified for sampling are shown with red outlines in Figure 3-1. The two areas are referred to as the northern sampling area and the southern sampling area. The selection of homes in the northern and southern sampling areas was based on proximity to soil gas locations RISG-59 and RISG-1, respectively, which had the highest chloroform results (>4,000 µg/$m^3$ at 15 feet bgs) from the November 2019 soil gas sampling event. The homes in the background sampling area (H6 and H7) were selected near soil gas location RISG-65, which had chloroform results from the November 2019 sampling event almost 10 times below the targeted areas.

Only homes that were representative of the housing stock in the sampling areas and did not have an ambient source of chloroform (i.e., no home with pools or hot tubs or adjacent to such sources) were considered for sampling. Seven representative residential properties were selected in the sampling program from the southern sampling area (designated as H1, H2, and H3, near soil gas sampling location RISG-1), the northern sampling area (designated as H5 and H13, near soil gas sampling location RISG-59), and the background sampling area (designated as H6 and H7, near soil gas sampling location RISG-65). The sampling approach adhered to the procedures specified in the BHRA Modification (Ramboll 2021e).

As described in the BHRA Modification (Ramboll 2021e), at each residential property identified for sampling within the Target Indoor Air Sampling Areas, samples were collected for the following purposes:

- Indoor air samples were collected to determine if target VOCs (i.e., chloroform, carbon tetrachloride, trichloroethene, tetrachloroethene)[15] are present in the indoor air of a residence.
- Sub-slab air and ambient air samples were collected to quantify the effect of ambient and indoor chemical sources on indoor air concentrations.
- Soil gas samples were collected (at 5 and 15 feet bgs) in the adjacent right-of-way to model the indoor air concentrations to use as the basis for the comparative analysis directed in the USEPA Letter.

At each residential property identified within the background sampling area, samples were collected for the following purposes:

- Indoor air samples were collected to assess the levels of chloroform from the use of chlorinated municipal water, the use of household products (e.g., household cleaning products), and resulting from sources of chloroform other than the subject groundwater plume.
- Ambient air samples were collected to assess the effect of outdoor chemical sources on indoor air concentrations.

[15] As stated in the BHRA Modification, in order to perform the comparative analysis with the BHRA modeling results, all samples collected were analyzed for a list of target VOCs that were widely detected at a frequency greater than 85% in previous deeper soil gas samples: chloroform, carbon tetrachloride, tetrachloroethene, and trichloroethene. The 85% detection frequency threshold was selected to include the chlorinated hydrocarbons with relatively higher median detected concentrations of at least 10 µg/$m^3$, because these chemicals would be more likely to be detected in both soil gas and indoor air.

These air samples were analyzed for the target VOCs and trihalomethanes. In addition, at all properties, tap water samples were collected to determine the presence of trihalomethanes, including chloroform.

The analytical data for all sampled media (i.e., indoor air, ambient air, soil gas, and tap water) for this indoor air investigation are reported in the DVSR in Appendix J-1 of this BHRA Report and presented in Table J-1. The indoor air, ambient air, and soil gas results associated with the sampling were summarized in and presented in the *OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum* submitted to NDEP on August 29, 2022 (Ramboll 2022a) (see Appendix J-2 of the BHRA Report).

The indoor air results for chloroform were compared to the health-based screening level threshold of 12 µg/$m^3$ to confirm that the vapor intrusion risk to residents does not exceed the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The data are further assessed to confirm the results of the site-specific vapor intrusion modeling as discussed further in Section 5.2.2 and the associated risks are discussed in Section 5.4 of this BHRA Report.

# 4. DATA USABILITY EVALUATION AND DATA ANALYSIS

This section presents the DUE conducted for the soil gas and groundwater BHRA data sets. Section 4.1 presents the first component of the DUE, in which the available soil gas and groundwater BHRA data sets are reviewed to ensure that the quality of the data is sufficient to support the BHRA; this component of the evaluation focuses on the quality of each individual data point. Section 4.2 presents the data analysis component of the DUE, which focuses on the entire BHRA data set. As described in NDEP guidance (NDEP 2010b), the purpose of the data analysis step is to "use simple exploratory data analysis (EDA) to compare data to the expectations of the CSM for the OU-2 BHRA, to determine if the data adequately represent the source terms and exposure areas or evaluation areas." In particular, through statistical summaries, spatial plots, and other exploratory analyses, the data are reviewed relative to our current understanding of the OU-2 BHRA Area (as represented by the CSM) and for possible data gaps or other investigation issues. A discussion of results from the EDA and a comparison of the BHRA data set to expectations of the CSM for the OU-2 BHRA is presented in Section 4.2.

## 4.1 Data Usability Evaluation

The DUE was conducted in accordance with NDEP's Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Facility in Henderson, NV (NDEP 2010b), 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.

The soil gas and groundwater data sets evaluated using the data quality criteria are identified in Section 4.1.1. Sections 4.1.2 through 4.1.7 briefly describe the evaluation criteria and results of the evaluation. The detailed results are presented in tabular form (Tables 4-1 and 4-2) using the worksheet templates provided by NDEP (2010b).

### 4.1.1 Soil Gas and Shallow Groundwater Data Sets and Data Processing

Consistent with agency guidance from USEPA (2015), soil gas data collected within the OU-2 BHRA Area since 2008 were used to evaluate potential exposure for current and future residents and workers via inhalation of vapors migrating from the subsurface to indoor air, outdoor air, and trench air. The soil gas data used in this BHRA were specifically collected to evaluate the vapor intrusion pathway. Soil gas data is generally the preferred 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). In addition, the groundwater data used in this BHRA was collected to delineate the groundwater plume and not necessarily for the evaluation of vapor intrusion. Therefore, this BHRA 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.

#### *Soil Gas*

The soil gas BHRA data set comprises the analytical results that are representative of current conditions within the OU-2 BHRA Area. The soil gas sampling locations included in the BHRA data set are presented in Table 4-3. Specifically, the data set includes data for VOCs from soil gas samples collected as part of the following investigations[16]:

- Shallow soil gas samples collected at 5 feet bgs from the 2008 Phase B Soil Gas Investigation;
- Shallow soil gas samples collected at 5 feet bgs and deep soil gas samples collected at 10-15 feet bgs from the 2015 Phase 1 RI;
- Shallow soil gas samples collected at 5 feet bgs and deep soil gas samples collected at 10-15 feet bgs from the Phase 2 RI Modification No. 11; and
- Shallow soil gas samples collected at 5 feet bgs and deep soil gas samples collected at 10-15 feet bgs from the Phase 3 RI Modification No. 9.

#### *Groundwater*

Consistent with USEPA's most recent vapor intrusion guidance (USEPA 2015), shallow groundwater data were incorporated in this BHRA to provide a secondary line of evidence for the vapor intrusion risk analysis. All wells with the top of the screen shallower than 60 feet bgs were included in this BHRA as they were deemed to provide the most representative data for the vapor intrusion models. The monitoring wells from which groundwater samples were analyzed for VOCs and included in the BHRA data set are presented in Table 4-4.

[16] In the RI soil gas investigations, in addition to sampling at a shallow depth interval (i.e., 5 feet bgs), soil gas sampling data were also collected at a deeper depth (either 10 or 15 feet bgs, depending on the depth to groundwater), consistent with current vapor intrusion guidance (USEPA 2015) recommending samples closer to the source (i.e., VOCs in groundwater). The majority of the deeper soil gas samples were collected at 15 feet bgs except that seven soil gas samples were collected at either 10 feet bgs or 13 feet bgs. The soil gas samples collected at 10-15 feet bgs were grouped and evaluated together as deeper soil gas samples in this BHRA.

According to USEPA (2015), when collecting groundwater data for vapor intrusion analysis it is recommended that groundwater samples be taken from wells screened (preferably over short intervals) across the top of the water table and that to the extent practical, groundwater samples be collected over a narrow interval (e.g., a few feet or less) just below the water table. As shown in Table 4-4, some of the groundwater VOC data were collected at depths below the first encountered groundwater and may not be the most representative data for evaluating the vapor intrusion pathway. The uncertainties associated with the groundwater well selection is discussed in Section 6.1.1.

The shallow groundwater BHRA data set comprises the analytical results that are representative of current conditions within the OU-2 BHRA Area (Table 4-4). Specifically, the data set includes VOC data from groundwater samples collected from shallow monitoring wells with the top of the well screen less than 60 feet bgs as part of the following groundwater investigations since 2015:

- 2015 Phase 1 RI;[17]
- 2017-2018 Phase 2 RI;
- 2018 Phase 3 RI; and
- 2016-2020 Groundwater Remedial Performance Monitoring.

After identifying the preliminary set of data for the BHRA, 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 for the BHRA data set. The following items were completed:

- Standardize chemical names and Chemical Abstract Service (CAS) registry numbers.
- Standardize reporting units, e.g., micrograms per liter (µg/L) for groundwater and micrograms per cubic meter (µg/$m^3$) 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 BHRA 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 other by USEPA Method 8260 Selective Ion Monitoring (SIM) – the result used in the BHRA was identified as that from the 8260 SIM analysis because of the greater sensitivity (lower reporting limits) of this method.
- Calculate the data for total mixtures of a chemical which was analyzed for individual isomers. The purpose of this step is to generate the data to use in the BHRA to match the toxicity values. For example, the data for m,p-xylenes and o-xylene in the same sample were summed to calculate the data for xylenes (total) for which the toxicity values are reported; the data for cis-1,3-dichloropropene and trans-1,3-

[17] The Phase 1 RI investigation started in 2014, but the groundwater sampling was conducted in 2015.

dichloropropene in the same sample were summed to calculate the data for 1,3-dichloropropene (total) for which the toxicity values are reported.

- Develop database queries and confirm that queries returned the correct output.

The above steps were necessary due to the approximately 12-year period over which the soil gas data were collected and the approximately six-year period over which the groundwater data were collected. This can be understood in the context of soil gas and groundwater samples collected by different entities, analyzed by different analytical laboratories for overlapping suites of chemicals, and the use of different reporting conventions.

No change was made to a datum without first understanding the issue and the steps necessary to correct the issue. As needed, sampling plans, laboratory reports, DVSRs, and other supporting documents were reviewed. Data points were considered unusable for risk assessment if the information could not be located to confirm and/or correct an identified issue. No soil gas data were excluded from the BHRA data set during data processing. Shallow groundwater data excluded from the BHRA data set during data processing are summarized in Appendix C, Table C-1.

The soil gas and groundwater BHRA data sets are presented in Appendices D and E (Table D-1 for soil gas and Table E-1 for groundwater). The soil gas BHRA data set includes a total of 136 soil gas samples collected at 50 locations, consisting of 11 soil gas samples at 10 locations collected from the Phase B soil gas investigation (ENSR 2008a) and 125 soil gas samples collected at 40 locations during the RI (i.e., Phase 1 RI, Phase 2 RI Modification No. 11, and Phase 3 RI Modification No. 9). The groundwater data set includes 310 groundwater samples collected from 79 locations, consisting of 85 groundwater samples at 44 locations collected during the RI (i.e., Phase 1 RI, Phase 2 RI, and Phase 3 RI), and 225 groundwater samples at 52 locations collected as part of the groundwater monitoring and GWETS performance reporting program.[18]

### 4.1.2 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 in the documents associated with the data collection efforts, as listed in Tables 4-1 and 4-2.

### 4.1.3 Criterion II – Documentation

The objective of the documentation review is to confirm 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 gas and groundwater samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. The steps completed during the review are listed in Tables 4-1 and 4-2. Figure 4-1 depicts all soil gas and shallow groundwater sampling locations (groundwater wells and soil gas probes) included in the

[18] Some of the monitoring wells were sampled as part of the RI and in the groundwater monitoring program.

BHRA data set. The analytical results for each soil gas and shallow groundwater sample are included in Appendices D and E, respectively.

### 4.1.4 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 are appropriate to identify chemicals and derive associated exposure point concentrations (EPCs) for the BHRA.

The review of sample coverage from the BHRA data sets are described in Tables 4-1 and 4-2, which are based on the distribution of sample locations from both historical and recent investigations. Based on this review, sample coverage is considered adequate for purposes of the BHRA.

The analytical methods used in the soil gas investigations conducted in the OU-2 BHRA Area are described in Tables 4-1 and 4-2. The USEPA analytical methods were appropriate for characterizing potential VOCs in soil gas and shallow groundwater and provide quantitative analytical results that are of adequate quality for deriving EPCs.

### 4.1.5 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. The analytical methods used for the historical and recent investigations are listed in Tables 4-1 and 4-2.

For analytes where the detection frequency was less than 100%, the SQLs from the BHRA data set were compared to 0.1 times the risk-based target concentration (RBTC)[19] to confirm that they were sufficiently low for risk characterization. For chemicals where a RBTC was not available, representative surrogates were identified and used for the comparison. Tables 4-5, 4-6, and 4-7 present the results of the SQL evaluation along with the RBTCs for soil gas at 5 feet bgs, 10-15 feet bgs, and groundwater, respectively. Chemicals with SQLs above 0.1 x RBTCs in soil and groundwater are summarized under Criterion IV in Tables 4-1 and 4-2, respectively.

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

### 4.1.6 Criterion V – Data Review

The data review included evaluation of completeness, instrument calibration, laboratory precision, laboratory accuracy, blanks, adherence to method specification and quality control (QC) limits, and method performance in sample matrix. Details of this review are presented in Tables 4-1 and 4-2. In summary, the tabular summaries of the data qualifications included in the NDEP-approved DVSRs listed in Criterion I were reviewed, and with the exception of the rejected data discussed in the DVSRs, all data are deemed to be

[19] The site-specific RBTCs developed for the residents based on vapor intrusion into a slab-on-grade house (see detailed discussions on the RBTC development in Section 5.4).

usable for risk assessment purposes. These data qualifications are further discussed in Section 4.1.7 as a component of Criterion VI.

### 4.1.7 Criterion VI – Data Quality Indicators

The project QAPPs (ENSR 2008c, ENVIRON 2014d, Ramboll Environ 2017c, and Ramboll 2019f) 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 VOCs, characterization of EPCs, and risk descriptors used in support of the BHRA and the risk management decisions that will be made for the OU-2 BHRA Area. Specifically, the DQIs address field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment.

The DQI evaluation is presented in Tables 4-1 and 4-2. 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, except the rejected data discussed in Tables 4-1 and 4-2 and listed in Appendix C, Table C-2, all data are deemed to be usable for risk assessment purposes.

## 4.2 Data Analysis

As described in NDEP guidance (NDEP 2010a), the purpose of the data analysis step is to "use simple exploratory data analysis 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, the steps of the EDA, as described in the following sections, include 1) preparation of summary statistics for the BHRA data set (Section 4.2.1), 2) preparation and review of spatial plots for the risk-driving analyte(s) (Section 4.2.2), 3) preparation and review of temporal trends of VOC concentrations in groundwater (Section 4.2.3), 4) preparation and review of plots of VOC concentrations in co-located soil gas and shallow groundwater samples (Section 4.2.4), and 5) review and discussion of the EDA in the context of current and former land use and operations within the OU-2 BHRA Area and the CSM (Section 4.2.5).

### 4.2.1 Summary Statistics

This section presents summary statistics for the analytical data for soil gas samples and shallow groundwater samples included in this BHRA.

Summary statistics for analytical data are presented in Tables 4-8 and 4-9 for the soil gas samples collected at 5 feet bgs and at 10-15 feet bgs, respectively. Summary statistics for analytical data collected from the shallow groundwater samples are presented in Table 4-10. Individual sample locations are shown in Figure 4-1.

In developing the summary statistics, soil gas and groundwater samples with primary and field duplicate results were treated as independent samples. The effects of duplicate treatment on the overall risk evaluation are further discussed in Section 6.1.5.

For most analytes, the summary statistics are based on the results of between 40 and 80 samples for soil gas and 270-290 samples for groundwater, although the soil gas analytical

data set for some analytes is much more limited (<20 samples). However, the analytes with limited sample size were never detected and/or were not site-related. Therefore, the limited sample size for these analytes does not have any impact on the overall risk evaluation.

Considering the data review conducted by both Ramboll and NDEP for each soil gas and groundwater investigation, the OU-2 soil gas and groundwater BHRA data sets are considered adequate for risk assessment purposes.

### 4.2.2 Spatial Analysis of VOCs in Soil Gas and Groundwater

Spatial quartile plots (Figures 4-2 through 4-4) were prepared for chloroform which is the most widespread VOC and the primary risk driver in the OU-2 BHRA Area (Ramboll 2023), to illustrate the spatial distribution of the data, identify potential locations where risk exceeds target thresholds, and compare the results to the expectations of the CSM. Each spatial quartile plot presents the following information:

- Sample locations;
- Chloroform plume; and
- Chemical concentrations. The concentration shown at each location is the maximum detected concentration among all samples, 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 (25th percentiles);
  - ✓ Yellow – concentrations within the interquartile range (IQR, the difference between the 75th and 25th percentiles);
  - ✓ Orange – concentrations > Q3 (75th percentiles) and <= (Q3 + 1.5×IQR); and
  - ✓ Red – concentrations > (Q3 + 1.5×IQR).

The spatial quartile plots are presented in Figures 4-2 through 4-4 for chloroform in soil gas at 5 feet bgs, in soil gas at 10-15 feet bgs, and in shallow groundwater, respectively.

In addition, spatial concentration bubble plots for chloroform were prepared to support the spatial analysis of chlorinated VOC plumes in the OU-2 BHRA Area (Figures 4-5 through 4-7 for soil gas at 5 feet bgs, soil gas at 10-15 feet bgs, and shallow groundwater). As shown in these spatial concentration plots, the spatial distributions for chloroform are consistent with the spatial quartile plots shown in Figures 4-2 through 4-4. For soil gas, it is evident that the highest concentrations of chloroform are present at the southernmost regions of the OU-2 BHRA Area (bordering Former Parcel D and the TIMET site located to the south of OU-2) where the VOC plumes come onto the OU-2 BHRA Area from the upstream sources (see Figure 4-8) and the northwestern region bordering the Henderson Water Reclamation Facility located north of OU-2. The spatial distribution shown on the spatial concentration bubble plot of chloroform in groundwater indicates that the highest concentrations of chloroform in groundwater within the OU-2 BHRA Area are present at the southernmost

regions (bordering the Former Parcel D and the TIMET site located to the south of OU-2), the central-eastern portion, and the northeastern portion of the OU-2 BHRA Area. In general, the chloroform concentrations are higher in the eastern portion of the OU-2 BHRA Area in both soil gas and groundwater and much lower in the western portion. This spatial distribution pattern for chloroform is generally consistent between soil gas and groundwater and follows the groundwater chloroform plumes map, as shown in Figure 4-8.

### 4.2.3 Temporal Trends of Chloroform in Soil Gas and Groundwater

#### *Soil Gas*

To analyze the temporal trend of chloroform concentrations in soil gas in the OU-2 BHRA Area,[20] soil gas samples collected from 5 feet bgs and 10-15 feet bgs during the Phase 1 RI in March 2015, Phase 2 RI Modification No. 11 in March 2019, and Phase 3 RI Modification No. 9 in March 2019 to November 2019 were extracted from the OU-2 soil gas BHRA data set (Appendix D) and selected for temporal trend plotting. The locations for the time series plots were selected based on the following criteria:

- Locations sampled in at least three investigations (see Table 4-3);
- Locations co-located with shallow groundwater wells; and
- Locations with high chloroform concentrations (i.e., approximately 1,000 µg/m$^3$ or above).
- The locations selected for time series plots were RISG-1, RISG-2, and RISG-3. As indicated in Figures 4-9 and 4-10, the soil gas concentrations of chloroform in RISG-1, RISG-2, and RISG-3 at 10 to 15 feet bgs were generally greater than the concentrations of chloroform in the same wells at 5 feet bgs. At 5 feet bgs, the concentrations of chloroform at RISG-2 and RISG-3 decreased approximately 66% and 87%, respectively, from 2015 to 2019. The chloroform concentration in RISG-1 remained relatively stable and changes are within 8% from 2015 to 2019. At 10 to 15 feet bgs, the concentrations of chloroform in RISG-2 and RISG-3 decreased approximately 66% and 65%, respectively from 2015 to 2019. The chloroform concentrations in RISG-1 decreased approximately 24% from 2015 to March 2019, then increased approximately 38% from March to November 2019.

#### *Shallow Groundwater*

To analyze the temporal trend of chloroform concentrations in shallow groundwater in the OU-2 BHRA Area, chloroform concentrations in selected wells were extracted from the OU-2 shallow groundwater BHRA data set (Appendix E) and plotted over the time period from 2015 to 2020 (see Figure 4-11). These groundwater chloroform results were collected during Phase 1 RI in January 2015 and the groundwater performance monitoring programs from May 2017, May 2018, May 2019, and May 2020. The wells for the time series plots were selected based on the following criteria:

[20] Chloroform is the only chemical evaluated temporally since it is the primary cancer risk-driving chemical, contributing 90% or higher of the total cancer risk for all soil gas samples. Though several other chemicals are driving noncancer HI for various exposure scenarios alongside chloroform, the estimated total noncancer HIs for all the soil gas scenarios were well below the NDEP and USEPA target HI of greater than one and therefore were not further evaluated.

- Wells sampled in at least three sampling events (see Table 4-4);
- Wells co-located with higher concentrations in soil gas; and
- Wells at locations with cancer risk above 1 x $10^{-6}$ (see Section 5.4.2).

The wells selected for time series plots were PC-21A (located near RISG-3), PC-24 (located near RISG-2), PC-28, and PC-67 (located near RISG-1). As indicated in Figure 4-11, the concentrations of chloroform for all wells generally decreased from 2015 to 2020. The chloroform concentrations in PC-21A decreased approximately 68% from 2015 to 2020. The chloroform concentrations in PC-24 decreased approximately 83% from 2015 to 2019, then remained relatively stable with changes within 11% from 2019 to 2020. The chloroform concentrations in PC-28 decreased approximately 53% from 2015 to 2017, then remained relatively stable with changes within 11% from 2017 to 2020. The chloroform concentrations in PC-67 decreased 58% from 2015 to 2019, then slightly increased approximately 19% from 2019 to 2020. The temporal trend of chloroform concentrations detected in the shallow groundwater samples are generally consistent with the chloroform concentrations detected in the co-located soil gas samples.

### 4.2.4 Chloroform in Co-located Soil Gas and Groundwater Samples

A comparison of chloroform concentrations in co-located soil gas and shallow groundwater samples was conducted to support the findings in the RI Report for OU-1 and OU-2 (Ramboll 2023) that the chloroform detected in soil gas in the OU-2 BHRA Area was transported in groundwater from the upgradient sources (i.e., OU-1 and the TIMET site). The soil gas and shallow groundwater samples used to examine the correlation were collected within the same general timeframe (i.e., soil gas samples were collected during the RI sampling in March 2019, and shallow groundwater samples were collected during the groundwater monitoring sampling event in May 2019). To conduct this correlation analysis, shallow groundwater samples that best met USEPA's recommendations (USEPA 2015) for vapor intrusion analysis (wells preferably screened over relatively narrow intervals and close to the top of the groundwater table, see Table 4-4) were selected.

The data and scatterplots of chloroform concentrations are presented in Figure 4-12 for co-located 5 feet bgs soil gas and shallow groundwater samples, and in Figure 4-13 for co-located 15 feet bgs soil gas and shallow groundwater samples. Data were plotted on both arithmetic and logarithmic scales. Given the wide range of reported chloroform concentrations, the logarithmic scale generally provides a more even data distribution across the concentration range and a better visualization of results reported at low concentrations. As indicated in Figures 4-12 and 4-13, strong and statistically significant positive correlations between chloroform concentrations in soil gas (both 5 and 10-15 feet bgs) and shallow groundwater were observed in plots on both arithmetic and logarithmic scales for soil gas concentrations at 5 feet bgs and for plots on an arithmetic scale for soil gas concentrations at 10 to 15 feet bgs, with squared correlation coefficients ($R^2$ values) greater than 0.6 and p values less than 0.05. For the plot on an arithmetic scale for soil gas concentrations at 10 to 15 feet bgs, the square correlation coefficient ($R^2$ value) is 0.49 and the p value is 0.12.

However, a limitation in the data set must be considered when interpreting the correlations: eight pairs of co-located soil gas at 5 feet bgs samples and shallow groundwater samples

and six pairs of co-located soil gas samples at 10 to 15 feet bgs and shallow groundwater samples were included in this analysis. Some of the pairs have relatively low chloroform concentrations reported in soil gas and/or shallow groundwater and the correlation between these low chloroform concentrations in soil gas and groundwater tends to show lower variability. As a result, the strength of the correlation is determined primarily by the sample pairs in the lower concentration range when data are plotted on an arithmetic scale. For plots on a logarithmic scale, the data are more evenly distributed across the concentration range and show stronger and more statistically significant positive correlations between the co-located soil gas and chloroform concentrations.

In summary, based on the data evaluated, strong and statistically significant positive correlations were observed between the chloroform concentrations in soil gas (both 5 and 10 to 15 feet bgs) and shallow groundwater. In addition, the chloroform concentrations detected in the deeper soil gas samples collected at 10-15 feet bgs are consistently higher than the ones detected in shallow soil gas samples collected at 5 feet bgs. These results support the CSM conclusion that the chloroform detected in soil gas in the OU-2 BHRA Area is from VOCs migrating in groundwater which originated from upgradient sources rather than in the OU-2 vadose zone soils.

### 4.2.5 Comparison with Conceptual Site Model

As the last step of the DUE, results from the EDA (i.e., summary statistics, background evaluation, spatial analysis, temporal analysis, and correlation analysis based on co-located soil gas and groundwater results) should be used to compare the data included in the OU-2 BHRA to the expectations of the CSM. The Site-wide CSM was summarized in the RI Report for OU-1 and OU-2 (Ramboll 2023). This section focuses on the comparison of EDA results to the applicable CSM components, specifically those related to the OU-2 BHRA Area, including historical operations, sources of impacts, and migration and distribution of contaminants in soil gas and shallow groundwater, which are summarized below:

- Soil gas concentrations generally increased with depth indicating that chloroform present in soil gas is from groundwater rather than a source in the vadose zone.
- Elevated chloroform concentrations in shallow groundwater in the OU-2 BHRA Area result from migration from upgradient source(s) of contamination (i.e., the OSSM site, OU-1, and the TIMET site).

The details of the EDA (including the review of the spatial quartile plots, Figures 4-2 through 4-4) are presented in Sections 4.2.1 through 4.2.4. Comparison of EDA results to the westside CSM is discussed below.

As part of the ongoing RI/FS, NERT completed an extensive review of existing information and data generated previously in the NERT RI Study Area and developed a preliminary Site-wide CSM, as presented in the RI/FS Work Plan (ENVIRON 2014a). More recently, NERT conducted further review and analysis of historical and recently collected sampling results to assess the magnitude and extent of contaminants (including chloroform) in soil, soil gas, and groundwater within OU-1 and OU-2, including groundwater sampling within the OU-2 BHRA Area and development of an updated Site-wide CSM which is presented in the RI Report for OU-1 and OU-2 (Ramboll 2023).

As discussed in the Site-wide CSM in the RI Report for OU-1 and OU-2 (Ramboll 2023) and shown in Figure 4-14, OU-2 is immediately north (downgradient) of OU-1 and extends to the east. Due to substantial differences in historical land use and source areas in OU-2 east and west of Pabco Road, separate CSMs have been established (i.e., East Side and West Side CSMs). The West Side CSM is comprised of OU-1 and the NERT Off-Site Study Area component of OU-2, west of Pabco Road. As depicted in the West Side CSM (Figure 4-15), property in the OU-2 BHRA Area has been used for residential or commercial purposes unrelated to the historic and current operations of the BMI Complex, inclusive of OU-1. There are no current sources of NERT Site-related contamination within the OU-2 BHRA Area; however, groundwater contamination is present within this area resulting from migration in groundwater from upgradient sources (including OU-1). In addition, chemical migration in groundwater associated with releases that occurred during the early years of manufacturing within OU-1 and adjacent properties within the BMI Complex has resulted in residual contamination in the UMCf which acts as an ongoing source of contamination to the overlying alluvium via slow upward matrix diffusion (Ramboll 2023 and Figure 4-15).

As discussed in detail in the RI Report for OU-1 and OU2, within the OU-2 BHRA Area, the primary source of VOC contamination in groundwater is the migration in groundwater from upgradient sites, including OU-1, the OSSM site, and the TIMET site. The locations of these upgradient properties are shown in Figure 1-2. Chloroform and other VOCs migrating from OU-1 originate from multiple source areas including former manufacturing operations near the Unit 4 and Unit 5 buildings within OU-1, OSSM's dense non-aqueous phase liquid (DNAPL) and groundwater plume, and the TIMET site, as shown in Figure 4-8. The highest concentrations of chloroform migrating into the OU-2 BHRA Area are associated with OSSM's trespassing plume which migrates into OU-1 across the western border of OU-1, migrates across OU-1 within the UMCf in a northwesterly direction, passes between OSSM's and NERT's GWETS, and migrates into OU-2. The migration of chemicals offsite north of the OSSM property was largely mitigated after the installation of the OSSM groundwater extraction and treatment system in 1983. However, VOCs still remain in the groundwater downgradient of the OSSM extraction wells. These VOCs are a combination of legacy contamination that migrated to this area prior to the construction of OSSM's GWETS and contaminants that migrated into OU-1 from the OSSM site and then migrated into OU-2 between the OSSM and NERT GWETS. As indicated previously, VOCs related to the TIMET site have also been identified in the OU-2 BHRA Area and continue to migrate northward across OU-2. A bentonite-slurry barrier wall and GWETS were installed by TIMET in 2014 along the northern boundary of the TIMET property to capture and treat groundwater contaminated by VOCs. Prior to the installation of the barrier wall and groundwater extraction and treatment system, VOCs in groundwater migrated from the TIMET site offsite into OU-2. Given when the extraction systems were installed at each property (1983 for OSSM, 1987 for NERT, and 2014 for TIMET), uncontrolled chloroform migrated from the TIMET site into OU-2 for approximately 30 years longer than from the OSSM site and OU-1.

As shown in Figures 4-11 and 4-12, the strong and statistically significant positive correlations between chloroform concentrations in soil gas (both at 5 and 10 - 15 feet bgs) and shallow groundwater are consistent with the expectations of the CSM, indicating that the chloroform detected in soil gas in the OU-2 BHRA Area is due to the VOCs transported in contaminated groundwater from the source areas described above into OU-2. Additionally, soil gas concentrations generally increase with depth, indicating that VOCs present in soil

gas are migrating upward from groundwater rather than a source in the vadose zone. This is consistent with the CSM for the OU-2 BHRA Area because no industrial activities were reported to have occurred in this area.

As shown in Figures 4-2 through 4-4, the highest chloroform concentrations are in the area which is located downgradient of the TIMET site and OSSM's plume (which migrates across OU-1 into OU-2). This is consistent with the findings in the West Side CSM for OU-2 in the RI Report for OU-1 and OU-2 (Ramboll 2023) because the particle tracking, and plume geometry evaluations indicate that sources within the TIMET site are the primary sources of the chloroform plume in the OU-2 BHRA Area (Ramboll 2023). OSSM's trespassing plume contains higher concentration of chloroform but has not migrated north of Boulder Highway. VOCs in the dissolved phase migrating from the upgradient sources and are present in the shallow and middle water bearing zones (WBZs) are expected to have impacts on concentrations in soil gas in the western portion of OU-2 (Ramboll 2023).

In summary, the soil gas and shallow groundwater data are consistent with the expectations of the NERT Westside CSM, indicating that groundwater is the main source of chloroform detected in soil gas in the OU-2 BHRA Area.

# 5. BASELINE HEALTH RISK ASSESSMENT

The following sections describe the methodology for evaluating potential health risks associated with vapor migration from soil gas and groundwater, which includes the following elements:

- Identification of chemicals to be evaluated;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization

The soil gas and groundwater BHRA for the OU-2 BHRA Area uses the approach described in the NDEP-approved 2018 BHRA Work Plan (Ramboll 2018a), with incorporation of additional recent soil gas and shallow groundwater VOC data.

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

- Guidelines for Exposure Assessment (USEPA 1992c);
- Soil Screening Guidance: Technical Background Document (USEPA 1996);
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002a);
- 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 2002b);
- User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (USEPA 2004b);
- Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline (Interstate Technology & Regulatory Council [ITRC] 2007);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009);
- Soil Physical and Chemical Property Measurement and Calculation Guidance, BMI Plant Sites and Common Areas Projects, Henderson, Nevada (NDEP 2010d).
- OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (USEPA 2015);
- User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas (NDEP 2023b); and
- Regional Screening Levels – User's Guide (USEPA 2023b).

## 5.1 Identification of Chemicals to be Evaluated

As indicated previously, this BHRA quantitatively evaluates the risk associated with VOCs in soil gas and groundwater within the OU-2 BHRA Area.[21] All VOCs detected in one or more soil gas or groundwater samples in the BHRA data sets described in Section 4 were quantitatively evaluated in this BHRA. The list of VOCs detected in soil gas and groundwater is presented in Table 5-1. A total of 67 and 51 VOCs were detected in soil gas collected at 5 feet bgs and 10-15 feet bgs, respectively. A total of 23 VOCs were detected in shallow 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. The exposure assessment includes the CSM, fate and transport modeling, 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. A CSM was developed in order to characterize potential human exposures in the OU-2 BHRA Area. The 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 in the OU-2 BHRA Area, and 3) identifying exposure pathways and routes through which human exposure might occur. The CSM can be an important tool in guiding site characterization, evaluating data quality in the context of potential risks to exposure populations, and developing exposure scenarios.

Development of the CSM is an iterative process; the CSM is revised, as appropriate, over the course of an RI based on additional information and understanding gained following review of existing and newly collected data. A CSM was first developed for the NERT Site in 2005 based on the information available at that time (ENSR 2005). The 2005 CSM presented detailed information on the LOU source areas identified by NDEP, summarized available analytical results for each LOU, and identified the NERT Site-related chemicals based on a review of the activities and/or processes associated with each LOU. Potential contaminant migration pathways and receptors were also described. The CSM was updated in 2014 during development of the RI/FS Work Plan (ENVIRON 2014a) and covered both the NERT Site and downgradient areas, which provided a refined, but still preliminary, identification of sources, release mechanisms, exposure media, exposure routes, and potentially exposed populations based on a then current understanding of on-Site and off-Site environmental conditions. The Site-wide CSM was revised and summarized in the RI Report for OU-1 and OU-2 (Ramboll 2023). In this BHRA, the CSM for the OU-2 BHRA Area

[21] Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities is possible in the very limited areas where depth to groundwater is less than 10 feet bgs. Due to the limited number of monitoring wells and the low concentrations detected at these wells, significant health risks are not expected to occur through the groundwater direct contact pathway in this area. This potential pathway is discussed as part of the uncertainty analysis in Section 6.2.4 of this BHRA.

has been updated by incorporating the findings from the RI Report for OU-1 and OU-2 (Ramboll 2023) and is presented in Figure 5-1. The major elements of the CSM are discussed below.

#### 5.2.1.1 Potential Chemical Sources and Release Mechanisms

As discussed in Section 1, OU-2 is immediately downgradient of OU-1 and extends east/northeast for approximately two miles. The subject of this BHRA is the NERT Off-Site Study Area component of OU-2 located west of Pabco Road, also referred to the OU-2 BHRA Area. In summary, the following are the identified sources of groundwater VOC contamination in the OU-2 BHRA Area (Ramboll 2023):

- Migration of groundwater from OU-1 into OU-2. As discussed in Section 9 of the RI Report for OU-1 and OU-2, the sources of VOCs in OU-1 groundwater are related to releases from historic operations at the Unit 4 and 5 Buildings, the former P and S Ponds, the former unlined Beta Ditch, the former AP Plant and associated facilities, and features north of the interceptor well field (IWF)/barrier wall (e.g., the former Trade Effluent Ponds and recharge trenches). In addition, trespassing VOCs from the OSSM plume have impacted groundwater in OU-1 and continue to migrate uncontrolled from OU-1 into OU-2.
- Migration of chemicals in groundwater from the OSSM site, across OU-1 and into OU-2. The highest concentrations of chloroform in groundwater within OU-2 are located downgradient of OSSM's plume (which migrates across OU-1 into OU-2). This VOC plume contains the highest concentrations of chloroform found in OU-2.
- Migration of VOCs in groundwater directly downgradient from the OSSM site into OU-2. VOCs including chloroform and elevated TDS originating from the OSSM site are detected in OU-2 groundwater in the area downgradient of the OSSM extraction wells. Migration of VOCs north of the OSSM property was mitigated after the installation of their groundwater extraction and treatment system. However, VOCs still remain in groundwater downgradient of the OSSM extraction wells.
- Migration of VOCs in groundwater directly downgradient from the TIMET Site into OU-2. Elevated PCE and chloroform are detected in OU-2 groundwater in the area downgradient of the TIMET Site.
- Upward migration. Residual contamination in the UMCf has been and will continue to be an ongoing source to shallower groundwater within OU-2 via upward migration due to matrix diffusion and the upward gradient. Upward migration will be significant for the chemicals that have impacted the UMCf first in OU-1 and the OSSM and TIMET sites and then migrated within the UMCf to OU-2, including perchlorate, chlorate, chromium, and chloroform. The mass of these chemicals in the UMCf will continue to slowly migrate upwards into the alluvium for an extended period of time.

As discussed in Section 1, land in the OU-2 BHRA Area has been used for residential or commercial purposes unrelated to operation of OU-1 or the BMI Complex. Therefore, the source of Site-related contamination within this area is groundwater contamination that resulted from migration of chemicals in groundwater from upgradient sources. As discussed in the RI Report for OU-1 and OU-2 (Ramboll, 2023) some impacts from the infiltration of contaminants from wastewater that migrated through former ditches may have impacted

groundwater. In addition, residual contamination in the UMCf represents a long-term secondary source to shallow groundwater.

Historical releases from potential source areas have been documented or inferred from field investigations. As indicated in the CSM (Figure 5-1), chemicals were released from upgradient sources through several primary release mechanisms, such as spills/leaks and infiltration/overtopping to soils and runoff to surface water. In addition to the primary release mechanisms, secondary/tertiary release mechanisms included leaching of chemicals into groundwater, transport to the OU-2 BHRA Area, and, finally, migration of VOCs in the subsurface through the soil column to indoor air, outdoor air, or trench air. The potentially contaminated exposure media in the OU-2 BHRA Area include air and groundwater. Potential exposures to surface water (i.e., runoff) by populations located in the OU-2 BHRA Area were not quantitatively evaluated in the BHRA because there are no significant surface water bodies in the area. As discussed in Section 1, exposure via domestic use of groundwater was not evaluated because groundwater in OU-2 is not and is not anticipated to be used as a domestic water supply. Incidental ingestion of and dermal contact with groundwater during short-term construction activities are not considered complete exposure pathways in most of the OU-2 BHRA Area to the groundwater depth being greater than 10 feet bgs. Depths to groundwater in a very limited area near monitoring wells PC-161 and PC-162 were identified to be shallower than 10 feet bgs. Potential exposures through direct contact with groundwater may occur during construction excavation activities in this area. Due to limited numbers of wells with depth to groundwater shallower than 10 feet bgs in the OU-2 BHRA Area and the low concentrations detected at these two wells, significant health risks are not expected to occur through the groundwater direct contact pathway in this area. The health risks associated with this pathway are semi-quantitatively discussed as part of the uncertainty analysis in Section 6.2.4.

#### 5.2.1.2 Potentially Exposed Human Populations and Exposure Pathways

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).

The current and future land use in the OU-2 BHRA Area is mixed commercial/light industrial and residential use. Accordingly, the potentially exposed populations identified for the BHRA include indoor industrial/commercial workers, outdoor industrial/commercial workers, short-term construction workers, and residents, consistent with USEPA guidance (2002b).

Based on the source and release mechanisms presented in the CSM, the following exposure pathways are identified for quantitative evaluation in this BHRA:

- Residents

  - ✓ Inhalation of vapors migrating from soil gas/groundwater to indoor air in a slab-on-grade building
  - ✓ Inhalation of vapors migrating from soil gas/groundwater to indoor air in a residential trailer
- Indoor commercial/industrial workers
  - ✓ Inhalation of vapors migrating from soil gas/groundwater to indoor air
- Outdoor commercial/industrial workers
  - ✓ Inhalation of vapors migrating from soil gas/groundwater to outdoor air
- Construction workers
  - ✓ Inhalation of vapors migrating from soil gas/groundwater to trench air[22]

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.

### 5.2.2 Fate and Transport Modeling

Fate and transport modeling was conducted to characterize the VOCs migrating from soil gas or groundwater into indoor air, outdoor air, and trench air for the residents and workers in the OU-2 BHRA Area.

#### 5.2.2.1 Site-Specific Vapor Intrusion Modeling

The migration of VOCs detected in soil gas or groundwater were quantified 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 construction trench air (in $\mu g/m^3$), which represents the EPC in the air to which a receptor (i.e., a member of a potentially exposed population) is exposed over an assumed duration of exposure. In general, we use the term "transfer factor" to refer to transport from either soil gas or groundwater in lieu of the term "attenuation factor", which is applicable to only transport from soil gas to air (i.e., within the same medium).

For populations in the western portion of OU-2, Ramboll developed transfer factors for the following scenarios:

- Transport of soil gas from five, 10, and 15 feet bgs into a current/future residential slab-on-grade building.
- Transport of soil gas from five, 10, and 15 feet bgs into a current/future residential trailer.

[22] Potential exposures through direct contact with groundwater may occur during construction excavation activities. However, due to limited numbers of wells with depth to groundwater shallower than 10 feet bgs in the OU-2 BHRA Area and the low concentrations detected at these wells, significant health risks are not expected to occur through the groundwater direct contact pathway. Therefore, quantitative evaluation for the groundwater direct contact pathway were not conducted and the health risks associated with this pathway were semi-quantitatively discussed as part of the uncertainty analysis in Section 6.2.4.

- Transport of soil gas from five, 10, and 15 feet bgs into a commercial/industrial slab-on-grade building.
- Transport of soil gas from five, 10, and 15 feet bgs to outdoor air for an outdoor commercial/industrial worker scenario.
- Transport of soil gas from five feet away from the wall and five feet below the base into a 10-foot construction trench.
- Transport of vapors from groundwater at 10 and 20 feet bgs into a current/future residential slab-on-grade building.
- Transport of vapors from groundwater at 10 and 20 feet bgs into a current/future residential trailer.
- Transport of vapors from groundwater at 10 and 20 feet bgs into a commercial/industrial slab-on-grade building.
- Transport of vapors from groundwater at 10 and 20 feet bgs to outdoor air for an outdoor commercial/industrial worker scenario.
- Transport of vapors from groundwater at one foot below the base of a 10-foot dry construction trench into the trench for wells with depth to groundwater shallower than 20 feet bgs.
- Transport of vapors from groundwater at 10 feet below the base of a 10-foot dry construction trench into the trench for wells with depth to groundwater at 20 feet bgs or deeper.

The intermediate transfer factors were estimated using the screening-level model described by Johnson and Ettinger (1991). Specifically, the USEPA Spreadsheet Modeling Subsurface Vapor Intrusion, version 6.0 (USEPA 2017) was used. The Johnson and Ettinger model was originally developed to predict vapor intrusion into buildings using a combination of diffusion and advection. However, as described below, it is easily adapted to predict vapor intrusion into outdoor air or trench air. The calculation of transfer factors was based on parameters describing the properties of the chemicals evaluated, the vadose zone, the surface barrier, and the air dispersion zone. The physical/chemical properties for the VOCs detected in soil gas and groundwater that were used in these calculations are presented in Table 5-2. Based on guidance from USEPA (2023), only chemicals that easily volatilize were included in the evaluation of vapor migration. These include chemicals with a Henry's Law constant of greater than $1 \times 10^{-5}$ atm-$m^3$/mole or a vapor pressure of greater than 1 millimeter of mercury (mm Hg). The source of all physical/chemical properties is noted in Table 5-2. In general, priority is given to the most recent physical/chemical data as well as the most relevant data for a site located in Nevada. As such, the hierarchy for selecting physical/chemical properties is:

1. NDEP values from the BCL tables (NDEP 2023a);
2. USEPA values from the Johnson and Ettinger model (USEPA 2017);
3. USEPA values from the regional screening level (RSL) tables (USEPA 2023a); and
4. USEPA values from EPISuite (2012) combined with using surrogate chemicals for diffusivities in air and water.

Soil physical properties, including soil classification (grain size distribution/Atterberg Limits), total organic carbon, bulk density, water content, and total porosity were collected at 5 feet bgs and 10-15 feet bgs at nine soil gas sample locations during the Phase 2 RI Modification No. 11 sampling, where the soil properties had not been collected previously[23] in the OU-2 BHRA Area. The Phase 2 RI Modification No. 11 soil physical property testing reports are included in Appendix F; the soil property data are summarized in Table 5-3. The mean soil property measurements collected from 5 feet bgs and 10-15 feet bgs, respectively, in the Qal at soil gas sample locations RISG-1 through RISG-9 were used in the site-specific Johnson and Ettinger modeling for this BHRA Report.

Depth to groundwater was determined by evaluating both current and historic groundwater elevations for non-artisanal shallow wells within the OU-2 BHRA Area. Depth to groundwater ranges from approximately 20 to 60 feet bgs, with depth to groundwater shallower than 20 feet at some locations (see Table 4-4). To be conservative, depths of groundwater of 10 and 20 feet bgs were selected for modeling in this BHRA.[24]

A conservative default commercial/industrial building was assumed for the indoor air scenario with a building area of 16145.9 square feet (or 1,500 square meters) and a vapor flow rate of 337.5 L/minute into the building (USEPA 2017). USEPA's default air exchange rate of 1.5 air change per hour for a commercial/industrial building (USEPA 2017) was used. A conservative building height of 9.8 feet (or 3 meters) was assumed.

A conservative default residential slab-on-grade building was assumed for the indoor air scenario with a building area of 150 square meters and a vapor flow rate of 8.2 L/minute into the building (USEPA 2017). USEPA's default air exchange rate of 0.45 air change per hour and building height of 2.44 meters for a residential building (USEPA 2017) were used. A residential trailer with a dirt floor was also assessed. The residential trailer was modeled as a crawl space with a dirt floor using the USEPA's default building area, building height, and air exchange rate for a residential building (USEPA 2017), as described above. It is assumed that there was no building foundation for the trailer scenario (i.e., the building foundation thickness was assumed to be zero).

For the trench scenario, a box model was used to simulate dispersion. Trench dimensions of 10 feet deep, 20 feet long, and five feet wide were assumed. For this box model, the air flow through the trench was controlled by a site-specific wind speed that is reduced by a factor of 10 to ensure it is conservative for a trench scenario where the breathing zone may be a few feet bgs. The flux of VOCs from the source assuming unit concentration into the trench air was calculated using the effective diffusion coefficient through the unsaturated zone estimated in the Johnson and Ettinger model spreadsheet (USEPA 2017). The transfer factors were estimated by dividing the flux into the trench air with dispersion factors. Additionally, VOCs were assumed to be emitted from the trench walls and the base of the

[23] Soil classification (grain size distribution/Atterberg Limits) and total organic carbon had previously been collected at PC-172 (co-located with RISG-4, at 13.5 feet bgs), PC-167 (co-located with RISG-7, at 11.0 feet bgs), and PC-166 (co-located with RISG-9, at 11.5 feet bgs) during the Phase 2 RI.

[24] Depths to groundwater in a very limited area near monitoring wells PC-161 and PC-162 were identified to be shallower than 10 feet bgs. Due to limited numbers of wells with depth to groundwater shallower than 10 feet bgs in the OU-2 BHRA Area and the low concentrations of VOCs detected at these two wells, significant health risks are not expected to occur. The health risks associated with a wet trench scenario are qualitatively discussed as part of the uncertainty analysis in Section 6.2.4.

trench. The transfer factors for soil gas migrating from 5, 10, and 15 feet bgs into the construction trench were assumed to be emitted from five feet away from all the trench walls and below the base of the trench. The transfer factors for groundwater migrating from 10 and 20 feet bgs into a trench were conservatively assumed to be emitted from one and 10 feet from all the trench walls and below the base of the trench. The transfer factors for soil gas migrating from 5, 10, and 15 feet bgs into the trench were assumed to be emitted from five feet away from all the trench walls and below the base of the trench. The transfer factors for groundwater migrating from 10 and 20 feet bgs into the trench were conservatively assumed to be emitted from one and 10 feet from the base of the trench.

Benzene readily biodegrades under natural aerobic conditions in shallow soil. In the NERT RI Study Area, measured concentrations of benzene at shallower depths are consistently lower than would be predicted from deeper sources (soil gas and groundwater) using the Johnson and Ettinger model which conservatively assumes that there is no biodegradation. Consistent with the BHRA Work Plan, the BioVapor (American Petroleum Institute [API] 2012) was used to calculate the relative impact of benzene biodegradation within the unsaturated zone for all soil gas and groundwater scenarios. BioVapor is virtually identical to the Johnson and Ettinger model except it includes biodegradation. The model breaks the soil into a shallow soil layer near the surface where oxygen is present and first-order biodegradation occurs, and a deeper anaerobic layer where no biodegradation occurs. To quantify the effect of biodegradation in the unsaturated zone, the ratio of the BioVapor results with biodegradation and without biodegradation was calculated. This ratio was then multiplied by the indoor and outdoor transfer factors for benzene calculated using the approach described above. Consistent with the 2018 BHRA Work Plan, biodegradation was only quantified for benzene. The input parameters for this calculation are also presented in Table 5-4. The biodegradation rate for benzene used in the evaluation is the BioVapor default value, which represents the median of measured rates for benzene, ethylbenzene, toluene, xylenes, and alkylbenzenes. The biodegradation ratios for soil gas migrating to outdoor air are conservatively using the ratios calculated for soil gas migrating to commercial indoor air. The biodegradation ratios for soil gas migrating to trailer air are conservatively using the ratios calculated for soil gas migrating to residential indoor air. The BioVapor modeling files used to predict the biodegradation ratios are provided in Appendix I-2 of this report.

Tables 5-5 and 5-6 summarize the transfer factors for all VOCs analyzed in the soil gas and shallow groundwater BHRA data sets migrating to indoor air, outdoor air, and trench air. The vapor intrusion calculations used to predict the transfer factors for each scenario, using chloroform as an example, are provided in Appendix I-1 of this report. The model-predicted results are confirmed using the data collected in the IAQ investigation in the Pittman Neighborhood, as discussed in further detail in Section 5.2.2.2. The conservative nature of the model input parameters and modeling uncertainties are discussed in Section 6.2.2.

#### 5.2.2.2 Confirmation of Site-Specific Vapor Intrusion Model Using the IAQ Results

At the direction of NDEP (NDEP 2021), a targeted indoor air sampling investigation of chloroform in areas of OU-2 with elevated soil gas and groundwater concentrations within the eastern portion of the Pittman Neighborhood was conducted (see details of the indoor air sampling in Section 3.3 and Appendix J-2). NDEP requested NERT use the indoor air data to "confirm that chloroform indoor air levels remain below long-term, health-based

thresholds and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements". The long-term, health-based threshold was defined in the USEPA Letter attached to the NDEP Letter (NDEP 2021) as 12 µg/m$^3$ based on default residential exposure assumptions and a target cancer risk level of $10^{-4}$.

The results of the IAQ investigation are summarized in Table J-1 in Appendix J and the *OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum* (Ramboll 2022a, see Appendix J-2). The analytical results associated with other target VOCs were analyzed and used to confirm the site-specific vapor intrusion modeling results for the Pittman Neighborhood.

The chloroform sampling results for each home are shown in Table 1 in Appendix J-2. The measured indoor air results for chloroform ranged from 0.40 to 1.1 µg/m$^3$ in the background area and ranged from 0.31 to 3.4 µg/m$^3$ in the Target Indoor Air Sampling Areas, all well below the threshold of 12 µg/m$^3$ as defined in the USEPA Letter. The chloroform soil gas sample results are also shown in Table 1 in Appendix J-1 for homes in the Target Indoor Air Sampling Areas. All soil gas results show lower concentrations than the November 2019 soil gas sampling event.

Table 2 in Appendix J-2 compares the model-predicted chloroform indoor air concentrations to the measured indoor air concentrations. The predicted indoor air concentrations were calculated by multiplying the measured soil gas concentrations at 5 and 15 feet bgs (as listed in Table 1 in Appendix J-2) by the corresponding soil gas-to-indoor air attenuation factors calculated in the site-specific vapor intrusion modeling for that soil gas depth. As described in Section 5.2.2.1 of this BHRA Report, the attenuation factors representing the ratio between indoor air concentrations and soil gas concentrations were calculated using the J&E model (USEPA 2017) based on site-specific soil properties. The modeled attenuation factors for soil gas at 5 and 15 ft bgs are also included in Table 2 in Appendix J-2. Since the J&E model does not account for indoor or ambient sources of chloroform, the minimum and maximum background chloroform indoor air concentrations found in the background area houses (i.e., 0.4 and 1.1 µg/m$^3$, respectively, see Table J-1) were added to the model-predicted indoor air concentrations (calculated based on measured soil gas concentrations and site-specific model-predicted transfer factors for the sampling depth) for each house to estimate the range of predicted indoor air chloroform concentrations, as shown in Table 2 in Appendix J-2. This is consistent with USEPA guidance that recommends accounting for background contributions when evaluating vapor intrusion (USEPA 2015). The predicted indoor air concentrations for the homes in the two Target Indoor Air Sampling Areas ranged from 0.49 to 2.9 µg/m$^3$ and are comparable with the measured indoor air concentrations which ranged from 0.31 to 3.4 µg/m$^3$. Therefore, the IAQ results demonstrate that the results predicted using the site-specific vapor intrusion modeling are representative of the conditions in the area.

The human health risks for the indoor air chloroform concentrations are further discussed in Section 5.4.1.3 to confirm that the vapor intrusion modeling risk to residents does not exceed the NDEP and USEPA risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ for carcinogenic impacts.

### 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. 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 2009).

As shown in Table 5-7, exposure assumptions recommended by NDEP (2023b) were used for residents and indoor/outdoor commercial/industrial workers. For the construction workers, exposure assumptions recommended by USEPA (2023b) were used, except that a utility trench scenario was evaluated assuming that the construction workers could be exposed to VOCs migrating from soil gas and groundwater to air in a 10-foot construction trench when conducting excavation activities for four hours per day, 30 days per year for one year (NDEP 2017, General Comment #3). In general, the exposure assessment in this BHRA is based on a reasonable maximum exposure (RME) scenario, which is defined by USEPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (USEPA 1989).

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

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

where:

| | | |
|---|---|---|
| $IF_{inh}$ | = | Intake Factor for air inhalation (unitless) |
| ET | = | Exposure Time (hour/day) |
| EF | = | Exposure Frequency (day/year) |
| ED | = | Exposure Duration (year) |
| AT | = | Averaging Time (day) |
| CF | = | Conversion Factor (hour/day) |

For carcinogens, the intake factor averaged over a 70-year lifetime was used in the risk characterization, while for non-carcinogens, the intake factor averaged over the exposure period was used (USEPA 1989).

## 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 noncarcinogenic. Different methods are used to estimate the potential for carcinogenic and noncarcinogenic health effects to occur. Several chemicals produce noncarcinogenic 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, noncarcinogens generally are thought to produce adverse health effects only when some minimum exposure level is reached (i.e., a threshold dose).

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 potential carcinogenic chemicals. The IUR is defined as an upper-bound estimate of the probability of an individual developing cancer per unit concentration 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 levels not expected to cause adverse health effects 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 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.

For the VOCs detected in soil gas and groundwater, an initial list of chronic toxicity values was developed based on the values used by NDEP for the derivation of the 2023 BCLs (NDEP 2023a). 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 Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database, were selected over the IRIS values. For chemicals not included in IRIS, NDEP relied on other sources for toxicity values. Ramboll checked the chronic toxicity values from the 2023 BCL table against the identified source to confirm that the most current values were being used.

For chemicals 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 2023b) were used; and
- For chemicals for which toxicity values are not available from any of the sources listed, Ramboll used the toxicity values from surrogate chemicals (chemicals with similar chemical structure), when available.

- For construction workers who were assumed to be present in the OU-2 BHRA Area for one year, subchronic toxicity values were used whenever available for the evaluation of adverse noncancer effects in accordance with recommendations by USEPA (USEPA 2023a). 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 2009a).

In addition, for each carcinogen, the USEPA weight-of-evidence classification was also identified.

The chronic and subchronic toxicity values for all the analyzed VOCs in the soil gas and shallow groundwater BHRA data sets are presented in Table 5-8. The uncertainties in the selection of toxicity values are further discussed in Section 6.2.3.

## 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. In order to evaluate the potential human health risk from each exposure medium (i.e., soil gas and shallow groundwater) to the potentially exposed populations, RBTCs, representing the concentration of a chemical protective of human health, were first developed for all the analyzed VOCs in the soil gas and shallow groundwater BHRA data sets (Appendices D and E). Then, potential excess lifetime cancer risks and noncancer adverse health effects for each VOC in soil gas and shallow groundwater were characterized separately by comparing concentrations detected in each soil gas and shallow groundwater sample to the RBTCs. Cancer risks and noncancer hazards associated with the vapor intrusion pathway were evaluated for each sample, and the highest estimated cancer risk and noncancer hazard for individual sampling locations (i.e., statistical averages are not estimated) were reported. In addition, 0.1 x RBTC was used to evaluate the SQLs for the nondetects as discussed in Section 4.1.5. The uncertainties associated with the SQLs higher than 0.1 x RBTC are discussed in Section 6.1.2.

The NCP (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for the risk management range by NDEP (2023b). According to NDEP (2023b), the lifetime incremental cancer risks posed by a site should not exceed one in a million ($1 \times 10^{-6}$) to one hundred in a million ($1 \times 10^{-4}$).[25] According to the NCP and NDEP (2023b), noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a hazard index [HI] greater than one). As a conservative measure, the RBTCs were calculated to correspond to a target cancer risk of $1 \times 10^{-6}$ and a target noncancer hazard quotient (HQ) of one.

It should be noted that the cancer risk and noncancer hazard estimated in this BHRA do not represent absolute estimates in the OU-2 BHRA Area, since generic and conservative

[25] According to NDEP (2023b), the acceptability of any calculated incremental cancer risk is generally evaluated relative to the cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ described in the NCP.

assumptions were used, which are likely to overestimate actual exposures and calculated risks. Exceedance of the NDEP and USEPA cancer risk management range of 1 x $10^{-6}$ to 1 x $10^{-4}$ or the target noncancer HI of one does not indicate that adverse impacts to human health are occurring or will occur but suggests that further evaluation may be warranted.

Consistent with agency guidance from USEPA (2015), soil gas data collected within the OU-2 BHRA Area since 2008 were used to evaluate potential exposure for current and future residents and workers via inhalation of vapors migrating from the subsurface to indoor air, outdoor air, and trench air. The soil gas data used in this BHRA were specifically collected to evaluate the vapor intrusion pathway. Soil gas data is generally preferred as a 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). In addition, the groundwater data used in this BHRA was collected to delineate the groundwater plume and not necessarily for the evaluation of vapor intrusion. For this reason, some of the groundwater data has been collected at depths below the first encountered groundwater. Therefore, this BHRA 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 for a more comprehensive understanding of the evaluation and to check consistency between soil gas and groundwater results.

### 5.4.1 Soil Gas

#### 5.4.1.1 Cancer Risks

The excess lifetime cancer risk is estimated as the upper-bound incremental probability of an individual developing cancer over a lifetime (i.e., 70 years) as a result of exposure to a potential carcinogen at a given concentration. The equation used to calculate soil gas RBTCs for vapor migration to air for the carcinogenic endpoint is as follows:

$$RBTC_{SG.c} = \frac{TR}{IF_{inh} \times \alpha \times IUR}$$

where:

| | | |
|---|---|---|
| $RBTC_{SG.c}$ | = | Risk-Based Target Concentration, soil gas, carcinogenic endpoint (µg/m$^3$) |
| TR | = | Target Risk (unitless) |
| $IF_{inh}$ | = | Inhalation Intake Factor (unitless) |
| α | = | Transfer Factor for soil gas migrating to air (µg/m$^3$ per µg/m$^3$) |
| IUR | = | Inhalation Unit Risk (µg/m$^3$)$^{-1}$ |

The RBTCs for VOCs in soil gas for vapor migration from soil gas to air based on the carcinogenic endpoint are presented in Tables 5-9 through 5-12 for residents (for both the

slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers,[26] and construction workers, respectively.

The equation used to calculate excess lifetime cancer risk due to exposure via inhalation of VOCs migrating from soil gas to air is as follows:

$$Cancer\ Risk = \frac{Soil\ Gas\ Concentration}{Cancer\ RBTC} \times 10^{-6}$$

The methodology for estimating excess lifetime cancer risks for soil gas using the soil gas RBTCs developed for various exposure scenarios are summarized below:

- For the residents under the slab-on-grade building scenario, soil gas data collected at approximately 5, 10, and 15 feet bgs at sample locations in the residential area were compared to the residential soil gas RBTCs modeled at 5, 10, and 15 feet bgs for the slab-on-grade building scenario. Data from one soil gas sample collected slightly shallower than 15 feet bgs (i.e., 13 feet bgs at RISG-1) were conservatively compared to the soil gas RBTCs modeled at 10 feet bgs.
- For the residents under the trailer scenario, shallow soil gas data collected at approximately 5 feet bgs and 15 feet bgs at two sample locations (RISG-77 and RISG-78) near the residential trailer area were compared to the residential soil gas RBTCs modeled at 5 feet bgs and 15 feet bgs for the residential trailer scenario, respectively.
- For the indoor commercial/industrial worker scenario, soil gas data collected at approximately 5, 10, and 15 feet bgs at sample locations in the commercial area were compared to the soil gas RBTCs modeled at 5, 10, and 15 feet bgs for the indoor commercial/industrial workers, respectively.
- For the construction worker scenario, the soil gas data collected from the OU-2 BHRA Area (regardless if a sample was collected in a residential or commercial area or depth intervals) were compared with soil gas RBTCs developed for construction workers assuming the soil gas sample is either 5 feet away from the wall (for the 5 feet and 10 feet bgs soil gas samples) or below the base of a 10-foot construction trench (for the 15 feet bgs soil gas samples).
- For the resident (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial worker, and construction worker scenarios, the concentration for each detected carcinogenic VOC in a soil gas sample was used in the cancer risk calculations for each sample. Also, the estimated excess lifetime cancer risk for each carcinogenic VOC was summed for each sample and the highest total cancer risk estimates were reported for each applicable scenario at each location.

For the outdoor commercial/industrial worker scenario, outdoor air EPCs were developed using 95% UCLs of the mean model-predicted outdoor air concentrations for VOCs

[26] For the outdoor commercial/industrial worker scenario, RBTCs were developed for outdoor air (Table 5-11) to compare to outdoor air EPCs. The outdoor air EPCs were developed by calculating 95% UCLs for model-predicted outdoor air concentrations for each VOC migrating from soil gas or shallow groundwater. The 95% UCL inputs were developed by multiplying detected soil gas or shallow groundwater concentrations with medium and depth-specific transfer factors within commercial/industrial areas in the western portion of OU-2.

migrating from soil gas over the commercial/industrial areas in the OU-2 BHRA Area and compared to the outdoor air RBTCs (Table 5-11). The R codes provided by NDEP's consultant, Neptune, were used to calculate the UCLs. The outdoor air concentrations were calculated first by multiplying VOC concentrations in soil gas with depth-specific transfer factors from soil gas to outdoor air (see Section 4.2.2.1 and Table 5.5) within the commercial/industrial areas in the western portion of OU-2. Then the 95% UCLs were calculated using the model-predicted maximum outdoor air concentrations at each soil gas sample location presented in Tables H-1 and H-2 as inputs. The outputs of the 95%UCLs were shown in Tables H-4 and H-5.

The total estimated excess lifetime cancer risks at both 5 and 10-15 feet bgs for the most conservative exposure scenarios (i.e., for residents under both the slab-on-grade and trailer scenarios in the residential area and for the indoor commercial/industrial worker scenario in the commercial area) at each soil gas sample location in relation to the nearby chloroform groundwater plume (as defined by >70 µg/L chloroform concentration) are shown in Figures 5-2 through 5-5. The range of total excess lifetime cancer risk estimates for soil gas at 5 feet bgs and 10-15 feet bgs for each exposure scenario is summarized in Table 5-13. The source concentration, air EPC, and cancer risk for each VOC detected in the soil gas sample with the maximum cancer risk estimate for all the exposure scenarios are shown in Tables G-1 through G-10.

As shown in Table 5-13, the maximum total estimated excess lifetime cancer risks for soil gas at 5 feet bgs and 10-15 feet bgs for each evaluated exposure scenario are summarized below:

- $2 \times 10^{-5}$ for a resident in a slab-on-grade building at both 5 feet bgs and 10-15 feet bgs (at RISG-1, see Figures 5-2 and 5-3);
- $1 \times 10^{-5}$ and $7 \times 10^{-6}$ for a resident in a trailer at 5 feet bgs and 10-15 feet bgs, respectively (at RISG-77, see Figures 5-2 and 5-3);
- $3 \times 10^{-6}$ and $2 \times 10^{-6}$ for an indoor commercial/industrial worker at 5 feet bgs and 10-15 feet bgs, respectively (at RISG-6, see Figures 5-4 and 5-5);
- $2 \times 10^{-10}$ for an outdoor commercial/industrial worker at both 5 feet bgs and 10-15 feet bgs;[27] and
- $1 \times 10^{-11}$ and $2 \times 10^{-11}$ for a construction worker at 5 feet bgs and 10-15 feet bgs, respectively (at RISG-6);

All cancer risk estimates for soil gas were within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. Therefore, potential exposure to VOCs in soil gas in the OU-2 BHRA Area is not expected to pose an unacceptable carcinogenic health effect under the conditions evaluated and additional assessment is not warranted based on the cancer risk results for soil gas in the OU-2 BHRA Area.

[27] The cancer risk and noncancer chronic HI for the outdoor commercial/industrial workers were estimated based on the 95% UCLs calculated using the soil gas VOC data collected in commercial/industrial areas in the OU-2 BHRA Area.

The cancer risk driver for the soil gas samples was chloroform, contributing 90% or higher of the total cancer risk for all soil gas samples. The cancer risk estimates for the outdoor commercial/industrial workers and construction workers for all evaluated soil gas sample locations are well below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.[28] As shown in Figures 5-2 and 5-3, soil gas sample locations with cancer risks above $1 \times 10^{-6}$ were identified within the groundwater plume of chlorinated VOCs (as defined by >70 µg/L chloroform concentration). The locations with the highest residential cancer risks (RISG-1, RISG-68, RISG-71, and RISG-77) are all located in the southeastern portion of the Pittman neighborhood, which is closest to the upgradient sources, consistent with the spatial distribution of chloroform found in shallow groundwater in the OU-2 BHRA Area. As shown in Figures 5-4 and 5-5, there is only one soil gas location (RISG-6) with cancer risks above $1 \times 10^{-6}$ for the indoor commercial/industrial worker scenario. This location is in the commercial area north of East Galleria Drive and just south of the AWF extraction wells, also within the groundwater plume of chlorinated VOCs in the OU-2 BHRA Area.

#### 5.4.1.2 Noncancer Health Effects

The likelihood of noncancer adverse effects is quantified by the development of an HQ. The equation used to calculate soil gas RBTCs for vapor migration to air for the non-carcinogenic endpoint is as follows:

$$RBTC_{SG.nc} = \frac{THQ}{IF_{inh} \times \alpha / RfC_{inh}}$$

where:

| | | |
|---|---|---|
| $RBTC_{SG.nc}$ | = | Risk-Based Target Concentration, soil gas, noncarcinogenic endpoint (µg/m$^3$) |
| THQ | = | Target Hazard Quotient (unitless) |
| $IF_{inh}$ | = | Inhalation Intake Factor (unitless) |
| A | = | Transfer Factor for soil gas migrating to air (µg/m$^3$ per µg/m$^3$) |
| $RfC_{inh}$ | = | Inhalation Reference Concentration (µg/m$^3$) |

The RBTCs for vapor migration from soil gas to air for the noncarcinogenic endpoint are presented in Tables 5-9 through 5-12 for residents (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers,[29] and construction workers, respectively.

[28] Due to the low risk levels for the outdoor commercial/industrial workers and construction workers, figures presenting the risk results for these two scenarios are not shown in this BHRA report.

[29] For the outdoor commercial/industrial worker scenario, RBTCs were developed for outdoor air (Table 5-11) to compare to outdoor air EPCs. The outdoor air EPCs were developed by calculating 95% UCLs for model-predicted outdoor air concentrations for each VOC migrating from soil gas or shallow groundwater. The 95% UCL inputs were developed by multiplying detected soil gas or shallow groundwater concentrations with medium and depth-specific transfer factors within commercial/industrial areas in the OU-2 BHRA Area.

The equation used to calculate the HQ due to exposure via inhalation of VOCs migrating from soil gas to air is as follows:

$$HQ = \frac{Soil\ Gas\ Concentration}{Noncancer\ RBC}$$

Similar methodology and data sets were used to estimate the HQs for soil gas for each evaluated scenario as the methodology and data sets used for estimating the excess lifetime cancer risks for soil gas, as discussed in Section 5.4.1.1.

The range of the estimated total HIs associated with exposures through vapor inhalation for residents (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers to VOCs migrating from soil gas at 5 feet bgs and 10-15 feet bgs to indoor, outdoor air, and trench air in the OU-2 BHRA Area are summarized in Table 5-13. The source concentration, air EPC, and HQ for each VOC detected in soil gas at the locations with the highest estimated HIs for all the exposure scenarios are shown in Tables G-1 through G-10.

As shown in Table 5-13, the maximum total HI estimate is 0.03 for a resident (for both the slab-on-grade and trailer scenarios), 0.01 for an indoor commercial/industrial worker, 0.00006 for an outdoor commercial/industrial worker, and 0.00001 for a construction worker, all well below the NDEP and USEPA target HI of greater than one. Therefore, potential exposure to VOCs in soil gas is not expected to pose an unacceptable non-carcinogenic health effect under the conditions evaluated and additional assessment is not warranted based on the noncancer HI results for soil gas in the OU-2 BHRA Area.

#### 5.4.1.3 Comparison to IAQ Results

In addition, at the direction of NDEP (NDEP 2021), the indoor air results collected from the targeted indoor air sampling investigation of chloroform in the eastern portion of the Pittman Neighborhood were used to confirm that chloroform indoor air levels remain below the long-term, health-based threshold of 12 µg/m$^3$, which was presented in The USEPA Letter attached to the NDEP Letter (NDEP 2021). The threshold of 12 µg/m$^3$ was developed based on the USEPA RSL for Resident Ambient Area (May 2023), which is the same as the default indoor air/ambient air BCL for a resident (NDEP 2023a) and a target cancer risk level of $10^{-4}$. This threshold was used to confirm that chloroform concentrations within indoor air are below or within the NDEP and USEPA cancer risk management range of 1 x $10^{-6}$ to 1 x $10^{-4}$ and remain less than 12 µg/m$^3$, as recommended in the USEPA Letter.

As shown in Table 1 in the *OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum* (Ramboll 2022a, see Appendix J-2), all chloroform concentrations detected in the indoor air sampling are within the NDEP and USEPA risk management range of 1 x $10^{-6}$ to 1 x $10^{-4}$ for carcinogenic impacts and less than 12 µg/m$^3$. This conclusion is consistent with the findings based on the health risk results for residents in a slab-on-grade building estimated based on Site-specific vapor intrusion modeling and soil gas data collected in the OU-2 BHRA Area (see details in Section 5.4.1.1).

In summary, the IAQ data confirmed the modeled risk results as presented in this BHRA Report and that the human health risks due to vapor intrusion associated with the VOC

plume in the Pittman Neighborhood are all within or below the NDEP and USEPA cancer risk management range of 1 x $10^{-6}$ to 1 x $10^{-4}$.

### 5.4.2 Shallow Groundwater

#### 5.4.2.1 Cancer Risks

The equation used to calculate shallow groundwater RBTCs for vapor migration to air for the carcinogenic endpoint is as follows:

$$RBTC_{GW.c} = \frac{TR}{IF_{inh} \times \alpha \times IUR}$$

where:

| | | |
|---|---|---|
| $RBTC_{GW.c}$ | = | Risk-Based Target Concentration, groundwater, carcinogenic endpoint (µg/L) |
| TR | = | Target Risk (unitless) |
| $IF_{inh}$ | = | Inhalation Intake Factor (unitless) |
| A | = | Transfer Factor for groundwater vapor migrating to air (µg/$m^3$ per µg/L) |
| IUR | = | Inhalation Unit Risk (µg/$m^3$) |

The RBTCs for VOCs in shallow groundwater based on the carcinogenic endpoint are presented in Tables 5-14, 5-15, 5-11, and 5-16 for residents (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers,[30] and construction workers, respectively.

The equation used to calculate excess lifetime cancer risk due to exposure via inhalation of VOCs migrating from shallow groundwater to air is as follows:

$$Cancer\ Risk = \frac{Shallow\ Groundwater\ Concentration}{Cancer\ RBTC} \times 10^{-6}$$

The methodology and data sets for estimating excess lifetime cancer risks for groundwater using the groundwater RBTCs developed for various exposure scenarios are summarized below:

- For the residential slab-on-grade building scenario, the groundwater BHRA data set collected from wells with depth to groundwater at 20 feet bgs or deeper and from wells with depth to groundwater shallower than 10 feet bgs in the residential area were conservatively compared to the residential groundwater RBTCs modeled at 20

[30] For the outdoor commercial/industrial worker scenario, RBTCs were developed for outdoor air (Table 5-11) to compare to outdoor air EPCs. The outdoor air EPCs were developed by calculating 95% UCLs for model-predicted outdoor air concentrations for each VOC migrating from soil gas or shallow groundwater. The 95% UCL inputs were developed by multiplying detected soil gas or shallow groundwater concentrations with medium and depth-specific transfer factors within commercial/industrial areas in the OU-2 BHRA Area.

feet bgs and 10 feet bgs for the residential slab-on-grade building scenario, respectively.

- For the residential trailer scenario, the groundwater data collected at two wells (PC-174 and PC-175) near the residential trailer area were compared to the residential groundwater RBTCs modeled at 20 feet bgs for the residential trailer scenario.
- For the commercial/industrial worker scenario, the groundwater BHRA data set collected from wells with depth to groundwater at 20 feet bgs or deeper and from wells with depth to groundwater shallower than 10 feet bgs in the commercial area were conservatively compared to the groundwater RBTCs modeled at 20 feet bgs and 10 feet bgs for the indoor commercial/industrial worker scenario, respectively.
- For the construction worker scenario, the groundwater BHRA data set (regardless if a sample was collected in a residential or commercial area) collected from wells with depth to groundwater at 20 feet bgs or deeper and from wells with depth to groundwater shallow than 20 feet bgs were compared with depth-specific groundwater RBTCs developed for construction workers, assuming the groundwater is at a depth of 10 feet bgs or one foot below the base of a 10-foot construction trench, respectively.
- For the resident (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial worker, and construction worker scenarios, the concentration for each VOC detected in each shallow groundwater sample was used in the cancer risk calculation. Also, the estimated excess lifetime cancer risk for each carcinogenic VOC was conservatively summed for each sample to estimate the total cancer risk from shallow groundwater for an exposed individual at each location.
- For the outdoor commercial/industrial worker scenario, outdoor air EPCs were developed using 95% UCLs based on model predicted outdoor air concentrations for VOCs migrating from shallow groundwater over the commercial/industrial area in the OU-2 BHRA Area and compared to the outdoor air RBTCs (Table 5-11). The R codes provided by NDEP's consultant, Neptune, were used to calculate the UCLs. The 95% UCL inputs were developed by multiplying VOC concentrations in shallow groundwater with medium and depth-specific transfer factors within commercial/industrial areas in the western portion of OU-2. Therefore, the UCL input concentrations presented in Table H-3 and used to develop the output shown in Table H-6 are not the concentrations presented in the analytical data tables (Appendix E for shallow groundwater) or summary statistics Table 4-10, but are the product of those concentrations and the outdoor air transfer factors presented in Table 5-6.

The total estimated excess lifetime cancer risks for the most conservative exposure scenarios (i.e., for the resident under both the slab-on-grade and trailer scenarios in the residential area and for the indoor commercial/industrial worker scenario in the commercial area) at each shallow groundwater sample location in relation to the nearby chloroform groundwater plume (as defined by >70 µg/L chloroform concentration) are shown in Figures 5-6 and 5-7, respectively. The range of total excess lifetime cancer risks for shallow groundwater for all the exposure scenarios are summarized in Table 5-17. The source concentration, air EPC, and cancer risk for each VOC detected in shallow groundwater at the maximum location for all the exposure scenarios are shown in Tables G-11 through G-15.

As shown in Table 5-17 and Figures 5-6 and 5-7, the maximum total estimated excess lifetime cancer risks for shallow groundwater for each evaluated exposure scenario are summarized below:

- $1 \times 10^{-4}$ for a resident in a slab-on-grade building (at PC-67);
- $4 \times 10^{-5}$ for a resident in a trailer (at PC-175);
- $3 \times 10^{-6}$ for an indoor commercial/industrial worker (at PC-187);
- $2 \times 10^{-8}$ for an outdoor commercial/industrial worker;[31] and
- $7 \times 10^{-9}$ for a construction worker (at PC-67).

All cancer risk estimates for shallow groundwater were within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. Consistent with the soil gas results, potential exposure to VOCs in shallow groundwater in the OU-2 BHRA Area is not expected to pose an unacceptable carcinogenic health effect under the conditions evaluated and additional assessment is not warranted based on the cancer risk results for shallow groundwater in the OU-2 BHRA Area.

The cancer risk driver for the shallow groundwater samples was chloroform, contributing to 90% or higher in the total cancer risk for all soil gas samples. The cancer risk estimates for the outdoor commercial/industrial workers and construction workers for all evaluated shallow groundwater samples are well below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.[32] As shown in Figure 5-6, shallow groundwater wells in the residential area with cancer risks above $1 \times 10^{-6}$ were identified within the groundwater plume of chlorinated VOCs (as defined by >70 µg/L chloroform concentration). The locations with the highest residential cancer risks (PC-67, PC-168, and PC-175) are located in an area closer to the upgradient sources, consistent with the spatial distribution of chloroform found in soil gas in the OU-2 BHRA Area. As shown in Figure 5-7, there are a few wells (i.e., PC-24, PC-122, PC-124, PC-126, PC-187, PC-187R, and PC-188) with cancer risks above $1 \times 10^{-6}$ for the indoor commercial/industrial worker scenario either in the commercial areas north of Warm Springs Road or north of Sunset Road, all within the groundwater plume of chlorinated VOCs in the OU-2 BHRA Area.

The soil gas location with the highest cancer risk estimates for the resident scenarios (i.e., RISG-1) is co-located with the shallow groundwater well with the highest residential cancer risk estimate (i.e., PC-67). The soil gas location with the highest cancer risk estimates for the indoor commercial/industrial worker scenario (i.e., RISG-6) is also co-located with a shallow groundwater well that is among the wells with the highest cancer risk estimates (i.e., PC-122).

As discussed previously, this BHRA 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 the consistency between soil

[31] The cancer risk and noncancer chronic HI for the outdoor commercial/industrial workers were estimated based on the 95% UCLs calculated using the soil gas VOC data collected within commercial/industrial areas in the OU-2 BHRA Area.

[32] Due to the low risk levels for the outdoor commercial/industrial workers and construction workers, figures presenting the risk results for these two scenarios are not shown in this BHRA report.

gas and groundwater results. The spatial distribution of locations with cancer risk above $10^{-6}$ for shallow groundwater are also generally consistent with those for soil gas in the OU-2 BHRA Area. The results and conclusions of the groundwater risk evaluation are generally consistent with the results and conclusions of the soil gas risk evaluations for the OU-2 BHRA Area, supporting the OU-2 CSM developed in the RI Report for OU-1 and OU-2 (Ramboll 2023) which identified that groundwater is the main source of chloroform detected in soil gas in this area. The highest cancer risk estimates occur at locations where the highest chloroform concentrations were detected in groundwater within the OU-2 BHRA Area and are located generally downgradient of the upgradient sources.

#### 5.4.2.2 Noncancer Health Effects

The equation used to calculate shallow groundwater RBTCs for vapor migration to air for the noncarcinogenic endpoint is as follows:

$$RBTC_{GW.nc} = \frac{THQ}{IF_{inh} \times \alpha / RfC_{inh}}$$

where:

| | | |
|---|---|---|
| $RBTC_{GW.nc}$ | = | Risk-Based Target Concentration, groundwater, noncarcinogenic endpoint (µg/L) |
| THQ | = | Target Hazard Quotient (unitless) |
| $IF_{inh}$ | = | Inhalation Intake Factor (unitless) |
| α | = | Transfer Factor for soil gas migrating to air (µg/m$^3$ per µg/L) |
| $RfC_{inh}$ | = | Inhalation Reference Concentration (µg/m$^3$) |

The RBTCs for VOCs detected in shallow groundwater for the noncarcinogenic endpoint are presented in Tables 5-14, 5-15, 5-11, and 5-16 for residents (for both a slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers,[33] and construction workers, respectively. The RBTCs for VOCs in the shallow groundwater BHRA data set (Appendix E) are presented in Tables G-11 through G-15 for residents, indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers, respectively.

The equation used to calculate the HQ due to exposure via inhalation of VOCs migrating from shallow groundwater to air is as follows:

$$HQ = \frac{Shallow\ Groundwater\ Concentration}{Noncancer\ RBTC}$$

[33] For the outdoor commercial/industrial worker scenario, RBTCs were developed for outdoor air (Table 5-11) to compare to outdoor air EPCs. The outdoor air EPCs were developed by calculating 95% UCLs for model-predicted outdoor air concentrations for each VOC migrating from soil gas or shallow groundwater. The 95% UCL inputs were developed by multiplying detected soil gas or shallow groundwater concentrations with medium and depth-specific transfer factors within commercial/industrial areas in the western portion of OU-2.

Similar methodology and data sets were used to estimate the HQs for groundwater for each evaluated scenario as the methodology and data sets used for estimating the excess lifetime cancer risks for groundwater, as discussed in Section 5.4.2.1.

The range of the estimated total HIs associated with exposures through vapor inhalation for residents (for both the slab-on-grade building and trailer scenarios), indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers to VOCs migrating from shallow groundwater to indoor, outdoor air, and trench air in the OU-2 BHRA Area are summarized in Table 5-17. The source concentration, air EPC, and HQ for each VOC detected in soil gas at the locations with the highest estimate HIs for all the exposure scenarios are shown in Tables G-11 through G-15.

As shown in Table 5-17, the maximum total HI estimate for shallow groundwater through vapor inhalation is 0.1 for a resident in a slab-on-grade building, 0.08 for a resident in a residential trailer, 0.004 for an indoor commercial/industrial worker, 0.00006 for an outdoor commercial/industrial worker, and 0.0001 for a construction worker, all well below the NDEP and USEPA target HI of greater than one. Consistent with the soil gas results, potential exposure to VOCs in shallow groundwater through the vapor inhalation pathway is not expected to pose an unacceptable non-carcinogenic health effect under the conditions evaluated and additional assessment is not warranted based on the non-cancer HI results for shallow groundwater in the OU-2 BHRA Area.

As discussed previously, this BHRA 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 the consistency between soil gas and groundwater results. The results and conclusions of the groundwater risk evaluation are generally consistent with the results and conclusions of the soil gas risk evaluations for the OU-2 BHRA Area, supporting the OU-2 CSM developed in the RI Report for OU-1 and OU-2 (Ramboll 2023) which identified that chloroform in groundwater is the main source of chloroform detected in soil gas in this area.

# 6. UNCERTAINTY ANALYSIS

The process of risk assessment has inherent uncertainties associated with the calculations and assumptions used in the assessment. The approach used in this BHRA 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 this BHRA is presented below.

## 6.1 Uncertainties Identified in the Data Usability Evaluation

### 6.1.1 Site Characterization Data

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

Sample locations for soil gas data used in the BHRA were selected based on the previous soil gas and groundwater sampling and the presence of several VOCs in the soil gas and groundwater samples in the OU-2 BHRA Area. Soil gas samples collected from these locations were analyzed for the full suite of VOCs using USEPA Method TO-15.

Sample locations for shallow groundwater data used in the BHRA were identified based on the review of available historical groundwater data to characterize the vertical and horizontal extent of impacted groundwater. It should be noted that only soil gas samples were specifically collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling in the OU-2 BHRA Area have been primarily to characterize chemicals in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. However, along with the soil gas data, shallow groundwater data are sufficient to provide a secondary line of evidence for the vapor intrusion risk analysis. In addition, maximum shallow groundwater results at each well were used in the risk analysis which is a conservative approach.

Overall, the placement of the soil gas and shallow groundwater sample locations was deemed representative to evaluate the current conditions within the OU-2 BHRA Area in the context of the CSM, and the relative uncertainty in the characterization data was considered to be low.

### 6.1.2 Detection Limits

For VOCs detected in soil gas and shallow groundwater for which the detection frequency was less than 100%, the SQLs from the soil gas and shallow groundwater BHRA data sets were compared to 0.1 x RBTC to confirm that they were sufficiently low for risk characterization (see Section 4.1.5). As presented in Tables 4-5 through 4-7, most of the

SQLs in the Study Area were less than 0.1 x RBTC, with a few exceptions. The impacts of elevated SQLs on the overall risk evaluation are discussed below.[34]

***Soil Gas at 5 feet bgs:***

- For seven analytes (acrolein, acrylonitrile, benzyl chloride, bromodichloromethane, 1,2-dichloroethane, hexachlorobutadiene, and 1,1,2,2-tetrachloroethane), the SQL exceeded 10% of the minimum RBTC (0.1 x RBTC) in 1.3 to 36% of non-detected samples, with no SQLs exceeding the minimum RBTC (Table 4-5). The estimated excess lifetime cancer risks associated with the elevated SQLs of these VOCs fall within the range of $7 \times 10^{-9}$ to $4 \times 10^{-7}$, which is below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The estimated HQs associated with the exceeded SQLs for the detected VOCs fall within the range of 0.000001 to 0.2, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, elevated SQLs for these chemicals are not expected to have a significant impact on the overall soil gas risk evaluation at 5 feet bgs.
- 1,2-dibromoethane was detected in six out of 78 samples; the SQL exceeded 10% of the minimum RBTC in 32% of the nondetected samples, with the SQL in one sample exceeding the minimum RBTC (Table 4-5). The maximum estimated excess lifetime cancer risk associated with the exceeded SQLs of 1,2-dibromoethane would be $5 \times 10^{-7}$ for a residential trailer or residential slab-on-grade building scenario, which is below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The maximum estimated HQ associated with the exceeded SQLs is 0.0003 for a trailer residential scenario, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, elevated SQLs for 1,2-dibromoethane are not expected to have a significant impact on the overall soil gas risk evaluation at 5 feet bgs.
- 1,2-dibromo-3-chloropropane was not detected in any samples; the SQL exceeded 10% of the minimum RBTC in 81% of these nondetected samples and exceeded the minimum RBTC in 78% of the nondetected samples (Table 4-5). The maximum estimated excess lifetime cancer risk associated with the elevated SQLs of 1,2-dibromo-3-chloropropane would be $5 \times 10^{-5}$ for a trailer residential scenario, which is within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The maximum estimated HQ associated with the SQLs would be 0.1 for a trailer residential scenario, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, if 1,2-dibromo-3-chloropropane had been detected in soil gas at 5 feet bgs for the OU-2 BHRA Area, it is not expected to have a significant impact on the overall soil gas risk evaluation.

***Soil Gas at 10 to 15 feet bgs:***

- For five analytes (acrolein, acrylonitrile, benzyl chloride, 1,2-dibromoethane, and hexachlorobutadiene), the SQL exceeded 10% of the minimum RBTC (0.1 x RBTC) in

[34] SQLs were first screened against the minimum RBTCs (i.e., residential RBTCs) as a conservative first tier analysis. For chemicals with SQLs exceeding 10% of the minimum RBTCs (0.1xRBTC), cancer risk and noncancer HQ estimates were calculated using land-use-specific/scenario-specific RBTCs. For chemicals with SQLs exceeding the minimum RBTCs, maximum cancer risks and noncancer HQs are reported in detail.

3.5 to 38% of non-detected samples, with no SQLs exceeding the minimum RBTC (Table 4-6). The estimated excess lifetime cancer risk associated with the SQLs for these VOCs fall within the range of $6 \times 10^{-9}$ to $3 \times 10^{-7}$, which is below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The estimated HQ range associated with the elevated SQLs for these VOCs is 0.000004 to 0.2, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, the maximum SQLs of these chemicals are not expected to have a significant impact on the overall soil gas risk evaluation at 10 to 15 feet bgs.

- 1,2-dibromo-3-chloropropane was detected in one out of 46 samples; the SQL exceeded 10% of the minimum RBTC in 93% of nondetected samples and exceeded the minimum RBTC in 91% of the nondetected samples (Table 4-6). The maximum estimated excess lifetime cancer risk associated with the elevated SQLs of 1,2-dibromo-3-chloropropane would be $3 \times 10^{-5}$ for a trailer scenario, which is within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The maximum estimated HQ would be 0.06 for a trailer scenario, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, the elevated SQLs for 1,2-dibromo-3-chloropropane are not expected to have a significant impact on the overall soil gas risk evaluation at 10 to 15 feet bgs.

In summary, the total estimated excess lifetime cancer risk associated with the elevated SQLs in the soil gas BHRA data would be $5 \times 10^{-5}$ at 5 feet bgs and $3 \times 10^{-5}$ at 10 to 15 feet bgs for a trailer scenario, both within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The total HIs associated with the elevated SQLs in soil gas BHRA data are also well below the NDEP and USEPA target HI of greater than one at 5 feet bgs and 10 to 15 feet bgs. Therefore, the elevated SQLs are not expected to have a significant impact on the overall soil gas risk evaluation for the OU-2 BHRA Area.

***Shallow Groundwater***:

- For seven analytes (bromodichloromethane, carbon tetrachloride, 1,2-dibromoethane, 1,2-dichloroethane, hexachlorobutadiene, trichloroethene, and vinyl chloride), the SQL exceeded 10% of the minimum RBTC (0.1 x RBTC) in 3.1 to 10% of nondetected samples, with no SQLs exceeding the minimum RBTC (Table 4-7). The estimated excess lifetime cancer risk range associated with the elevated SQLs of these analytes is $4 \times 10^{-9}$ to $8 \times 10^{-7}$, which is below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The estimated HQs associated with the elevated SQLs of these analytes range from 0.0000004 to 0.04, which are well below the NDEP and USEPA target HQ of greater than one. Therefore, the elevated SQLs of these chemicals are 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 minimum RBTC in 100% of these nondetected samples and exceeded the minimum RBTC in 7.2% of the nondetected samples (Table 4-7). The maximum estimated excess lifetime cancer risk associated with the elevated SQLs of 1,2-dibromo-3-chloropropane is $4 \times 10^{-6}$ for a residential scenario, which is within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The maximum estimated HQ associated with the elevated SQLs is 0.008 for a residential

scenario, which is well below the NDEP and USEPA target HQ of greater than one. Therefore, if 1,2-dibromo-3-chloropropane had been quantitatively included in the BHRA, it is not expected to have any significant impact on the overall groundwater risk evaluation.

In summary, the total estimated excess lifetime cancer risk associated with the elevated SQLs in the shallow groundwater BHRA data would be $4 \times 10^{-6}$ for a residential scenario, which is within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The total HI associated with the elevated SQLs is also well below the NDEP and USEPA target HI of greater than one. Therefore, the elevated SQLs are not expected to have a significant impact on the overall shallow groundwater risk evaluation for the OU-2 BHRA Area.

### 6.1.3 Completeness

No soil gas data were rejected, and the percent completeness for the soil gas BHRA data set is 100%. Therefore, the completeness of the soil gas BHRA data set has no impact on the overall risk evaluation.

The rejected ("R" qualified) data associated with shallow groundwater samples are summarized in Appendix C, Table C-2. The percent completeness for the shallow groundwater BHRA data set is 99.98%. The only analyte with rejected data is styrene. Given the small percentage of rejected data (three samples out of 278 shallow groundwater samples), these rejected data are not expected to have a significant impact on the spatial coverage of the shallow groundwater BHRA data set. Meanwhile, all the rejected data were nondetects, and styrene was never detected at any well locations. Additionally, the rejected data were all well below the lowest RBTCs among different exposure scenarios, indicating low potential risks. Therefore, even if these shallow groundwater data are not rejected, it is not expected to have a significant impact on the overall risk evaluation.

### 6.1.4 Comparability

As discussed in Tables 4-1 and 4-2, different reporting limits for the same analyte in soil gas or shallow groundwater may impact the comparability of the data sets. For most of the analytes, the SQLs are well below 0.1 x RBTC. There are some soil gas and shallow groundwater analytes with SQLs exceeding 0.1 x RBTC, as summarized in Tables 4-5 through 4-7, and their impacts on the overall risk evaluation are discussed in Section 6.1.2. In summary, different reporting limits for the same soil gas or shallow groundwater analyte are not expected to have a significant impact on the overall risk evaluation.

For the soil gas data used in the BHRA, the objective of the 2008 Phase B Investigation and RI was to provide sufficient spatial coverage to support this BHRA: samples from the 2008 Phase B investigation were taken primarily from former sale parcels (i.e. limited to the southern boundary of the OU-2 BHRA Area), while samples from the RI were taken throughout the OU-2 BHRA Area. Temporal trends are discussed in Section 4.2.3, and spatial representativeness is discussed in Section 4.2.2. Collectively, the soil gas data set provides sufficient coverage of the OU-2 BHRA Area, and the use of the maximum detected concentrations for the exposure estimates is considered conservative.

For the groundwater data used in the BHRA, as discussed in Section 4.1.5, the same analytical methods were used across most investigations; specifically, USEPA Method SW-8260 for VOCs. When a VOC was analyzed by both SW-8260 and 8260B SIM in some investigations, the results from the more sensitive SW-8260B SIM were used. Temporal trends are discussed in Section 4.2.3, and spatial representativeness is discussed in Section 4.2.2. Collectively, the shallow groundwater data set provides sufficient coverage of the OU-2 BHRA Area, and the use of the maximum detected concentrations for the risk estimates is considered conservative.

### 6.1.5 Precision

#### *Soil Gas*

As presented in Appendix B, Table B-1, in the soil gas BHRA data set, a total of 16 pairs of primary and field duplicate results were qualified due to practical quantitation limit (PQL) criterion exceedance, and no primary and field duplicate results were qualified due to relative percent difference (RPD) criterion exceedance. For laboratory duplicates, there were no data points qualified due to RPD or PQL criterion exceedance (see DVSRs tables in Appendix B). The impacts of field duplicate data qualified due to PQL criterion exceedance are discussed as follows:

- Nine pairs of qualified field duplicate results came from the 2008 Phase B Investigation, one pair of qualified field duplicate results came from Phase 1 RI, and six pairs of qualified field duplicate results came from Phase 3 RI. However, none of these qualified field duplicate results include risk-driving chemicals, therefore they do not have a significant impact on risk results.
- Further, all the qualified field duplicate data were well below the lowest RBTCs among different exposure scenarios, indicating low potential risks.

Therefore, the field duplicate data qualified due to PQL criterion exceedance are not expected to have a significant impact on the overall risk evaluation.

#### *Shallow Groundwater*

As presented in Appendix C, Table C-3, in the shallow groundwater BHRA data set, a total of two pairs of primary and field duplicate results were qualified due to PQL criterion exceedance, and no primary and field duplicate results were qualified due to RPD criterion exceedance. For laboratory duplicates, there were no data points qualified due to RPD or PQL criterion exceedance (see DVSRs tables in Appendix B). The impacts of field duplicate data qualified due to PQL criterion exceedance are discussed as follows:

- One pair of qualified field duplicate results came from the 2016 Semi-Annual Groundwater Monitoring sampling, and one pair of qualified field duplicate results came from the 2020 Annual Groundwater Monitoring sampling. However, none of these qualified field duplicate results include risk-driving chemicals; therefore, they do not have significant impacts on risk results.
- Further, all the qualified field duplicate data were well below the lowest RBTCs among different exposure scenarios, indicating low potential risks.

Therefore, the field duplicate data qualified due to PQL criterion exceedance are not expected to have a significant impact on the overall risk evaluation.

### 6.1.6 Accuracy

#### *Soil Gas*

The soil gas analytical data were evaluated in DVSRs presented in Appendix B, 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 (1,158 out of 7,731 data points, see Appendix D); 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 risk analysis was evaluated:

- J and J+ Qualified Data: A review of the J and J+ qualified data indicated that the estimated results were well below the lowest RBTCs among different exposure scenarios. In summary, correction for the bias of the J and J+ qualified data is not expected to have a significant impact on the overall risk evaluation.
- J- Qualified Data: A review of the J- qualified data indicated that only one estimated result with low bias was included in the risk calculation and it was well below the lowest RBTCs among different exposure scenarios. Therefore, correction for the low bias of the J- qualified data is not expected to have a significant impact on the overall risk evaluation.

As discussed in Table 4-1, in accordance with the most recent guidance (NDEP 2012) for evaluating data associated with blank contamination, Ramboll queried the censored (or nondetect) data for blank contamination from the project database and changed them from nondetected values at the PQLs (U qualified) to detected values at reported concentrations (J qualified) if the PQLs were higher than the reported concentrations. The revisions of censored data for blank contamination are summarized in Appendix B, Table B-2. The corrected results were well below the lowest RBTCs among different exposure scenarios, indicating the risks of these results were low. Therefore, the revisions of data associated with blank contamination to estimated detected values are not expected to have a significant impact on the overall risk evaluation.

#### *Shallow Groundwater*

The shallow groundwater analytical data were evaluated in DVSRs presented in Appendix C, 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 (475 out of 16,709 data points, see Appendix E); 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 risk analysis was evaluated:

- J and J+ Qualified Data: A review of the J and J+ qualified data indicated that the estimated results were all well below the lowest RBTCs among different exposure scenarios (Appendix C, Table C-4). Therefore, correction for the bias of the J and J+ qualified data is not expected to have a significant impact on the overall risk evaluation.
- J- Qualified Data: A review of the J- qualified data indicated that the estimated results with low bias were all below the lowest RBTCs among different exposure scenarios (Appendix C, Table C-4). Therefore, correction for the low bias of the J-

qualified data is not expected to have a significant impact on the overall risk evaluation.

### 6.1.7 Duplicate Treatment

For soil gas and shallow groundwater samples with primary and field duplicate results, the maximum detected concentrations at the same locations were conservatively used in the risk evaluation. The impacts are discussed as follows.

***Soil Gas***

As previously indicated, chloroform is the cancer risk driver in soil gas. Among the soil gas BHRA data used in the risk calculation, a total of eight pairs of field duplicate samples collected at five soil gas sample locations (RISG-5, RISG-6, RISG-68, RISG-71, and RISG-74) have an estimated excess lifetime cancer risk above $10^{-6}$ for residents or indoor commercial/industrial workers. Among these samples, RISG-6 has the highest risk for the workers scenarios for soil gas at 5 feet bgs, and the associated chloroform concentrations were 10,000 µg/$m^3$ and 11,000 µg/$m^3$ in the primary and field duplicate samples. The field duplicate samples were treated as independent samples and the highest by sample risk estimate were selected to report for each location and depth interval for each scenario. Therefore, this approach is considered conservative for estimating the health risks for soil gas at locations where field duplicate samples were collected.

***Shallow Groundwater***

Chloroform is also the cancer risk driver in shallow groundwater. Among the shallow groundwater BHRA data set used in the risk calculation, a total of five pairs of field duplicate samples collected at four shallow groundwater wells (PC-28, PC-124, PC-126, and PC-187) have estimated excess lifetime cancer risk above $10^{-6}$ for residents or indoor commercial/industrial workers. None of the cancer risk estimates for these groundwater samples are the highest for the evaluated scenarios. The field duplicate samples were treated as independent samples and the highest by sample risk estimate were selected to report for each well for the evaluated scenarios. Therefore, this approach is considered conservative for estimating the health risks for shallow groundwater wells where the field duplicate samples were collected.

## 6.2 Uncertainties Identified in the Risk Assessment

### 6.2.1 Identification of Chemicals to Include in Quantitative Risk Assessment

All VOCs detected in one or more soil gas or shallow groundwater samples in the BHRA data sets were evaluated in the quantitative risk assessment. Among the 77 soil gas analytes, 67 and 51 detected VOCs were identified for samples collected at 5 feet bgs and 10-15 feet bgs, respectively. A total of 23 out of 91 analytes were identified as detected VOCs for shallow groundwater samples. For most of the chemicals that were not quantitatively evaluated in this BHRA, the SQLs were well below 0.1 x RBTC; therefore, the exclusion of these chemicals from the quantitative risk assessment is not expected to have a significant impact on the overall results of the BHRA. It should be noted that, for a few chemicals, the SQLs were higher than 0.1 x RBTC in a few soil gas or shallow groundwater samples (see Tables 4-5 through 4-7). The impacts of elevated SQLs on the risk evaluation are discussed in Section 6.1.2.

### 6.2.2 Exposure Assessment

#### 6.2.2.1 Exposure Scenarios

The exposure assessment in this BHRA is based on an RME scenario, which is defined by 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 BHRA assumes that the residents spend every hour of every day in their homes for 26 years. The USEPA has estimated that the 50$^{th}$ percentile for years lived in the current home is 8 years, with a 90$^{th}$ percentile value of 32 years (USEPA 2011x, Table 16-90). Further, adults, and most children, do not typically spend 100% of their total daily time at home (USEPA 2011), as assumed in this BHRA. The exposure assessment for an outdoor commercial/industrial worker assumes the worker would inhale vapor migrating from soil gas or shallow groundwater to outdoor air eight hours per day, 225 days per year for 25 years. These and other upper-bound, default exposure assumptions overestimate the potential health risks associated with the OU-2 BHRA Area.

#### 6.2.2.2 EPCs

The maximum detected concentrations in soil gas and shallow groundwater at each individual sample location were multiplied by the transfer factors estimated from the fate and transport modeling to predict the air EPCs in indoor air and trench air. This approach is expected to overestimate the EPCs (and associated risks), because the maximum concentration at a single location is not likely representative for an entire exposure area (e.g., rooms within an entire building). Furthermore, this is a conservative procedure for the purposes of estimating potential health risks associated with the inhalation of vapors in a construction trench, because it is unlikely that a construction worker would stay at only a single location over an extended period of time.

As discussed in Section 5.2.2.1, for EPCs in outdoor air, the 95% UCL on the VOC concentrations over the commercial/industrial areas in the OU-2 BHRA Area were developed using the R codes provided by NDEP's consultant, Neptune. The inputs for the UCL calculations were developed by multiplying VOC concentrations in soil gas and groundwater with the medium-specific outdoor air transfer factors estimated from the fate and transport modeling. The UCLs represent the predicted air EPCs in outdoor air (unless a 95% UCL could not be calculated due to a limited number of detections, in which case the maximum detected concentrations in the commercial/industrial areas within the OU-2 BHRA Area were used). This assumption is representative of an RME estimate. The maximum model-predicted outdoor air concentrations for the VOCs at each sampling location were used as inputs to calculate the 95% UCLs to be conservative and accommodate the issue of potential temporal overweighting. In addition, the proposed soil gas and groundwater samplings were designed to focus more on the areas within the VOC plumes in the OU-2 BHRA Area; the sample density within the VOC plumes is much higher than the sample density outside the VOC plumes (i.e., more samples were collected from the areas with higher VOC concentrations than from the areas with lower VOC concentrations). Therefore, the EPCs developed using these data sets tend to overestimate the exposures and risks. It is very unlikely that an outdoor commercial/industrial worker would be exposed to VOCs in soil gas and shallow groundwater at concentrations higher than the 95% UCLs over an extended period of time. In addition, the maximum cancer risk calculated based on the

maximum model predicted outdoor chloroform concentration is 0.00047 µg/$m^3$, which is orders of magnitude below the threshold concentration of 12 µg/$m^3$. Therefore, it is not expected that using the maximum location-specific concentrations to estimate the health risks for outdoor workers would result in cancer risks higher than the NDEP and USEPA cancer risk management range of 1 x $10^{-6}$ to 1 x $10^{-4}$.

#### 6.2.2.3 Fate-and-Transport Modeling

Fate-and-transport models were used to estimate indoor, outdoor, and trench air concentrations from measured soil gas or shallow groundwater concentrations. For indoor air, the USEPA Johnson and Ettinger model spreadsheet (USEPA 2017) was used. The Johnson and Ettinger model has numerous assumptions and limitations, each of which may over- or underestimate the predicted indoor air concentration. In this BHRA, 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. Similarly, this approach also has assumptions that may over- or underestimate the predicted outdoor air concentrations.

The soil properties specific for the OU-2 BHRA Area used for the Johnson and Ettinger model (Table 5-3) were based on mean soil property measurements collected from 5 feet bgs and 10-15 feet bgs in the Qal at soil gas sample locations RISG-1 through RISG-9. Additionally, the one soil sample collected from approximately 10 feet bgs at RISG-7 was not used in our evaluation due to super saturated conditions under which soil properties were measured at that location. The assumption that the entire unsaturated zone in the OU-2 BHRA Area is Qal is conservative because for areas where the UMCf is part of the unsaturated zone, the finer-grained UMCf would act to reduce vapor transport of VOCs. If default soil properties for loamy sand recommended by USEPA (2017) were used in the evaluation, the risk results would increase by approximately a factor of one to six. Currently, the maximum estimated excess lifetime cancer risk was 2 x $10^{-5}$ and 1 x $10^{-4}$ for soil gas and shallow groundwater, respectively; and the maximum estimated noncancer HI was 0.03 for soil gas and 0.1 for shallow groundwater (Tables 5-13 and 5-17).

Soil gas data collected at approximately 5 feet bgs, 10 feet bgs, and 15 feet bgs were compared to soil gas RBTCs modeled at 5 feet, 10 feet, and 15 feet bgs, respectively. Data from one soil gas sample collected at 13 feet bgs at RISG-1 were conservatively compared to the soil gas RBTCs modeled at 10 feet bgs. The transfer factors at a shallower depth (10 feet bgs) would be higher (more conservative) than those at a deeper depth (13 feet bgs) due to shorter diffusion up through the vadose zone, resulting in slightly increased risks. Overall, the slight variation in soil gas sampling depth is not expected to have a significant impact on the overall risk results for soil gas. In addition, as shown in Appendix A, most of the soil gas samples in the OU-2 BHRA Area were collected in areas with a land cover (i.e., asphalt street) which creates a barrier between the soil and the air. The presence of a land cover tends to decrease the migration of VOCs to air and increase the amount of VOCs accumulating and remaining in the subsurface and is considered similar to the conditions when a building is present. The soil gas samples were collected near actual residential homes or commercial buildings. Therefore, the soil gas samples were collected at locations that are considered representative of the conditions for residents and indoor workers that may be exposed to VOCs migrating from soil gas to indoor air in the OU-2 BHRA Area.

Depths to groundwater used in the Johnson and Ettinger model were based on measurements for wells located in the OU-2 BHRA Area and selected to be conservative considering both current and historical data for this area. Groundwater data from wells with depth to groundwater deeper than 20 feet bgs were conservatively compared to the groundwater RBTCs modeled at 20 feet bgs, and groundwater data from wells with depth to groundwater from 10 -20 feet bgs were conservatively compared to RBTCs modeled at 10 feet bgs. Depths to groundwater in a very limited area near monitoring wells PC-161 and PC-162 were identified to be shallower than 10 feet bgs. Potential construction worker exposure to shallow groundwater is addressed in Section 6.2.4. In general, the depth assumptions used in the modeling would overestimate the exposures and health risks for the vapor intrusion pathway for shallow groundwater.

For the indoor air scenario, a conservative default residential slab-on-grade building, a residential trailer, and a commercial building (with the building characteristics shown on Table 5-4), were assumed for modeling. The default floor space area used in the modeling might be different from the actual residential or commercial buildings in the OU-2 BHRA Area. However, the size of building footprint is expected to have little impact on the modeling of transfer factors, because when the size of building footprint changes, the air flow into the building would be changed accordingly, which would offset the effects. A conservative (lower) building height of three meters was assumed for the commercial building which would result in higher transfer factors, although many commercial buildings have higher first floor ceilings.

The residential trailer scenario was modeled as a crawl space with a dirt floor using the USEPA's default assumptions as discussed in Section 5.2.2. When removing the building foundation (i.e., the barrier) it should increase the airflow into the building, making the model more conservative. However, the transport of air into the trailer is limited by diffusion through the vadose zone instead of advection. Therefore, the overall results are very similar to the modeling results with a building foundation (i.e., slab-on-grade scenario) and the impacts on the risk results are considered low.

For the outdoor air scenario, the 95% UCLs on the mean VOC concentrations in soil gas or shallow groundwater samples within commercial/industrial areas in the western portion of OU-2 were used as EPCs, which would offset the impacts of conservatively using the entire area of the chloroform groundwater plume (as defined by chloroform concentration >70 µg/L) in the OU-2 BHRA Area as the source area in the modeling. The inputs and outputs for calculating the 95% UCLs on the mean VOC concentrations in soil gas and shallow groundwater are included in Appendix H.

The vapor intrusion calculations used to predict the transfer factors for each scenario, using chloroform as an example, are provided in Appendix I-1 of this report.

When evaluating the construction trench scenario, 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. 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 10 to ensure it would be conservative for a construction trench scenario where the breathing zone may be a few feet bgs. This is especially

conservative because many construction trenches include a fan to increase air flow through the construction trench or are shallower than 10 feet, potentially increasing the breathing zone to above the ground surface.

For BioVapor modeling, the default building parameters from the Johnson and Ettinger model (USEPA 2017), instead of the default BioVapor building parameters, were used for consistency. The BioVapor model is very sensitive to the air flow through the building foundation, and the default building parameters from the Johnson and Ettinger model corresponded to a lower air flow through the building foundation, which resulted in a decreased biodegradation ratio by two to three orders of magnitude (a lower attenuation factor with biodegradation) when compared to the default BioVapor building parameters. However, since the risk contributions from benzene were extremely low when considering biodegradation (see Appendix G), the use of default building parameters from the Johnson and Ettinger model is not expected to have a significant impact on the overall risk evaluation. In addition, the biodegradation ratios for indoor air scenarios were used as the surrogates for outdoor and trench scenarios at the corresponding depths. This is a conservative approach because there is likely more oxygen and biological activities available when no slab/building is present, and higher biodegradation (lower attenuation factors with biodegradation) is expected for outdoor and trench scenarios.

In addition, the IAQ results collected in the two Target Indoor Air Sampling Areas and background sampling area in the Pittman Neighborhood were used to confirm that chloroform indoor air levels remain below the long-term, health-based threshold of 12 $\mu g/m^3$ and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements. The uncertainties associated with the IAQ sampling and results are discussed below:

- The two Target Indoor Air Sampling Areas were selected based on the residential locations where chloroform concentrations in soil gas at depths of 10 to 15 feet exceeded 4,000 $\mu g/m^3$ in the Pittman Neighborhood. Homes were selected that would be representative of the housing stock in each sampling area.

- The use of chlorine in pools or hot tubs can be an ambient source of chloroform. These ambient sources of chloroform may potentially contribute to and increase the chloroform concentrations detected in the indoor air and ambient air samples. Thus, the IAQ sampling program only selected homes that do not have an ambient source of chloroform (i.e., no pools or hot tubs) on the property or are not adjacent to such sources to minimize the influence of ambient sources of chloroform. In addition, ambient air samples were collected to assess the effect of outdoor chemical sources on indoor air concentrations. Therefore, the impact from the ambient chloroform sources is expected to be low.

- There are many indoor sources of chloroform in a residential home such as tap water in the bathroom or kitchen, household cleaning products, or solvents. These indoor sources of chloroform may potentially contribute to and increase indoor air chloroform concentrations. As part of the IAQ sampling protocol, potential indoor sources of chloroform, such as household cleaning products or solvents were identified and asked to be removed from the home. The air and vapors were field

screened for total organic vapors using a calibrated photoionization detector (PID). Pre-indoor air sampling activities and proposed sampling procedures were implemented to minimize the influence of indoor chloroform sources. Therefore, although the impact from the indoor chloroform sources may not be completely removed they are expected to be low.

Overall, the uncertainties associated with the IAQ sampling and results tend to show in indoor chloroform concentrations that are biased higher than the actual average indoor air chloroform concentrations due to vapor migration from the subsurface into a home in the residential area in the OU-2 BHRA Area. Therefore, these uncertainties are unlikely to change the conclusion that all chloroform concentrations detected in the indoor air sampling are less than the threshold concentration (12 µg/$m^3$).

### 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 the 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 BHRA 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 major cancer risk drivers with soil gas and/or shallow groundwater estimated excess lifetime cancer risks above $10^{-6}$ (i.e., chloroform) as well as for chemicals with noncancer toxicity criteria obtained from PPRTV appendices (bromochloromethane, 2-chlorotoluene, dibromomethane, dichlorodifluoromethane, n-propylbenzene, and 1,1,2-trichloroethane), followed by a discussion regarding soil gas and groundwater analytes for which surrogate criteria were used.

***Chloroform***

The IUR for chloroform is obtained from IRIS based primarily on a mouse gavage study (USEPA 2020c). 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. In summary, the

uncertainty associated with the IUR for chloroform is not expected to have a significant impact on the overall risk evaluation.

***Bromochloromethane***

The inhalation chronic RfC for bromochloromethane is a screening toxicity value taken from an appendix of a PPRTV assessment based on an inhalation subchronic study of rats (USEPA 2009b). Chronic inhalation toxicity testing of bromochloromethane has not been conducted. The critical effect considered in the derivation of the inhalation chronic RfC is increased relative liver weight in rats. USEPA applied a large composite uncertainty factor of 10,000 to the lowest-observed-adverse-effect level (LOAEL) to account for interspecies extrapolation, intraspecies differences for extrapolation to sensitive humans, database uncertainty (the key study is very old and incompletely reported; there are no developmental or reproductive toxicity data), the use of a LOAEL as the point of departure and using data from a subchronic study to assess chronic exposures. USEPA concluded that due to lack of chronic toxicity testing and large uncertainties associated with the subchronic studies, derivation of a provisional chronic RfC for bromochloromethane is not feasible, and there are considerably more uncertainties associated with the appendix screening chronic RfC. Bromochloromethane was not detected in soil gas (Appendix D) or shallow groundwater (Table 5-1); therefore, it did not contribute to any risks. As indicated in Table 4-6, the maximum SQL of bromochloromethane was well below 0.1 x RBTC. In summary, the uncertainty associated with the inhalation chronic RfC for bromochloromethane is not expected to have a significant impact on the overall risk evaluation.

***2-Chlorotoluene***

The inhalation subchronic RfC for 2-chlorotoluene is a screening toxicity value taken from an appendix of a PPRTV assessment based primarily on a rat developmental study (USEPA 2010a). The critical effects considered in the derivation of the subchronic RfC were slight ataxia (coordination issues), decreased body-weight gains and food consumption, and increased water consumption. USEPA applied a composite uncertainty factor of 300 to the no-observed-adverse-effect level (NOAEL) to account for animal to human extrapolation, intraspecies differences for potentially susceptible individuals, and database uncertainty (no acceptable two-generation reproduction or neurotoxicity studies). USEPA concluded that insufficient data were available to derive provisional toxicity values for 2-chlorotoluene, and there is considerably more uncertainty associated with the appendix screening subchronic RfC. Additionally, a screening chronic RfC was not derived due to the short duration of developmental studies (14−23 days) and lack of longer-term studies to detect more sensitive respiratory or systemic effects. The inhalation chronic RfC for chlorobenzene was used as a surrogate for 2-chlorotoluene. As indicated in Appendix G, 2-chlorotoluene was not a driver for noncancer HI for any receptor population in the OU-2 BHRA Area. Therefore, the uncertainty associated with the inhalation subchronic RfC for 2-chlorotoluene is not expected to have a significant impact on the overall risk evaluation.

***Dibromomethane***

The inhalation chronic and subchronic RfC values for dibromomethane are screening toxicity values taken from an appendix of a PPRTV assessment based on an unpublished subchronic inhalation study in rats and dogs (USEPA 2009c). This study is the only adequate evaluation on the inhalation toxicity of dibromomethane; no chronic inhalation toxicity studies were located. The critical effect considered in the derivation of the RfCs is increased

blood carboxyhemoglobin levels in rats, which was the only effect observed in the study. Benchmark dose modeling was conducted to derive a lower bound benchmark human equivalent concentration used as a point of departure. To derive the screening subchronic RfC, USEPA applied a composite uncertainty factor of 300 to the point of departure to account for interspecies extrapolation, protection of sensitive human subpopulations, and database deficiencies (no developmental or reproductive toxicity studies); for the screening chronic RfC, an additional uncertainty factor of 10 was also applied to account for using a subchronic study to approximate chronic exposures. USEPA concluded that insufficient data were available to derive provisional toxicity values for dibromomethane, and there is considerably more uncertainty associated with the appendix screening RfC values. Dibromomethane was not detected in soil gas (Appendix D) or shallow groundwater (Table 5-1); therefore, it did not contribute to any risks. As indicated in Table 4-6, the maximum SQL of dibromomethane was well below 0.1 x RBTC. In summary, the uncertainty associated with the inhalation chronic RfC for dibromomethane is not expected to have a significant impact on the overall risk evaluation.

***Dichlorodifluoromethane***

The inhalation chronic RfC for dichlorodifluoromethane is a screening toxicity value taken from an appendix of a PPRTV assessment based on a six-week intermittent inhalation study in guinea pigs, rabbits, dogs, and monkeys (USEPA 2010b). No chronic inhalation studies have been conducted. There are a few existing subchronic human inhalation studies, but they all have significant limitations. The only chronic inhalation toxicity studies available are two experiments in rats and mice, designed as cancer bioassays, and there are no dose-response data available for non-tumor related effects in animals following chronic inhalation exposure. The critical effect considered in the derivation of the inhalation chronic RfC is reduced body-weight gain. USEPA applied a composite uncertainty factor of 10,000 to the LOAEL to account for interspecies extrapolation, intraspecies differences for potentially susceptible individuals, extrapolation from a LOAEL to a NOAEL, using data from a subchronic study to assess chronic exposures, and database inadequacies (i.e., limited reproductive and developmental toxicity studies via the inhalation route). USEPA concluded that insufficient data were available to derive a provisional chronic toxicity value for dichlorodifluoromethane, and there is considerably more uncertainty associated with the appendix screening chronic RfC. As indicated in Appendix G, dichlorodifluoromethane was not a driver for noncancer HI for any receptor population in the OU-2 BHRA Area. Therefore, the uncertainty associated with the inhalation chronic RfC for dichlorodifluoromethane is not expected to have a significant impact on the overall risk evaluation.

***n-Propylbenzene***

The inhalation chronic and subchronic RfC values for n-propylbenzene are screening toxicity values taken from an appendix of a PPRTV assessment based on using ethylbenzene as a surrogate (USEPA 2009d). The ototoxicity of ethylbenzene in a subchronic study of rats was shown to be qualitatively similar to that shown by n-propylbenzene following short-term oral exposure; therefore, the resulting assumption is that inhalation exposures of the two compounds would likely have similar results. The chronic RfC for ethylbenzene from IRIS is based on developmental toxicity studies in rats and rabbits, and because of this, the same value is recommended as a screening subchronic RfC. In deriving the screening chronic and subchronic RfCs, USEPA applied a composite uncertainty factor of 300 to the NOAEL to

account for intra- and interspecies extrapolation and database deficiencies (lack of multigenerational reproductive and chronic studies). USEPA concluded that insufficient data were available to derive provisional toxicity values for n-propylbenzene, and there is considerably more uncertainty associated with the appendix screening RfC values. As indicated in Appendix G, n-propylbenzene was not a driver for noncancer HI for any receptor population in the OU-2 BHRA Area. Therefore, the uncertainty associated with the inhalation chronic and subchronic RfCs for n-propylbenzene is not expected to have a significant impact on the overall risk evaluation.

### *1,1,2-Trichloroethane*

The inhalation chronic and subchronic RfC values for 1,1,2-trichloroethane are screening toxicity values taken from an appendix of a PPRTV assessment based on a subchronic inhalation study with rats. The inhalation chronic RfC for 1,1,2-trichloroethane is a screening toxicity value taken from an appendix of a PPRTV assessment based on an inhalation subchronic study of rats (USEPA 2009b). Chronic inhalation toxicity testing of 1,1,2-trichloroethane has not been conducted. The critical effect considered in the derivation of the inhalation chronic RfC is increased relative liver weight in rats. USEPA applied a large composite uncertainty factor of 10,000 to the LOAEL to account for interspecies extrapolation, intraspecies differences for extrapolation to sensitive humans, database uncertainty (the key study is very old and incompletely reported; there are no developmental or reproductive toxicity data), the use of a LOAEL as the point of departure and using data from a subchronic study to assess chronic exposures. USEPA concluded that due to lack of chronic toxicity testing and large uncertainties associated with the subchronic studies, derivation of a provisional chronic RfC for 1,1,2-trichloroethane is not feasible, and there are considerably more uncertainties associated with the appendix screening chronic RfC. 1,1,2-Trichloroethane was not detected in soil gas (Appendix D) or shallow groundwater (Table 5-1); therefore, it did not contribute to any risks. As indicated in Table 4-6, the maximum SQL of 1,1,2-trichloroethane was well below 0.1 x RBTC. In summary, the uncertainty associated with the inhalation chronic RfC for 1,1,2-trichloroethane is not expected to have a significant impact on the overall risk evaluation.

### *Surrogate Criteria*

As identified in Table 5-8, 68 of the 87 VOCs analyzed for the soil gas and shallow groundwater samples included in BHRA data sets have toxicity values and 19 VOCs used surrogate toxicity criteria (i.e., inhalation RfC). Of these chemicals, 11 surrogates are those identified by NDEP (2023b). Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane) was specified as a surrogate for Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane) in *NDEP Response to Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation* (NDEP 2010d). The surrogates used for the seven remaining analytes are as follows:

| Analyte | Surrogate |
|---|---|
| tert-Amyl methyl ether | Methyl tert butyl ether |
| 4-Chlorotoluene | Chlorobenzene |
| 2,2-Dichloropropane | 1,2-Dichloropropane |
| 1,1-Dichloropropene | 1,3-Dichloropropene |
| Ethyl tert-butyl ether | Methyl tert butyl ether |
| n-Octane | n-Nonane |
| 1,2,3-Trichlorobenzene | 1,2,4-Trichlorobenzene |

Among the 19 analytes using surrogate RfCs, 17 analytes were detected in the soil gas and/or shallow groundwater BHRA data sets. Depending on how similar the surrogate is to the analyte, the use of surrogate RfCs for evaluating soil gas and groundwater VOCs may introduce uncertainties and either overestimate or underestimate the potential for noncancer health effects. However, recognizing the very low noncancer HQs estimated for these VOCs (less than 0.002), use of surrogate RfCs is not expected to have a significant impact on the noncancer hazard evaluation or conclusions.

### 6.2.4 Risk Characterization

Because the risk characterization combines the site characterization, selection of chemicals quantitatively evaluated, exposure assumptions and toxicity assessment, the uncertainties and conservativeness discussed above are carried over into the risk characterization. In addition, risks cannot be quantitatively characterized for chemicals for which toxicity criteria have not been established. In this BHRA, potential health risks were quantified for current and future residents and workers in the OU-2 BHRA Area associated with inhalation of soil gas and shallow groundwater vapor migrating to indoor, outdoor, and trench air. Given the highly conservative nature of the exposure parameters used to characterize these pathways in this BHRA, 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. Because of all the conservative assumptions build into each component of the risk assessment to address uncertainty, this methodology is believed to not underestimate the true risk but likely 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 is 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. In this BHRA, risk assessments of chemical mixtures summed cancer risks regardless of tumor type, and summed 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.

For four soil gas and shallow groundwater VOCs (dibromochloromethane, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and trichlorofluoromethane, all of which are noncarcinogens), inhalation chronic RfCs are not available. Also, an inhalation subchronic RfC is not available for dibromochloromethane. In the absence of toxicity values, these VOCs were not evaluated quantitatively for the corresponding noncancer effects in the BHRA. The impacts of these VOCs on the overall risk estimates were evaluated using the RfCs developed by Cal/EPA (2019), which are derived based on route-to-route extrapolation from oral reference dose (RfD) values developed by the IRIS assuming an inhalation rate of 20 $m^3$ per day and a body weight of 70 kilograms. Use of the Cal/EPA RfCs would result in very low noncancer HQs estimated for these VOCs (less than 0.001). Therefore, the exclusion of these VOCs from quantitative risk assessment is not expected to have a significant impact on the risk estimates or overall conclusions of the BHRA.

Depths to groundwater in a very limited area near monitoring wells PC-161 and PC-162 were identified to be shallower than 10 feet bgs. Potential exposures through direct contact with groundwater may occur during construction excavation activities in this area. Due to limited numbers of monitoring wells with depth to groundwater shallower than 10 feet bgs in the OU-2 BHRA Area and the relatively low concentrations detected at these two wells, the health risks associated with this pathway were not quantitatively evaluated in the BHRA. The groundwater data collected between 2015 and 2020 from these two wells were evaluated using a semi-quantitative approach.

As shown in Table K-1 in Appendix K, to semi-quantitatively evaluate the potential exposure through groundwater direct contact for the construction workers during excavation activities at areas near monitoring wells PC-161 and PC-162, the maximum detected concentrations for all chemicals analyzed at these two wells were compared to groundwater screening levels developed for the construction workers. The groundwater screening levels for the construction workers were calculated based on maximum contaminant levels (MCLs), maximum contaminant level goals (MCLGs) (40 CFR Part 141), BCLs or RSLs for tap water

for each detected chemical at these two wells and the ratio of the intake factors for the drinking water pathway and incidental groundwater ingestion pathway for the construction worker (see additional details in Tables K-1 and K-2). As discussed in Section 5.2, for the construction workers, exposure assumptions recommended by USEPA (2023b) were used, except that a utility trench scenario was evaluated assuming that the construction workers could be in a 10-foot construction trench when conducting excavation activities for 4 hours per day, 5 days per year for one year given the area with depth to groundwater shallower than 10 feet is fairly limited in the OU-2 BHRA Area. The rate of incidental ingestion of groundwater for a construction worker in a utility trench was assumed to be 0.02 L/day per the recommendation of the NDEP (NDEP 2017) to use the assumptions for construction trench scenario from Virginia Department of Environmental Quality (VDEQ) [VDEQ 2023]) (see Table K-2). As shown in Table K-1, the maximum detected concentrations for chemicals detected at PC-161 and PC-162 are well below their respective construction worker groundwater screening levels. Health risks through dermal contact are normally much lower than health risks through ingestion. Therefore, based on the screening results of this analysis, significant health risks are not expected to occur through the groundwater direct contact pathway for the construction workers in this area.

In addition, there are four soil gas[35] and 14 shallow groundwater sample locations[36] located just north of Sunset Road (Figure 4-1). These locations are located within a commercial area and therefore were evaluated under the commercial/industrial scenarios in the risk analysis of this BHRA. These sample locations are located just across Sunset Road which borders the Pittman neighborhood to the north. Due to the proximity of these locations to the residential area, a sensitivity analysis was conducted to conservatively evaluate samples collected at these locations under the residential slab-on-grade building scenario to assess uncertainties associated with evaluating these locations under the commercial/industrial scenario in the risk analysis. Under a residential slab-on-grade building scenario (instead of an indoor commercial/industrial worker scenario), estimated total excess lifetime cancer risks for soil gas at these locations ranged from $6 \times 10^{-7}$ to $2 \times 10^{-5}$ and $2 \times 10^{-7}$ to $8 \times 10^{-6}$ for 5 feet bgs and 10-15 feet bgs, respectively. Noncancer HI estimates ranged from 0.008 to 0.1 and 0.01 to 0.2 for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. Shallow groundwater cancer risks ranged from $3 \times 10^{-8}$ to $4 \times 10^{-5}$ and noncancer HI ranged from 0.0004 to 0.06. When conservatively applying an indoor air residential slab-on-grade scenario for these commercial locations near the residential area, though the estimated cancer risk and non-cancer HI results would be higher than the ones for the indoor commercial/industrial worker scenario, the cancer risk estimates were still within the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and noncancer HI estimates were well below the NDEP and USEPA target HI of greater than one at these locations. Therefore, evaluating these sample locations under the commercial/industrial scenario is not expected to change the conclusions of this BHRA.

In summary, assumptions used in each step of risk assessment contribute to the overall uncertainty in the BHRA results. However, given that the largest sources of uncertainty generally cause overestimates of exposure or risk, the results presented in this BHRA are considered to represent conservative estimates of the carcinogenic and noncarcinogenic

[35] RISG-2, RISG-30, RISG-55, and RISG-56 for soil gas.
[36] PC-24, PC-50, PC-124, PC-125, PC-126, PC-127, PC-128, PC-129, PC-130, PC-131, PC-132, PC-153, PC-153R, PC-194

risks, if any, posed by VOCs in soil gas and shallow groundwater in the OU-2 BHRA Area through the vapor intrusion pathway.

# 7. DATA QUALITY ASSESSMENT

Data quality assessment is an analysis that is performed after the risk assessment is completed to determine whether enough data has been collected to support the risk-based decisions that are recommended by the risk assessment. The results of the data quality assessment for soil gas and groundwater data are discussed below.

## 7.1 Soil Gas Data

For soil gas, the evaluations of the residential slab-on-grade building, residential trailer, indoor commercial/industrial worker, and construction worker scenarios were based on the maximum total excess lifetime cancer risk estimates, while the evaluation of the outdoor commercial/industrial worker scenario was based on excess lifetime cancer risk estimates using the 95% UCLs of model-predicted VOC concentrations migrating from soil gas.

### 7.1.1 Exposure Scenario using Maximum Detected Concentrations

For the residential (for both slab-on-grade and trailer scenarios), indoor commercial/industrial worker, and construction worker scenarios, the evaluation of the risk of vapor intrusion was based on maximum risks at soil gas sample locations for each scenario, 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 sample results that are associated with an unacceptable risk of vapor intrusion. The soil gas data quality assessment for the residential, indoor commercial/industrial worker, and construction worker scenarios are summarized in Table 7-1.

As summarized in Table 5-13, the maximum excess lifetime cancer risk estimates for each exposed population are all below the upper limit of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and the noncancer HI does not exceed the NDEP and USEPA target HI of greater than 1. Because the estimated risks and hazards at all sample locations did not exceed their respective thresholds, the proportion of samples with unacceptable risk is 0 out of the total number of samples for the scenario, or 0%. The total number of 5 feet bgs and 10-15 feet bgs soil gas samples evaluated in this BHRA for the residential slab-on-grade building, residential trailer, indoor commercial/industrial worker, and construction worker scenarios are summarized in Table 7-1.

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 ($\alpha$) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on the false acceptance rate ($\beta$), p1, and p2. The number of samples required for $\beta$ at 15%, 20% to 25% was tested for all scenarios in Table 7-1.

As a starting point, an effect size of one over the sample size was considered, which would be equivalent to one sample having an 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 numbers of samples required are larger than the corresponding sample sizes for the residential slab-on-grade building, indoor commercial/industrial worker, and construction worker scenarios with an effect size of one over the sample size and β equal to or smaller than 25%, and the residential trailer scenario with an effect size of one over the sample size and β equal to or smaller than 20%. For the above scenarios, the null hypothesis that no soil gas samples would have unacceptable risk is rejected, meaning no sample having unacceptable risk within the current sample size cannot guarantee that all samples would have unacceptable risk. For the residential trailer scenario with an effect size of one over the sample size and β equal to 25%, the number of samples required is the same as the number of samples evaluated. For this scenario, the null hypothesis that no soil gas samples would have unacceptable risk is not rejected. Therefore, the current sample size is sufficient to guarantee that no sample location over the entire OU-2 BHRA Area would have an unacceptable risk.

For the scenarios where the null hypothesis is rejected with an effect size of one sample over the total number of samples, an effect size of two over the sample size 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. The test using an effect size of two cannot be conducted for the residential trailer scenario because there is a limited sample size of two. As shown in Table 7-1, the number of samples required is smaller than the corresponding sample size with an effect size of two samples over the sample size and β equal to or smaller than 25% for the residential slab-on-grade building, indoor commercial/industrial worker, and construction worker scenarios, meaning 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, the current sample size is sufficient to guarantee that no more than one sample location over the entire OU-2 BHRA Area would have an unacceptable risk.

### 7.1.2 Exposure Scenario using 95% UCL

For the outdoor commercial/industrial worker scenario, the evaluation of the cancer risk or HI was based on the 95% UCL of the soil gas concentrations from commercial area soil gas samples, which is a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was based on a statistical test of comparing the estimated excess lifetime cancer risk (or HI) based on 95% UCLs of soil gas results with the target cancer risk (or target HI). The soil gas data quality assessment for the outdoor commercial/industrial worker scenario is summarized in Table 7-2.

In a hypothesis testing framework, a t-test can be used to evaluate the possibility that the mean of total cancer risk or HI is greater than or smaller than the target cancer risk or the target HI. The null hypothesis is that the mean of the total cancer risk or the HI is the same as the cancer risk or the target HI based on the 95% UCL of sample results ($Mean_0$). The alternative hypothesis is that the mean of the total cancer risk or the HI is greater than the target cancer risk or the target HI ($Mean_1$) if $Mean_1$ is greater than $Mean_0$, or the mean of

the total cancer risk or the HI is smaller than the target cancer risk or the target HI ($Mean_1$) if $Mean_1$ is smaller than $Mean_0$.

The target cancer risk for an outdoor worker is set as $1 \times 10^{-6}$, the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The target HI for an outdoor worker is 1. As shown in Tables G-3 and G-4, the total cancer risks and HIs are all significantly lower than the corresponding target cancer risk and HI. Chloroform was detected at all samples and was the only major cancer risk driver and HI driver for outdoor worker scenarios based on Tables G-3 and G-4. The number of 5 feet bgs and 10-15 feet bgs soil gas samples for the outdoor worker scenario are 35 and 23, respectively, which are summarized in Table 7-2. The sample size of the chemical as the cancer risk or HI driver for the outdoor worker scenario was tested to evaluate if a sufficient number of samples were collected using the t-tests – "Means: difference from constant (one sample case) test" in the software program G*Power version 3.1.9 (Faul et al. 2009).

In the BHRA, the number of samples required to support the risk assessment depends on the false rejection error rate (α), false acceptance rate (β), mean of sample risk ($Mean_0$), mean of target risk/HI ($Mean_1$), and standard deviation of risk/HQ (SD) in a scenario. A value of 5% was used for both α and β. $Mean_0$ is defined as the total risk or HI based on the 95% UCL of sample results for each corresponding scenario. SD is the standard deviation of total risk/HQ, which is simplified to be the standard deviation of risk/HQ based on the 95% UCL of the risk driver. In the G*Power program, the target risk ($Mean_1$) is set to $1.49 \times 10^{-4}$ which is rounded to $1 \times 10^{-4}$ for cancer risk, and the target HI ($Mean_0$) is set to 1.49 which is rounded to 1 for noncancer HI.

As shown in Table 7-2, the number of soil gas samples required to support risk assessment for each depth interval evaluated for the outdoor worker scenario is smaller than the corresponding sample size. With α and β equal to 5%, the null hypothesis that the mean of the total cancer risk or the noncancer HI is the same as the total risk or HI is not rejected, and the alternative hypothesis is rejected. Since the cancer risk and noncancer HIs based on the 95% UCL of sample results were below the target thresholds, the mean of the cancer risk or the noncancer HI are also expected to be below the target thresholds. Based on this analysis, the number of soil gas samples collected is sufficient for the purpose of risk characterization.

## 7.2 Groundwater Data

### 7.2.1 Exposure Scenario using Maximum Detected Concentrations

For the residential (for both slab-on-grade and trailer scenarios), indoor commercial/industrial worker, and construction worker scenarios, the evaluation of the risk of vapor intrusion was based on maximum risks at groundwater sample locations for each scenario, 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 sample results that are associated with an unacceptable risk of vapor intrusion. The groundwater data quality assessment for the residential, indoor commercial/industrial worker and construction worker scenarios are summarized in Table 7-3.

As summarized in Table 5-17, the maximum excess lifetime cancer risk estimates for each exposed population are all below the upper limit of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and the noncancer hazard does not exceed the NDEP and USEPA target HI of greater than 1. Because the estimated risks and hazards at all sample locations did not exceed their respective thresholds, the proportion of samples with unacceptable risk is 0 out of the total number of samples for the scenario, or 0%. The total numbers of samples are summarized in Table 7-3. The numbers of shallow groundwater samples are 69, 4, 241, and 310 for the slab-on-grade residential, trailer residential, indoor worker, and construction worker, respectively.

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 ($\alpha$) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on the false acceptance rate ($\beta$), p1, and p2. The number of samples required for $\beta$ at 15%, 20% to 25% was tested for all scenarios in Table 7-3.

As a starting point, an effect size of one over the sample size was considered, which would be equivalent to one sample having an 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 7-3, the numbers of samples required are larger than the corresponding sample sizes for the slab-on-grade residential, indoor worker, and construction worker scenarios with an effect size of one over the sample size and $\beta$ equal to or smaller than 25%, and the trailer residential scenario with an effect size of one over the sample size and $\beta$ equal to or smaller than 20%. For the above scenarios, the null hypothesis that no groundwater samples would have unacceptable risk is rejected, meaning no sample having unacceptable risk within the current sample size cannot guarantee that all samples would have unacceptable risk. For the trailer residential scenario with an effect size of one over the sample size and $\beta$ equal to 25%, the numbers of samples required are the same as the numbers of samples evaluated. For this scenario, the null hypothesis that no groundwater samples would have unacceptable risk is not rejected, meaning no sample having unacceptable risk within the current sample size can guarantee that no sample would have unacceptable risk.

For the scenarios where the null hypothesis is rejected with an effect size of one sample over the total number of samples, an effect size of two over the sample size 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. The test using an effect size of two cannot be conducted for the trailer residential scenario because there is a limited sample size of two. As shown in Table 7-3, the number of samples required are smaller than the

corresponding sample size with an effect size of two samples over the sample size and β equal to or smaller than 25% for the slab-on-grade residential, indoor worker, and construction worker scenarios, meaning 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, the current sample size is sufficient to guarantee that no more than one sample location over the entire OU-2 BHRA Area would have an unacceptable risk.

### 7.2.2 Exposed Scenario using 95% UCL

For the outdoor commercial/industrial worker scenario, the evaluation of the cancer risk or HI was based on the 95% UCL of the groundwater concentrations from commercial area groundwater samples, which is a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was based on a statistical test of comparing the estimated excess lifetime cancer risk (or HI) based on 95% UCLs of groundwater results with the target cancer risk (or target noncancer HI). The groundwater data quality assessment for the outdoor commercial/industrial worker scenario is summarized in Table 7-4.

In a hypothesis testing framework, a t-test can be used to evaluate the possibility that the mean of total cancer risk or HI is greater than or smaller than the target cancer risk or the target noncancer HI. The null hypothesis is that the mean of the total cancer risk or the HI is the same as the cancer risk or the target noncancer HI based on the 95% UCL of sample results ($Mean_0$). The alternative hypothesis is that the mean of the total cancer risk or the noncancer HI is greater than the target cancer risk or the target noncancer HI ($Mean_1$) if $Mean_1$ is greater than $Mean_0$, or the mean of the total cancer risk or the noncancer HI is smaller than the target cancer risk or the target HI ($Mean_1$) if $Mean_1$ is smaller than $Mean_0$.

The target cancer risk for an outdoor worker is set as $1 \times 10^{-6}$, the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The target HI for an outdoor worker is 1. As shown in Table G-12, the total cancer risks and HIs are all significantly lower than the corresponding target cancer risk and target HI. Chloroform was detected in all samples and was the only major cancer risk driver and noncancer HI driver for outdoor worker scenarios based on Table G-12. The number of groundwater samples for the outdoor worker scenario is 241, which is summarized in Table 7-4. The sample size of the chemical as the cancer risk or noncancer HI driver for the outdoor worker scenario was tested to evaluate if a sufficient number of samples were collected using the t-tests – "Means: difference from constant (one sample case) test" in the software program G*Power version 3.1.9 (Faul et al. 2009).

In the BHRA, the number of samples required to support the risk assessment depends on the false rejection error rate (α), false acceptance rate (β), mean of sample risk ($Mean_0$), mean of target risk/HI ($Mean_1$), and standard deviation of risk/HQ (SD) in a scenario. A value of 5% was used for both α and β. $Mean_0$ is defined as the total risk or HI based on the 95% UCL of sample results for each corresponding scenario. SD is the standard deviation of total risk/HQ, which is simplified to be the standard deviation of risk/HQ based on the 95% UCL of the risk driver. In the G*Power program, the target risk ($Mean_1$) is set to $1.49 \times 10^{-4}$ which is rounded to $1\times 10^{-4}$ for cancer risk, and the target HI ($Mean_0$) is set to 1.49 which is rounded to 1 for noncancer risk.

As shown in Table 7-4, the number of groundwater samples required to support risk assessment for the outdoor worker scenario is smaller than the corresponding sample size. With α and β equal to 5%, the null hypothesis that the mean of the total cancer risk or the noncancer HI is the same as the total risk or HI is not rejected, and the alternative hypothesis is rejected. Since the cancer risk and noncancer HIs based on the 95% UCL of sample results were below the target thresholds, the mean of the cancer risk or the noncancer HI are also expected to be below the target thresholds. Based on this analysis, the number of groundwater samples collected is sufficient for the purpose of risk characterization.

# 8. SUMMARY AND CONCLUSIONS

The BHRA was conducted to evaluate potential health risks to current and future residents and workers from exposures to residual levels of VOCs released from soil gas and groundwater to indoor, outdoor, and trench air in the OU-2 BHRA Area, which was previously defined to be the NERT Off-Site Study Area component of OU-2 located west of Pabco Road. This BHRA report has been prepared according to the methodology described in the BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Revision 1 (Ramboll 2018a), submitted to the NDEP on December 18, 2018 and approved by NDEP on January 24, 2019.[37]

The initial BHRA Report for OU-2 Soil Gas and Groundwater was submitted to NDEP on July 23, 2021 (Ramboll 2021a), and NDEP comments were received on October 13, 2022. As requested by NDEP, this version was prepared to address NDEP comments and to incorporate the data collected during the IAQ investigation as summarized in the OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum submitted to NDEP on August 29, 2022 (Ramboll 2022a). The purpose of the IAQ investigation was to confirm that chloroform indoor air levels remain below a long-term, health-based threshold of 12 $\mu g/m^3$ and to allow direct comparisons between modeled indoor air estimates and direct indoor air measurements. The revised BHRA includes spatial plots consistent with Neptune's draft technical memorandum "NERT Spatial Plot Recommendations" dated February 18, 2022 (Neptune 2022).

Subsequent to the initial version of the BHRA submitted in 2021, NDEP released updated BCL tables (NDEP 2020a, 2023a) and User's Guide and Background Technical Documents (NDEP 2020b, 2023b), with the latest updates issued in June 2023. 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 USEPA updated toxicity values in the recent RSL tables released in May 2023 (USEPA 2023a). The relevant updates from NDEP and USEPA as described above have been incorporated into this BHRA Report.

Consistent with agency guidance from USEPA (2015), soil gas data collected within the OU-2 BHRA Area since 2008 were used to evaluate potential exposure for current and future residents and workers via inhalation of vapors migrating from the subsurface to indoor air, outdoor air, and trench air. The soil gas data used in this BHRA were specifically collected to evaluate the vapor intrusion pathway. Soil gas data is the preferred 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 BHRA 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 the consistency between soil gas and groundwater results.

[37] A separate BHRA report for OU-1 soil gas and groundwater was submitted on September 29, 2021 (Ramboll 2021b) and is currently being revised to address the NDEP comments.

Analytical results of soil gas and shallow groundwater samples collected within the OU-2 BHRA Area were assessed through the data processing and DUE steps (see Section 4.1), and data representative of current conditions were selected for purposes of the BHRA. The VOCs selected for evaluation, the CSM and the estimated excess lifetime cancer risks and chronic HIs are summarized as follows:

- All VOCs detected in one or more soil gas or shallow groundwater samples in the BHRA data sets were evaluated in the risk assessment. As summarized in Table 5-1, a total of 71 VOCs were detected in soil gas and a total of 23 VOCs were detected in shallow groundwater.
- Based on the CSM for the OU-2 BHRA Area, potential exposure to soil gas and shallow groundwater was evaluated for residents, indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers via inhalation of vapors migrating from soil gas and shallow groundwater to indoor air, outdoor air, and trench air. In addition, a trailer scenario was evaluated for residents living in residential trailers in a limited area in the OU-2 BHRA Area. To be conservative, construction workers were assumed to be exposed to vapors migrating from soil gas/shallow groundwater while standing in a 10-foot trench in the unsaturated zone, placing them closer to the potential sources.
- Excess lifetime cancer risks and noncancer HIs associated with inhalation of vapors migrating from soil gas and shallow groundwater were estimated for detected VOCs in soil gas and shallow groundwater for each sample for indoor air and trench air scenarios, and based on the 95% UCLs on the mean concentrations over the entire OU-2 BHRA Area (or the maximum outdoor air concentrations predicted over the entire OU-2 BHRA Area if 95% UCLs could not be calculated due to limited detections or higher than the maximum outdoor concentrations) for outdoor air scenarios. The risk results based on the soil gas data evaluation are presented in Table 5-13 and summarized below.
- For the residential slab-on-grade scenario, the estimated excess lifetime cancer risk ranged from $6 \times 10^{-8}$ to $2 \times 10^{-5}$ and $2 \times 10^{-7}$ to $2 \times 10^{-5}$ for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. As shown in Figures 5-2 and 5-3, the highest risk estimates for both depth intervals correspond to sample location RISG-1. For the residential trailer scenario, the estimated excess lifetime cancer risks ranged from $5 \times 10^{-7}$ to $1 \times 10^{-5}$ and $3 \times 10^{-7}$ to $7 \times 10^{-6}$ for soil gas at 5 feet bgs and 10-15 feet bgs, respectively. As shown in Figures 5-2 and 5-3, the highest risk estimates at both depth intervals correspond to sample location RISG-77. All of these excess lifetime cancer risk estimates are within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cancer risk driver for the soil gas samples was chloroform, contributing to over 97% of the total cancer risk for the location with the highest estimated cancer risks for residents.
- As shown in Figures 5-2 and 5-3, soil gas sample locations with cancer risks above $10^{-6}$ and less than $10^{-4}$ for residential indoor air scenarios were located over the area of higher chloroform concentrations in groundwater in the residential area in the OU-2 BHRA Area.
- For indoor commercial/industrial workers, the estimated excess lifetime cancer risks ranged from $5 \times 10^{-9}$ to $3 \times 10^{-6}$ and $4 \times 10^{-9}$ to $2 \times 10^{-6}$ for soil gas at 5 feet bgs and

10-15 feet bgs, respectively. As shown in Figures 5-4 and 5-5, the highest risk estimates correspond to sample location RISG-6. However, all of these excess lifetime cancer risk estimates were within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cancer risk driver for the soil gas samples was chloroform, contributing to over 99% of the total cancer risk at the location with the highest estimated cancer risk for indoor commercial/industrial workers. As shown in Figures 5-4 and 5-5, soil gas sample locations with cancer risks above $10^{-6}$ for commercial/industrial indoor air scenarios were located over the area of higher chloroform concentrations in groundwater in the commercial/industrial area in the OU-2 BHRA Area.

- The estimated excess lifetime cancer risks for outdoor commercial/industrial workers and construction workers exposed to soil gas at 5 feet bgs and at 10-15 feet bgs were below the lower end of the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$.
- The estimated total noncancer His for all the soil gas scenarios were below the NDEP and USEPA target HI of greater than one.

As discussed above, this BHRA 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 the consistency between soil gas and groundwater results. Groundwater results for VOCs from shallow monitoring wells (with top of well screens less than 60 feet bgs) collected from 2015 to 2020 within the OU-2 BHRA Area were included in this BHRA analysis. Similar to soil gas, the estimated excess lifetime cancer risks for vapor intrusion from shallow groundwater fell within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and chloroform was the primary chemical contributor to the estimated total cancer risk. All estimated total noncancer HIs for all the groundwater scenarios were below the NDEP and USEPA target HI of greater than one. Because of all the conservative assumptions built into each component of the risk assessment, the results presented in this BHRA are considered to represent conservative estimates of the carcinogenic and noncarcinogenic risks, if any, posed by VOCs in soil gas and shallow groundwater in the OU-2 BHRA Area through the vapor intrusion pathway.

The spatial distribution of locations with cancer risk above $10^{-6}$ for shallow groundwater is also generally consistent with those for soil gas in the OU-2 BHRA Area. The soil gas location with the highest cancer risk estimates (i.e., RISG-1 in the residential area) is co-located with the shallow groundwater well with the highest residential cancer risk estimate (i.e., PC-67). The soil gas location with the highest cancer risk estimates for indoor commercial/industrial workers (i.e., RISG-6 in the commercial area) is also co-located with a shallow groundwater well that is among the wells with the highest cancer risk estimate (i.e., PC-122). The results and conclusions of the groundwater risk evaluation are generally consistent with the results and conclusions of the soil gas risk evaluations for the OU-2 BHRA Area, supporting the OU-2 CSM developed in the RI Report for OU-1 and OU-2 (Ramboll 2023) which identified that chloroform in groundwater is the main source of chloroform detected in soil gas in this area. The highest cancer risk estimates occur at locations where the highest chloroform concentrations were detected in groundwater within

the OU-2 BHRA Area and are located generally downgradient of the upgradient sources (i.e., TIMET, OU-1, and OSSM).

Exposure via domestic use of groundwater was not evaluated because groundwater is not currently used as a domestic water supply and is not anticipated to be used as a domestic water supply given the high concentrations of total dissolved solids (TDS) in shallow groundwater in the OU-2 BHRA area. Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities is possible in very limited areas near PC-161 and PC-162 where the depth to groundwater is less than 10 feet bgs. Due to the limited number of monitoring wells and the low concentrations detected at these wells, significant health risks during short-term construction activities are not expected to occur through the groundwater direct contact pathway in this area. This potential pathway is discussed as part of the uncertainty analysis of this BHRA.

In addition, the IAQ data collected in the indoor air sampling program conducted in the eastern portion of the Pittman Neighborhood in OU-2 were used to confirm the site-specific vapor intrusion modeling conducted in the BHRA for OU-2. The indoor air results for chloroform were compared to the health-based screening level threshold of 12 $\mu g/m^3$ to confirm that the vapor intrusion risk to residents is within or below the NDEP and USEPA cancer risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ for carcinogenic impacts. The IAQ data confirmed the modeled results as presented in the BHRA Report and that there is no unacceptable human health risk due to vapor intrusion associated with the groundwater plume in the Pittman Neighborhood.

In summary, potential human health risks to residents, indoor and outdoor commercial/ industrial workers, and construction workers due to exposure to VOCs in soil gas and shallow groundwater in the OU-2 BHRA Area are within or below the NDEP and USEPA risk management range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$ for carcinogenic impacts and do not exceed the target HI of greater than one for noncarcinogenic impacts, under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the risk characterization results for soil gas and shallow groundwater in the OU-2 BHRA Area as multiple lines of evidence.

# 9. REFERENCES

American Petroleum Institute (API). 2012. BioVapor A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation. http://www.api.org/oil-and-natural-gas/environment/clean-water/ground-water/vapor-intrusion/biovapor

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

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

Cal/EPA. 2019. Human and Ecological Risk Office (HERO) Human Health Risk assessment (HHRA) Note Number 10, Issue: Toxicity Criteria. February.

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

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

ENVIRON. 2014c. Field Sampling Plan, Revision 1; Nevada Environmental Response Trust Site; Henderson, Nevada. July 18. Approved by NDEP on August 1, 2014.

ENVIRON. 2014d. Quality Assurance Project Plan, Revision 1; Nevada Environmental Response Trust Site; Henderson, Nevada. July 18. Approved by NDEP on 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.

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

National Oceanic and Atmospheric Administration (NOAA). 2020. Climate Data Online: Las Vegas Weather Station #USW00023169. Data from January 1980 to December 2019. https://www.ncdc.noaa.gov/cdo-web/. Accessed December 8, 2020.

Neptune and Company (Neptune). 2022. Technical Memorandum Re: NERT Spatial Plot Recommendations. February 18.

Nevada Division of Environmental Protection (NDEP). 1994. Phase II Letter of Understanding between NDEP and the Henderson Industrial Site Steering Committee (HISSC). August 15.

NDEP. 2008a. NDEP Response to: Technical Memorandum Data Review for 2007 Tronox Parcels A/B Investigation. Dated February 11, 2008. April 8.

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

NDEP. 2009. NDEP Response to: Site Investigation Report (Revised). Dated April 24, 2009. And Errata to: Site Investigation Report – March 5, 2009, Revised April 24, 2009. Dated June 15, 2008. And Completion of Remedial Action, Site Investigation Report – June 15, 2009. Dated September 22, 2009. October 6.

NDEP. 2010a. NDEP Response to: Health Risk Assessment Work Plan, Phase B Investigation, Tronox LLC, Henderson, Nevada, Dated: March 9, 2010. March 16.

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

NDEP. 2012. Revised Guidance on Qualifying Data due to Blank Contamination for the BMI Complex and Common Areas, BMI Plant Site and Common Areas Projects, Henderson, Nevada. January 5.

NDEP. 2013. No Further Action Determination – NERT Parcels A and B. November 26.

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

NDEP. 2018a. Email communication with Weiquan Dong at NDEP, re: NFA Status of Sale Parcels I and J. May 15.

NDEP. 2018b. Re: Nevada Division of Environmental Protection (NDEP) Response to: Phase 2 Remedial Investigation Modification No. 11 (Soil Gas Sampling). Dated: May 23, 2018. June 21.

NDEP. 2020a. Basic Comparison Level (BCL) Table. Revision 15. June.

NDEP. 2020b. 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 15, June.

NDEP. 2023a. Basic Comparison Level (BCL) Table. Revision 16. August.

NDEP. 2023b. 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, August.

NDEP. 2021. Nevada Division of Environmental Protection Response to: Quality Assurance Project Plan Addendum: BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater Modification #1. Nevada Environmental Response Trust Site, Henderson, Nevada. December 8.

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

Northgate and Exponent. 2010a. Health Risk Assessment Work Plan, Tronox Facility, Henderson, Nevada, March 9. NDEP approved March 16, 2010.

Northgate and Exponent. 2010b. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada, November 22 (not reviewed by NDEP).

Ramboll Environ US Corporation (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. 2016c. Annual Remedial Performance Report for Chromium and Perchlorate, Nevada Environmental Response Trust Site, Henderson, Nevada. Dated October 31, 2016. NDEP approved on December 6, 2016.

Ramboll Environ. 2017a. Work Plan Addendum: Phase 3 Remedial Investigation, Revision 1. October 27. NDEP approved November 8, 2017.

Ramboll Environ. 2017b. Phase 1 Remedial Investigation Data Validation Summary Report and Electronic Data Deliverable for Soil Gas Data, Nevada Environmental Response Trust, Henderson, Nevada. November 3. NDEP approved January 25, 2018.

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

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

Ramboll Environ. 2017e. Data Validation Summary Report for July through December 2016 Semi-Annual Remedial Performance Sampling, Revision 1, Nevada Environmental Response Trust (NERT), Henderson, Nevada. June 26. NDEP approved on August 17, 2017.

Ramboll Environ. 2017f. Remedial Performance and Groundwater Sampling and Analysis Plan, Revision 1. March 27. NDEP approved on April 30, 2017.

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

Ramboll 2018b. Phase 2 Remedial Investigation Modification No. 11. May 23. NDEP approved June 21, 2018.

Ramboll. 2018c. Data Validation Summary Report Revision 1, January through March and May 2015 Groundwater Remedial Investigation Sampling, Nevada Environmental Response Trust Site, Henderson, Nevada. June 22. NDEP approved August 14, 2018.

Ramboll. 2018d. Data Validation Summary Report, Revision 1, January through June 2016, Annual Remedial Performance Sampling, Nevada Environmental Response Trust Henderson, Nevada. June 20. NDEP approved July 10, 2018.

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

Ramboll. 2018f. 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. 2018g. Data Validation Summary Report for the Semi-Annual Remedial Performance Sampling January through June 2018, Revision 1 and Associated EDD, Response to Comments. February 13. NDEP approved March 14, 2019.

Ramboll. 2019a. Phase 3 RI Modification No. 9: Proposed Soil Gas Sampling in OU-1 and OU-2; Nevada Environmental Response Trust Site; Henderson, Nevada. October 7. Approved by NDEP on October 14, 2019.

Ramboll. 2019b. Data Validation Summary Report, Revision 1, Soil and Groundwater Remedial Investigation Phase 2, February through June 2017, Nevada Environmental Response Trust Site, Henderson, Nevada. June 26. NDEP approved July 10, 2019.

Ramboll. 2019c. Data Validation Summary Report, Revision 1, Soil and Groundwater Remedial Investigation Phase 2, July through November 2017, Nevada Environmental Response Trust Site, Henderson, Nevada. May 31. NDEP approved June 3, 2019.

Ramboll. 2019d. Phase 3 Remedial investigation Data Validation Summary Report for December 2017 through November 2018 Data, Nevada Environmental Response Trust Site, Henderson, Nevada. September 26. NDEP approved October 28, 2019.

Ramboll. 2019e. Data Validation Summary Report and Electronic Data Deliverable, Annual Remedial Performance Sampling, January through June 2019, Nevada Environmental Response Trust Site, Henderson, Nevada. December 31. NDEP approved January 13, 2020Ramboll. 2019f. Quality Assurance Project Plan, Revision 3. Nevada Environmental Response Trust Site, Henderson, Nevada. April 8. NDEP approved on April 17, 2019.

Ramboll. 2019g. Quality Assurance Project Plan, Revision 4. Nevada Environmental Response Trust Site, Henderson, Nevada. December 30. NDEP approved on March 16, 2020.

Ramboll. 2020a. Technical Memorandum, Soil Gas Sampling Results for OU-1 and OU-2. Nevada Environmental Response Trust Site, Henderson, Nevada. March 31. NDEP commented on January 28, 2021.

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 on April 9, 2020.

Ramboll. 2020c. Annual Remedial Performance Report for Chromium and Perchlorate, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. March 9. NDEP approved on April 30, 2020.

Ramboll. 2020d. Quality Assurance Project Plan, Revision 4. Nevada Environmental Response Trust Site, Henderson, Nevada. March 12. NDEP approved March 16, 2020.

Ramboll. 2020e. Remedial Performance and Groundwater Sampling and Analysis Plan, Revision 1. March 9. NDEP approved April 30, 2020.

Ramboll. 2021a. Baseline Health Risk Assessment for OU-2 Soil Gas and Groundwater., Revision 0, Nevada Environmental Response Trust Site, Henderson, Nevada. July 23. NDEP comments received on October 13, 2022.

Ramboll. 2021b. Baseline Health Risk Assessment Report for OU-1 Soil Gas and Groundwater, Nevada Environmental Response Trust Site, Henderson, Nevada. September 29. NDEP comments received on March 9, 2022.

Ramboll. 2021c. Data Validation Summary Report, Remedial Investigation Sampling Phase 3, February 2019 through January 2020, Nevada Environmental Response Trust, Henderson, Nevada. January 13. NDEP approved on January 27, 2021.

Ramboll. 2021d. Annual Groundwater Monitoring and GWETS Performance Report, July 2019 - June 2020; Nevada Environmental Response Trust Site; Henderson, Nevada. February 26. NDEP Approved on May 6, 2021

Ramboll. 2021e. BHRA Work Plan for OU-1 and OU-2 Soil Gas and Groundwater, Modification #1 (Revision 1). Nevada Environmental Response Trust Site, Henderson, Nevada. Revised October 29.

Ramboll. 2021f. Data Validation Summary Report, 2020 Annual Groundwater Monitoring and GWETS Performance Report (Rev 1). November 1, 2021. NDEP approved December 22, 2021.

Ramboll. 2022a. OU-1 and OU-2 Soil Gas and Groundwater Modification #1 Technical Memorandum, Nevada Environmental Response Trust Site; Henderson, Nevada. August 29. NDEP comments received on October 13, 2022.

Ramboll. 2022b. Baseline Health Risk Assessment for OU-1 Soils, Revision 2. May 6. Approved by NDEP on June 2, 2022.

Ramboll. 2022c. Baseline Health Risk Assessment Work Plan for OU-3, Revision 1, Nevada Environmental Response Trust Site, Henderson, Nevada. December 5. Approved by NDEP on February 1.

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

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

United States Environmental Protection Agency (USEPA). National Primary Drinking Water Regulations. Code of Federal Regulations. 40 CRF Part 141.

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

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

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. 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. EPA Spreadsheet 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.

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

# TABLES

**TABLE ES-1. Summary of Detected VOCs in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical [1] | Soil Gas | | | Shallow Groundwater [2] | | |
|---|---|---|---|---|---|---|
| | 5 ft bgs | 10 - 15 ft bgs | All Depth Intervals | < 20 ft bgs | ≥ 20 ft bgs and < 60 ft bgs | All Shallow Groundwater |
| Acetone | X | X | X | | | |
| Acrolein | | X | X | | | |
| Acrylonitrile | X | X | X | | | |
| Benzene | X | X | X | X | X | X |
| Benzyl chloride | X | | X | | | |
| Bromodichloromethane | X | X | X | X | X | X |
| Bromoform | X | | X | | X | X |
| Bromomethane | X | | X | | | |
| 2-Butanone | X | X | X | | | |
| tert-Butyl alcohol | X | | X | | | |
| n-Butylbenzene | X | | X | | | |
| sec-Butylbenzene | X | | X | | | |
| tert-Butylbenzene | X | | X | X | | X |
| Carbon disulfide | X | X | X | | | |
| Carbon tetrachloride | X | X | X | X | X | X |
| 3-Chloro-1-propene | X | | X | | | |
| Chlorobenzene | X | X | X | X | X | X |
| Chloroethane | X | X | X | | | |
| Chloroform | X | X | X | X | X | X |
| Chloromethane | X | X | X | | | |
| Cumene | X | | X | | | |
| Cyclohexane | X | X | X | | | |
| p-Cymene | X | | X | | | |
| 1,2-Dibromo-3-chloropropane | | X | X | | | |
| Dibromochloromethane | X | X | X | | X | X |
| 1,2-Dibromoethane | X | X | X | | | |
| 1,2-Dichlorobenzene | X | | X | X | X | X |
| 1,3-Dichlorobenzene | X | X | X | X | X | X |
| 1,4-Dichlorobenzene | X | X | X | X | X | X |
| Dichlorodifluoromethane | X | X | X | | | |
| 1,1-Dichloroethane | X | X | X | X | X | X |
| 1,2-Dichloroethane | X | X | X | X | X | X |
| 1,1-Dichloroethene | X | X | X | X | X | X |
| cis-1,2-Dichloroethene | X | X | X | | | |
| trans-1,2-Dichloroethene | X | X | X | | | |
| 1,2-Dichloropropane | X | X | X | | | |
| 1,4-Dioxane | X | | X | X | X | X |
| Ethanol | X | X | X | | | |
| Ethyl acetate | | X | X | | | |
| Ethyl benzene | X | X | X | | | |
| 4-Ethyltoluene | X | X | X | | | |
| Freon 114 | X | | X | | | |
| n-Heptane | X | X | X | | | |
| Hexachlorobutadiene | X | X | X | | X | X |

**TABLE ES-1. Summary of Detected VOCs in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical [1] | Soil Gas | | | Shallow Groundwater [2] | | |
|---|---|---|---|---|---|---|
| | 5 ft bgs | 10 - 15 ft bgs | All Depth Intervals | < 20 ft bgs | ≥ 20 ft bgs and < 60 ft bgs | All Shallow Groundwater |
| n-Hexane | X | X | X | | | |
| 2-Hexanone | X | X | X | | | |
| alpha-Methyl styrene | X | | X | | | |
| Methyl tert-butyl ether | X | | X | | | |
| 4-Methyl-2-pentanone | X | X | X | | | |
| Methylene Chloride | X | X | X | X | X | X |
| Methylmethacrylate | | X | X | | | |
| Naphthalene | X | X | X | | | |
| n-Octane | X | | X | | | |
| n-Propylbenzene | X | | X | | | |
| Styrene | X | X | X | | | |
| 1,1,1,2-Tetrachloroethane | X | X | X | | | |
| 1,1,2,2-Tetrachloroethane | X | | X | | | |
| Tetrachloroethene | X | X | X | X | X | X |
| Tetrahydrofuran | X | X | X | | | |
| Toluene | X | X | X | X | X | X |
| 1,2,3-Trichlorobenzene | | | | X | X | X |
| 1,2,4-Trichlorobenzene | X | X | X | X | X | X |
| 1,1,1-Trichloroethane | X | | X | | | |
| 1,1,2-Trichloroethane | X | X | X | | | |
| Trichloroethene | X | X | X | X | X | X |
| Trichlorofluoromethane | X | X | X | | | |
| 1,2,3-Trichloropropane | | | | X | X | X |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | X | X | X | | | |
| 1,2,4-Trimethylbenzene | X | X | X | | | |
| 1,3,5-Trimethylbenzene | X | X | X | | | |
| Vinyl acetate | X | | X | | | |
| Vinyl chloride | X | X | X | | | |
| Xylenes (total) | X | X | X | | | |

**Notes:**

bgs = below ground surface

ft = feet

BHRA = Baseline Health Risk Assessment

OU = Operable Unit

VOC = volatile organic compound

[1] VOCs detected in the soil gas or shallow groundwater samples included in the BHRA.

[2] Based on VOC results from the shallow monitoring wells (with top of well screens less than 60 ft bgs) collected between 2015-2020 in the OU-2 BHRA Area.

## TABLE ES-2. Summary of Estimated Soil Gas Cancer Risks and Noncancer Hazard Indices for the OU-2 BHRA Area

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Scenario | Depth Interval (ft bgs) | Cancer Risk | Chronic HI |
|---|---|---|---|
| Residents (Slab-on-Grade Scenario) [1] | 5 | 6E-08 - 2E-05 | 0.0004 - 0.03 |
| | 10 - 15 | 2E-07 - 2E-05 | 0.0008 - 0.03 |
| Residents (Trailer Scenario) [1] | 5 | 5E-07 - 1E-05 | 0.003 - 0.03 |
| | 10 - 15 | 3E-07 - 7E-06 | 0.002 - 0.01 |
| Indoor Commercial/Industrial Worker [1] | 5 | 5E-09 - 3E-06 | 0.00002 - 0.007 |
| | 10 - 15 | 4E-09 - 2E-06 | 0.00003 - 0.01 |
| Outdoor Commercial/Industrial Worker [2] | 5 | 2E-10 | 0.000001 |
| | 10 - 15 | 2E-10 | 0.00006 |
| Construction Worker[1] | 5 | 1E-14 - 1E-11 | 0.000000003 - 0.0000002 |
| | 10 - 15 | 5E-14 - 2E-11 | 0.000000007 - 0.00001 |

**Notes:**

bgs = below ground surface

ft = feet

HI = hazard index

OU = Operable Unit

VOC = volatile organic compound

UCL = upper confidence level

[1] The cancer risk and non-cancer chronic HI estimates for the residents, indoor commercial/industrial workers and construction workers were based on the maximum by sample risk/HI results for each scenario.

[2] The cancer risk and non-cancer chronic HI for the outdoor commercial/industrial workers were estimated based on the 95% UCLs calculated using the soil gas VOC data collected in the commercial/industrial area in the OU-2 BHRA Area.

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| **Data Usability Criterion**<br>*(description of criterion)* | **Evaluation Result** |
|---|---|
| **I. Reports to the Risk Assessor**<br>*List all reports and dates and confirm that report(s) relied upon are complete and appropriate for use in the BHRA* | **Historical Investigations**<br>The work plans and DVSRs[1] for historical investigations completed within the OU-2 BHRA Area are reported in the following documents.<br>*Phase B Investigation (between May 17 and May 20, 2008)*<br>• *Phase B Source Area Investigation Soil Gas Survey Work Plan* (ENSR 2008a, approved by NDEP on March 26, 2008);<br>• (A Phase B soil gas investigation results report was not identified); and<br>• *DVSR, Phase B Source Area Investigation Soil Gas Survey, Tronox LLC Facility* (ENSR 2008b, approved by NDEP on October 20, 2008).<br>**Remedial Investigation**<br>*Phase 1 RI (between March 6 and March 19, 2015), Phase 2 RI Modification No. 11 (between March 8 and March 22, 2019), and Phase 3 RI Modification No. 9 (between November 8, 2019 and January 22, 2020)*<br>• *Remedial Investigation and Feasibility Study Work Plan* (ENVIRON 2014a, approved by NDEP on July 2, 2014);<br>• *Phase 2 RI Modification No. 11, Recommended Soil Gas Sampling Locations* (Ramboll 2018b, approved by NDEP on June 21, 2018);<br>• *Phase 3 RI Modification No. 9, Proposed Soil Gas Sampling in OU-1 and OU-2* (Ramboll 2019a, approved by NDEP on October 14, 2019);<br>• *Remedial Investigation Data Evaluation Technical Memorandum* (Ramboll Environ 2016a, approved by NDEP on August 23, 2016); |

[1] DVSRs are provided in Appendix B.

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| | |
|---|---|
| | • *Technical Memorandum, Soil Gas Sampling Results for OU-1 and OU-2* (Ramboll 2020a, with comments provided by NDEP on January 28, 2021);<br>• *OU-1 and OU-2 Remedial Investigation Report* (Ramboll 2023, under NDEP review);<br>• *DVSR, Phase 1 Remedial Investigation, Soil Gas Remediation Sampling, March 2015* (Ramboll 2017b, approved by NDEP on January 25, 2018);<br>• *DVSR, Phase 2 Remedial Investigation, March 2018 through March 2019* (Ramboll 2020b, approved by NDEP on April 9, 2020); and<br>• *DVSR, Phase 3 Remedial Investigation, February 2019 through January 2020* (Ramboll 2021c, approved by NDEP on January 27, 2021)<br>Overall, the available reports, and the accompanying laboratory reports and DVSRs, are considered complete for BHRA purposes. |
| **II. Documentation**<br>*Confirm that each analytical result is associated with a specific sample location and that the appropriate sampling procedure is documented.* | For this step, Ramboll reviewed the soil gas samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. The following steps were then completed (presented in chronological order):<br>• Confirmation of sampling procedures: As discussed in the work plans listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved QAPP (ENSR 2008c, ENVIRON 2014c, Ramboll Environ 2017c, and Ramboll 2019f). Ramboll reviewed the chain-of-custody forms prepared in the field and compared them with the analytical data results provided by the laboratories to ensure completeness of the data set.<br>The available information is adequate to relate each analytical result retained in the BHRA soil gas data set to a geographic location, depth interval, and sampling procedure. |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| | |
|---|---|
| **III. Data Sources**<br><br>*Confirmation that source areas are adequately sampled and that analytical methods are appropriate to identify COPCs and estimate EPCs.* | **Historical Investigations**<br><br>Soil gas samples from historical investigations were: 1) located near or within LOUs where VOCs may have been used in past operations; 2) located in areas overlying trespassing groundwater plumes (in the eastern portion of the OU-2 BHRA Study Area); 3) co-located with existing groundwater monitoring wells; and (4) located randomly throughout the OU-2 BHRA Area to obtain spatial coverage.<br><br>The specific analysis conducted for VOCs was identified based on the review of the historical sampling results; analysis with standard USEPA analytical method (listed under Criterion IV) was conducted by NDEP-certified laboratories.<br><br>**Remedial Investigation**<br><br>As part of the ongoing RI/FS (ENVIRON 2014a; Ramboll 2018b, 2019a, and 2023), soil gas samples were collected within the OU-2 BHRA Area during the Phase 1 RI, Phase 2 RI, and Phase 3 RI to address data gaps in the Phase B soil gas investigation identified through the further evaluation of VOC data in shallow groundwater, i.e., to obtain VOC data at a deeper depth (15 feet bgs) and in areas where high chloroform concentrations were detected in the previous soil gas and/or groundwater sampling.<br><br>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 collected in the OU-2 BHRA Area.<br><br>As shown in Figure 4-1, the ten 2008 Phase B investigation soil gas sampling locations and the 40 RI soil gas sample locations (2015-2020) are located throughout the OU-2 BHRA Area and adjacent to shallow groundwater monitoring wells. In summary, the review of sampling coverage from the BHRA data set is based on the distribution of sample locations from both historical and recent investigations. Sample coverage is considered adequate for purposes of the BHRA, assuming groundwater conditions remain stable. The USEPA analytical methods are adequate for characterizing potential contaminants in soil gas and provide quantitative analytical results that are of adequate quality for deriving EPCs. |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| | |
|---|---|
| **IV. Analytical Methods and Detection Limits**<br>*Confirm that analytical methods appropriately identify the chemical form or species and that the SQL is at or below a concentration appropriate for the BHRA.* | Standard analytical methods were used for all analyses as listed below.<br>**Historical Investigations and Remedial Investigation**<br>• USEPA Method TO-15 (VOCs)<br>The above method is adequate to characterize a broad spectrum of VOCs in soil gas.<br>The SQLs were evaluated to confirm that they were sufficiently low for risk characterization (i.e., below 0.1xRBTC, as derived in Section 5.4.1). As shown in Table 4-5 (for soil gas data at 5 feet bgs) and Table 4-6 (for soil gas data at 10-15 feet bgs), maximum SQLs were less than 0.1xRBTC, with the following exceptions:<br>*For soil gas data at 5 feet bgs:*<br>• Five analytes, benzyl chloride, bromodichloromethane, 1,2-dichloroethane, hexachlorobutadiene, and 1,1,2,2-tetrachloroethane, were detected in a range of one to 40 samples out of a total of 78 analyzed samples; the SQLs exceeded 0.1xRBTC in one of the samples reported as nondetect for each of these analytes, with no SQLs exceeding the RBTCs.<br>• Acrolein was reported as less than detection limits in all samples; the SQLs exceeded 0.1xRBTC in 36% of the nondetects (four out of 11 samples), with no SQLs exceeding the RBTC.<br>• Acrylonitrile was detected in five out of 63 samples; the SQLs exceeded 0.1xRBTC in 36% of the nondetects (21 out of 58 samples), with no SQLs exceeding the RBTC.<br>• 1,2-Dibromo-3-chloropropane was reported as less than detection limits in all samples; the SQLs exceeded 0.1xRBTC in 81% of the nondetects (51 out of 63 samples) and exceeded the RBTC in 78% of the nondetects (49 out of 63 samples).<br>• 1,2-Dibromoethane was detected in six out of 78 samples; the SQLs exceeded 0.1xRBTC in 32% of the nondetects (23 out of 72 samples); the SQL of one sample exceeded the RBTC.<br>*For soil gas data at 10 to 15 feet bgs:*<br>• Acrolein was detected in one out of nine samples; the SQLs exceeded 0.1xRBTC in 38% of the nondetects (three out of eight samples), with no SQLs exceeding the RBTC. |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| | |
|---|---|
| | • Acrylonitrile was detected in one out of 46 samples; the SQLs exceeded 0.1xRBTC in 24% of the nondetects (11 out of 45 samples), with no SQLs exceeding the RBTC.<br>• Benzyl chloride was not detected in any of the 10-15 feet bgs soil gas samples; the SQLs exceeded 0.1xRBTC in 3.5% of the nondetects (two out of 58 samples), with no SQLs exceeding the RBTC.<br>• 1,2-Dibromo-3-chloropropane was detected in one out of 46 samples; the SQLs exceeded 0.1xRBTC in 93% of the nondetects (42 out of 45 samples) and exceeded the RBTC in 91% of the nondetected samples (41 out of 45 samples).<br>• 1,2-Dibromoethane was detected in six out of 58 samples; the SQLs exceeded 0.1xRBTC in 31% of the nondects (16 out of 52 samples), with no SQLs exceeding the RBTC.<br>• Hexachlorobutadiene was detected in three out of 58 samples; the SQLs exceeded 0.1xRBTC in 3.6% of the nondetects (two out of 55 samples), with no SQLs exceeding the RBTC.<br>Overall, the SQLs were sufficiently low for risk characterization. The impacts of the few exceptions with elevated SQLs on the overall risk evaluation are further discussed in Section 6.1.2. Of the analytes mentioned above, only bromodichloromethane was retained as an OU-2 groundwater chemical of potential concern (COPC) in the RI Report for OU-1 and OU-2. |
| **V. Data Review**<br>*Confirm that the quality of the analytical data is assessed by professionals knowledgeable in field collection procedures and analytical chemistry and that data quality is adequate to estimate EPCs.* | The laboratory results from historical investigations and the RI were subjected to formal data validation consistent with USEPA guidelines (USEPA 1999, 2001, 2004a, 2005a, 2005b, 2008, and 2009a), *the BMI Plant Site Specific Supplemental Guidance on Data Validation* (NDEP 2009d), and *BRC Standard Operating Procedure (SOP) 40 and Data Review/Validation* (BRC 2009). The USEPA guidelines, which were prepared for Contract Laboratory Program data, were adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events and NDEP guidance.<br>The NDEP-approved DVSRs listed in Criterion I for soil gas data included in the BHRA data set are provided in Appendix B, 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 tabular summaries of the data qualifications:<br>• Summary of data qualified due to holding time exceedances |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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| | • Summary of data qualified due to detection below quantitation limit<br>• Summary of data qualified due to laboratory blank contamination<br>• Summary of data qualified due to field blank contamination<br>• Summary of data qualified due to matrix spike (MS)/matrix spike duplicate (MSD) recovery exceedances<br>• Summary of data qualified due to laboratory control spike (LCS) recovery exceedances<br>• Summary of data qualified due to field/laboratory duplicate<br>• Summary of data qualified due to surrogate recovery exceedances<br>• Summary of data qualified due to calibration violations<br>• Summary of data qualified due to calibration range exceedances<br>• Summary of data qualified due to internal standard recovery exceedances<br>• Summary of data qualified due to serial dilutions<br>• Summary of qualified data results<br>• Summary of rejected data results<br>These data qualifications are further discussed below as a component of Criterion VI. |
| **VI. Data Quality Indicators**<br>*Document that sampling and analysis DQIs are evaluated using criteria specific to the risk assessment.* | <u>Completeness</u><br>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 QAPPs is 90% or greater.<br>Completeness was reviewed as reported in the DVSR prepared for each individual investigation contributing to the soil gas BHRA data set, and no data were rejected. Therefore, completeness for the soil gas BHRA data set for OU-2 BHRA Area (Appendix D) was 100%, which meets the completeness goals of 90% established in the QAPPs. |



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**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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**Henderson, Nevada**

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| | <u>Comparability</u><br><br>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 gas samples identified for this BHRA were collected by different entities and analyzed by different analytical laboratories over a span of approximately 12 years in the following four investigations.<br><br>• In 2008, as part of the Phase B soil gas investigation, eleven soil gas samples were collected at 5 feet bgs at ten locations in the former Parcel B area near the southwestern boundary of the Study Area.<br>• In 2015, as part of the Phase 1 RI investigation, six soil gas samples were collected at 5 feet bgs and 10-15 feet bgs at the three locations (RISG-1, 2, and 3) with the highest chloroform concentrations identified in groundwater in the southern, central, and northern portions of the chloroform groundwater plume extending into the OU-2 BHRA Area.<br>• In March 2019, as part of the Phase 2 RI Modification No. 11 soil gas investigation, 27 soil gas samples were collected at both 5 feet bgs and 10-15 feet bgs at 13 locations (including RISG-1, 2, and 3) where high chloroform concentrations were detected in the previous soil gas and/or groundwater sampling in the OU-2 BHRA Area in the portion of the chloroform groundwater plume with relatively higher chloroform concentrations, or at locations that help delineate lateral extent of VOCs in soil gas to the west where chloroform concentrations are relatively lower.<br>• In November 2019 - January 2020, as part of the Phase 3 RI Modification No. 9 soil gas investigation, 91 soil gas samples were collected at both 5 feet bgs and 10-15 feet bgs at 40 locations (including the 13 locations sampled in Phase 2 RI Modification No. 11 throughout the OU-2 BHRA Area to collect additional data that is necessary to delineate the horizontal and vertical extent of VOCs in soil gas to complete the RI and to evaluate human health risks as part of the BHRA.<br><br>In the Phase B Soil Gas Investigation in 2008, the Phase 2 RI Modification No. 11 in 2019, and the Phase 3 RI Modification No. 9 in 2019-2020, helium was used as the tracer gas for leak checking during sample collection; helium was analyzed in the soil gas samples collected in the 2008 Phase B Investigation, the 2015 Phase 1 RI soil gas sampling, and the 2019-2020 Phase 3 RI Modification No. 9. USEPA Method TO-15 was used as the analytical method for samples collected from all three investigations, and the sampling |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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| | results were all reported in µg/$m^3$. Additionally, all four investigations used the same sample preservation, extraction, and preparation techniques.<br><br>Different reporting limits for the same analyte may also impact the comparability of the data sets. The ranges of the SQLs for each analyte where the detection frequency was less than 100% are presented in Tables 4-5 and 4-6. For most of the analytes, the SQLs are well below 0.1xRBTC; therefore, different reporting limits for the same analyte would not affect the overall risk evaluation. There are a few analytes with SQLs exceeding 0.1xRBTC, and their impacts on the overall risk evaluation are further discussed in the uncertainty analysis in Section 6.1.2.<br><br>Temporal factors were also considered in the comparability evaluation. Soil gas concentrations would be expected to follow trends of groundwater concentrations, in cases where groundwater is the source of VOCs. The temporal trends of VOCs in soil gas and groundwater are further discussed in Section 4.2.3.<br><br><u>Representativeness</u><br><br>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 QAPPs.<br><br>Spatial representativeness was discussed previously under Criterion III. The 2008 Phase B investigation soil gas sampling locations and the RI soil gas sample locations are located near where high chloroform concentrations were detected in previous groundwater or soil gas sampling, or at locations that help delineate lateral extent of VOCs in soil gas in the OU-2 BHRA Area. The sample coverage is considered adequate for purposes of the BHRA; the data provide a conservative representation of current conditions within the OU-2 BHRA Area in the context of the CSM. The objectives of the sampling programs were met, considering the phased approach used to delineate contaminated areas. |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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| | As presented in the DVSRs listed under Criterion I, standard methods for sampling and analysis were used for all the investigations, which confirmed that the analytical data are representative of the soil gas concentrations at the locations sampled.<br><br>Entrainment of contaminants and dilution with surface air can impact the representativeness of soil gas analytical results. Helium gas was used in all four investigations as a leak check compound during purging and sampling. Therefore, the concentration representativeness is further evaluated below by reviewing the helium leak check data from the Phase B soil gas investigation in 2008 and the three RI soil gas investigations between 2015 and 2020 as discussed below:<br><br>• For the 2008 Phase B soil gas 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 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). Helium was not detected in any of the 11 Phase B soil gas samples collected within the OU-2 BHRA Area. None of the analytical results from these samples were J-qualified due to this criterion and did not need to be corrected.<br><br>• For the 2015 Phase 1 RI soil gas sampling, 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 not detected in any of the soil gas samples. Therefore, the analytical results from this investigation were not corrected.<br><br>• For the 2019 Phase 2 RI Modification No. 11 soil gas sampling, helium concentrations in shrouds were monitored for leak check purposes during sampling and no helium leak was noted. 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 from this investigation. The analytical results from this soil gas investigation were not corrected.<br><br>• For the 2019-2020 Phase 3 RI Modification No. 9 soil gas sampling, 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 15-foot samples collected at RISG-57, with leak percentages at 3.3% (see Ramboll 2021b). The leak percentage for this sample was |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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| | less than the QAPP criterion of 5%. Therefore, the analytical results for the soil gas samples from this investigation were not corrected.<br><br>Precision<br><br>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 practical quantitation limit (PQL). For the latter case, the acceptance criterion 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.<br><br>Field precision for the soil gas samples collected in the OU-2 BHRA Area was assessed by evaluating the field duplicate results in accordance with the *Statistical Analysis Recommendations for Field Duplicates and Field Splits* (NDEP 2008a), where the primary sample and field duplicate are independent samples. A total of 16 pairs of primary and field duplicate results were qualified due to PQL criterion exceedance, and no primary and field duplicate results were qualified due to RPD criterion exceedance (see Appendix B, Table B-1). For laboratory duplicates, there were no data points qualified due to RPD or PQL criterion exceedance (see Appendix D). 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 BHRA, and the effects of these qualified data on the overall risk evaluation are further discussed in Sections 6.1.5 and 6.1.6.<br><br>Accuracy<br><br>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. As specified in the QAPPs, the objective for trip and equipment blanks is for no analyte to be present at levels greater than the PQL. Accuracy in the laboratory analytical data is a measure of the |

**TABLE 4-1. Data Usability Evaluation – Soil Gas**
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| | overestimation or underestimation of reported concentrations. Several QC parameters are used to evaluate the accuracy of reported analytical results, including:<br>• Holding times;<br>• Field and laboratory blanks;<br>• MS/MSD percent recovery;<br>• Surrogate spike recovery; and<br>• LCS percent recovery.<br>All qualified results (i.e., U, J, J-, and J+ qualified data) for the soil gas analytes are presented in Appendix D along with the reason codes for these qualified results, and a summary of qualified results is included in Appendix B, Table B-3. 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 each DVSR), the laboratory does not believe that the observed exceedances of laboratory criteria are cause for concern. Therefore, the qualified data are determined to be usable and valid for purposes of the BHRA and are included in the BHRA data set. The impacts of qualified data on the overall risk evaluation are further discussed in Section 6.1.6.<br>Data collected from the 2008 Phase B Soil Gas Investigation and associated with field and laboratory blank contamination were originally qualified as nondetects based on the NDEP guidance at that time. As requested by NDEP and in accordance with the most recent guidance (NDEP 2012) for evaluating data associated with blank contamination, if there were detections between the SQL and PQL for samples with blank contamination, these data were changed from nondetected values (U qualified) to detected values (J qualified) at reported concentrations. The revisions of censored data for blank contamination are summarized in Appendix B, Table B-2, and the impacts on the overall risk evaluation are further discussed in Section 6.1.6.<br>In summary, all data are acceptable through the DQI evaluation and deemed to be usable for risk assessment purposes. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| **Data Usability Criterion**<br>*(description of criterion)* | **Evaluation Result** |
|---|---|
| **I. Reports to the Risk Assessor**<br>*List all reports and dates and confirm that report(s) relied upon are complete and appropriate for use in the BHRA* | The work plans, reports, and DVSRs[1] for shallow groundwater investigations completed within the OU-2 BHRA Area are reported in the following documents.<br>**Remedial Investigation**<br>*Phase 1 RI (between January 12 and January 26, 2015), Phase 2 RI (between August 24, 2017 and November 14, 2018), and Phase 3 RI (April 25, 2018)*<br>• *Remedial Investigation and Feasibility Study Work Plan* (ENVIRON 2014a, approved by NDEP on July 2, 2014)<br>• *Remedial Investigation Data Evaluation Technical Memorandum* (Ramboll Environ 2016a, approved by NDEP on August 23, 2016)<br>• *OU-1 and OU-2 Remedial Investigation Report, Revision 1* (Ramboll 2023, under NDEP review)<br>• *DVSR, Phase 1 Remedial Investigation, Groundwater Remedial Investigation Sampling, January through March and May 2015* (Ramboll 2018c, approved by NDEP on August 14, 2018)<br>• *DVSR, Phase 2 Remedial Investigation, February through June 2017* (Ramboll 2019b, approved by NDEP on July 10, 2019)<br>• *DVSR, Phase 2 Remedial Investigation, July through November 2017* (Ramboll 2019c, approved by NDEP on June 3, 2019)<br>• *DVSR, Phase 2 Remedial Investigation, March 2018 through March 2019* (Ramboll 2020b, approved by NDEP on April 9, 2020)<br>• *DVSR, Phase 3 Remedial Investigation, December 2017 through November 2018* (Ramboll 2019d, approved by NDEP on October 28, 2019) |

[1] DVSRs are provided in Appendix C.

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| | **Annual Groundwater Monitoring**<br>*2016 (between February 10 and September 14, 2016), 2017 (between May 3 and June 16, 2017), 2018 (May 9 and May 11, 2018), 2019 (between May 7 and May 16, 2019), and 2020 (between May 5 and May 12, 2020)*<br>• *2016 Groundwater Monitoring Optimization Plan* (Ramboll Environ 2016b, approved by NDEP on June 24, 2016)<br>• *2016 Annual Remedial Performance Report for Chromium and Perchlorate* (Ramboll Environ 2016c, approved by NDEP on December 6, 2016)<br>• *DVSR, 2016 Annual Remedial Performance Sampling* (Ramboll 2018d, approved by NDEP on July 10, 2018)<br>• *DVSR, 2016 Semi-Annual Remedial Performance Sampling* (Ramboll Environ 2017e, approved by NDEP on August 17, 2017)<br>• *2017 Annual Remedial Performance Report for Chromium and Perchlorate* (Ramboll Environ 2017d, approved by NDEP on February 6, 2018)<br>• *DVSR, 2017 Annual Remedial Performance Report* (Ramboll 2018f, approved by NDEP on March 5, 2018)<br>• *2018 Annual Remedial Performance Report for Chromium and Perchlorate* (Ramboll 2018e, approved by NDEP on January 18, 2019)<br>• *DVSR, 2018 Annual Remedial Performance Report* (Ramboll 2018g, approved by NDEP on May 14, 2019)<br>• *2019 Annual Remedial Performance Report for Chromium and Perchlorate* (Ramboll 2020c, approved by NDEP on April 30, 2020)<br>• *DVSR, 2019 Annual Remedial Performance Sampling, January through June 2019* (Ramboll 2019e, approved by NDEP on January 13, 2020)<br>• *2020 Annual Groundwater Monitoring and GWETS Performance Report* (Ramboll 2021d, approved by NDEP on May 6, 2021) |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| | • *DVSR, 2020 Annual Groundwater Monitoring and GWETS Performance Report* (Ramboll 2021f, approved by NDEP on December 22, 2021)<br><br>Overall, the available reports, and the accompanying laboratory reports and DVSRs, are considered complete for BHRA purposes. |
| **II. Documentation**<br><br>*Confirm that each analytical result is associated with a specific sample location and that the appropriate sampling procedure is documented.* | For this step, Ramboll reviewed the shallow groundwater samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. The following steps were then completed (presented in chronological order):<br><br>• Confirmation of sample locations: Samples with missing geographic location information (i.e., x, y coordinates and/or depth) were removed from the BHRA data set. The geographic location of each sample was confirmed relative to the current boundaries of the OUs and parcels. As noted in the OU-2 BHRA Report, Parcels A and the western portion of Parcel B have previously received no further action determinations for vapor intrusion and are not included in this evaluation. Parcel A data was not included in the BHRA data set; Parcel B data were included in this BHRA for better spatial coverage in the evaluation of the health risks for neighboring Parcels I and J.<br><br>• Confirmation of well types and depths: Only samples collected from shallow monitoring wells (with top of well screens less than 60 feet bgs) are included in the BHRA data set. Grab groundwater samples or samples collected from injection wells, extraction wells, or monitoring wells equal to or deeper than 60 feet bgs were removed from the BHRA data set.<br><br>• Confirmation of volatile compounds: Only data for volatile compounds are included in the BHRA data set. Volatile compounds are identified using the following criteria consistent with USEPA (2023a): 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law constant greater than 0.00001 atm-$m^3$/mol. Data for non-volatile compounds were removed from the BHRA data set.<br><br>• Confirmation of sampling procedures: As discussed in the work plans listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved QAPPs (ENSR 2008c, AECOM and Northgate 2009, ENVIRON 2014b, Ramboll Environ 2017c, Ramboll Environ 2017f, Ramboll 2019f, Ramboll 2019g, Ramboll 2020d, and Ramboll 2020e). Ramboll reviewed the chain-of-custody forms prepared in the field and compared them with the analytical data results provided by the laboratories to confirm completeness of the data set. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| | The available information is adequate to relate each analytical result retained in the risk assessment dataset to a geographic location, depth interval, and sampling procedure. |
| **III. Data Sources**<br><br>*Confirmation that source areas are adequately sampled and that analytical methods are appropriate to identify COPCs and estimate EPCs.* | **Remedial Investigation**<br><br>As part of the ongoing RI/FS (ENVIRON 2014a; Ramboll Environ 2016b; Ramboll 2023), shallow groundwater samples were collected in the OU-2 BHRA Area during the Phase 1 RI, Phase 2 RI, and Phase 3 RI to address spatial data gaps identified through the review of available historical groundwater data. Review of the analytical results indicates that these spatial data gaps have been addressed.<br><br>The specific analyses conducted for VOCs were identified based on the review of the sampling results; Analyses with standard USEPA analytical methods (listed under Criterion IV) were conducted by NDEP-certified laboratories.<br><br>**Annual Groundwater Monitoring**<br><br>As directed by NDEP, VOCs were first added to the groundwater monitoring program as part of the 2016 *Groundwater Monitoring Optimization Plan* (Ramboll Environ 2016c) after initial evaluations of Phase 1 RI data suggested that these chemicals were present at detectable levels throughout the NERT Site (Ramboll Environ 2016a). Comprehensive groundwater sampling for volatile compounds throughout the Site has been conducted on an annual basis (usually in May every year) as part of the annual groundwater sampling event since 2017.<br><br>The specific analysis conducted for VOCs was identified based on the review of the Phase 1 RI sampling results; analyses with standard USEPA analytical methods (listed under Criterion IV) were conducted by NDEP-certified laboratories.<br><br>In summary, the review of sampling coverage from the BHRA data set is based on the distribution of sample locations from recent shallow groundwater investigations. Sample coverage is considered adequate for purposes of the BHRA. The USEPA analytical methods are adequate for characterizing potential contaminants in shallow groundwater and provide quantitative analytical results that are of adequate quality for deriving EPCs. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| **IV. Analytical Methods and Detection Limits**<br>*Confirm that analytical methods appropriately identify the chemical form or species and that the SQL is at or below a concentration appropriate for the BHRA.* | Standard analytical methods were used for all analyses as listed below.<br>**Remedial Investigation**<br>• USEPA Method 8260 and 8260 selective ion monitoring (SIM) (VOCs)<br>**Annual Groundwater Monitoring**<br>• USEPA Method 8260 and 8260B SIM (VOCs)<br>The above methods are adequate to characterize the corresponding chemical groups in shallow groundwater.<br>The SQLs were evaluated to confirm that they were sufficiently low for risk characterization (i.e., below 0.1xRBTC, as derived in Section 5.4.2). As shown in Table 4-7, maximum SQLs were less than 0.1xRBTC, with the following exceptions:<br>• For 7 analytes (bromodichloromethane, carbon tetrachloride, 1,2-dibromoethane, 1,2-dichloroethane, hexachlorobutadiene, trichloroethene, and vinyl chloride), the SQLs exceeded 0.1xRBTC in 3.1 to 10% of the samples reported as nondetected.<br>• 1,2-Dibromo-3-chloropropane was reported as less than detection limits in all samples; the SQLs exceeded 0.1xRBTC in all 278 nondetected samples, including the SQLs of 20 samples exceeding the RBTC.<br>Overall, the SQLs were sufficiently low for risk characterization. The impacts of the few exceptions with elevated SQLs on the overall risk evaluation are further discussed in Section 6.1.2. Of the analytes mentioned above, bromodichloromethane and carbon tetrachloride were the only ones retained as OU-2 groundwater chemicals of potential concern (COPCs) in the RI Report for OU-1 and OU-2. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| **V. Data Review**<br>*Confirm that the quality of the analytical data is assessed by professionals knowledgeable in field collection procedures and analytical chemistry and that data quality is adequate to estimate EPCs.* | The laboratory results from the RI and annual groundwater monitoring were subjected to formal data validation consistent with USEPA guidelines (USEPA 1999, 2001, 2004b, 2005a,b, 2008, 2009b), the *BMI Plant Site Specific Supplemental Guidance on Data Validation* (NDEP 2009d), and *BRC Standard Operating Procedure (SOP) 40 and Data Review/Validation* (BRC 2009). The USEPA guidelines, which were prepared for Contract Laboratory Program data, were adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events and NDEP guidance.<br><br>The NDEP-approved DVSRs listed in Criterion I for shallow groundwater data included in the BHRA data set are provided in Appendix C, 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 tabular summaries of the data qualifications:<br>• Summary of data qualified due to holding time exceedances<br>• Summary of data qualified due to detection below quantitation limit<br>• Summary of data qualified due to laboratory blank contamination<br>• Summary of data qualified due to field blank contamination<br>• Summary of data qualified due to matrix spike (MS)/matrix spike duplicate (MSD) recovery exceedances<br>• Summary of data qualified due to laboratory control spike (LCS) recovery exceedances<br>• Summary of data qualified due to field/laboratory duplicate<br>• Summary of data qualified due to surrogate recovery exceedances<br>• Summary of data qualified due to calibration violations<br>• Summary of data qualified due to calibration range exceedances<br>• Summary of data qualified due to internal standard recovery exceedances<br>• Summary of data qualified due to serial dilutions<br>• Summary of qualified data results<br>• Summary of rejected data results<br>These data qualifications are further discussed below as a component of Criterion VI. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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**Henderson, Nevada**

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| **VI. Data Quality Indicators**<br>*Document that sampling and analysis DQIs are evaluated using criteria specific to the risk assessment.* | <u>Completeness</u><br>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 QAPPs is 90% or greater.<br>First, completeness was reviewed as reported in the DVSR prepared for each individual investigation contributing to the shallow groundwater BHRA data set. Depending on the specific DVSR, 98.8% to 100% completeness was archived based on validated data, with 0% to 1.2% of the data qualified as rejected ("R" qualified).<br>Rejected ("R" qualified) shallow groundwater data associated with shallow groundwater samples in the OU-2 BHRA Area are summarized in Appendix C, Table C-2. Completeness for the shallow groundwater BHRA data set for the OU-2 BHRA Area (Appendix E) was calculated as 99.98%.<br>In summary, the completeness for the BHRA shallow groundwater data meet the completeness goals of 90% established in the QAPPs. Rejected data are excluded from the shallow groundwater BHRA data set, and a discussion of how these rejected data occurrences potentially affect the overall risk evaluation are further discussed in Section 6.1.3.<br><u>Comparability</u><br>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.<br>Shallow groundwater samples identified for the BHRA were collected by different entities and analyzed by different analytical laboratories (and in some cases, different analytical methods were used for the same analyte); overall, the investigations from which data are being used span a period of approximately five years. The same analytical methods were used across most investigations; specifically, USEPA Method 8260 for VOCs. In some investigations, the more sensitive USEPA Method 8260 SIM was used for VOCs. All groundwater sampling results were reported in µg/L. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
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| | |
|---|---|
| | Different reporting limits for the same analyte may also impact the comparability of the data sets. The ranges of the SQLs for each analyte where the detection frequency was less than 100% are presented in Table 4-7. For most of the analytes, the SQLs are well below 0.1xRBTC; therefore, different reporting limits for the same analyte would not affect the overall risk evaluation. There are a few analytes with SQLs exceeding 0.1xRBTC, and their impacts on the overall risk evaluation are further discussed in Section 6.1.2.<br><br>Temporal factors were also considered in the comparability evaluation. The temporal trends of VOCs in groundwater are further discussed in Section 4.2.3.<br><br><u>Representativeness</u><br><br>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 QAPPs.<br><br>Spatial representativeness was discussed previously under Criterion III. As noted, shallow groundwater sample locations were identified based on the review of available historical groundwater data to characterize the vertical and horizontal extent of impacted groundwater, ensuring that the data provide a conservative representation of current conditions within the OU-2 BHRA Area in the context of the CSM. The objectives of the sampling programs were met, considering the phased approach used to delineate contaminated areas.<br><br>As presented in the DVSRs listed under Criterion I, standard methods for sampling and analysis were used for all the investigations, which confirmed that the analytical data are representative of the shallow groundwater concentrations at the locations sampled.<br><br><u>Precision</u><br><br>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 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 |



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| | goal established in the QAPPs is a RPD of less than or equal to 30%, except for the case in which one (or both) of the primary or duplicate result 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.<br><br>Field precision for the shallow groundwater samples from the OU-2 BHRA Area 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 two pairs of primary and field duplicate results were qualified due to PQL criterion exceedance, and no primary and field duplicate results were qualified due to RPD criterion exceedance (see Appendix C, Table C-3). For laboratory duplicates, there were no data points qualified due to RPD or PQL criterion exceedance (see Appendix E). 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 BHRA, and the effects of these qualified data on the overall risk evaluation are further discussed in Sections 6.1.5 and 6.1.6.<br><br><u>Accuracy</u><br><br>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. As specified in the QAPPs, the objective for trip and equipment blanks is for no analyte to be present at levels greater than the PQL. 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:<br><br>• Holding times;<br>• Field and laboratory blanks;<br>• MS/MSD percent recovery;<br>• Surrogate spike recovery; and<br>• LCS percent recovery. |

**TABLE 4-2. Data Usability Evaluation – Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| | |
|---|---|
| | All qualified results (i.e., U, J, J-, and J+ qualified data) for the shallow groundwater analytes are presented in Appendix E along with the reason codes for these qualified results, and a summary of qualified results is included in Appendix C, Table C-4. 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 each DVSR), the laboratory does not believe that the observed exceedances of laboratory criteria are cause for concern. Therefore, the qualified data are determined to be usable and valid for purposes of the BHRA and are included in the BHRA data set. The impacts of qualified data on the overall risk evaluation are further discussed in Section 6.1.6.<br><br>In summary, with the exception of the rejected data discussed in Appendix C, Table C-2, all data are acceptable through the DQI evaluation and deemed to be usable for risk assessment purposes. |

**TABLE 4-3. Soil Gas Samples Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Sample Location ID | Start Depth (ft bgs) | Depth Category | Well Owner | Land Use | Investigations for VOC Sampling |
|---|---|---|---|---|---|
| RISG-1 | 5 | 5 ft | NERT | Residential | Phase 1 RI, Phase 2 RI, Phase 3 RI |
| | 13 | 10-15 ft | NERT | | |
| | 15 | 10-15 ft | NERT | | |
| RISG-2 | 5 | 5 ft | NERT | Commercial | Phase 1 RI, Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-3 | 5 | 5 ft | NERT | Commercial | Phase 1 RI, Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-4 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-5 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-6 | 5 | 5 ft | NERT | Commercial | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-7 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| | 10 | 10-15 ft | NERT | | |
| RISG-8 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| RISG-9 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| RISG-27 | 5 | 5 ft | NERT | Commercial | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-28 | 5 | 5 ft | NERT | Commercial | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-29 | 5 | 5 ft | NERT | Residential | Phase 2 RI, Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-30 | 5 | 5 ft | NERT | Commercial | Phase 2 RI, Phase 3 RI |
| | 10 | 10-15 ft | NERT | | |
| RISG-52 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-53 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-54 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-55 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-56 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-57 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-58 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-59 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-60 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |

**TABLE 4-3. Soil Gas Samples Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Sample Location ID | Start Depth (ft bgs) | Depth Category | Well Owner | Land Use | Investigations for VOC Sampling |
|---|---|---|---|---|---|
| RISG-61 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 10 | 10-15 ft | NERT | | |
| RISG-62 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-63 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-64 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-65 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-66 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-67 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-68 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-69 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-70 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-71 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-72 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-73 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-74 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-75 | 5 | 5 ft | NERT | Residential | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-76 | 5 | 5 ft | NERT | Commercial | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-77 | 5 | 5 ft | NERT | Trailer | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| RISG-78 | 5 | 5 ft | NERT | Trailer | Phase 3 RI |
| | 15 | 10-15 ft | NERT | | |
| SG06 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG07 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG08 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG09 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG10 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG11 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG12 | 5 | 5 ft | NERT | Commercial | Phase B |

**TABLE 4-3. Soil Gas Samples Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Sample Location ID | Start Depth (ft bgs) | Depth Category | Well Owner | Land Use | Investigations for VOC Sampling |
|---|---|---|---|---|---|
| SG13 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG14 | 5 | 5 ft | NERT | Commercial | Phase B |
| SG15 | 5 | 5 ft | NERT | Commercial | Phase B |

**Notes:**

-- = not applicable
bgs = below ground surface
ft = feet
BHRA = Baseline Health Risk Assessment
NERT = Nevada Environmental Response Trust
RI = Remedial Investigation
VOC = volatile organic compound

**TABLE 4-4. Shallow Groundwater Wells with VOC Sampling Data Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Well ID | Screen Top Depth (ft bgs) | Screen Bottom Depth (ft bgs) | Minimum Depth to Groundwater (ft bgs) | Maximum Depth to Groundwater (ft bgs) | Water Bearing Zone | Well Type | Well Owner | Land Use | Depth Category [1] | Sampling Events for VOCs | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ARP-1 | 14 | 44 | 21.4 | 30.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| ARP-2A | 23.7 | 53.7 | 23.3 | 32.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| ARP-3A | 20.7 | 40.7 | 13.9 | 32.6 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| ARP-4A | 17.7 | 32.7 | 28 | 33.3 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2017 Annual Groundwater Monitoring | |
| ARP-5A | 12.7 | 37.7 | 31.2 | 33.6 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| ARP-6B | 27.7 | 42.7 | 29.9 | 33.3 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| ARP-7 | 14 | 39 | 29.0 | 31.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| ART-6 | 17.9 | 37.9 | 26.8 | 35.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring | |
| BHE1-10 | 10 | 30 | 12.4 | 12.4 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 1 RI | saturated screen thickness > 10 ft |
| M-44 | 5 | 35 | 15.7 | 26.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 2 RI | |
| M-48A | 19.7 | 39.7 | 29 | 31 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| MW-K4 | 9.5 | 50 | 26.5 | 32.9 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-101R | 20 | 50 | 25.0 | 37.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-122 | 23 | 38 | 30.2 | 33.7 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| PC-123 | 20 | 35 | 22.6 | 24.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-124 | 20.3 | 35.3 | 25 | 25.9 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| PC-125 | 18.7 | 33.7 | 23.0 | 25.8 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| PC-126 | 19.5 | 34.5 | 18 | 23 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-127 | 15 | 35 | 18.3 | 19.6 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-128 | 14.8 | 34.8 | 18.4 | 19.4 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-129 | 12.8 | 37.8 | 18.2 | 19.9 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-130 | 14.8 | 49.8 | 14.7 | 21.2 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-131 | 9.8 | 39.8 | 11.2 | 12.3 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-132 | 9.8 | 39.8 | 9.9 | 10.4 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-134A | 59.7 | 69.7 | 28.3 | 36.4 | Middle | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | top screen depth - water table > 5 ft |
| PC-135A | 30.7 | 50.7 | 28.0 | 36.9 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-136 | 21.7 | 41.7 | 32.0 | 34.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| PC-142 | 21.7 | 31.7 | 26.9 | 31.8 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |

**TABLE 4-4. Shallow Groundwater Wells with VOC Sampling Data Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Well ID | Screen Top Depth (ft bgs) | Screen Bottom Depth (ft bgs) | Minimum Depth to Groundwater (ft bgs) | Maximum Depth to Groundwater (ft bgs) | Water Bearing Zone | Well Type | Well Owner | Land Use | Depth Category [1] | Sampling Events for VOCs | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PC-143 | 29.7 | 64.7 | 28.9 | 36.8 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-144 | 29.7 | 39.7 | 28.2 | 36.6 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | |
| PC-145 | 24.7 | 44.7 | 32.7 | 34 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-148 | 24.5 | 44.5 | 27.3 | 33 | Middle | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-149 | 24.5 | 44.5 | 28.4 | 34 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-153 | 10 | 30 | 9.8 | 10.0 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2016 Annual Groundwater Monitoring Q1, 2016 Annual Groundwater Monitoring Q2, 2016 Annual Groundwater Monitoring Q3, Phase 1 RI | saturated screen thickness > 10 ft |
| PC-153R | 10 | 30 | 9.5 | 10.0 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, Phase 2 RI | saturated screen thickness > 10 ft |
| PC-160 | 9 | 24 | 13 | 14.2 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, 2016 Annual Groundwater Monitoring Q1, 2016 Annual Groundwater Monitoring Q2, 2016 Annual Groundwater Monitoring Q3, Phase 1 RI | |
| PC-161 | 9 | 34 | 7.0 | 7.0 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-162 | 10 | 45 | 8.2 | 8.2 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-163 | 10 | 25 | 16 | 16.4 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | |
| PC-164 | 15 | 30 | 21.5 | 21.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | |
| PC-165 | 13 | 38 | 12.2 | 12.2 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-166 | 12 | 32 | 12.3 | 12.3 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-167 | 15 | 35 | 11 | 11 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-168 | 15 | 35 | 20 | 19.6 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI, Phase 3 RI | saturated screen thickness > 10 ft |
| PC-169 | 15 | 30 | 23.4 | 23.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | |
| PC-171 | 15 | 30 | 20.6 | 20.6 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | |
| PC-172D | 30 | 50 | 24.1 | 24.1 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI, Phase 3 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-174 | 10 | 25 | 22.7 | 23 | Shallow | Monitoring | NERT | Trailer | ≥ 20 ft bgs | Phase 2 RI | |
| PC-175 | 14 | 39 | 22.9 | 22.9 | Shallow | Monitoring | NERT | Trailer | ≥ 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-177 | 45 | 60 | 22.0 | 22.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-179 | 35 | 50 | 12.0 | 12.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-18 | 11.5 | 51.5 | 23.7 | 37.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-180 | 35 | 45 | 27.2 | 27.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-181 | 55 | 65 | 26.4 | 26.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-183 | 35 | 45 | 23.0 | 23 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-184 | 55 | 65 | 24.4 | 24.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-186 | 20 | 35 | 18.4 | 18.4 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-187 | 45 | 55 | 26 | 25.7 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-187R | 45 | 55 | 25.8 | 25.8 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft |
| PC-188 | 50 | 60 | 32.0 | 32.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, Phase 2 RI | top screen depth - water table > 5 ft |
| PC-189 | 50 | 60 | 30 | 30.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, Phase 2 RI | top screen depth - water table > 5 ft |

**TABLE 4-4. Shallow Groundwater Wells with VOC Sampling Data Evaluated in the BHRA**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Well ID | Screen Top Depth (ft bgs) | Screen Bottom Depth (ft bgs) | Minimum Depth to Groundwater (ft bgs) | Maximum Depth to Groundwater (ft bgs) | Water Bearing Zone | Well Type | Well Owner | Land Use | Depth Category [1] | Sampling Events for VOCs | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PC-190 | 14 | 34 | 11 | 11 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | Phase 2 RI | saturated screen thickness > 10 ft |
| PC-192 | 35 | 50 | 16 | 15.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-193 | 35 | 50 | 16.2 | 16.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-194 | 44 | 59 | 10.1 | 10 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | Phase 2 RI | top screen depth - water table > 5 ft; saturated screen thickness > 10 ft |
| PC-21A | 14 | 34 | 29.3 | 32.8 | Shallow | Monitoring | NERT | Trailer | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-24 | 15 | 30 | 20 | 21.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-28 | 10 | 19.5 | 12.3 | 13.3 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-31 | 14.5 | 49.5 | 11.1 | 12.0 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-37 | 16.8 | 41.8 | 30.4 | 37.1 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2017 Annual Groundwater Monitoring, Phase 2 RI | |
| PC-50 | 11.8 | 41.8 | 12.5 | 13.7 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-54 | 9.5 | 34.5 | 24 | 25.8 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-55 | 15.3 | 55.3 | 23.9 | 35.5 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring | saturated screen thickness > 10 ft |
| PC-64 | 4 | 19 | 11.1 | 12.2 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-65 | 4.1 | 18.7 | 11.0 | 12.5 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-66 | 6.9 | 26.9 | 14 | 20.5 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | |
| PC-67 | 11 | 35.6 | 14.6 | 16 | Shallow | Monitoring | NERT | Commercial | < 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 1 RI | saturated screen thickness > 10 ft |
| PC-71 | 13.4 | 28.4 | 25.4 | 30.0 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 2 RI | |
| PC-72 | 15 | 35 | 28.4 | 32.2 | Shallow | Monitoring | NERT | Commercial | ≥ 20 ft bgs | 2020 Annual Groundwater Monitoring, 2019 Annual Groundwater Monitoring, 2018 Annual Groundwater Monitoring, 2017 Annual Groundwater Monitoring, Phase 2 RI | |

**Notes:**

-- = not applicable
bgs = below ground surface
ft = feet
BHRA = Baseline Health Risk Assessment
NERT = Nevada Environmental Response Trust
Q = Quarter
RI = Remedial Investigation
VOC = volatile organic compound

[1] Groundwater wells categorized as "< 20 ft bgs" were conservatively modeled as 10 ft bgs and those categorized as "≥ 20 ft bgs" were conservatively modeled as 20 ft bgs during risk evaluation.

**TABLE 4-5. Evaluation of Sample Quantitation Limits – Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 |
| Acetone | 49,700,000 | Indoor resident scenario | µg/m$^3$ | 78 | 61 | 78 | 0.72 | 38 | 0 | 0 |
| Acrolein | 32 | Indoor resident scenario | µg/m$^3$ | 11 | 0 | 0 | 0.23 | 21 | 0 | 4 |
| Acrylonitrile | 62 | Indoor resident scenario | µg/m$^3$ | 63 | 5 | 7.9 | 0.10 | 29 | 0 | 21 |
| t-Amyl methyl ether | 7,570,000 | Indoor resident scenario | µg/m$^3$ | 14 | 0 | 0 | 0.074 | 1.2 | 0 | 0 |
| Benzene | 9.97E+17 | Indoor resident scenario | µg/m$^3$ | 78 | 48 | 62 | 0.16 | 15 | 0 | 0 |
| Benzyl chloride | 142 | Indoor resident scenario | µg/m$^3$ | 78 | 1 | 1.3 | 0.13 | 50 | 0 | 1 |
| Bromodichloromethane | 209 | Indoor resident scenario | µg/m$^3$ | 78 | 40 | 51 | 0.011 | 26 | 0 | 1 |
| Bromoform | 10,500 | Indoor resident scenario | µg/m$^3$ | 78 | 4 | 5.1 | 0.11 | 43 | 0 | 0 |
| Bromomethane | 8,830 | Indoor resident scenario | µg/m$^3$ | 29 | 2 | 6.9 | 0.074 | 77 | 0 | 0 |
| 1,3-Butadiene | 159 | Indoor resident scenario | µg/m$^3$ | 3 | 0 | 0 | 0.55 | 0.55 | 0 | 0 |
| 2-Butanone | 9,190,000 | Indoor resident scenario | µg/m$^3$ | 78 | 45 | 58 | 1.3 | 35 | 0 | 0 |
| tert Butyl alcohol | 8,320,000 | Indoor resident scenario | µg/m$^3$ | 14 | 11 | 79 | 17 | 17 | 0 | 0 |
| sec-Butylbenzene | 1,220,000 | Indoor resident scenario | µg/m$^3$ | 11 | 2 | 18 | 0.085 | 0.37 | 0 | 0 |
| tert-Butylbenzene | 1,220,000 | Indoor resident scenario | µg/m$^3$ | 11 | 1 | 9.1 | 0.074 | 0.32 | 0 | 0 |
| Carbon disulfide | 1,180,000 | Indoor resident scenario | µg/m$^3$ | 78 | 57 | 73 | 0.46 | 59 | 0 | 0 |
| Carbon tetrachloride | 1,280 | Indoor resident scenario | µg/m$^3$ | 78 | 72 | 92 | 2.0 | 2.0 | 0 | 0 |
| 3-Chloro-1-propene | 839 | Indoor resident scenario | µg/m$^3$ | 11 | 1 | 9.1 | 0.074 | 0.32 | 0 | 0 |
| Chlorobenzene | 116,000 | Indoor resident scenario | µg/m$^3$ | 78 | 22 | 28 | 0.075 | 18 | 0 | 0 |
| Chloroethane | 17,200,000 | Indoor resident scenario | µg/m$^3$ | 78 | 32 | 41 | 0.031 | 48 | 0 | 0 |
| Chloromethane | 135,000 | Indoor resident scenario | µg/m$^3$ | 78 | 27 | 35 | 0.043 | 24 | 0 | 0 |
| Cumene | 1,080,000 | Indoor resident scenario | µg/m$^3$ | 11 | 5 | 45 | 0.082 | 0.36 | 0 | 0 |
| Cyclohexane | 12,800,000 | Indoor resident scenario | µg/m$^3$ | 52 | 9 | 17 | 0.15 | 4.9 | 0 | 0 |
| p-Cymene | 899,000 | Indoor resident scenario | µg/m$^3$ | 11 | 10 | 91 | 0.10 | 0.10 | 0 | 0 |
| 1,2-Dibromo-3-chloropropane | 2.0 | Indoor resident scenario | µg/m$^3$ | 63 | 0 | 0 | 0.0056 | 130 | 49 | 51 |
| Dibromochloromethane | N/A | -- | µg/m$^3$ | 78 | 15 | 19 | 0.0048 | 40 | -- | -- |
| 1,2-Dibromoethane | 16 | Indoor resident scenario | µg/m$^3$ | 78 | 6 | 7.7 | 0.0037 | 34 | 1 | 23 |
| 1,2-Dichlorobenzene | 576,000 | Indoor resident scenario | µg/m$^3$ | 78 | 2 | 2.6 | 0.097 | 47 | 0 | 0 |
| 1,3-Dichlorobenzene | 482,000 | Indoor resident scenario | µg/m$^3$ | 78 | 40 | 51 | 0.092 | 39 | 0 | 0 |
| 1,4-Dichlorobenzene | 718 | Indoor resident scenario | µg/m$^3$ | 78 | 17 | 22 | 0.11 | 53 | 0 | 0 |
| Dichlorodifluoromethane | 222,000 | Indoor resident scenario | µg/m$^3$ | 78 | 67 | 86 | 3.0 | 43 | 0 | 0 |
| 1,1-Dichloroethane | 3,450 | Indoor resident scenario | µg/m$^3$ | 78 | 36 | 46 | 0.027 | 17 | 0 | 0 |
| 1,2-Dichloroethane | 208 | Indoor resident scenario | µg/m$^3$ | 78 | 11 | 14 | 0.024 | 21 | 0 | 1 |
| 1,1-Dichloroethene | 400,000 | Indoor resident scenario | µg/m$^3$ | 78 | 39 | 50 | 0.023 | 3.2 | 0 | 0 |
| cis-1,2-Dichloroethene | 78,400 | Indoor resident scenario | µg/m$^3$ | 78 | 10 | 13 | 0.027 | 21 | 0 | 0 |

**TABLE 4-5. Evaluation of Sample Quantitation Limits – Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 |
| trans-1,2-Dichloroethene | 79,000 | Indoor resident scenario | µg/m$^3$ | 78 | 5 | 6.4 | 0.025 | 24 | 0 | 0 |
| 1,2-Dichloropropane | 1,670 | Indoor resident scenario | µg/m$^3$ | 78 | 4 | 5.1 | 0.010 | 66 | 0 | 0 |
| 1,3-Dichloropropene | 1,490 | Indoor resident scenario | µg/m$^3$ | 29 | 0 | 0 | 0.093 | 28 | 0 | 0 |
| Diisopropyl ether | 1,770,000 | Indoor resident scenario | µg/m$^3$ | 14 | 0 | 0 | 0.087 | 0.38 | 0 | 0 |
| 1,4-Dioxane | 724 | Indoor resident scenario | µg/m$^3$ | 63 | 6 | 9.5 | 0.091 | 26 | 0 | 0 |
| Ethanol | 119,000,000 | Indoor resident scenario | µg/m$^3$ | 63 | 48 | 76 | 0.33 | 14 | 0 | 0 |
| Ethyl tert-butyl ether | 84,900 | Indoor resident scenario | µg/m$^3$ | 14 | 0 | 0 | 0.075 | 0.80 | 0 | 0 |
| Ethyl acetate | 143,000 | Indoor resident scenario | µg/m$^3$ | 52 | 0 | 0 | 0.36 | 48 | 0 | 0 |
| Ethylbenzene | 2,620 | Indoor resident scenario | µg/m$^3$ | 78 | 46 | 59 | 0.098 | 16 | 0 | 0 |
| 4-Ethyltoluene | 899,000 | Indoor resident scenario | µg/m$^3$ | 78 | 22 | 28 | 0.088 | 55 | 0 | 0 |
| Freon 114 | 20,700,000 | Indoor resident scenario | µg/m$^3$ | 29 | 4 | 14 | 0.077 | 64 | 0 | 0 |
| n-Heptane | 1,060,000 | Indoor resident scenario | µg/m$^3$ | 63 | 15 | 24 | 0.22 | 5.7 | 0 | 0 |
| Hexachlorobutadiene | 694 | Indoor resident scenario | µg/m$^3$ | 78 | 8 | 10 | 0.13 | 270 | 0 | 1 |
| n-Hexane | 1,610,000 | Indoor resident scenario | µg/m$^3$ | 52 | 8 | 15 | 0.31 | 8.6 | 0 | 0 |
| 2-Hexanone | 69,300 | Indoor resident scenario | µg/m$^3$ | 78 | 13 | 17 | 0.16 | 21 | 0 | 0 |
| Methyl tert-butyl ether | 23,100 | Indoor resident scenario | µg/m$^3$ | 14 | 7 | 50 | 0.077 | 0.51 | 0 | 0 |
| 4-Methyl-2-pentanone | 7,040,000 | Indoor resident scenario | µg/m$^3$ | 78 | 16 | 21 | 0.16 | 33 | 0 | 0 |
| Methylene Chloride | 477,000 | Indoor resident scenario | µg/m$^3$ | 78 | 40 | 51 | 0.34 | 10 | 0 | 0 |
| Methylmethacrylate | 1,560,000 | Indoor resident scenario | µg/m$^3$ | 63 | 0 | 0 | 0.11 | 140 | 0 | 0 |
| alpha-Methylstyrene | 2,610,000 | Indoor resident scenario | µg/m$^3$ | 11 | 4 | 36 | 0.11 | 0.47 | 0 | 0 |
| Naphthalene | 212 | Indoor resident scenario | µg/m$^3$ | 63 | 29 | 46 | 0.076 | 6.5 | 0 | 0 |
| n-Octane | 53,200 | Indoor resident scenario | µg/m$^3$ | 11 | 9 | 82 | 0.077 | 0.083 | 0 | 0 |
| n-Propylbenzene | 2,720,000 | Indoor resident scenario | µg/m$^3$ | 11 | 9 | 82 | 0.080 | 0.33 | 0 | 0 |
| Propylene | 4,940,000 | Indoor resident scenario | µg/m$^3$ | 3 | 0 | 0 | 19 | 19 | 0 | 0 |
| Styrene | 2,350,000 | Indoor resident scenario | µg/m$^3$ | 78 | 19 | 24 | 0.078 | 15 | 0 | 0 |
| 1,1,1,2-Tetrachloroethane | 1,200 | Indoor resident scenario | µg/m$^3$ | 52 | 1 | 1.9 | 0.0070 | 92 | 0 | 0 |
| 1,1,2,2-Tetrachloroethane | 150 | Indoor resident scenario | µg/m$^3$ | 78 | 1 | 1.3 | 0.0076 | 28 | 0 | 1 |
| Tetrahydrofuran | 3,470,000 | Indoor resident scenario | µg/m$^3$ | 52 | 4 | 7.7 | 0.21 | 11 | 0 | 0 |
| Toluene | 10,900,000 | Indoor resident scenario | µg/m$^3$ | 78 | 67 | 86 | 0.53 | 4.0 | 0 | 0 |
| 1,2,4-Trichlorobenzene | 7,860 | Indoor resident scenario | µg/m$^3$ | 78 | 2 | 2.6 | 0.11 | 190 | 0 | 0 |
| 1,1,1-Trichloroethane | 12,700,000 | Indoor resident scenario | µg/m$^3$ | 29 | 3 | 10 | 0.074 | 21 | 0 | 0 |
| 1,1,2-Trichloroethane | 416 | Indoor resident scenario | µg/m$^3$ | 78 | 1 | 1.3 | 0.012 | 22 | 0 | 0 |
| Trichloroethene | 1,590 | Indoor resident scenario | µg/m$^3$ | 78 | 70 | 90 | 0.12 | 34 | 0 | 0 |
| Trichlorofluoromethane | 1.25E+13 | Construction worker scenario | µg/m$^3$ | 78 | 47 | 60 | 1.8 | 66 | 0 | 0 |

**TABLE 4-5. Evaluation of Sample Quantitation Limits – Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 |
| 1,2,3-Trichloropropane | 839 | Indoor resident scenario | $\mu g/m^3$ | 49 | 0 | 0 | 1.6 | 81 | 0 | 0 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 20,700,000 | Indoor resident scenario | $\mu g/m^3$ | 78 | 25 | 32 | 0.27 | 74 | 0 | 0 |
| 1,2,4-Trimethylbenzene | 162,000 | Indoor resident scenario | $\mu g/m^3$ | 78 | 38 | 49 | 0.18 | 47 | 0 | 0 |
| 1,3,5-Trimethylbenzene | 163,000 | Indoor resident scenario | $\mu g/m^3$ | 78 | 20 | 26 | 0.092 | 37 | 0 | 0 |
| Vinyl acetate | 404,000 | Indoor resident scenario | $\mu g/m^3$ | 78 | 12 | 15 | 0.32 | 30 | 0 | 0 |
| Vinyl chloride | 1,030 | Indoor resident scenario | $\mu g/m^3$ | 78 | 3 | 3.9 | 0.0075 | 18 | 0 | 0 |
| Xylenes (total) | 243,000 | Indoor resident scenario | $\mu g/m^3$ | 78 | 64 | 82 | 0.18 | 26 | 0 | 0 |

**Notes:**

-- = no value
$\mu g/m^3$ = microgram per cubic meter
bgs = below ground surface
N/A = no screening level available
RBTC = risk-based target concentration
SQL = sample quantitation limit

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

**TABLE 4-6. Evaluation of Sample Quantitation Limits – Soil Gas at 10 to 15 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 |
| Acetone | 151,000,000 | Indoor resident scenario | µg/m$^3$ | 58 | 46 | 79 | 6.2 | 72 | 0 | 0 |
| Acrolein | 100 | Indoor resident scenario | µg/m$^3$ | 9 | 1 | 11 | 0.23 | 21 | 0 | 3 |
| Acrylonitrile | 195 | Indoor resident scenario | µg/m$^3$ | 46 | 1 | 2.2 | 0.20 | 43 | 0 | 11 |
| t-Amyl methyl ether | 25,600,000 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 1.2 | 1.2 | 0 | 0 |
| Benzene | 1.15E+19 | Indoor resident scenario | µg/m$^3$ | 58 | 30 | 52 | 0.41 | 19 | 0 | 0 |
| Benzyl chloride | 477 | Indoor resident scenario | µg/m$^3$ | 58 | 0 | 0 | 0.19 | 64 | 0 | 2 |
| Bromodichloromethane | 716 | Indoor resident scenario | µg/m$^3$ | 58 | 26 | 45 | 0.45 | 33 | 0 | 0 |
| Bromoform | 36,700 | Indoor resident scenario | µg/m$^3$ | 58 | 0 | 0 | 0.22 | 55 | 0 | 0 |
| Bromomethane | 28,400 | Indoor resident scenario | µg/m$^3$ | 16 | 0 | 0 | 0.36 | 98 | 0 | 0 |
| 1,3-Butadiene | 511 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 0.55 | 0.55 | 0 | 0 |
| 2-Butanone | 29,000,000 | Indoor resident scenario | µg/m$^3$ | 58 | 33 | 57 | 1.7 | 44 | 0 | 0 |
| tert Butyl alcohol | 24,100,000 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 17 | 17 | 0 | 0 |
| Carbon disulfide | 3,770,000 | Indoor resident scenario | µg/m$^3$ | 58 | 32 | 55 | 0.53 | 110 | 0 | 0 |
| Carbon tetrachloride | 4,360 | Indoor resident scenario | µg/m$^3$ | 58 | 54 | 93 | 2.0 | 4.6 | 0 | 0 |
| Chlorobenzene | 388,000 | Indoor resident scenario | µg/m$^3$ | 58 | 6 | 10 | 0.16 | 22 | 0 | 0 |
| Chloroethane | 55,100,000 | Indoor resident scenario | µg/m$^3$ | 58 | 12 | 21 | 0.034 | 61 | 0 | 0 |
| Chloromethane | 420,000 | Indoor resident scenario | µg/m$^3$ | 58 | 18 | 31 | 0.12 | 31 | 0 | 0 |
| Cyclohexane | 42,300,000 | Indoor resident scenario | µg/m$^3$ | 46 | 5 | 11 | 0.20 | 9.3 | 0 | 0 |
| 1,2-Dibromo-3-chloropropane | 7.0 | Indoor resident scenario | µg/m$^3$ | 46 | 1 | 2.2 | 0.0056 | 190 | 41 | 42 |
| Dibromochloromethane | N/A | -- | µg/m$^3$ | 58 | 7 | 12 | 0.0048 | 51 | -- | -- |
| 1,2-Dibromoethane | 57 | Indoor resident scenario | µg/m$^3$ | 58 | 6 | 10 | 0.0037 | 44 | 0 | 16 |
| 1,2-Dichlorobenzene | 1,970,000 | Indoor resident scenario | µg/m$^3$ | 58 | 0 | 0 | 0.16 | 59 | 0 | 0 |
| 1,3-Dichlorobenzene | 1,620,000 | Indoor resident scenario | µg/m$^3$ | 58 | 25 | 43 | 0.26 | 50 | 0 | 0 |
| 1,4-Dichlorobenzene | 2,460 | Indoor resident scenario | µg/m$^3$ | 58 | 5 | 8.6 | 0.14 | 68 | 0 | 0 |
| Dichlorodifluoromethane | 740,000 | Indoor resident scenario | µg/m$^3$ | 58 | 40 | 69 | 0.56 | 54 | 0 | 0 |
| 1,1-Dichloroethane | 11,400 | Indoor resident scenario | µg/m$^3$ | 58 | 36 | 62 | 0.046 | 7.7 | 0 | 0 |
| 1,2-Dichloroethane | 681 | Indoor resident scenario | µg/m$^3$ | 58 | 9 | 16 | 0.028 | 27 | 0 | 0 |
| 1,1-Dichloroethene | 1,310,000 | Indoor resident scenario | µg/m$^3$ | 58 | 42 | 72 | 0.12 | 7.7 | 0 | 0 |
| cis-1,2-Dichloroethene | 256,000 | Indoor resident scenario | µg/m$^3$ | 58 | 8 | 14 | 0.039 | 27 | 0 | 0 |
| trans-1,2-Dichloroethene | 259,000 | Indoor resident scenario | µg/m$^3$ | 58 | 7 | 12 | 0.042 | 30 | 0 | 0 |
| 1,2-Dichloropropane | 5,560 | Indoor resident scenario | µg/m$^3$ | 58 | 5 | 8.6 | 0.010 | 84 | 0 | 0 |
| 1,3-Dichloropropene | 4,960 | Indoor resident scenario | µg/m$^3$ | 16 | 0 | 0 | 0.30 | 36 | 0 | 0 |

**TABLE 4-6. Evaluation of Sample Quantitation Limits – Soil Gas at 10 to 15 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 | 5,970,000 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 0.35 | 0.35 | 0 | 0 |
| 1,4-Dioxane | 1,820 | Indoor resident scenario | µg/m$^3$ | 46 | 0 | 0 | 0.13 | 38 | 0 | 0 |
| Ethanol | 306,000,000 | Indoor resident scenario | µg/m$^3$ | 46 | 26 | 57 | 0.38 | 26 | 0 | 0 |
| Ethyl tert-butyl ether | 287,000 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 0.80 | 0.80 | 0 | 0 |
| Ethyl acetate | 465,000 | Indoor resident scenario | µg/m$^3$ | 46 | 3 | 6.5 | 0.36 | 72 | 0 | 0 |
| Ethylbenzene | 8,800 | Indoor resident scenario | µg/m$^3$ | 58 | 23 | 40 | 0.11 | 21 | 0 | 0 |
| 4-Ethyltoluene | 3,000,000 | Indoor resident scenario | µg/m$^3$ | 58 | 7 | 12 | 0.21 | 69 | 0 | 0 |
| Freon 114 | 73,100,000 | Indoor resident scenario | µg/m$^3$ | 16 | 0 | 0 | 0.60 | 82 | 0 | 0 |
| n-Heptane | 3,620,000 | Indoor resident scenario | µg/m$^3$ | 46 | 2 | 4.4 | 0.26 | 9.2 | 0 | 0 |
| Hexachlorobutadiene | 2,490 | Indoor resident scenario | µg/m$^3$ | 58 | 3 | 5.2 | 0.15 | 350 | 0 | 2 |
| n-Hexane | 5,380,000 | Indoor resident scenario | µg/m$^3$ | 46 | 8 | 17 | 0.37 | 16 | 0 | 0 |
| 2-Hexanone | 227,000 | Indoor resident scenario | µg/m$^3$ | 58 | 2 | 3.5 | 0.16 | 27 | 0 | 0 |
| Methyl tert-butyl ether | 76,800 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 0.51 | 0.51 | 0 | 0 |
| 4-Methyl-2-pentanone | 23,300,000 | Indoor resident scenario | µg/m$^3$ | 58 | 7 | 12 | 0.19 | 42 | 0 | 0 |
| Methylene Chloride | 1,540,000 | Indoor resident scenario | µg/m$^3$ | 58 | 27 | 47 | 0.42 | 15 | 0 | 0 |
| Methylmethacrylate | 5,160,000 | Indoor resident scenario | µg/m$^3$ | 46 | 2 | 4.4 | 0.42 | 200 | 0 | 0 |
| Naphthalene | 719 | Indoor resident scenario | µg/m$^3$ | 46 | 14 | 30 | 0.19 | 12 | 0 | 0 |
| Propylene | 15,700,000 | Indoor resident scenario | µg/m$^3$ | 4 | 0 | 0 | 19 | 19 | 0 | 0 |
| Styrene | 7,870,000 | Indoor resident scenario | µg/m$^3$ | 58 | 6 | 10 | 0.086 | 19 | 0 | 0 |
| 1,1,1,2-Tetrachloroethane | 4,160 | Indoor resident scenario | µg/m$^3$ | 46 | 1 | 2.2 | 0.0070 | 140 | 0 | 0 |
| 1,1,2,2-Tetrachloroethane | 514 | Indoor resident scenario | µg/m$^3$ | 58 | 0 | 0 | 0.0076 | 36 | 0 | 0 |
| Tetrachloroethene | 114,000 | Indoor resident scenario | µg/m$^3$ | 58 | 57 | 98 | 1.7 | 1.7 | 0 | 0 |
| Tetrahydrofuran | 10,900,000 | Indoor resident scenario | µg/m$^3$ | 46 | 5 | 11 | 0.21 | 11 | 0 | 0 |
| Toluene | 36,200,000 | Indoor resident scenario | µg/m$^3$ | 58 | 39 | 67 | 0.53 | 15 | 0 | 0 |
| 1,2,4-Trichlorobenzene | 27,600 | Indoor resident scenario | µg/m$^3$ | 58 | 2 | 3.5 | 0.17 | 240 | 0 | 0 |
| 1,1,1-Trichloroethane | 43,100,000 | Indoor resident scenario | µg/m$^3$ | 16 | 0 | 0 | 0.35 | 27 | 0 | 0 |
| 1,1,2-Trichloroethane | 1,400 | Indoor resident scenario | µg/m$^3$ | 58 | 3 | 5.2 | 0.012 | 28 | 0 | 0 |
| Trichloroethene | 5,350 | Indoor resident scenario | µg/m$^3$ | 58 | 50 | 86 | 0.30 | 13 | 0 | 0 |
| Trichlorofluoromethane | 1.25E+13 | Construction worker scenario | µg/m$^3$ | 58 | 25 | 43 | 1.6 | 83 | 0 | 0 |
| 1,2,3-Trichloropropane | 2,850 | Indoor resident scenario | µg/m$^3$ | 42 | 0 | 0 | 1.4 | 120 | 0 | 0 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 73,100,000 | Indoor resident scenario | µg/m$^3$ | 58 | 8 | 14 | 0.33 | 94 | 0 | 0 |
| 1,2,4-Trimethylbenzene | 550,000 | Indoor resident scenario | µg/m$^3$ | 58 | 20 | 34 | 0.31 | 60 | 0 | 0 |
| 1,3,5-Trimethylbenzene | 555,000 | Indoor resident scenario | µg/m$^3$ | 58 | 9 | 16 | 0.19 | 46 | 0 | 0 |

**TABLE 4-6. Evaluation of Sample Quantitation Limits – Soil Gas at 10 to 15 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 | 1,320,000 | Indoor resident scenario | $\mu g/m^3$ | 58 | 0 | 0 | 0.55 | 39 | 0 | 0 |
| Vinyl chloride | 3,270 | Indoor resident scenario | $\mu g/m^3$ | 58 | 2 | 3.5 | 0.0075 | 23 | 0 | 0 |
| Xylenes (total) | 816,000 | Indoor resident scenario | $\mu g/m^3$ | 58 | 37 | 64 | 1.7 | 33 | 0 | 0 |

**Notes:**

-- = no value
$\mu g/m^3$ = microgram per cubic meter
bgs = below ground surface
N/A = no screening level available
RBTC = risk-based target concentration
SQL = sample quantitation limit

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

**TABLE 4-7. Evaluation of Sample Quantitation Limits – Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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 | 1,510,000,000 | Construction worker scenario | µg/L | 278 | 4 | 1.4 | 0.20 | 2.5 | 0 | 0 |
| Bromobenzene | 11,200 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | 0 | 0 |
| Bromochloromethane | 6,950 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.15 | 2.5 | 0 | 0 |
| Bromodichloromethane | 13 | Indoor resident scenario | µg/L | 278 | 21 | 7.6 | 0.17 | 2.5 | 0 | 18 |
| Bromoform | 2,300 | Indoor resident scenario | µg/L | 278 | 13 | 4.7 | 0.29 | 4.0 | 0 | 0 |
| Bromomethane | 133 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| 2-Butanone | 12,900,000 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 2.5 | 25 | 0 | 0 |
| n-Butylbenzene | 13,900 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.24 | 4.0 | 0 | 0 |
| sec-Butylbenzene | 12,200 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| tert-Butylbenzene | 16,100 | Indoor resident scenario | µg/L | 278 | 1 | 0.36 | 0.17 | 2.5 | 0 | 0 |
| Carbon tetrachloride | 6.1 | Indoor resident scenario | µg/L | 278 | 123 | 44 | 0.18 | 2.5 | 0 | 10 |
| Chlorobenzene | 5,070 | Indoor resident scenario | µg/L | 278 | 44 | 16 | 0.18 | 2.5 | 0 | 0 |
| Chloroethane | 173,000 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.36 | 4.0 | 0 | 0 |
| Chloroform | 8.6 | Indoor resident scenario | µg/L | 289 | 277 | 96 | 0.25 | 0.25 | 0 | 0 |
| Chloromethane | 1,570 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| 2-Chlorotoluene | 5,580 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.18 | 2.5 | 0 | 0 |
| 4-Chlorotoluene | 4,670 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| Cumene | 15,300 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| p-Cymene | 69 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| 1,2-Dibromo-3-chloropropane | 1.4 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.50 | 5.0 | 20 | 278 |
| Dibromochloromethane | N/A | -- | µg/L | 278 | 5 | 1.8 | 0.25 | 2.5 | -- | -- |
| 1,2-Dibromoethane | 2.9 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | 0 | 29 |
| Dibromomethane | 1,630 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| 1,2-Dichlorobenzene | 43,700 | Indoor resident scenario | µg/L | 278 | 97 | 35 | 0.19 | 2.5 | 0 | 0 |
| 1,3-Dichlorobenzene | 22,700 | Indoor resident scenario | µg/L | 278 | 77 | 28 | 0.18 | 2.5 | 0 | 0 |
| 1,4-Dichlorobenzene | 43 | Indoor resident scenario | µg/L | 278 | 86 | 31 | 0.17 | 2.5 | 0 | 0 |
| Dichlorodifluoromethane | 85 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 4.0 | 0 | 0 |
| 1,1-Dichloroethane | 75 | Indoor resident scenario | µg/L | 278 | 106 | 38 | 0.24 | 2.5 | 0 | 0 |
| 1,2-Dichloroethane | 21 | Indoor resident scenario | µg/L | 278 | 18 | 6.5 | 0.20 | 2.5 | 0 | 8 |
| 1,1-Dichloroethene | 1,810 | Indoor resident scenario | µg/L | 278 | 25 | 9.0 | 0.25 | 2.5 | 0 | 0 |
| cis-1,2-Dichloroethene | 2,330 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | 0 | 0 |
| trans-1,2-Dichloroethene | 1,020 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.23 | 2.5 | 0 | 0 |

**TABLE 4-7. Evaluation of Sample Quantitation Limits – Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Screening Levels[1] | Screening Level 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-Dichloropropane | 76 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| 1,3-Dichloropropane | 1,160 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | 0 | 0 |
| 2,2-Dichloropropane | 52 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.16 | 4.0 | 0 | 0 |
| 1,1-Dichloropropene | 81 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.20 | 2.5 | 0 | 0 |
| 1,3-Dichloropropene | 55 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| 1,4-Dioxane | 9,680 | Indoor resident scenario | µg/L | 278 | 145 | 52 | 0.50 | 0.50 | 0 | 0 |
| Ethyl tert-butyl ether | 4,620 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | 0 | 0 |
| Ethylbenzene | 47 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | 0 | 0 |
| Hexachlorobutadiene | 11 | Indoor resident scenario | µg/L | 278 | 3 | 1.1 | 0.25 | 2.5 | 0 | 19 |
| Methylene Chloride | 17,000 | Indoor resident scenario | µg/L | 278 | 22 | 7.9 | 0.88 | 8.8 | 0 | 0 |
| Naphthalene | 63 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.21 | 4.0 | 0 | 0 |
| n-Propylbenzene | 39,600 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| Styrene | 119,000 | Indoor resident scenario | µg/L | 275 | 0 | 0 | 0.25 | 2.5 | 0 | 0 |
| 1,1,1,2-Tetrachloroethane | 70 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.15 | 2.5 | 0 | 0 |
| 1,1,2,2-Tetrachloroethane | 46 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | 0 | 0 |
| Tetrachloroethene | 266 | Indoor resident scenario | µg/L | 278 | 130 | 47 | 0.14 | 2.5 | 0 | 0 |
| Toluene | 219,000 | Indoor resident scenario | µg/L | 278 | 13 | 4.7 | 0.17 | 2.5 | 0 | 0 |
| 1,2,3-Trichlorobenzene | 1,030 | Indoor resident scenario | µg/L | 278 | 51 | 18 | 0.23 | 4.0 | 0 | 0 |
| 1,2,4-Trichlorobenzene | 836 | Indoor resident scenario | µg/L | 278 | 67 | 24 | 0.20 | 4.0 | 0 | 0 |
| 1,1,1-Trichloroethane | 96,100 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | 0 | 0 |
| 1,1,2-Trichloroethane | 61 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | 0 | 0 |
| Trichloroethene | 21 | Indoor resident scenario | µg/L | 278 | 143 | 51 | 0.20 | 2.5 | 0 | 8 |
| Trichlorofluoromethane | 2,070,000 | Construction worker scenario | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | 0 | 0 |
| 1,2,3-Trichloropropane | 281 | Indoor resident scenario | µg/L | 299 | 209 | 70 | 0.0025 | 0.40 | 0 | 0 |
| 1,2,4-Trimethylbenzene | 4,030 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| 1,3,5-Trimethylbenzene | 2,870 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | 0 | 0 |
| Vinyl chloride | 4.0 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.18 | 2.5 | 0 | 29 |
| Xylenes (total) | 5,210 | Indoor resident scenario | µg/L | 278 | 0 | 0 | 0.38 | 5.0 | 0 | 0 |

**Notes:**

-- = no value
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 residents, indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers.

**TABLE 4-8. Summary Statistics for VOCs in Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| Acetone | µg/m$^3$ | 78 | 61 | 78 | 0.72 | 38 | 3.6 | 140 | 18 | 27 | 28 | 1.0 | RISG-2 |
| Acrolein | µg/m$^3$ | 11 | 0 | 0 | 0.23 | 21 | -- | -- | -- | -- | -- | -- | -- |
| Acrylonitrile | µg/m$^3$ | 63 | 5 | 7.9 | 0.10 | 29 | 0.11 | 0.26 | 0.14 | 0.16 | 0.060 | 0.39 | SG14 |
| t-Amyl methyl ether | µg/m$^3$ | 14 | 0 | 0 | 0.074 | 1.2 | -- | -- | -- | -- | -- | -- | -- |
| Benzene | µg/m$^3$ | 78 | 48 | 62 | 0.16 | 15 | 0.23 | 10 | 1.8 | 2.4 | 2.3 | 0.96 | RISG-30 |
| Benzyl chloride | µg/m$^3$ | 78 | 1 | 1.3 | 0.13 | 50 | 10 | 10 | 10 | 10 | -- | -- | RISG-5 |
| Bromodichloromethane | µg/m$^3$ | 78 | 40 | 51 | 0.011 | 26 | 0.18 | 340 | 4.5 | 25 | 73 | 3.0 | RISG-74 |
| Bromoform | µg/m$^3$ | 78 | 4 | 5.1 | 0.11 | 43 | 0.27 | 4.5 | 0.71 | 1.5 | 2.0 | 1.3 | RISG-5 |
| Bromomethane | µg/m$^3$ | 29 | 2 | 6.9 | 0.074 | 77 | 0.088 | 0.091 | 0.089 | 0.089 | 0.0021 | 0.024 | SG07 |
| 1,3-Butadiene | µg/m$^3$ | 3 | 0 | 0 | 0.55 | 0.55 | -- | -- | -- | -- | -- | -- | -- |
| 2-Butanone | µg/m$^3$ | 78 | 45 | 58 | 1.3 | 35 | 0.56 | 44 | 4.1 | 6.3 | 7.6 | 1.2 | RISG-2 |
| tert Butyl alcohol | µg/m$^3$ | 14 | 11 | 79 | 17 | 17 | 0.37 | 3.2 | 0.58 | 0.85 | 0.83 | 0.97 | SG13 |
| n-Butylbenzene | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.14 | 1.1 | 0.50 | 0.50 | 0.30 | 0.60 | SG15 |
| sec-Butylbenzene | µg/m$^3$ | 11 | 2 | 18 | 0.085 | 0.37 | 0.15 | 0.23 | 0.19 | 0.19 | 0.057 | 0.30 | SG07 |
| tert-Butylbenzene | µg/m$^3$ | 11 | 1 | 9.1 | 0.074 | 0.32 | 0.14 | 0.14 | 0.14 | 0.14 | -- | -- | SG12 |
| Carbon disulfide | µg/m$^3$ | 78 | 57 | 73 | 0.46 | 59 | 1.1 | 49 | 11 | 13 | 11 | 0.80 | RISG-7 |
| Carbon tetrachloride | µg/m$^3$ | 78 | 72 | 92 | 2.0 | 2.0 | 0.15 | 340 | 7.5 | 39 | 82 | 2.1 | RISG-54 |
| 3-Chloro-1-propene | µg/m$^3$ | 11 | 1 | 9.1 | 0.074 | 0.32 | 0.19 | 0.19 | 0.19 | 0.19 | -- | -- | SG09 |
| Chlorobenzene | µg/m$^3$ | 78 | 22 | 28 | 0.075 | 18 | 0.085 | 8.2 | 0.58 | 1.7 | 2.2 | 1.3 | RISG-8 |
| Chloroethane | µg/m$^3$ | 78 | 32 | 41 | 0.031 | 48 | 0.064 | 160 | 0.30 | 17 | 45 | 2.7 | RISG-30 |
| Chloroform | µg/m$^3$ | 78 | 78 | 100 | -- | -- | 14 | 11,000 | 490 | 1,370 | 2,080 | 1.5 | RISG-6 |
| Chloromethane | µg/m$^3$ | 78 | 27 | 35 | 0.043 | 24 | 0.047 | 1.6 | 0.13 | 0.21 | 0.29 | 1.4 | RISG-2 |
| Cumene | µg/m$^3$ | 11 | 5 | 45 | 0.082 | 0.36 | 0.088 | 0.56 | 0.12 | 0.26 | 0.22 | 0.85 | SG14 |
| Cyclohexane | µg/m$^3$ | 52 | 9 | 17 | 0.15 | 4.9 | 0.37 | 9.8 | 0.64 | 1.8 | 3.1 | 1.7 | RISG-2 |
| p-Cymene | µg/m$^3$ | 11 | 10 | 91 | 0.10 | 0.10 | 0.16 | 12 | 0.57 | 2.3 | 3.7 | 1.6 | SG15 |
| 1,2-Dibromo-3-chloropropane | µg/m$^3$ | 63 | 0 | 0 | 0.0056 | 130 | -- | -- | -- | -- | -- | -- | -- |
| Dibromochloromethane | µg/m$^3$ | 78 | 15 | 19 | 0.0048 | 40 | 0.12 | 40 | 0.88 | 6.4 | 12 | 2.0 | RISG-74 |
| 1,2-Dibromoethane | µg/m$^3$ | 78 | 6 | 7.7 | 0.0037 | 34 | 0.09 | 0.35 | 0.10 | 0.14 | 0.10 | 0.71 | RISG-75 |
| 1,2-Dichlorobenzene | µg/m$^3$ | 78 | 2 | 2.6 | 0.097 | 47 | 3.7 | 7.3 | 5.5 | 5.5 | 2.5 | 0.46 | RISG-5 |
| 1,3-Dichlorobenzene | µg/m$^3$ | 78 | 40 | 51 | 0.092 | 39 | 0.098 | 22 | 3.5 | 5.1 | 5.5 | 1.1 | RISG-74 |
| 1,4-Dichlorobenzene | µg/m$^3$ | 78 | 17 | 22 | 0.11 | 53 | 0.13 | 19 | 0.75 | 3.9 | 6.1 | 1.5 | SG13 |
| Dichlorodifluoromethane | µg/m$^3$ | 78 | 67 | 86 | 3.0 | 43 | 1.9 | 9.2 | 2.8 | 3.4 | 1.4 | 0.41 | RISG-64 |
| 1,1-Dichloroethane | µg/m$^3$ | 78 | 36 | 46 | 0.027 | 17 | 0.053 | 120 | 0.83 | 12 | 33 | 2.8 | RISG-30 |
| 1,2-Dichloroethane | µg/m$^3$ | 78 | 11 | 14 | 0.024 | 21 | 0.028 | 4.4 | 0.26 | 1.3 | 1.7 | 1.3 | RISG-30 |
| 1,1-Dichloroethene | µg/m$^3$ | 78 | 39 | 50 | 0.023 | 3.2 | 0.088 | 93 | 3.7 | 14 | 24 | 1.6 | RISG-2 |
| cis-1,2-Dichloroethene | µg/m$^3$ | 78 | 10 | 13 | 0.027 | 21 | 0.13 | 11 | 0.58 | 1.6 | 3.3 | 2.0 | RISG-2 |

**TABLE 4-8. Summary Statistics for VOCs in Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| trans-1,2-Dichloroethene | µg/m$^3$ | 78 | 5 | 6.4 | 0.025 | 24 | 0.054 | 1.1 | 0.77 | 0.56 | 0.48 | 0.85 | RISG-2 |
| 1,2-Dichloropropane | µg/m$^3$ | 78 | 4 | 5.1 | 0.010 | 66 | 0.088 | 0.59 | 0.18 | 0.26 | 0.23 | 0.87 | RISG-1 |
| 1,3-Dichloropropene | µg/m$^3$ | 29 | 0 | 0 | 0.093 | 28 | -- | -- | -- | -- | -- | -- | -- |
| Diisopropyl ether | µg/m$^3$ | 14 | 0 | 0 | 0.087 | 0.38 | -- | -- | -- | -- | -- | -- | -- |
| 1,4-Dioxane | µg/m$^3$ | 63 | 6 | 9.5 | 0.091 | 26 | 0.14 | 0.79 | 0.21 | 0.31 | 0.25 | 0.81 | SG07 |
| Ethanol | µg/m$^3$ | 63 | 48 | 76 | 0.33 | 14 | 0.93 | 32 | 8.1 | 10 | 7.7 | 0.75 | SG12 |
| Ethyl tert-butyl ether | µg/m$^3$ | 14 | 0 | 0 | 0.075 | 0.80 | -- | -- | -- | -- | -- | -- | -- |
| Ethyl acetate | µg/m$^3$ | 52 | 0 | 0 | 0.36 | 48 | -- | -- | -- | -- | -- | -- | -- |
| Ethylbenzene | µg/m$^3$ | 78 | 46 | 59 | 0.098 | 16 | 0.10 | 35 | 0.57 | 2.4 | 5.4 | 2.3 | RISG-29 |
| 4-Ethyltoluene | µg/m$^3$ | 78 | 22 | 28 | 0.088 | 55 | 0.11 | 4.0 | 0.80 | 1.2 | 1.2 | 0.99 | RISG-60 |
| Freon 114 | µg/m$^3$ | 29 | 4 | 14 | 0.077 | 64 | 0.089 | 0.10 | 0.10 | 0.097 | 0.0055 | 0.057 | SG11 |
| n-Heptane | µg/m$^3$ | 63 | 15 | 24 | 0.22 | 5.7 | 0.11 | 7.3 | 1.0 | 1.4 | 1.8 | 1.3 | RISG-2 |
| Hexachlorobutadiene | µg/m$^3$ | 78 | 8 | 10 | 0.13 | 270 | 0.21 | 11 | 0.81 | 3.3 | 4.5 | 1.4 | SG15 |
| n-Hexane | µg/m$^3$ | 52 | 8 | 15 | 0.31 | 8.6 | 0.38 | 24 | 1.3 | 4.8 | 8.1 | 1.7 | RISG-2 |
| 2-Hexanone | µg/m$^3$ | 78 | 13 | 17 | 0.16 | 21 | 0.32 | 4.0 | 0.76 | 1.6 | 1.4 | 0.88 | RISG-2 |
| Methyl tert-butyl ether | µg/m$^3$ | 14 | 7 | 50 | 0.077 | 0.51 | 0.33 | 13 | 3.7 | 6.2 | 5.2 | 0.83 | SG07 |
| 4-Methyl-2-pentanone | µg/m$^3$ | 78 | 16 | 21 | 0.16 | 33 | 0.15 | 20 | 0.40 | 5.1 | 7.3 | 1.4 | SG13 |
| Methylene Chloride | µg/m$^3$ | 78 | 40 | 51 | 0.34 | 10 | 0.23 | 28 | 1.2 | 4.1 | 7.4 | 1.8 | RISG-30 |
| Methylmethacrylate | µg/m$^3$ | 63 | 0 | 0 | 0.11 | 140 | -- | -- | -- | -- | -- | -- | -- |
| alpha-Methylstyrene | µg/m$^3$ | 11 | 4 | 36 | 0.11 | 0.47 | 0.39 | 7.7 | 0.46 | 2.2 | 3.6 | 1.6 | SG12 |
| Naphthalene | µg/m$^3$ | 63 | 29 | 46 | 0.076 | 6.5 | 0.082 | 4.2 | 0.56 | 0.90 | 0.99 | 1.1 | SG06 |
| n-Octane | µg/m$^3$ | 11 | 9 | 82 | 0.077 | 0.083 | 0.23 | 93 | 1.3 | 11 | 31 | 2.7 | SG14 |
| n-Propylbenzene | µg/m$^3$ | 11 | 9 | 82 | 0.080 | 0.33 | 0.084 | 1.1 | 0.24 | 0.39 | 0.37 | 0.94 | SG14 |
| Propylene | µg/m$^3$ | 3 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| Styrene | µg/m$^3$ | 78 | 19 | 24 | 0.078 | 15 | 0.11 | 6.1 | 0.31 | 0.80 | 1.4 | 1.7 | RISG-5 |
| 1,1,1,2-Tetrachloroethane | µg/m$^3$ | 52 | 1 | 1.9 | 0.0070 | 92 | 0.065 | 0.065 | 0.065 | 0.065 | -- | -- | RISG-2 |
| 1,1,2,2-Tetrachloroethane | µg/m$^3$ | 78 | 1 | 1.3 | 0.0076 | 28 | 5.6 | 5.6 | 5.6 | 5.6 | -- | -- | RISG-5 |
| Tetrachloroethene | µg/m$^3$ | 78 | 78 | 100 | -- | -- | 1.1 | 7,800 | 95 | 260 | 910 | 3.5 | RISG-2 |
| Tetrahydrofuran | µg/m$^3$ | 52 | 4 | 7.7 | 0.21 | 11 | 0.44 | 6.6 | 0.83 | 2.2 | 3.0 | 1.4 | RISG-27 |
| Toluene | µg/m$^3$ | 78 | 67 | 86 | 0.53 | 4.0 | 0.48 | 62 | 3.9 | 6.3 | 8.9 | 1.4 | RISG-77 |
| 1,2,4-Trichlorobenzene | µg/m$^3$ | 78 | 2 | 2.6 | 0.11 | 190 | 0.26 | 3.6 | 1.9 | 1.9 | 2.4 | 1.2 | RISG-2 |
| 1,1,1-Trichloroethane | µg/m$^3$ | 29 | 3 | 10 | 0.074 | 21 | 0.10 | 0.11 | 0.11 | 0.11 | 0.0058 | 0.054 | SG07 |
| 1,1,2-Trichloroethane | µg/m$^3$ | 78 | 1 | 1.3 | 0.012 | 22 | 0.072 | 0.072 | 0.072 | 0.072 | -- | -- | RISG-9 |
| Trichloroethene | µg/m$^3$ | 78 | 70 | 90 | 0.12 | 34 | 0.10 | 240 | 3.5 | 19 | 45 | 2.4 | RISG-30 |
| Trichlorofluoromethane | µg/m$^3$ | 78 | 47 | 60 | 1.8 | 66 | 1.1 | 15 | 1.4 | 2.2 | 2.3 | 1.1 | RISG-56 |
| 1,2,3-Trichloropropane | µg/m$^3$ | 49 | 0 | 0 | 1.6 | 81 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | µg/m$^3$ | 78 | 25 | 32 | 0.27 | 74 | 0.42 | 0.79 | 0.54 | 0.56 | 0.081 | 0.14 | RISG-1 |
| 1,2,4-Trimethylbenzene | µg/m$^3$ | 78 | 38 | 49 | 0.18 | 47 | 0.12 | 15 | 2.0 | 3.1 | 3.2 | 1.1 | RISG-1 |

**TABLE 4-8. Summary Statistics for VOCs in Soil Gas at 5 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| 1,3,5-Trimethylbenzene | $\mu g/m^3$ | 78 | 20 | 26 | 0.092 | 37 | 0.090 | 5.9 | 0.79 | 1.6 | 2.0 | 1.2 | RISG-5 |
| Vinyl acetate | $\mu g/m^3$ | 78 | 12 | 15 | 0.32 | 30 | 1.3 | 19 | 3.5 | 5.1 | 4.7 | 0.93 | RISG-2 |
| Vinyl chloride | $\mu g/m^3$ | 78 | 3 | 3.9 | 0.0075 | 18 | 0.21 | 1.6 | 0.22 | 0.68 | 0.80 | 1.2 | RISG-8 |
| Xylenes (total) | $\mu g/m^3$ | 78 | 64 | 82 | 0.18 | 26 | 0.41 | 225 | 3.1 | 11 | 29 | 2.8 | RISG-29 |

**Notes:**

-- = no value

$\mu g/m^3$ = microgram per cubic meter

bgs = below ground surface

VOC = volatile organic compound

**TABLE 4-9. Summary Statistics for VOCs in Soil Gas at 10 to 15 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| Acetone | µg/m$^3$ | 58 | 46 | 79 | 6.2 | 72 | 5.9 | 210 | 22 | 30 | 31 | 1.0 | RISG-2 |
| Acrolein | µg/m$^3$ | 9 | 1 | 11 | 0.23 | 21 | 11 | 11 | 11 | 11 | -- | -- | RISG-2 |
| Acrylonitrile | µg/m$^3$ | 46 | 1 | 2.2 | 0.20 | 43 | 0.86 | 0.86 | 0.86 | 0.86 | -- | -- | RISG-2 |
| t-Amyl methyl ether | µg/m$^3$ | 4 | 0 | 0 | 1.2 | 1.2 | -- | -- | -- | -- | -- | -- | -- |
| Benzene | µg/m$^3$ | 58 | 30 | 52 | 0.41 | 19 | 0.21 | 75 | 2.2 | 5.6 | 13 | 2.4 | RISG-1 |
| Benzyl chloride | µg/m$^3$ | 58 | 0 | 0 | 0.19 | 64 | -- | -- | -- | -- | -- | -- | -- |
| Bromodichloromethane | µg/m$^3$ | 58 | 26 | 45 | 0.45 | 33 | 0.77 | 760 | 7.7 | 70 | 200 | 2.9 | RISG-74 |
| Bromoform | µg/m$^3$ | 58 | 0 | 0 | 0.22 | 55 | -- | -- | -- | -- | -- | -- | -- |
| Bromomethane | µg/m$^3$ | 16 | 0 | 0 | 0.36 | 98 | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Butadiene | µg/m$^3$ | 4 | 0 | 0 | 0.55 | 0.55 | -- | -- | -- | -- | -- | -- | -- |
| 2-Butanone | µg/m$^3$ | 58 | 33 | 57 | 1.7 | 44 | 0.85 | 51 | 11 | 12 | 9.7 | 0.78 | RISG-2 |
| tert Butyl alcohol | µg/m$^3$ | 4 | 0 | 0 | 17 | 17 | -- | -- | -- | -- | -- | -- | -- |
| Carbon disulfide | µg/m$^3$ | 58 | 32 | 55 | 0.53 | 110 | 0.56 | 170 | 16 | 26 | 37 | 1.4 | RISG-66 |
| Carbon tetrachloride | µg/m$^3$ | 58 | 54 | 93 | 2.0 | 4.6 | 1.1 | 640 | 27 | 79 | 140 | 1.8 | RISG-6 |
| Chlorobenzene | µg/m$^3$ | 58 | 6 | 10 | 0.16 | 22 | 0.46 | 1.8 | 1.0 | 1.1 | 0.58 | 0.53 | RISG-30 |
| Chloroethane | µg/m$^3$ | 58 | 12 | 21 | 0.034 | 61 | 0.085 | 93 | 0.53 | 17 | 32 | 1.8 | RISG-30 |
| Chloroform | µg/m$^3$ | 58 | 58 | 100 | -- | -- | 62 | 22,000 | 1,800 | 3,210 | 4,150 | 1.3 | RISG-6 |
| Chloromethane | µg/m$^3$ | 58 | 18 | 31 | 0.12 | 31 | 0.13 | 1.0 | 0.44 | 0.43 | 0.25 | 0.59 | RISG-27 |
| Cyclohexane | µg/m$^3$ | 46 | 5 | 11 | 0.20 | 9.3 | 0.37 | 1.0 | 0.48 | 0.59 | 0.25 | 0.43 | RISG-66 |
| 1,2-Dibromo-3-chloropropane | µg/m$^3$ | 46 | 1 | 2.2 | 0.0056 | 190 | 0.13 | 0.13 | 0.13 | 0.13 | -- | -- | RISG-3 |
| Dibromochloromethane | µg/m$^3$ | 58 | 7 | 12 | 0.0048 | 51 | 0.28 | 210 | 1.8 | 58 | 97 | 1.7 | RISG-74 |
| 1,2-Dibromoethane | µg/m$^3$ | 58 | 6 | 10 | 0.0037 | 44 | 0.047 | 0.17 | 0.11 | 0.12 | 0.049 | 0.42 | RISG-65 |
| 1,2-Dichlorobenzene | µg/m$^3$ | 58 | 0 | 0 | 0.16 | 59 | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Dichlorobenzene | µg/m$^3$ | 58 | 25 | 43 | 0.26 | 50 | 0.92 | 36 | 4.7 | 6.8 | 7.3 | 1.1 | RISG-61 |
| 1,4-Dichlorobenzene | µg/m$^3$ | 58 | 5 | 8.6 | 0.14 | 68 | 0.13 | 0.79 | 0.31 | 0.35 | 0.26 | 0.74 | RISG-1 |
| Dichlorodifluoromethane | µg/m$^3$ | 58 | 40 | 69 | 0.56 | 54 | 2.0 | 8.8 | 3.5 | 3.7 | 1.4 | 0.39 | RISG-64 |
| 1,1-Dichloroethane | µg/m$^3$ | 58 | 36 | 62 | 0.046 | 7.7 | 0.10 | 95 | 2.2 | 9.4 | 20 | 2.1 | RISG-30 |
| 1,2-Dichloroethane | µg/m$^3$ | 58 | 9 | 16 | 0.028 | 27 | 0.13 | 1.1 | 0.73 | 0.61 | 0.34 | 0.55 | RISG-1 |
| 1,1-Dichloroethene | µg/m$^3$ | 58 | 42 | 72 | 0.12 | 7.7 | 0.076 | 170 | 7.7 | 28 | 45 | 1.6 | RISG-2 |
| cis-1,2-Dichloroethene | µg/m$^3$ | 58 | 8 | 14 | 0.039 | 27 | 0.076 | 2.6 | 0.53 | 0.99 | 0.94 | 0.95 | RISG-2 |
| trans-1,2-Dichloroethene | µg/m$^3$ | 58 | 7 | 12 | 0.042 | 30 | 0.059 | 0.37 | 0.25 | 0.23 | 0.12 | 0.50 | RISG-30 |
| 1,2-Dichloropropane | µg/m$^3$ | 58 | 5 | 8.6 | 0.010 | 84 | 1.1 | 1.6 | 1.2 | 1.2 | 0.21 | 0.17 | RISG-58 |
| 1,3-Dichloropropene | µg/m$^3$ | 16 | 0 | 0 | 0.30 | 36 | -- | -- | -- | -- | -- | -- | -- |
| Diisopropyl ether | µg/m$^3$ | 4 | 0 | 0 | 0.35 | 0.35 | -- | -- | -- | -- | -- | -- | -- |
| 1,4-Dioxane | µg/m$^3$ | 46 | 0 | 0 | 0.13 | 38 | -- | -- | -- | -- | -- | -- | -- |
| Ethanol | µg/m$^3$ | 46 | 26 | 57 | 0.38 | 26 | 2.3 | 160 | 15 | 21 | 30 | 1.4 | RISG-1 |
| Ethyl tert-butyl ether | µg/m$^3$ | 4 | 0 | 0 | 0.80 | 0.80 | -- | -- | -- | -- | -- | -- | -- |
| Ethyl acetate | µg/m$^3$ | 46 | 3 | 6.5 | 0.36 | 72 | 7.7 | 9.4 | 7.8 | 8.3 | 0.95 | 0.11 | RISG-2 |
| Ethylbenzene | µg/m$^3$ | 58 | 23 | 40 | 0.11 | 21 | 0.14 | 74 | 3.5 | 6.8 | 15 | 2.2 | RISG-1 |
| 4-Ethyltoluene | µg/m$^3$ | 58 | 7 | 12 | 0.21 | 69 | 0.59 | 54 | 6.2 | 12 | 19 | 1.6 | RISG-1 |
| Freon 114 | µg/m$^3$ | 16 | 0 | 0 | 0.60 | 82 | -- | -- | -- | -- | -- | -- | -- |

**TABLE 4-9. Summary Statistics for VOCs in Soil Gas at 10 to 15 feet bgs**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| n-Heptane | µg/m$^3$ | 46 | 2 | 4.4 | 0.26 | 9.2 | 3.7 | 57 | 30 | 30 | 38 | 1.2 | RISG-1 |
| Hexachlorobutadiene | µg/m$^3$ | 58 | 3 | 5.2 | 0.15 | 350 | 2.5 | 80 | 38 | 40 | 39 | 0.97 | RISG-27 |
| n-Hexane | µg/m$^3$ | 46 | 8 | 17 | 0.37 | 16 | 1.4 | 55 | 3.0 | 10 | 18 | 1.8 | RISG-1 |
| 2-Hexanone | µg/m$^3$ | 58 | 2 | 3.5 | 0.16 | 27 | 1.7 | 2.7 | 2.2 | 2.2 | 0.71 | 0.32 | RISG-2 |
| Methyl tert-butyl ether | µg/m$^3$ | 4 | 0 | 0 | 0.51 | 0.51 | -- | -- | -- | -- | -- | -- | -- |
| 4-Methyl-2-pentanone | µg/m$^3$ | 58 | 7 | 12 | 0.19 | 42 | 0.89 | 33 | 3.0 | 7.7 | 11 | 1.5 | RISG-1 |
| Methylene Chloride | µg/m$^3$ | 58 | 27 | 47 | 0.42 | 15 | 0.67 | 23 | 2.8 | 6.3 | 6.8 | 1.1 | RISG-6 |
| Methylmethacrylate | µg/m$^3$ | 46 | 2 | 4.4 | 0.42 | 200 | 4.1 | 5.2 | 4.7 | 4.7 | 0.78 | 0.17 | RISG-3 |
| Naphthalene | µg/m$^3$ | 46 | 14 | 30 | 0.19 | 12 | 0.22 | 150 | 0.46 | 12 | 40 | 3.3 | RISG-1 |
| Propylene | µg/m$^3$ | 4 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| Styrene | µg/m$^3$ | 58 | 6 | 10 | 0.086 | 19 | 0.68 | 4.8 | 0.91 | 1.9 | 1.7 | 0.92 | RISG-61 |
| 1,1,1,2-Tetrachloroethane | µg/m$^3$ | 46 | 1 | 2.2 | 0.0070 | 140 | 0.084 | 0.084 | 0.084 | 0.084 | -- | -- | RISG-2 |
| 1,1,2,2-Tetrachloroethane | µg/m$^3$ | 58 | 0 | 0 | 0.0076 | 36 | -- | -- | -- | -- | -- | -- | -- |
| Tetrachloroethene | µg/m$^3$ | 58 | 57 | 98 | 1.7 | 1.7 | 3.8 | 11,000 | 200 | 610 | 1,610 | 2.6 | RISG-2 |
| Tetrahydrofuran | µg/m$^3$ | 46 | 5 | 11 | 0.21 | 11 | 2.4 | 7.6 | 4.2 | 4.8 | 2.1 | 0.44 | RISG-2 |
| Toluene | µg/m$^3$ | 58 | 39 | 67 | 0.53 | 15 | 0.40 | 220 | 2.9 | 17 | 45 | 2.7 | RISG-61 |
| 1,2,4-Trichlorobenzene | µg/m$^3$ | 58 | 2 | 3.5 | 0.17 | 240 | 0.82 | 3.7 | 2.3 | 2.3 | 2.0 | 0.90 | RISG-2 |
| 1,1,1-Trichloroethane | µg/m$^3$ | 16 | 0 | 0 | 0.35 | 27 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2-Trichloroethane | µg/m$^3$ | 58 | 3 | 5.2 | 0.012 | 28 | 0.20 | 0.62 | 0.58 | 0.47 | 0.23 | 0.50 | RISG-3 |
| Trichloroethene | µg/m$^3$ | 58 | 50 | 86 | 0.30 | 13 | 0.20 | 160 | 10 | 30 | 38 | 1.3 | RISG-2 |
| Trichlorofluoromethane | µg/m$^3$ | 58 | 25 | 43 | 1.6 | 83 | 1.1 | 15 | 1.6 | 3.1 | 3.5 | 1.2 | RISG-52 |
| 1,2,3-Trichloropropane | µg/m$^3$ | 42 | 0 | 0 | 1.4 | 120 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | µg/m$^3$ | 58 | 8 | 14 | 0.33 | 94 | 0.48 | 2.1 | 0.61 | 0.85 | 0.54 | 0.64 | RISG-1 |
| 1,2,4-Trimethylbenzene | µg/m$^3$ | 58 | 20 | 34 | 0.31 | 60 | 0.34 | 240 | 2.0 | 16 | 53 | 3.2 | RISG-1 |
| 1,3,5-Trimethylbenzene | µg/m$^3$ | 58 | 9 | 16 | 0.19 | 46 | 0.30 | 81 | 2.4 | 12 | 26 | 2.1 | RISG-1 |
| Vinyl acetate | µg/m$^3$ | 58 | 0 | 0 | 0.55 | 39 | -- | -- | -- | -- | -- | -- | -- |
| Vinyl chloride | µg/m$^3$ | 58 | 2 | 3.5 | 0.0075 | 23 | 0.046 | 0.049 | 0.048 | 0.048 | 0.0021 | 0.045 | RISG-30 |
| Xylenes (total) | µg/m$^3$ | 58 | 37 | 64 | 1.7 | 33 | 0.54 | 450 | 4.5 | 25 | 74 | 3.0 | RISG-1 |

**Notes:**

-- = no value

µg/m$^3$ = microgram per cubic meter
bgs = below ground surface

VOC = volatile organic compound

**TABLE 4-10. Summary Statistics for VOCs in Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| Benzene | µg/L | 278 | 4 | 1.4 | 0.20 | 2.5 | 0.28 | 34 | 26 | 22 | 15 | 0.68 | PC-194 |
| Bromobenzene | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Bromochloromethane | µg/L | 278 | 0 | 0 | 0.15 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Bromodichloromethane | µg/L | 278 | 21 | 7.6 | 0.17 | 2.5 | 0.26 | 2.0 | 0.44 | 0.69 | 0.57 | 0.81 | PC-187 |
| Bromoform | µg/L | 278 | 13 | 4.7 | 0.29 | 4.0 | 0.40 | 7.7 | 0.80 | 2.4 | 2.6 | 1.1 | PC-187 |
| Bromomethane | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 2-Butanone | µg/L | 278 | 0 | 0 | 2.5 | 25 | -- | -- | -- | -- | -- | -- | -- |
| n-Butylbenzene | µg/L | 278 | 0 | 0 | 0.24 | 4.0 | -- | -- | -- | -- | -- | -- | -- |
| sec-Butylbenzene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| tert-Butylbenzene | µg/L | 278 | 1 | 0.36 | 0.17 | 2.5 | 0.34 | 0.34 | 0.34 | 0.34 | -- | -- | PC-166 |
| Carbon tetrachloride | µg/L | 278 | 123 | 44 | 0.18 | 2.5 | 0.25 | 13 | 1.3 | 2.0 | 2.2 | 1.1 | PC-188 |
| Chlorobenzene | µg/L | 278 | 44 | 16 | 0.18 | 2.5 | 0.27 | 54 | 1.0 | 5.1 | 9.4 | 1.8 | PC-166 |
| Chloroethane | µg/L | 278 | 0 | 0 | 0.36 | 4.0 | -- | -- | -- | -- | -- | -- | -- |
| Chloroform | µg/L | 289 | 277 | 96 | 0.25 | 0.25 | 0.25 | 1,000 | 16 | 100 | 160 | 1.6 | PC-67 |
| Chloromethane | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 2-Chlorotoluene | µg/L | 278 | 0 | 0 | 0.18 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 4-Chlorotoluene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Cumene | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| p-Cymene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromo-3-chloropropane | µg/L | 278 | 0 | 0 | 0.50 | 5.0 | -- | -- | -- | -- | -- | -- | -- |
| Dibromochloromethane | µg/L | 278 | 5 | 1.8 | 0.25 | 2.5 | 0.35 | 1.3 | 1.2 | 0.94 | 0.46 | 0.49 | PC-187 |
| 1,2-Dibromoethane | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Dibromomethane | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dichlorobenzene | µg/L | 278 | 97 | 35 | 0.19 | 2.5 | 0.27 | 16 | 2.0 | 3.7 | 3.5 | 0.94 | PC-166 |
| 1,3-Dichlorobenzene | µg/L | 278 | 77 | 28 | 0.18 | 2.5 | 0.25 | 3.0 | 1.2 | 1.2 | 0.73 | 0.59 | PC-186 |
| 1,4-Dichlorobenzene | µg/L | 278 | 86 | 31 | 0.17 | 2.5 | 0.25 | 23 | 3.2 | 5.5 | 5.1 | 0.93 | PC-166 |
| Dichlorodifluoromethane | µg/L | 278 | 0 | 0 | 0.17 | 4.0 | -- | -- | -- | -- | -- | -- | -- |
| 1,1-Dichloroethane | µg/L | 278 | 106 | 38 | 0.24 | 2.5 | 0.25 | 3.9 | 1.4 | 1.5 | 0.79 | 0.52 | PC-18 |
| 1,2-Dichloroethane | µg/L | 278 | 18 | 6.5 | 0.20 | 2.5 | 0.25 | 0.53 | 0.39 | 0.39 | 0.079 | 0.21 | PC-160 |
| 1,1-Dichloroethene | µg/L | 278 | 25 | 9.0 | 0.25 | 2.5 | 0.27 | 2.7 | 0.66 | 0.86 | 0.62 | 0.72 | PC-175 |
| cis-1,2-Dichloroethene | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| trans-1,2-Dichloroethene | µg/L | 278 | 0 | 0 | 0.23 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dichloropropane | µg/L | 278 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Dichloropropane | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 2,2-Dichloropropane | µg/L | 278 | 0 | 0 | 0.16 | 4.0 | -- | -- | -- | -- | -- | -- | -- |
| 1,1-Dichloropropene | µg/L | 278 | 0 | 0 | 0.20 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,3-Dichloropropene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |

**TABLE 4-10. Summary Statistics for VOCs in Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| 1,4-Dioxane | µg/L | 278 | 145 | 52 | 0.50 | 0.50 | 0.50 | 23 | 1.0 | 1.3 | 1.9 | 1.4 | PC-67 |
| Ethyl tert-butyl ether | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Ethylbenzene | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Hexachlorobutadiene | µg/L | 278 | 3 | 1.1 | 0.25 | 2.5 | 0.27 | 0.38 | 0.34 | 0.33 | 0.056 | 0.17 | M-48A |
| Methylene Chloride | µg/L | 278 | 22 | 7.9 | 0.88 | 8.8 | 1.0 | 25 | 2.8 | 4.7 | 5.3 | 1.1 | PC-67 |
| Naphthalene | µg/L | 278 | 0 | 0 | 0.21 | 4.0 | -- | -- | -- | -- | -- | -- | -- |
| n-Propylbenzene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Styrene | µg/L | 275 | 0 | 0 | 0.25 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,1,2-Tetrachloroethane | µg/L | 278 | 0 | 0 | 0.15 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2,2-Tetrachloroethane | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Tetrachloroethene | µg/L | 278 | 130 | 47 | 0.14 | 2.5 | 0.18 | 68 | 1.1 | 4.0 | 10 | 2.6 | PC-21A |
| Toluene | µg/L | 278 | 13 | 4.7 | 0.17 | 2.5 | 0.25 | 1.4 | 0.44 | 0.50 | 0.29 | 0.58 | PC-193 |
| 1,2,3-Trichlorobenzene | µg/L | 278 | 51 | 18 | 0.23 | 4.0 | 0.40 | 3.1 | 0.84 | 1.0 | 0.58 | 0.55 | PC-50 |
| 1,2,4-Trichlorobenzene | µg/L | 278 | 67 | 24 | 0.20 | 4.0 | 0.41 | 14 | 5.1 | 5.6 | 3.3 | 0.60 | PC-31 |
| 1,1,1-Trichloroethane | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2-Trichloroethane | µg/L | 278 | 0 | 0 | 0.19 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Trichloroethene | µg/L | 278 | 143 | 51 | 0.20 | 2.5 | 0.25 | 2.7 | 0.48 | 0.80 | 0.69 | 0.86 | PC-166 |
| Trichlorofluoromethane | µg/L | 278 | 0 | 0 | 0.21 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3-Trichloropropane | µg/L | 299 | 209 | 70 | 0.0025 | 0.40 | 0.0025 | 0.50 | 0.049 | 0.086 | 0.10 | 1.2 | PC-67 |
| 1,2,4-Trimethylbenzene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| 1,3,5-Trimethylbenzene | µg/L | 278 | 0 | 0 | 0.17 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Vinyl chloride | µg/L | 278 | 0 | 0 | 0.18 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| Xylenes (total) | µg/L | 278 | 0 | 0 | 0.38 | 5.0 | -- | -- | -- | -- | -- | -- | -- |

**Notes:**

-- = no value

µg/L = microgram per liter

VOC = volatile organic compound

**TABLE 5-1. Summary of Detected VOCs in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical [1] | Soil Gas | | Shallow Groundwater [2] | |
|---|---|---|---|---|
| | 5 ft bgs | 10 - 15 ft bgs | < 20 ft bgs | ≥ 20 ft bgs |
| Acetone | X | X | | |
| Acrolein | | X | | |
| Acrylonitrile | X | X | | |
| Benzene | X | X | X | X |
| Benzyl chloride | X | | | |
| Bromodichloromethane | X | X | X | X |
| Bromoform | X | | | X |
| Bromomethane | X | | | |
| 2-Butanone | X | X | | |
| tert-Butyl alcohol | X | | | |
| n-Butylbenzene | X | | | |
| sec-Butylbenzene | X | | | |
| tert-Butylbenzene | X | | X | |
| Carbon disulfide | X | X | | |
| Carbon tetrachloride | X | X | X | X |
| 3-Chloro-1-propene | X | | | |
| Chlorobenzene | X | X | X | X |
| Chloroethane | X | X | | |
| Chloroform | X | X | X | X |
| Chloromethane | X | X | | |
| Cumene | X | | | |
| Cyclohexane | X | X | | |
| p-Cymene | X | | | |
| 1,2-Dibromo-3-chloropropane | | X | | |
| Dibromochloromethane | X | X | | X |
| 1,2-Dibromoethane | X | X | | |
| 1,2-Dichlorobenzene | X | | X | X |
| 1,3-Dichlorobenzene | X | X | X | X |
| 1,4-Dichlorobenzene | X | X | X | X |
| Dichlorodifluoromethane | X | X | | |
| 1,1-Dichloroethane | X | X | X | X |
| 1,2-Dichloroethane | X | X | X | X |
| 1,1-Dichloroethene | X | X | X | X |
| cis-1,2-Dichloroethene | X | X | | |
| trans-1,2-Dichloroethene | X | X | | |
| 1,2-Dichloropropane | X | X | | |
| 1,4-Dioxane | X | | X | X |
| Ethanol | X | X | | |
| Ethyl acetate | | X | | |
| Ethylbenzene | X | X | | |
| 4-Ethyltoluene | X | X | | |
| Freon 114 | X | | | |
| n-Heptane | X | X | | |
| Hexachlorobutadiene | X | X | | X |
| n-Hexane | X | X | | |
| 2-Hexanone | X | X | | |

**TABLE 5-2. Physical/Chemical Properties for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 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) |
| Acrolein | 56.07 | 1.00E+00 | 1.12E-01 | 1.22E-05 | 2.12E+05 | 1.22E-04 | 325.60 | 506.00 | 6730.77 | 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) |
| 1,3-Butadiene | 54.09 | 3.96E+01 | 1.00E-01 | 1.03E-05 | 7.35E+02 | 7.36E-02 | 268.60 | 425.00 | 5370.33 | 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 5-2. Physical/Chemical Properties for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 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) |
| Freon 114 | 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) |
| Propylene | 42.08 | 2.17E+01 | 1.10E-01 | 1.07E-05 | 2.00E+02 | 1.96E-01 | 225.60 | 364.95 | 4402.41 | 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) |
| 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) |

**TABLE 5-2. Physical/Chemical Properties for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 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-$m^3$/mol) | Normal Boiling Point, $T_B$ ($^oK$) | Critical Temperature, $T_C$ ($^oK$) | Enthalpy of Vaporization at the Normal Boiling Point, ΔHv (cal/mol) | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| 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-$m^3$/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
$^o$K = degrees Kelvin
mg/L = milligram per liter
NDEP = Nevada Division of Environmental Protection
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

**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. December 2008. Revision 16, June.
USEPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. Washington, DC, USA.

**TABLE 5-3. Soil Properties Data for the OU-2 BHRA Area**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Sample Location | Sample ID [1] | Start Depth (ft) | End Depth (ft) | Water-filled Porosity [2] (%Vb) | Dry Bulk Density [3] ($g/cm^3$) | Soil Total Porosity [4] (%Vb) | Soil Type |
|---|---|---|---|---|---|---|---|
| RISG-1 | PT-RISG1-4.6-5.0-20190226 | 4.6 | 5 | 0.167 | 1.660 | 0.383 | Silty sand |
| RISG-2 | PT-RISG2-4.6-5.0-20190226 | 4.6 | 5 | 0.172 | 1.710 | 0.361 | Poorly graded sand with clay |
| RISG-3 | PT-RISG3-4.6-5.0-20190226 | 4.6 | 5 | 0.129 | 1.830 | 0.325 | Well-graded sand with silt |
| RISG-4 | PT-RISG4-4.6-5.0-20190226 | 4.6 | 5 | 0.121 | 1.770 | 0.342 | Clayey sand |
| RISG-7 | PT-RISG7-4.6-5.0-20190226 | 4.6 | 5 | 0.232 | 1.590 | 0.402 | Silty sand |
| RISG-8 | PT-RISG8-4.6-5.0 | 4.6 | 5 | 0.186 | 1.750 | 0.346 | Poorly graded sand with clay |
| RISG-9 | PT-RISG9-4.6-5.0-20190226 | 4.6 | 5 | 0.177 | 1.720 | 0.353 | Clayey sand |
| RISG-1 | PT-RISG1-9.6-10.0-20190226 | 9.6 | 10 | 0.226 | 1.520 | 0.434 | Poorly graded sand with clay |
| RISG-2 | PT-RISG2-9.6-10.0-20190226 | 9.6 | 10 | 0.195 | 1.710 | 0.357 | Silty sand |
| RISG-3 | PT-RISG3-9.6-10.0-20190226 | 9.6 | 10 | 0.190 | 1.700 | 0.371 | Well-graded sand with silt |
| RISG-4 | PT-RISG4-9.6-10.0-20190226 | 9.6 | 10 | 0.152 | 1.710 | 0.362 | Poorly graded sand with clay |
| RISG-5 | PT-RISG5-9.6-10.0-20190226 | 9.6 | 10 | 0.183 | 1.700 | 0.365 | Well-graded sand with silt |
| RISG-7 | PT-RISG7-9.6-10.0-20190226 [5] | 9.6 | 10 | 0.546 | 1.510 | 0.423 | Silty sand |
| RISG-8 | PT-RISG8-9.6-10.0 | 9.6 | 10 | 0.243 | 1.630 | 0.389 | Poorly graded sand with clay |
| RISG-9 | PT-RISG9-9.6-10.0-20190226 | 9.6 | 10 | 0.227 | 1.800 | 0.323 | Clayey sand |
| RISG-6 | PT-RISG6-12.0-12.5 | 12 | 12.5 | 0.089 | 1.770 | 0.335 | Clayey sand |
| RISG-6 | PT-RISG6-14.5-15 | 14.5 | 15 | 0.079 | 1.420 | 0.475 | Poorly graded sand with clay |
| RISG-1 | PT-RISG1-14.6-15.0-20190226 | 14.6 | 15 | 0.318 | 1.570 | 0.410 | Silty sand |
| RISG-2 | PT-RISG2-14.6-15.0-20190226 | 14.6 | 15 | 0.156 | 1.830 | 0.317 | Clayey sand |
| RISG-3 | PT-RISG3-14.6-15.0-20190226 | 14.6 | 15 | 0.199 | 1.680 | 0.369 | Silty sand |
| RISG-4 | PT-RISG4-14.6-15.0-20190226 | 14.6 | 15 | 0.217 | 1.550 | 0.421 | Silty sand |
| RISG-5 | PT-RISG5-14.6-15.0-20190226 | 14.6 | 15 | 0.112 | 1.770 | 0.338 | Well-graded sand with silt |
| RISG-8 | PT-RISG8-14.6-15.0 | 14.6 | 15 | 0.337 | 1.670 | 0.374 | Silty sand |
| | 5 ft Mean [6] | 4.6 | 5.0 | 0.169 | 1.719 | 0.359 | Loamy Sand |
| | 5 ft Minimum | 4.6 | 5.0 | 0.121 | 1.590 | 0.325 | -- |
| | 5 ft Maximum | 4.6 | 5.0 | 0.232 | 1.830 | 0.402 | -- |
| | Median | 4.6 | 5.0 | 0.172 | 1.720 | 0.353 | -- |
| | 10-15 ft Mean [6] | 12.1 | 12.5 | 0.195 | 1.669 | 0.376 | Loamy Sand |
| | 10-15 ft Minimum | 9.6 | 10.0 | 0.079 | 1.420 | 0.317 | -- |
| | 10-15 ft Maximum | 14.6 | 15.0 | 0.337 | 1.830 | 0.475 | -- |
| | Median | 12.0 | 12.5 | 0.195 | 1.700 | 0.369 | -- |

**Notes:**
ft = feet
$g/cm^3$ = grams per cubic centimeter
API = American Petroleum Institute
ASTM = American Society for Testing and Materials
OU = Operable Unit
Vb = volume-based
RI = Remedial Investigation
[1] The soil properties were collected as part of the Phase 2 RI Modification #11 sampling in February 2019.
[2] As measured according to ASTM D 2216.
[3] As measured according to ASTM D 2937.
[4] As measured according to API RP40.
[5] Sample not included in the evaluation because it represents wetter than average conditions in OU-2.
[6] Mean of the site-specific measurements were used in the models. Please see Table 5-4 Section Soil Parameters for details.

**Source:**
Core Laboratories. 2019. Physical Properties Data, NERT Phase 2 RI. July 11.

**TABLE 5-4. Modeling Parameters**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Parameter | Units | Value | Notes |
|---|---|---|---|
| ***Source/Receptor Parameters*** | | | |
| Depth to groundwater | feet | 10 | Site-specific estimate based on depth to groundwater measurements |
| Depth to groundwater | | 20 | |
| Soil gas sampling depth | feet | 5 | Site-specific estimate based on sampling depth |
| | | 10 | |
| | | 15 | |
| Soil temperature at source | Celsius | 17 | Site-specific measurement |
| ***Soil Parameters*** | | | |
| **0-5 feet soil** | | | |
| Bulk density | $g/cm^3$ | 1.719 | Mean of site-specific measurements. |
| Total porosity | unitless | 0.359 | Mean of site-specific measurements. |
| Water-filled porosity | unitless | 0.169 | Mean of site-specific measurements. |
| **5 - 15 feet soil** | | | |
| Bulk density | $g/cm^3$ | 1.669 | Mean of site-specific measurements. |
| Total porosity | unitless | 0.376 | Mean of site-specific measurements. |
| Water-filled porosity | unitless | 0.195 | Mean of site-specific measurements. |
| **Parameters Used For Benzene Degradation** | | | |
| Fraction organic carbon | unitless | 0.006 | Default value (USEPA 2002) |
| Minimum oxygen content for aerobic respiration | % | 1 | Default value (API 2012) |
| First order biodegradation rate for benzene | 1/hour | 0.79 | Default value (API 2012) |
| ***Building Foundation Parameters (Slab-on-Grade)*** | | | |
| **Commercial Indoor Air Scenario** | | | |
| Depth to Bottom of Foundation, Slab-on-grade | cm | 20 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation crack ratio | unitless | 0.001 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Average vapor flow rate into building | L/min | 337.5 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation thickness | cm | 20 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| **Residential Indoor Air Scenario - Slab-on-Grade** | | | |
| Depth to Bottom of Foundation, Slab-on-grade | cm | 10 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation crack ratio | unitless | 0.001 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Average vapor flow rate into building | L/min | 8.2 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation thickness | cm | 10 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| **Residential Indoor Air Scenario - Trailer** | | | |
| Depth to bottom of foundation, dirt floor | cm | 0 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation thickness | cm | 0 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Foundation crack ratio | unitless | 1 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| ***Air Dispersion Parameters*** | | | |
| **Commercial Indoor Air Scenario** | | | |
| Air exchange rate | 1/hour | 1.5 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Enclosed Floor Space Area | $m^2$ | 1500 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Mixing height of building, Slab-on-grade | m | 3 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| **Commercial Outdoor Air Scenario** | | | |
| Site-specific dispersion factor (Q/C) | $g/m^2$-s per $kg/m^3$ | 33.80 | Based on the area of the main chloroform groundwater plume (as defined by >70 ug/L chloroform concentration) in the western portion of OU-2. |
| **Construction Trench Scenario** | | | |
| Length of construction trench | cm | 609.60 | Assumed (20 feet) |
| Width of construction trench | cm | 152.40 | Assumed (5 feet) |
| Trench wind speed | m/s | 0.41 | Conservative estimate (1/10 of the site-specific windspeed) |
| Site-specific dispersion factor (Q/C) | $g/m^2$-s per $kg/m^3$ | 34.17 | Site-specific estimate based on box model |
| **Residential Indoor Scenario (Slab-on-Grade and Trailer)** | | | |
| Air exchange rate | 1/hour | 0.45 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Enclosed space floor area | $m^2$ | 150 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |
| Mixing height of building, Slab-on-grade and Trailer | m | 2.44 | Default value in USEPA Spreadsheet Modeling Vapor Intrusion (USEPA 2017) |

**Notes:**

API = American Petroleum Institute
cm = centimeter
$cm^2/s$ = square centimeter per second
$g/cm^3$ = gram per cubic centimeter
$g/m^2$-s per $kg/m^3$ = (gram per square meter-second) per (kilogram per cubic meter)
L/min = liter per minute
m = meter
m/s = meter per second
$m^2$ = square meter
µg/L = microgram per liter
OU = Operable Unit
USEPA = United States Environmental Protection Agency

**Source:**

American Petroleum Institute (API). 2012. User's Manual - BioVapor A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation. http://www.api.org/oil-and-natural-gas/environment/clean-water/ground-water/vapor-intrusion/biovapor
USEPA. 2017. EPA Spreadsheet Modeling Subsurface Vapor Intrusion. Version 6.0. September.
USEPA. 2023. Regional Screening Levels User's Guide. May.

**TABLE 5-5. Transfer Factors for VOCs Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | TF for Soil Gas Migrating to Indoor Air - Commercial ($\mu g/m^3$ per $\mu g/m^3$) | | | TF for Soil Gas Migrating to Indoor Air - Residential ($\mu g/m^3$ 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 $\mu g/m^3$) | TF for Soil Gas Migrating to Indoor Air in Trailer ($\mu g/m^3$ per $\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft below or beside Trench | 5 ft bgs | 10 ft bgs | 15 bgs |
| Acetone | 2.0E-04 | 8.7E-05 | 5.6E-05 | 6.5E-04 | 3.2E-04 | 2.1E-04 | 6.5E-06 | 2.9E-06 | 1.9E-06 | 3.2E-05 | 7.5E-04 | 3.4E-04 | 2.2E-04 |
| Acrolein | 2.0E-04 | 8.5E-05 | 5.4E-05 | 6.5E-04 | 3.2E-04 | 2.1E-04 | 1.9E-06 | 8.2E-07 | 5.2E-07 | 8.7E-06 | 7.5E-04 | 3.3E-04 | 2.1E-04 |
| Acrylonitrile | 2.0E-04 | 8.7E-05 | 5.5E-05 | 6.6E-04 | 3.2E-04 | 2.1E-04 | 1.8E-06 | 7.9E-07 | 5.1E-07 | 8.4E-06 | 7.7E-04 | 3.4E-04 | 2.2E-04 |
| tert-Amyl methyl ether | 1.2E-04 | 4.9E-05 | 3.1E-05 | 4.1E-04 | 1.9E-04 | 1.2E-04 | 7.2E-08 | 3.2E-08 | 2.0E-08 | 3.3E-07 | 4.3E-04 | 1.9E-04 | 1.2E-04 |
| Benzene | 2.9E-19 | 4.6E-20 | 2.4E-20 | 3.6E-19 | 5.9E-20 | 3.1E-20 | 6.1E-23 | 1.0E-23 | 5.3E-24 | 9.4E-24 | 4.0E-19 | 6.1E-20 | 3.2E-20 |
| Benzyl chloride | 1.2E-04 | 4.8E-05 | 3.0E-05 | 4.0E-04 | 1.9E-04 | 1.2E-04 | 3.6E-07 | 1.6E-07 | 1.0E-07 | 1.7E-06 | 4.2E-04 | 1.9E-04 | 1.2E-04 |
| Bromobenzene | 9.9E-05 | 4.1E-05 | 2.6E-05 | 3.5E-04 | 1.6E-04 | 1.0E-04 | 5.5E-08 | 2.4E-08 | 1.6E-08 | 2.6E-07 | 3.6E-04 | 1.6E-04 | 1.0E-04 |
| Bromochloromethane | 1.4E-04 | 5.9E-05 | 3.7E-05 | 4.8E-04 | 2.2E-04 | 1.5E-04 | 1.1E-07 | 4.9E-08 | 3.1E-08 | 5.1E-07 | 5.2E-04 | 2.3E-04 | 1.5E-04 |
| Bromodichloromethane | 1.0E-04 | 4.3E-05 | 2.7E-05 | 3.6E-04 | 1.6E-04 | 1.1E-04 | 5.6E-08 | 2.5E-08 | 1.6E-08 | 2.6E-07 | 3.7E-04 | 1.6E-04 | 1.0E-04 |
| Bromoform | 6.7E-05 | 2.8E-05 | 1.7E-05 | 2.4E-04 | 1.1E-04 | 7.0E-05 | 1.6E-07 | 7.2E-08 | 4.6E-08 | 7.6E-07 | 2.4E-04 | 1.1E-04 | 6.8E-05 |
| Bromomethane | 1.8E-04 | 7.5E-05 | 4.7E-05 | 5.9E-04 | 2.8E-04 | 1.8E-04 | 2.5E-08 | 1.1E-08 | 7.1E-09 | 1.2E-07 | 6.6E-04 | 2.9E-04 | 1.9E-04 |
| 1,3-Butadiene | 1.8E-04 | 7.5E-05 | 4.7E-05 | 5.9E-04 | 2.8E-04 | 1.8E-04 | 2.5E-09 | 1.1E-09 | 6.9E-10 | 1.1E-08 | 6.6E-04 | 2.9E-04 | 1.9E-04 |
| 2-Butanone | 1.7E-04 | 7.3E-05 | 4.6E-05 | 5.7E-04 | 2.7E-04 | 1.8E-04 | 3.5E-06 | 1.6E-06 | 1.0E-06 | 1.7E-05 | 6.3E-04 | 2.8E-04 | 1.8E-04 |
| tert-Butyl alcohol | 1.9E-04 | 8.7E-05 | 5.6E-05 | 6.3E-04 | 3.2E-04 | 2.2E-04 | 1.7E-05 | 8.2E-06 | 5.4E-06 | 9.3E-05 | 7.2E-04 | 3.4E-04 | 2.2E-04 |
| n-Butylbenzene | 9.7E-05 | 4.0E-05 | 2.5E-05 | 3.4E-04 | 1.5E-04 | 9.9E-05 | 9.3E-09 | 4.1E-09 | 2.6E-09 | 4.3E-08 | 3.5E-04 | 1.5E-04 | 9.8E-05 |
| sec-Butylbenzene | 9.7E-05 | 4.0E-05 | 2.5E-05 | 3.4E-04 | 1.5E-04 | 9.9E-05 | 8.2E-09 | 3.6E-09 | 2.3E-09 | 3.8E-08 | 3.5E-04 | 1.5E-04 | 9.8E-05 |
| tert-Butylbenzene | 9.7E-05 | 4.0E-05 | 2.5E-05 | 3.4E-04 | 1.5E-04 | 1.0E-04 | 1.1E-08 | 4.8E-09 | 3.0E-09 | 5.0E-08 | 3.5E-04 | 1.5E-04 | 9.8E-05 |
| Carbon disulfide | 1.9E-04 | 7.9E-05 | 5.0E-05 | 6.2E-04 | 3.0E-04 | 1.9E-04 | 1.4E-08 | 6.3E-09 | 4.0E-09 | 6.6E-08 | 7.0E-04 | 3.1E-04 | 2.0E-04 |
| Carbon tetrachloride | 1.0E-04 | 4.3E-05 | 2.7E-05 | 3.7E-04 | 1.7E-04 | 1.1E-04 | 4.2E-09 | 1.8E-09 | 1.2E-09 | 1.9E-08 | 3.8E-04 | 1.7E-04 | 1.1E-04 |
| 3-Chloro-1-propene | 1.7E-04 | 7.0E-05 | 4.4E-05 | 5.6E-04 | 2.6E-04 | 1.7E-04 | 1.7E-08 | 7.4E-09 | 4.7E-09 | 7.8E-08 | 6.2E-04 | 2.7E-04 | 1.7E-04 |
| Chlorobenzene | 1.3E-04 | 5.4E-05 | 3.4E-05 | 4.5E-04 | 2.1E-04 | 1.3E-04 | 5.2E-08 | 2.3E-08 | 1.5E-08 | 2.4E-07 | 4.8E-04 | 2.1E-04 | 1.3E-04 |
| Chloroethane | 1.8E-04 | 7.7E-05 | 4.9E-05 | 6.1E-04 | 2.9E-04 | 1.9E-04 | 1.7E-08 | 7.6E-09 | 4.9E-09 | 8.0E-08 | 6.9E-04 | 3.0E-04 | 1.9E-04 |
| Chloroform | 1.4E-04 | 5.8E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 4.2E-08 | 1.8E-08 | 1.2E-08 | 1.9E-07 | 5.1E-04 | 2.2E-04 | 1.4E-04 |
| Chloromethane | 2.2E-04 | 9.2E-05 | 5.8E-05 | 7.0E-04 | 3.4E-04 | 2.2E-04 | 2.5E-08 | 1.1E-08 | 6.9E-09 | 1.1E-07 | 8.2E-04 | 3.6E-04 | 2.3E-04 |
| 2-Chlorotoluene | 1.1E-04 | 4.7E-05 | 3.0E-05 | 4.0E-04 | 1.8E-04 | 1.2E-04 | 4.4E-08 | 1.9E-08 | 1.2E-08 | 2.0E-07 | 4.2E-04 | 1.8E-04 | 1.2E-04 |
| 4-Chlorotoluene | 1.1E-04 | 4.7E-05 | 3.0E-05 | 4.0E-04 | 1.8E-04 | 1.2E-04 | 3.6E-08 | 1.6E-08 | 1.0E-08 | 1.7E-07 | 4.1E-04 | 1.8E-04 | 1.2E-04 |
| Cumene | 1.1E-04 | 4.5E-05 | 2.9E-05 | 3.8E-04 | 1.7E-04 | 1.1E-04 | 1.3E-08 | 5.8E-09 | 3.7E-09 | 6.2E-08 | 4.0E-04 | 1.7E-04 | 1.1E-04 |
| Cyclohexane | 1.4E-04 | 6.0E-05 | 3.8E-05 | 4.9E-04 | 2.3E-04 | 1.5E-04 | 1.1E-09 | 4.8E-10 | 3.1E-10 | 5.0E-09 | 5.3E-04 | 2.3E-04 | 1.5E-04 |
| p-Cymene | 1.4E-04 | 5.6E-05 | 3.5E-05 | 4.6E-04 | 2.1E-04 | 1.4E-04 | 9.1E-11 | 4.0E-11 | 2.6E-11 | 4.2E-10 | 5.0E-04 | 2.2E-04 | 1.4E-04 |
| 1,2-Dibromo-3-chloropropane | 6.3E-05 | 2.6E-05 | 1.7E-05 | 2.3E-04 | 1.0E-04 | 6.7E-05 | 5.8E-07 | 2.6E-07 | 1.7E-07 | 2.8E-06 | 2.2E-04 | 1.0E-04 | 6.5E-05 |
| Dibromochloromethane | 6.8E-05 | 2.8E-05 | 1.8E-05 | 2.5E-04 | 1.1E-04 | 7.1E-05 | 9.1E-08 | 4.0E-08 | 2.5E-08 | 4.2E-07 | 2.4E-04 | 1.1E-04 | 6.9E-05 |
| 1,2-Dibromoethane | 8.0E-05 | 3.3E-05 | 2.1E-05 | 2.9E-04 | 1.3E-04 | 8.3E-05 | 1.5E-07 | 6.7E-08 | 4.3E-08 | 7.1E-07 | 2.9E-04 | 1.3E-04 | 8.1E-05 |
| Dibromomethane | 1.0E-04 | 4.2E-05 | 2.6E-05 | 3.6E-04 | 1.6E-04 | 1.0E-04 | 1.4E-07 | 6.3E-08 | 4.1E-08 | 6.7E-07 | 3.7E-04 | 1.6E-04 | 1.0E-04 |
| 1,2-Dichlorobenzene | 1.0E-04 | 4.2E-05 | 2.7E-05 | 3.6E-04 | 1.6E-04 | 1.1E-04 | 7.2E-08 | 3.1E-08 | 2.0E-08 | 3.3E-07 | 3.7E-04 | 1.6E-04 | 1.0E-04 |
| 1,3-Dichlorobenzene | 1.3E-04 | 5.2E-05 | 3.3E-05 | 4.3E-04 | 2.0E-04 | 1.3E-04 | 5.3E-08 | 2.3E-08 | 1.5E-08 | 2.4E-07 | 4.6E-04 | 2.0E-04 | 1.3E-04 |
| 1,4-Dichlorobenzene | 1.0E-04 | 4.2E-05 | 2.6E-05 | 3.6E-04 | 1.6E-04 | 1.0E-04 | 5.5E-08 | 2.4E-08 | 1.5E-08 | 2.5E-07 | 3.6E-04 | 1.6E-04 | 1.0E-04 |
| Dichlorodifluoromethane | 1.4E-04 | 5.7E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 4.6E-10 | 2.0E-10 | 1.3E-10 | 2.1E-09 | 5.0E-04 | 2.2E-04 | 1.4E-04 |
| 1,1-Dichloroethane | 1.5E-04 | 6.3E-05 | 4.0E-05 | 5.1E-04 | 2.4E-04 | 1.5E-04 | 3.0E-08 | 1.3E-08 | 8.3E-09 | 1.4E-07 | 5.5E-04 | 2.4E-04 | 1.5E-04 |
| 1,2-Dichloroethane | 1.5E-04 | 6.4E-05 | 4.1E-05 | 5.2E-04 | 2.4E-04 | 1.6E-04 | 1.5E-07 | 6.7E-08 | 4.3E-08 | 7.1E-07 | 5.7E-04 | 2.5E-04 | 1.6E-04 |
| 1,1-Dichloroethene | 1.6E-04 | 6.5E-05 | 4.1E-05 | 5.2E-04 | 2.4E-04 | 1.6E-04 | 6.3E-09 | 2.8E-09 | 1.8E-09 | 2.9E-08 | 5.7E-04 | 2.5E-04 | 1.6E-04 |
| cis-1,2-Dichloroethene | 1.6E-04 | 6.6E-05 | 4.2E-05 | 5.3E-04 | 2.5E-04 | 1.6E-04 | 4.4E-08 | 1.9E-08 | 1.2E-08 | 2.0E-07 | 5.9E-04 | 2.6E-04 | 1.6E-04 |
| trans-1,2-Dichloroethene | 1.6E-04 | 6.5E-05 | 4.1E-05 | 5.3E-04 | 2.5E-04 | 1.6E-04 | 1.9E-08 | 8.1E-09 | 5.2E-09 | 8.5E-08 | 5.8E-04 | 2.5E-04 | 1.6E-04 |
| 1,2-Dichloropropane | 1.3E-04 | 5.5E-05 | 3.5E-05 | 4.6E-04 | 2.1E-04 | 1.4E-04 | 5.5E-08 | 2.4E-08 | 1.5E-08 | 2.5E-07 | 4.9E-04 | 2.1E-04 | 1.4E-04 |
| 1,3-Dichloropropane | 1.3E-04 | 5.6E-05 | 3.5E-05 | 4.6E-04 | 2.1E-04 | 1.4E-04 | 1.7E-07 | 7.4E-08 | 4.7E-08 | 7.8E-07 | 4.9E-04 | 2.1E-04 | 1.4E-04 |
| 2,2-Dichloropropane | 1.3E-04 | 5.5E-05 | 3.5E-05 | 4.6E-04 | 2.1E-04 | 1.4E-04 | 6.7E-09 | 2.9E-09 | 1.9E-09 | 3.1E-08 | 4.9E-04 | 2.1E-04 | 1.4E-04 |
| 1,1-Dichloropropene | 1.4E-04 | 5.7E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 2.2E-09 | 9.7E-10 | 6.2E-10 | 1.0E-08 | 5.0E-04 | 2.2E-04 | 1.4E-04 |

**TABLE 5-5. Transfer Factors for VOCs Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | TF for Soil Gas Migrating to Indoor Air - Commercial ($\mu g/m^3$ per $\mu g/m^3$) | | | TF for Soil Gas Migrating to Indoor Air - Residential ($\mu g/m^3$ 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 $\mu g/m^3$) | TF for Soil Gas Migrating to Indoor Air in Trailer ($\mu g/m^3$ per $\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft bgs | 10 ft bgs | 15 ft bgs | 5 ft below or beside Trench | 5 ft bgs | 10 ft bgs | 15 bgs |
| 1,3-Dichloropropene | 1.4E-04 | 5.7E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 4.7E-08 | 2.0E-08 | 1.3E-08 | 2.2E-07 | 5.1E-04 | 2.2E-04 | 1.4E-04 |
| Diisopropyl ether | 1.2E-04 | 4.9E-05 | 3.1E-05 | 4.1E-04 | 1.9E-04 | 1.2E-04 | 3.6E-08 | 1.6E-08 | 1.0E-08 | 1.7E-07 | 4.3E-04 | 1.9E-04 | 1.2E-04 |
| 1,4-Dioxane | 2.5E-04 | 1.2E-04 | 8.2E-05 | 7.8E-04 | 4.4E-04 | 3.1E-04 | 6.7E-05 | 3.4E-05 | 2.3E-05 | 4.1E-04 | 9.5E-04 | 4.8E-04 | 3.2E-04 |
| Ethanol | 2.9E-04 | 1.4E-04 | 9.2E-05 | 8.8E-04 | 4.9E-04 | 3.4E-04 | 4.9E-05 | 2.4E-05 | 1.6E-05 | 2.8E-04 | 1.1E-03 | 5.5E-04 | 3.6E-04 |
| Ethyl tert-butyl ether | 1.2E-04 | 4.9E-05 | 3.1E-05 | 4.1E-04 | 1.9E-04 | 1.2E-04 | 5.8E-08 | 2.5E-08 | 1.6E-08 | 2.7E-07 | 4.3E-04 | 1.9E-04 | 1.2E-04 |
| Ethyl acetate | 1.5E-04 | 6.4E-05 | 4.0E-05 | 5.1E-04 | 2.4E-04 | 1.6E-04 | 1.3E-06 | 5.9E-07 | 3.8E-07 | 6.2E-06 | 5.6E-04 | 2.5E-04 | 1.6E-04 |
| Ethylbenzene | 1.2E-04 | 5.1E-05 | 3.2E-05 | 4.3E-04 | 2.0E-04 | 1.3E-04 | 2.0E-08 | 8.6E-09 | 5.5E-09 | 9.1E-08 | 4.5E-04 | 2.0E-04 | 1.3E-04 |
| 4-Ethyltoluene | 1.4E-04 | 5.6E-05 | 3.5E-05 | 4.6E-04 | 2.1E-04 | 1.4E-04 | 9.1E-11 | 4.0E-11 | 2.6E-11 | 4.2E-10 | 5.0E-04 | 2.2E-04 | 1.4E-04 |
| Freon 114 | 7.0E-05 | 2.8E-05 | 1.8E-05 | 2.5E-04 | 1.1E-04 | 7.1E-05 | 2.0E-11 | 8.6E-12 | 5.5E-12 | 9.0E-11 | 2.5E-04 | 1.1E-04 | 6.9E-05 |
| n-Heptane | 1.1E-04 | 4.6E-05 | 2.9E-05 | 3.9E-04 | 1.8E-04 | 1.2E-04 | 4.5E-11 | 2.0E-11 | 1.3E-11 | 2.1E-10 | 4.1E-04 | 1.8E-04 | 1.1E-04 |
| Hexachlorobutadiene | 5.0E-05 | 2.0E-05 | 1.3E-05 | 1.8E-04 | 8.0E-05 | 5.1E-05 | 6.7E-09 | 2.9E-09 | 1.9E-09 | 3.1E-08 | 1.8E-04 | 7.7E-05 | 5.0E-05 |
| n-Hexane | 1.3E-04 | 5.5E-05 | 3.5E-05 | 4.5E-04 | 2.1E-04 | 1.4E-04 | 8.2E-11 | 3.6E-11 | 2.3E-11 | 3.8E-10 | 4.8E-04 | 2.1E-04 | 1.4E-04 |
| 2-Hexanone | 1.3E-04 | 5.5E-05 | 3.5E-05 | 4.5E-04 | 2.1E-04 | 1.4E-04 | 1.8E-06 | 7.9E-07 | 5.1E-07 | 8.4E-06 | 4.8E-04 | 2.1E-04 | 1.4E-04 |
| alpha-Methyl styrene | 1.1E-04 | 4.7E-05 | 3.0E-05 | 4.0E-04 | 1.8E-04 | 1.2E-04 | 6.7E-08 | 2.9E-08 | 1.9E-08 | 3.1E-07 | 4.2E-04 | 1.8E-04 | 1.2E-04 |
| Methyl tert-butyl ether | 1.4E-04 | 5.7E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 2.6E-07 | 1.1E-07 | 7.2E-08 | 1.2E-06 | 5.0E-04 | 2.2E-04 | 1.4E-04 |
| 4-Methyl-2-pentanone | 1.3E-04 | 5.4E-05 | 3.4E-05 | 4.4E-04 | 2.1E-04 | 1.3E-04 | 1.2E-06 | 5.1E-07 | 3.3E-07 | 5.4E-06 | 4.7E-04 | 2.1E-04 | 1.3E-04 |
| Methylene Chloride | 1.8E-04 | 7.5E-05 | 4.7E-05 | 5.9E-04 | 2.8E-04 | 1.8E-04 | 6.0E-08 | 2.6E-08 | 1.7E-08 | 2.8E-07 | 6.6E-04 | 2.9E-04 | 1.9E-04 |
| Methylmethacrylate | 1.4E-04 | 5.7E-05 | 3.6E-05 | 4.7E-04 | 2.2E-04 | 1.4E-04 | 5.4E-07 | 2.4E-07 | 1.5E-07 | 2.5E-06 | 5.0E-04 | 2.2E-04 | 1.4E-04 |
| Naphthalene | 1.1E-04 | 4.6E-05 | 2.9E-05 | 3.9E-04 | 1.8E-04 | 1.1E-04 | 3.6E-07 | 1.6E-07 | 1.0E-07 | 1.7E-06 | 4.0E-04 | 1.8E-04 | 1.1E-04 |
| n-Octane | 1.1E-04 | 4.6E-05 | 2.9E-05 | 3.9E-04 | 1.8E-04 | 1.2E-04 | 2.8E-11 | 1.2E-11 | 7.8E-12 | 1.3E-10 | 4.1E-04 | 1.8E-04 | 1.1E-04 |
| n-Propylbenzene | 1.1E-04 | 4.5E-05 | 2.9E-05 | 3.8E-04 | 1.7E-04 | 1.1E-04 | 1.4E-08 | 6.0E-09 | 3.9E-09 | 6.3E-08 | 4.0E-04 | 1.7E-04 | 1.1E-04 |
| Propylene | 1.9E-04 | 8.2E-05 | 5.2E-05 | 6.3E-04 | 3.0E-04 | 2.0E-04 | 9.4E-10 | 4.1E-10 | 2.6E-10 | 4.3E-09 | 7.3E-04 | 3.2E-04 | 2.0E-04 |
| Styrene | 1.3E-04 | 5.3E-05 | 3.4E-05 | 4.4E-04 | 2.0E-04 | 1.3E-04 | 6.0E-08 | 2.6E-08 | 1.7E-08 | 2.7E-07 | 4.7E-04 | 2.1E-04 | 1.3E-04 |
| 1,1,1,2-Tetrachloroethane | 8.9E-05 | 3.6E-05 | 2.3E-05 | 3.2E-04 | 1.4E-04 | 9.1E-05 | 4.7E-08 | 2.0E-08 | 1.3E-08 | 2.1E-07 | 3.2E-04 | 1.4E-04 | 8.9E-05 |
| 1,1,2,2-Tetrachloroethane | 9.1E-05 | 3.8E-05 | 2.4E-05 | 3.2E-04 | 1.5E-04 | 9.4E-05 | 3.1E-07 | 1.4E-07 | 8.8E-08 | 1.5E-06 | 3.3E-04 | 1.4E-04 | 9.2E-05 |
| Tetrachloroethene | 9.3E-05 | 3.8E-05 | 2.4E-05 | 3.3E-04 | 1.5E-04 | 9.5E-05 | 6.3E-09 | 2.8E-09 | 1.8E-09 | 2.9E-08 | 3.3E-04 | 1.5E-04 | 9.3E-05 |
| Tetrahydrofuran | 1.8E-04 | 7.8E-05 | 4.9E-05 | 6.0E-04 | 2.9E-04 | 1.9E-04 | 3.0E-06 | 1.3E-06 | 8.5E-07 | 1.4E-05 | 6.8E-04 | 3.0E-04 | 1.9E-04 |
| Toluene | 1.4E-04 | 5.8E-05 | 3.7E-05 | 4.8E-04 | 2.2E-04 | 1.4E-04 | 2.5E-08 | 1.1E-08 | 7.1E-09 | 1.2E-07 | 5.1E-04 | 2.3E-04 | 1.4E-04 |
| 1,2,3-Trichlorobenzene | 7.4E-05 | 3.0E-05 | 1.9E-05 | 2.7E-04 | 1.2E-04 | 7.6E-05 | 9.3E-08 | 4.1E-08 | 2.6E-08 | 4.3E-07 | 2.6E-04 | 1.2E-04 | 7.4E-05 |
| 1,2,4-Trichlorobenzene | 7.4E-05 | 3.0E-05 | 1.9E-05 | 2.7E-04 | 1.2E-04 | 7.6E-05 | 7.4E-08 | 3.2E-08 | 2.1E-08 | 3.4E-07 | 2.6E-04 | 1.2E-04 | 7.4E-05 |
| 1,1,1-Trichloroethane | 1.2E-04 | 4.9E-05 | 3.1E-05 | 4.1E-04 | 1.9E-04 | 1.2E-04 | 7.7E-09 | 3.4E-09 | 2.2E-09 | 3.5E-08 | 4.3E-04 | 1.9E-04 | 1.2E-04 |
| 1,1,2-Trichloroethane | 1.2E-04 | 5.1E-05 | 3.2E-05 | 4.2E-04 | 1.9E-04 | 1.3E-04 | 1.8E-07 | 7.9E-08 | 5.1E-08 | 8.3E-07 | 4.4E-04 | 1.9E-04 | 1.2E-04 |
| Trichloroethene | 1.2E-04 | 5.2E-05 | 3.2E-05 | 4.3E-04 | 2.0E-04 | 1.3E-04 | 1.5E-08 | 6.4E-09 | 4.1E-09 | 6.8E-08 | 4.5E-04 | 2.0E-04 | 1.3E-04 |
| Trichlorofluoromethane | 1.2E-04 | 4.9E-05 | 3.1E-05 | 4.1E-04 | 1.9E-04 | 1.2E-04 | 1.3E-09 | 5.6E-10 | 3.6E-10 | 5.9E-09 | 4.3E-04 | 1.9E-04 | 1.2E-04 |
| 1,2,3-Trichloropropane | 1.1E-04 | 4.4E-05 | 2.8E-05 | 3.7E-04 | 1.7E-04 | 1.1E-04 | 4.0E-07 | 1.8E-07 | 1.1E-07 | 1.9E-06 | 3.9E-04 | 1.7E-04 | 1.1E-04 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 7.0E-05 | 2.8E-05 | 1.8E-05 | 2.5E-04 | 1.1E-04 | 7.1E-05 | 1.4E-10 | 6.1E-11 | 3.9E-11 | 6.4E-10 | 2.5E-04 | 1.1E-04 | 6.9E-05 |
| 1,2,4-Trimethylbenzene | 1.1E-04 | 4.6E-05 | 2.9E-05 | 3.9E-04 | 1.8E-04 | 1.1E-04 | 2.4E-08 | 1.1E-08 | 6.7E-09 | 1.1E-07 | 4.0E-04 | 1.8E-04 | 1.1E-04 |
| 1,3,5-Trimethylbenzene | 1.1E-04 | 4.5E-05 | 2.9E-05 | 3.8E-04 | 1.7E-04 | 1.1E-04 | 1.7E-08 | 7.3E-09 | 4.7E-09 | 7.7E-08 | 4.0E-04 | 1.7E-04 | 1.1E-04 |
| Vinyl acetate | 1.5E-04 | 6.4E-05 | 4.0E-05 | 5.2E-04 | 2.4E-04 | 1.6E-04 | 3.6E-07 | 1.6E-07 | 1.0E-07 | 1.6E-06 | 5.6E-04 | 2.5E-04 | 1.6E-04 |
| Vinyl chloride | 1.9E-04 | 8.0E-05 | 5.0E-05 | 6.2E-04 | 3.0E-04 | 1.9E-04 | 6.9E-09 | 3.0E-09 | 1.9E-09 | 3.2E-08 | 7.1E-04 | 3.1E-04 | 2.0E-04 |
| Xylenes (total) | 1.2E-04 | 5.1E-05 | 3.2E-05 | 4.3E-04 | 2.0E-04 | 1.3E-04 | 2.4E-08 | 1.0E-08 | 6.6E-09 | 1.1E-07 | 4.5E-04 | 2.0E-04 | 1.3E-04 |

**Notes:**

bgs = below ground surface
ft = feet

$\mu g/m^3$ = microgram per cubic meter
TF = transfer factor, equivalent to attenuation factor for soil gas
VOC = volatile organic compound

**TABLE 5-6. Transfer Factors for VOCs Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | TF for Groundwater Vapor Migrating to Commercial Indoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Residential Indoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Outdoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Trench Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Residential Indoor Air in Trailer ($\mu g/m^3$ per $\mu g/L$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs |
| Acetone | 8.5E-05 | 4.1E-05 | 3.2E-04 | 1.6E-04 | 3.0E-06 | 1.5E-06 | 1.1E-04 | 1.6E-05 | 3.3E-04 | 1.6E-04 |
| Acrolein | 2.5E-04 | 1.3E-04 | 9.5E-04 | 5.2E-04 | 8.9E-06 | 4.7E-06 | 1.9E-04 | 4.8E-05 | 9.9E-04 | 5.2E-04 |
| Acrylonitrile | 2.7E-04 | 1.4E-04 | 1.0E-03 | 5.5E-04 | 9.4E-06 | 5.0E-06 | 2.0E-04 | 5.1E-05 | 1.0E-03 | 5.5E-04 |
| tert-Amyl methyl ether | 1.6E-03 | 9.2E-04 | 6.2E-03 | 3.7E-03 | 5.5E-05 | 3.3E-05 | 7.0E-04 | 3.0E-04 | 6.1E-03 | 3.7E-03 |
| Benzene | 4.2E-18 | 1.9E-18 | 5.6E-18 | 2.5E-18 | 1.5E-19 | 6.8E-20 | 4.3E-07 | 3.4E-20 | 5.6E-18 | 2.5E-18 |
| Benzyl chloride | 3.6E-04 | 2.0E-04 | 1.4E-03 | 7.9E-04 | 1.3E-05 | 7.0E-06 | 2.1E-04 | 6.9E-05 | 1.4E-03 | 7.8E-04 |
| Bromobenzene | 1.4E-03 | 8.3E-04 | 5.6E-03 | 3.3E-03 | 5.0E-05 | 2.9E-05 | 6.4E-04 | 2.7E-04 | 5.5E-03 | 3.3E-03 |
| Bromochloromethane | 1.5E-03 | 8.9E-04 | 6.0E-03 | 3.6E-03 | 5.4E-05 | 3.2E-05 | 7.1E-04 | 3.0E-04 | 6.0E-03 | 3.5E-03 |
| Bromodichloromethane | 1.5E-03 | 8.9E-04 | 6.1E-03 | 3.6E-03 | 5.4E-05 | 3.2E-05 | 7.0E-04 | 3.0E-04 | 6.0E-03 | 3.5E-03 |
| Bromoform | 2.8E-04 | 1.5E-04 | 1.1E-03 | 6.0E-04 | 9.7E-06 | 5.2E-06 | 1.8E-04 | 5.3E-05 | 1.1E-03 | 5.8E-04 |
| Bromomethane | 1.0E-02 | 6.1E-03 | 3.9E-02 | 2.4E-02 | 3.6E-04 | 2.2E-04 | 4.3E-03 | 2.0E-03 | 4.0E-02 | 2.4E-02 |
| 1,3-Butadiene | 1.0E-01 | 6.2E-02 | 4.0E-01 | 2.5E-01 | 3.6E-03 | 2.2E-03 | 4.3E-02 | 2.0E-02 | 4.0E-01 | 2.4E-01 |
| 2-Butanone | 1.1E-04 | 5.3E-05 | 4.0E-04 | 2.1E-04 | 3.8E-06 | 1.9E-06 | 1.2E-04 | 2.0E-05 | 4.2E-04 | 2.1E-04 |
| tert-Butyl alcohol | 3.3E-05 | 1.5E-05 | 1.2E-04 | 6.1E-05 | 1.1E-06 | 5.5E-07 | 7.0E-05 | 6.4E-06 | 1.3E-04 | 6.1E-05 |
| n-Butylbenzene | 7.5E-03 | 4.5E-03 | 3.0E-02 | 1.8E-02 | 2.7E-04 | 1.6E-04 | 3.2E-03 | 1.5E-03 | 3.0E-02 | 1.8E-02 |
| sec-Butylbenzene | 8.5E-03 | 5.2E-03 | 3.4E-02 | 2.1E-02 | 3.0E-04 | 1.8E-04 | 3.6E-03 | 1.7E-03 | 3.3E-02 | 2.0E-02 |
| tert-Butylbenzene | 6.5E-03 | 3.9E-03 | 2.6E-02 | 1.6E-02 | 2.3E-04 | 1.4E-04 | 2.8E-03 | 1.3E-03 | 2.5E-02 | 1.5E-02 |
| Carbon disulfide | 2.0E-02 | 1.2E-02 | 7.7E-02 | 4.8E-02 | 7.0E-04 | 4.3E-04 | 8.4E-03 | 3.9E-03 | 7.8E-02 | 4.7E-02 |
| Carbon tetrachloride | 1.9E-02 | 1.2E-02 | 7.7E-02 | 4.7E-02 | 6.8E-04 | 4.2E-04 | 8.2E-03 | 3.8E-03 | 7.6E-02 | 4.6E-02 |
| 3-Chloro-1-propene | 1.3E-02 | 7.8E-03 | 5.1E-02 | 3.1E-02 | 4.6E-04 | 2.8E-04 | 5.5E-03 | 2.5E-03 | 5.1E-02 | 3.1E-02 |
| Chlorobenzene | 2.6E-03 | 1.6E-03 | 1.0E-02 | 6.2E-03 | 9.2E-05 | 5.5E-05 | 1.1E-03 | 5.1E-04 | 1.0E-02 | 6.1E-03 |
| Chloroethane | 1.5E-02 | 9.3E-03 | 6.0E-02 | 3.7E-02 | 5.5E-04 | 3.3E-04 | 6.6E-03 | 3.0E-03 | 6.1E-02 | 3.7E-02 |
| Chloroform | 3.6E-03 | 2.2E-03 | 1.4E-02 | 8.7E-03 | 1.3E-04 | 7.7E-05 | 1.6E-03 | 7.1E-04 | 1.4E-02 | 8.5E-03 |
| Chloromethane | 1.5E-02 | 9.3E-03 | 6.0E-02 | 3.7E-02 | 5.5E-04 | 3.4E-04 | 6.6E-03 | 3.0E-03 | 6.1E-02 | 3.7E-02 |
| 2-Chlorotoluene | 2.4E-03 | 1.4E-03 | 9.3E-03 | 5.7E-03 | 8.3E-05 | 5.0E-05 | 1.0E-03 | 4.6E-04 | 9.2E-03 | 5.5E-03 |
| 4-Chlorotoluene | 2.8E-03 | 1.7E-03 | 1.1E-02 | 6.8E-03 | 1.0E-04 | 6.0E-05 | 1.2E-03 | 5.5E-04 | 1.1E-02 | 6.7E-03 |
| Cumene | 6.9E-03 | 4.1E-03 | 2.7E-02 | 1.7E-02 | 2.4E-04 | 1.5E-04 | 2.9E-03 | 1.3E-03 | 2.7E-02 | 1.6E-02 |
| Cyclohexane | 1.5E-01 | 8.8E-02 | 5.7E-01 | 3.5E-01 | 5.1E-03 | 3.1E-03 | 6.1E-02 | 2.8E-02 | 5.7E-01 | 3.5E-01 |
| p-Cymene | 1.5E+00 | 9.3E-01 | 6.0E+00 | 3.7E+00 | 5.4E-02 | 3.3E-02 | 6.4E-01 | 3.0E-01 | 6.0E+00 | 3.7E+00 |
| 1,2-Dibromo-3-chloropropane | 8.4E-05 | 4.1E-05 | 3.3E-04 | 1.6E-04 | 2.9E-06 | 1.4E-06 | 9.6E-05 | 1.6E-05 | 3.2E-04 | 1.6E-04 |
| Dibromochloromethane | 4.7E-04 | 2.6E-04 | 1.9E-03 | 1.1E-03 | 1.7E-05 | 9.3E-06 | 2.6E-04 | 9.1E-05 | 1.8E-03 | 1.0E-03 |
| 1,2-Dibromoethane | 4.0E-04 | 2.2E-04 | 1.6E-03 | 8.8E-04 | 1.4E-05 | 7.7E-06 | 2.3E-04 | 7.7E-05 | 1.6E-03 | 8.6E-04 |
| Dibromomethane | 6.5E-04 | 3.6E-04 | 2.6E-03 | 1.5E-03 | 2.3E-05 | 1.3E-05 | 3.4E-04 | 1.2E-04 | 2.5E-03 | 1.4E-03 |
| 1,2-Dichlorobenzene | 1.2E-03 | 7.0E-04 | 4.8E-03 | 2.8E-03 | 4.2E-05 | 2.5E-05 | 5.5E-04 | 2.3E-04 | 4.7E-03 | 2.8E-03 |
| 1,3-Dichlorobenzene | 2.3E-03 | 1.4E-03 | 9.2E-03 | 5.6E-03 | 8.2E-05 | 5.0E-05 | 1.0E-03 | 4.5E-04 | 9.1E-03 | 5.5E-03 |
| 1,4-Dichlorobenzene | 1.5E-03 | 8.7E-04 | 5.9E-03 | 3.5E-03 | 5.2E-05 | 3.1E-05 | 6.7E-04 | 2.9E-04 | 5.8E-03 | 3.5E-03 |
| Dichlorodifluoromethane | 3.1E-01 | 1.9E-01 | 1.2E+00 | 7.6E-01 | 1.1E-02 | 6.7E-03 | 1.3E-01 | 6.1E-02 | 1.2E+00 | 7.5E-01 |
| 1,1-Dichloroethane | 5.9E-03 | 3.6E-03 | 2.3E-02 | 1.4E-02 | 2.1E-04 | 1.3E-04 | 2.6E-03 | 1.2E-03 | 2.3E-02 | 1.4E-02 |
| 1,2-Dichloroethane | 1.3E-03 | 7.7E-04 | 5.2E-03 | 3.1E-03 | 4.7E-05 | 2.7E-05 | 6.2E-04 | 2.6E-04 | 5.2E-03 | 3.0E-03 |
| 1,1-Dichloroethene | 2.9E-02 | 1.8E-02 | 1.2E-01 | 7.1E-02 | 1.0E-03 | 6.4E-04 | 1.2E-02 | 5.8E-03 | 1.2E-01 | 7.0E-02 |
| cis-1,2-Dichloroethene | 4.6E-03 | 2.7E-03 | 1.8E-02 | 1.1E-02 | 1.6E-04 | 9.8E-05 | 2.0E-03 | 8.9E-04 | 1.8E-02 | 1.1E-02 |
| trans-1,2-Dichloroethene | 1.0E-02 | 6.3E-03 | 4.1E-02 | 2.5E-02 | 3.7E-04 | 2.2E-04 | 4.4E-03 | 2.0E-03 | 4.1E-02 | 2.5E-02 |
| 1,2-Dichloropropane | 2.5E-03 | 1.5E-03 | 1.0E-02 | 6.1E-03 | 9.0E-05 | 5.4E-05 | 1.1E-03 | 5.0E-04 | 1.0E-02 | 6.0E-03 |
| 1,3-Dichloropropane | 9.2E-04 | 5.3E-04 | 3.6E-03 | 2.1E-03 | 3.2E-05 | 1.9E-05 | 4.4E-04 | 1.8E-04 | 3.6E-03 | 2.1E-03 |
| 2,2-Dichloropropane | 2.0E-02 | 1.2E-02 | 8.0E-02 | 4.9E-02 | 7.2E-04 | 4.4E-04 | 8.6E-03 | 4.0E-03 | 7.9E-02 | 4.8E-02 |
| 1,1-Dichloropropene | 6.5E-02 | 3.9E-02 | 2.6E-01 | 1.6E-01 | 2.3E-03 | 1.4E-03 | 2.7E-02 | 1.3E-02 | 2.5E-01 | 1.6E-01 |

**TABLE 5-6. Transfer Factors for VOCs Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | TF for Groundwater Vapor Migrating to Commercial Indoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Residential Indoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Outdoor Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Trench Air ($\mu g/m^3$ per $\mu g/L$) | | TF for Groundwater Vapor Migrating to Residential Indoor Air in Trailer ($\mu g/m^3$ per $\mu g/L$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs | 10 ft bgs | 20 ft bgs |
| 1,3-Dichloropropene | 3.2E-03 | 1.9E-03 | 1.3E-02 | 7.7E-03 | 1.1E-04 | 6.9E-05 | 1.4E-03 | 6.3E-04 | 1.3E-02 | 7.6E-03 |
| Diisopropyl ether | 3.0E-03 | 1.8E-03 | 1.2E-02 | 7.3E-03 | 1.1E-04 | 6.5E-05 | 1.3E-03 | 5.9E-04 | 1.2E-02 | 7.2E-03 |
| 1,4-Dioxane | 1.6E-05 | 8.0E-06 | 5.8E-05 | 3.1E-05 | 5.8E-07 | 2.9E-07 | 5.1E-05 | 3.5E-06 | 6.4E-05 | 3.2E-05 |
| Ethanol | 2.9E-05 | 1.4E-05 | 1.0E-04 | 5.4E-05 | 1.0E-06 | 5.1E-07 | 7.9E-05 | 6.1E-06 | 1.2E-04 | 5.6E-05 |
| Ethyl tert-butyl ether | 1.9E-03 | 1.1E-03 | 7.6E-03 | 4.6E-03 | 6.8E-05 | 4.1E-05 | 8.5E-04 | 3.7E-04 | 7.5E-03 | 4.5E-03 |
| Ethyl acetate | 1.9E-04 | 1.0E-04 | 7.5E-04 | 4.0E-04 | 6.8E-06 | 3.6E-06 | 1.5E-04 | 3.7E-05 | 7.6E-04 | 4.0E-04 |
| Ethylbenzene | 6.0E-03 | 3.6E-03 | 2.4E-02 | 1.5E-02 | 2.1E-04 | 1.3E-04 | 2.6E-03 | 1.2E-03 | 2.4E-02 | 1.4E-02 |
| 4-Ethyltoluene | 1.5E+00 | 9.3E-01 | 6.0E+00 | 3.7E+00 | 5.4E-02 | 3.3E-02 | 6.4E-01 | 3.0E-01 | 6.0E+00 | 3.7E+00 |
| Freon 114 | 1.8E+00 | 1.1E+00 | 7.2E+00 | 4.4E+00 | 6.3E-02 | 3.9E-02 | 7.5E-01 | 3.5E-01 | 7.0E+00 | 4.3E+00 |
| n-Heptane | 2.1E+00 | 1.3E+00 | 8.3E+00 | 5.1E+00 | 7.4E-02 | 4.5E-02 | 8.8E-01 | 4.1E-01 | 8.2E+00 | 5.0E+00 |
| Hexachlorobutadiene | 2.8E-03 | 1.6E-03 | 1.1E-02 | 6.7E-03 | 9.7E-05 | 5.9E-05 | 1.2E-03 | 5.4E-04 | 1.1E-02 | 6.5E-03 |
| n-Hexane | 1.6E+00 | 9.8E-01 | 6.4E+00 | 3.9E+00 | 5.7E-02 | 3.5E-02 | 6.8E-01 | 3.2E-01 | 6.3E+00 | 3.9E+00 |
| 2-Hexanone | 1.2E-04 | 5.8E-05 | 4.5E-04 | 2.3E-04 | 4.1E-06 | 2.1E-06 | 1.1E-04 | 2.2E-05 | 4.5E-04 | 2.3E-04 |
| alpha-Methyl styrene | 1.6E-03 | 9.3E-04 | 6.2E-03 | 3.7E-03 | 5.5E-05 | 3.3E-05 | 7.0E-04 | 3.1E-04 | 6.1E-03 | 3.7E-03 |
| Methyl tert-butyl ether | 6.4E-04 | 3.7E-04 | 2.5E-03 | 1.5E-03 | 2.3E-05 | 1.3E-05 | 3.2E-04 | 1.2E-04 | 2.5E-03 | 1.5E-03 |
| 4-Methyl-2-pentanone | 1.6E-04 | 8.3E-05 | 6.3E-04 | 3.3E-04 | 5.7E-06 | 3.0E-06 | 1.2E-04 | 3.1E-05 | 6.3E-04 | 3.3E-04 |
| Methylene Chloride | 4.2E-03 | 2.5E-03 | 1.7E-02 | 1.0E-02 | 1.5E-04 | 9.1E-05 | 1.9E-03 | 8.3E-04 | 1.7E-02 | 1.0E-02 |
| Methylmethacrylate | 3.4E-04 | 1.9E-04 | 1.3E-03 | 7.4E-04 | 1.2E-05 | 6.6E-06 | 2.0E-04 | 6.5E-05 | 1.3E-03 | 7.3E-04 |
| Naphthalene | 3.3E-04 | 1.8E-04 | 1.3E-03 | 7.3E-04 | 1.2E-05 | 6.5E-06 | 1.9E-04 | 6.4E-05 | 1.3E-03 | 7.2E-04 |
| n-Octane | 3.4E+00 | 2.0E+00 | 1.3E+01 | 8.2E+00 | 1.2E-01 | 7.3E-02 | 1.4E+00 | 6.6E-01 | 1.3E+01 | 8.1E+00 |
| n-Propylbenzene | 6.6E-03 | 4.0E-03 | 2.6E-02 | 1.6E-02 | 2.3E-04 | 1.4E-04 | 2.8E-03 | 1.3E-03 | 2.6E-02 | 1.6E-02 |
| Propylene | 3.2E-01 | 1.9E-01 | 1.2E+00 | 7.7E-01 | 1.1E-02 | 6.9E-03 | 1.3E-01 | 6.2E-02 | 1.2E+00 | 7.6E-01 |
| Styrene | 2.2E-03 | 1.3E-03 | 8.7E-03 | 5.3E-03 | 7.8E-05 | 4.7E-05 | 9.8E-04 | 4.3E-04 | 8.7E-03 | 5.2E-03 |
| 1,1,1,2-Tetrachloroethane | 1.4E-03 | 7.9E-04 | 5.4E-03 | 3.2E-03 | 4.8E-05 | 2.8E-05 | 6.2E-04 | 2.6E-04 | 5.3E-03 | 3.1E-03 |
| 1,1,2,2-Tetrachloroethane | 2.7E-04 | 1.4E-04 | 1.1E-03 | 5.8E-04 | 9.4E-06 | 5.1E-06 | 1.7E-04 | 5.1E-05 | 1.0E-03 | 5.6E-04 |
| Tetrachloroethene | 1.0E-02 | 6.1E-03 | 4.1E-02 | 2.5E-02 | 3.6E-04 | 2.2E-04 | 4.3E-03 | 2.0E-03 | 4.0E-02 | 2.4E-02 |
| Tetrahydrofuran | 1.4E-04 | 7.1E-05 | 5.3E-04 | 2.8E-04 | 5.0E-06 | 2.5E-06 | 1.3E-04 | 2.7E-05 | 5.5E-04 | 2.8E-04 |
| Toluene | 6.0E-03 | 3.6E-03 | 2.4E-02 | 1.5E-02 | 2.1E-04 | 1.3E-04 | 2.6E-03 | 1.2E-03 | 2.4E-02 | 1.4E-02 |
| 1,2,3-Trichlorobenzene | 5.1E-04 | 2.9E-04 | 2.0E-03 | 1.2E-03 | 1.8E-05 | 1.0E-05 | 2.6E-04 | 9.8E-05 | 2.0E-03 | 1.1E-03 |
| 1,2,4-Trichlorobenzene | 6.3E-04 | 3.6E-04 | 2.5E-03 | 1.4E-03 | 2.2E-05 | 1.3E-05 | 3.1E-04 | 1.2E-04 | 2.4E-03 | 1.4E-03 |
| 1,1,1-Trichloroethane | 1.4E-02 | 8.3E-03 | 5.4E-02 | 3.3E-02 | 4.8E-04 | 2.9E-04 | 5.8E-03 | 2.7E-03 | 5.4E-02 | 3.3E-02 |
| 1,1,2-Trichloroethane | 7.3E-04 | 4.1E-04 | 2.9E-03 | 1.7E-03 | 2.6E-05 | 1.5E-05 | 3.6E-04 | 1.4E-04 | 2.8E-03 | 1.6E-03 |
| Trichloroethene | 8.1E-03 | 4.9E-03 | 3.2E-02 | 2.0E-02 | 2.9E-04 | 1.7E-04 | 3.5E-03 | 1.6E-03 | 3.2E-02 | 1.9E-02 |
| Trichlorofluoromethane | 8.4E-02 | 5.1E-02 | 3.3E-01 | 2.0E-01 | 3.0E-03 | 1.8E-03 | 3.5E-02 | 1.6E-02 | 3.3E-01 | 2.0E-01 |
| 1,2,3-Trichloropropane | 2.8E-04 | 1.5E-04 | 1.1E-03 | 6.1E-04 | 9.9E-06 | 5.4E-06 | 1.8E-04 | 5.4E-05 | 1.1E-03 | 6.0E-04 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 2.5E-01 | 1.5E-01 | 1.0E+00 | 6.2E-01 | 8.9E-03 | 5.4E-03 | 1.1E-01 | 4.9E-02 | 9.8E-01 | 6.0E-01 |
| 1,2,4-Trimethylbenzene | 3.9E-03 | 2.3E-03 | 1.6E-02 | 9.5E-03 | 1.4E-04 | 8.4E-05 | 1.7E-03 | 7.6E-04 | 1.5E-02 | 9.3E-03 |
| 1,3,5-Trimethylbenzene | 5.5E-03 | 3.3E-03 | 2.2E-02 | 1.3E-02 | 1.9E-04 | 1.2E-04 | 2.3E-03 | 1.1E-03 | 2.1E-02 | 1.3E-02 |
| Vinyl acetate | 6.1E-04 | 3.4E-04 | 2.4E-03 | 1.4E-03 | 2.1E-05 | 1.2E-05 | 3.1E-04 | 1.2E-04 | 2.4E-03 | 1.4E-03 |
| Vinyl chloride | 4.1E-02 | 2.5E-02 | 1.6E-01 | 1.0E-01 | 1.5E-03 | 9.0E-04 | 1.8E-02 | 8.1E-03 | 1.6E-01 | 9.9E-02 |
| Xylenes (total) | 5.1E-03 | 3.0E-03 | 2.0E-02 | 1.2E-02 | 1.8E-04 | 1.1E-04 | 2.2E-03 | 9.9E-04 | 2.0E-02 | 1.2E-02 |

**Notes:**

bgs= below ground surface
ft = feet
µg/L = microgram per liter
$\mu g/m^3$ = microgram per cubic meter
TF = transfer factor
VOC = volatile organic compound

**TABLE 5-7. Exposure Assumptions**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Exposure Factors | Units | Symbol | Resident | | Indoor Commercial/ Industrial Worker | | Outdoor Commercial/ Industrial Worker | | Construction Worker | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Value | Source | Value | Source | Value | Source | Value | Source |
| **Population-Specific Exposure Assumptions** | | | | | | | | | | |
| Exposure Time | hours/day | ET | 24 | NDEP 2023 | 8 | NDEP 2023 | 8 | NDEP 2023 | 4 | VDEQ 2020 |
| Exposure Frequency | days/year | EF | 350 | NDEP 2023 | 250 | NDEP 2023 | 225 | NDEP 2023 | 30 | [1] |
| Exposure Duration | years | ED | 26 | NDEP 2023 | 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 | NDEP 2023 | 25,550 | USEPA 2023 |
| Averaging Time for Noncarcinogens | days | $AT_{nc}$ | 9,490 | NDEP 2023 | 9,125 | NDEP 2023 | 9,125 | NDEP 2023 | 365 | USEPA 2023 |
| **Inhalation of Vapor Migrating from Soil Gas or Groundwater to Indoor, Outdoor, or Trench Air** | | | | | | | | | | |
| Conversion Factor | hour/day | CF | 24 | -- | 24 | -- | 24 | -- | 24 | -- |
| Intake Factor for Vapor Inhalation, cancer | unitless | $IF_{vapor.inh\_c}$ | 3.6E-01 | USEPA 2009 | 8.2E-02 | USEPA 2009 | 7.3E-02 | USEPA 2009 | 2.0E-04 | USEPA 2009 |
| Intake Factor for Vapor Inhalation, noncancer | unitless | $IF_{vapor.inh\_nc}$ | 9.6E-01 | USEPA 2009 | 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 2017b).

**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. December 2008, Revision 16, June.

NDEP. 2017b. Response to: Soil Gas Investigation and Health Risk Assessment for Parcels C, D, F, G, and H, Revision 1. January 12.
VDEQ. 2023. Virginia Unified Risk Assessment Model - VURAM User's Guide For Risk Assessors. Appendix 2. August.
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 5-8. Chronic and Subchronic Inhalation Toxicity Criteria for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**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] |
| Acrolein | -- | -- | D | IRIS | 0.020 | IRIS | 0.092 | ATSDR |
| 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 |
| 1,3-Butadiene | 0.000030 | IRIS | A | IRIS | 2.0 | IRIS | 2.0 | IRIS [1] |
| 2-Butanone | -- | -- | D | IRIS | 5,000 | IRIS | 1,000 | HEAST |
| tert-Butyl alcohol | -- | -- | -- | -- | 5,000 | IRIS | 5,000 | IRIS [1] |
| n-Butylbenzene | -- | -- | -- | -- | 400 | IRIS [5] | 90 | HEAST [5] |
| sec-Butylbenzene | -- | -- | -- | -- | 400 | IRIS [5] | 90 | HEAST [5] |
| tert-Butylbenzene | -- | -- | -- | -- | 400 | IRIS [5] | 90 | HEAST [5] |
| 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 [6] | 800 | PPRTV Appendix |
| 4-Chlorotoluene | -- | -- | D | PPRTV | 50 | PPRTV [6] | 500 | PPRTV [6] |
| Cumene | -- | -- | D | IRIS | 400 | IRIS | 90 | HEAST |
| Cyclohexane | -- | -- | D | IRIS | 6,000 | IRIS | 18,000 | PPRTV |
| p-Cymene | -- | -- | -- | -- | 400 | IRIS [5] | 90 | HEAST [5] |
| 1,2-Dibromo-3-chloropropane | 0.0060 | PPRTV | B2 | PPRTV | 0.20 | IRIS | 2.0 | PPRTV |
| 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 [7] | 2,000 | HEAST [7] |
| 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 | PPRTV Appendix | 400 | PPRTV Appendix |

**TABLE 5-8. Chronic and Subchronic Inhalation Toxicity Criteria for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**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 ($\mu g/m^3$) | |
|---|---|---|---|---|---|---|---|---|
| trans-1,2-Dichloroethene | -- | -- | D | IRIS | 40 | PPRTV Appendix | 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 [5] | 90 | HEAST [5] |
| Freon 114 | -- | -- | -- | -- | 5,000 | PPRTV [10] | 50,000 | 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 |
| 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 |
| Propylene | -- | -- | -- | -- | 3,000 | Cal/EPA | 3,000 | Cal/EPA [1] |
| 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 |

**TABLE 5-8. Chronic and Subchronic Inhalation Toxicity Criteria for VOCs Analyzed in Soil Gas and Shallow Groundwater**
**Nevada Environmental Response Trust Site**
**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 ($\mu g/m^3$) | |
|---|---|---|---|---|---|---|---|---|
| 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 | 80 | ATSDR |
| 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)
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 sec-butyl alcohol as surrogate.
[5] Use cumene as surrogate.
[6] Use chlorobenzene as surrogate.
[7] Use 1,2-dichlorobenzene 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 5-9. Risk-Based Target Concentrations for Soil Gas – Residents Exposed to Soil Gas Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | Slab-on-Grade Building | | | | | | | | | Trailer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 ft bgs | | | 10 ft bgs | | | 15 ft bgs | | | 5 ft bgs | | | 15 ft bgs | | |
| | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| Acetone | -- | 5.0E+07 | 5.0E+07 | -- | 1.0E+08 | 1.0E+08 | -- | 1.5E+08 | 1.5E+08 | -- | 4.3E+07 | 4.3E+07 | -- | 1.5E+08 | 1.5E+08 |
| Acrolein | -- | 3.2E+01 | 3.2E+01 | -- | 6.6E+01 | 6.6E+01 | -- | 1.0E+02 | 1.0E+02 | -- | 2.8E+01 | 2.8E+01 | -- | 9.8E+01 | 9.8E+01 |
| Acrylonitrile | 6.2E+01 | 3.2E+03 | 6.2E+01 | 1.3E+02 | 6.5E+03 | 1.3E+02 | 1.9E+02 | 9.8E+03 | 1.9E+02 | 5.4E+01 | 2.7E+03 | 5.4E+01 | 1.9E+02 | 9.6E+03 | 1.9E+02 |
| tert-Amyl methyl ether | -- | 7.6E+06 | 7.6E+06 | -- | 1.7E+07 | 1.7E+07 | -- | 2.6E+07 | 2.6E+07 | -- | 7.2E+06 | 7.2E+06 | -- | 2.6E+07 | 2.6E+07 |
| Benzene | 1.0E+18 | 8.7E+19 | 1.0E+18 | 6.1E+18 | 5.3E+20 | 6.1E+18 | 1.1E+19 | 1.0E+21 | 1.1E+19 | 9.0E+17 | 7.9E+19 | 9.0E+17 | 1.1E+19 | 9.9E+20 | 1.1E+19 |
| Benzyl chloride | 1.4E+02 | 2.6E+03 | 1.4E+02 | 3.1E+02 | 5.6E+03 | 3.1E+02 | 4.8E+02 | 8.7E+03 | 4.8E+02 | 1.4E+02 | 2.5E+03 | 1.4E+02 | 4.8E+02 | 8.8E+03 | 4.8E+02 |
| Bromodichloromethane | 2.1E+02 | 1.7E+06 | 2.1E+02 | 4.6E+02 | 3.8E+06 | 4.6E+02 | 7.2E+02 | 5.9E+06 | 7.2E+02 | 2.0E+02 | 1.7E+06 | 2.0E+02 | 7.3E+02 | 6.0E+06 | 7.3E+02 |
| Bromoform | 1.0E+04 | -- | 1.0E+04 | 2.4E+04 | -- | 2.4E+04 | 3.7E+04 | -- | 3.7E+04 | 1.1E+04 | -- | 1.1E+04 | 3.8E+04 | -- | 3.8E+04 |
| Bromomethane | -- | 8.8E+03 | 8.8E+03 | -- | 1.9E+04 | 1.9E+04 | -- | 2.8E+04 | 2.8E+04 | -- | 7.8E+03 | 7.8E+03 | -- | 2.8E+04 | 2.8E+04 |
| 1,3-Butadiene | 1.6E+02 | 3.5E+03 | 1.6E+02 | 3.3E+02 | 7.5E+03 | 3.3E+02 | 5.1E+02 | 1.1E+04 | 5.1E+02 | 1.4E+02 | 3.1E+03 | 1.4E+02 | 5.0E+02 | 1.1E+04 | 5.0E+02 |
| 2-Butanone | -- | 9.2E+06 | 9.2E+06 | -- | 1.9E+07 | 1.9E+07 | -- | 2.9E+07 | 2.9E+07 | -- | 8.2E+06 | 8.2E+06 | -- | 2.9E+07 | 2.9E+07 |
| tert-Butyl alcohol | -- | 8.3E+06 | 8.3E+06 | -- | 1.6E+07 | 1.6E+07 | -- | 2.4E+07 | 2.4E+07 | -- | 7.3E+06 | 7.3E+06 | -- | 2.4E+07 | 2.4E+07 |
| n-Butylbenzene | -- | 1.2E+06 | 1.2E+06 | -- | 2.7E+06 | 2.7E+06 | -- | 4.2E+06 | 4.2E+06 | -- | 1.2E+06 | 1.2E+06 | -- | 4.3E+06 | 4.3E+06 |
| sec-Butylbenzene | -- | 1.2E+06 | 1.2E+06 | -- | 2.7E+06 | 2.7E+06 | -- | 4.2E+06 | 4.2E+06 | -- | 1.2E+06 | 1.2E+06 | -- | 4.3E+06 | 4.3E+06 |
| tert-Butylbenzene | -- | 1.2E+06 | 1.2E+06 | -- | 2.7E+06 | 2.7E+06 | -- | 4.2E+06 | 4.2E+06 | -- | 1.2E+06 | 1.2E+06 | -- | 4.3E+06 | 4.3E+06 |
| Carbon disulfide | -- | 1.2E+06 | 1.2E+06 | -- | 2.5E+06 | 2.5E+06 | -- | 3.8E+06 | 3.8E+06 | -- | 1.0E+06 | 1.0E+06 | -- | 3.7E+06 | 3.7E+06 |
| Carbon tetrachloride | 1.3E+03 | 2.8E+05 | 1.3E+03 | 2.8E+03 | 6.3E+05 | 2.8E+03 | 4.4E+03 | 9.7E+05 | 4.4E+03 | 1.2E+03 | 2.8E+05 | 1.2E+03 | 4.4E+03 | 9.9E+05 | 4.4E+03 |
| 3-Chloro-1-propene | 8.4E+02 | 1.9E+03 | 8.4E+02 | 1.8E+03 | 4.0E+03 | 1.8E+03 | 2.7E+03 | 6.1E+03 | 2.7E+03 | 7.6E+02 | 1.7E+03 | 7.6E+02 | 2.7E+03 | 6.0E+03 | 2.7E+03 |
| Chlorobenzene | -- | 1.2E+05 | 1.2E+05 | -- | 2.5E+05 | 2.5E+05 | -- | 3.9E+05 | 3.9E+05 | -- | 1.1E+05 | 1.1E+05 | -- | 3.9E+05 | 3.9E+05 |
| Chloroethane | -- | 1.7E+07 | 1.7E+07 | -- | 3.6E+07 | 3.6E+07 | -- | 5.5E+07 | 5.5E+07 | -- | 1.5E+07 | 1.5E+07 | -- | 5.4E+07 | 5.4E+07 |
| Chloroform | 2.6E+02 | 2.2E+05 | 2.6E+02 | 5.6E+02 | 4.7E+05 | 5.6E+02 | 8.6E+02 | 7.2E+05 | 8.6E+02 | 2.4E+02 | 2.0E+05 | 2.4E+02 | 8.6E+02 | 7.2E+05 | 8.6E+02 |
| Chloromethane | -- | 1.3E+05 | 1.3E+05 | -- | 2.8E+05 | 2.8E+05 | -- | 4.2E+05 | 4.2E+05 | -- | 1.1E+05 | 1.1E+05 | -- | 4.1E+05 | 4.1E+05 |
| Cumene | -- | 1.1E+06 | 1.1E+06 | -- | 2.4E+06 | 2.4E+06 | -- | 3.7E+06 | 3.7E+06 | -- | 1.0E+06 | 1.0E+06 | -- | 3.7E+06 | 3.7E+06 |
| Cyclohexane | -- | 1.3E+07 | 1.3E+07 | -- | 2.8E+07 | 2.8E+07 | -- | 4.2E+07 | 4.2E+07 | -- | 1.2E+07 | 1.2E+07 | -- | 4.2E+07 | 4.2E+07 |
| p-Cymene | -- | 9.0E+05 | 9.0E+05 | -- | 1.9E+06 | 1.9E+06 | -- | 3.0E+06 | 3.0E+06 | -- | 8.4E+05 | 8.4E+05 | -- | 3.0E+06 | 3.0E+06 |
| 1,2-Dibromo-3-chloropropane | 2.0E+00 | 9.1E+02 | 2.0E+00 | 4.5E+00 | 2.0E+03 | 4.5E+00 | 7.0E+00 | 3.1E+03 | 7.0E+00 | 2.1E+00 | 9.3E+02 | 2.1E+00 | 7.2E+00 | 3.2E+03 | 7.2E+00 |
| Dibromochloromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromoethane | 1.6E+01 | 3.3E+04 | 1.6E+01 | 3.6E+01 | 7.3E+04 | 3.6E+01 | 5.7E+01 | 1.1E+05 | 5.7E+01 | 1.6E+01 | 3.3E+04 | 1.6E+01 | 5.8E+01 | 1.2E+05 | 5.8E+01 |
| 1,2-Dichlorobenzene | -- | 5.8E+05 | 5.8E+05 | -- | 1.3E+06 | 1.3E+06 | -- | 2.0E+06 | 2.0E+06 | -- | 5.6E+05 | 5.6E+05 | -- | 2.0E+06 | 2.0E+06 |
| 1,3-Dichlorobenzene | -- | 4.8E+05 | 4.8E+05 | -- | 1.1E+06 | 1.1E+06 | -- | 1.6E+06 | 1.6E+06 | -- | 4.6E+05 | 4.6E+05 | -- | 1.6E+06 | 1.6E+06 |
| 1,4-Dichlorobenzene | 7.2E+02 | 2.3E+06 | 7.1790E+02 | 1.6E+03 | 5.2E+06 | 1.6E+03 | 2.5E+03 | 8.0E+06 | 2.5E+03 | 7.0E+02 | 2.3E+06 | 7.0E+02 | 2.5E+03 | 8.2E+06 | 2.5E+03 |
| Dichlorodifluoromethane | -- | 2.2E+05 | 2.2E+05 | -- | 4.8E+05 | 4.8E+05 | -- | 7.4E+05 | 7.4E+05 | -- | 2.1E+05 | 2.1E+05 | -- | 7.4E+05 | 7.4E+05 |
| 1,1-Dichloroethane | 3.5E+03 | -- | 3.5E+03 | 7.4E+03 | -- | 7.4E+03 | 1.1E+04 | -- | 1.1E+04 | 3.2E+03 | -- | 3.2E+03 | 1.1E+04 | -- | 1.1E+04 |
| 1,2-Dichloroethane | 2.1E+02 | 1.4E+04 | 2.1E+02 | 4.4E+02 | 3.0E+04 | 4.4E+02 | 6.8E+02 | 4.6E+04 | 6.8E+02 | 1.9E+02 | 1.3E+04 | 1.9E+02 | 6.8E+02 | 4.6E+04 | 6.8E+02 |
| 1,1-Dichloroethene | -- | 4.0E+05 | 4.0E+05 | -- | 8.6E+05 | 8.6E+05 | -- | 1.3E+06 | 1.3E+06 | -- | 3.7E+05 | 3.7E+05 | -- | 1.3E+06 | 1.3E+06 |
| cis-1,2-Dichloroethene | -- | 7.8E+04 | 7.8E+04 | -- | 1.7E+05 | 1.7E+05 | -- | 2.6E+05 | 2.6E+05 | -- | 7.1E+04 | 7.1E+04 | -- | 2.5E+05 | 2.5E+05 |
| trans-1,2-Dichloroethene | -- | 7.9E+04 | 7.9E+04 | -- | 1.7E+05 | 1.7E+05 | -- | 2.6E+05 | 2.6E+05 | -- | 7.2E+04 | 7.2E+04 | -- | 2.6E+05 | 2.6E+05 |
| 1,2-Dichloropropane | 1.7E+03 | 9.2E+03 | 1.7E+03 | 3.6E+03 | 2.0E+04 | 3.6E+03 | 5.6E+03 | 3.1E+04 | 5.6E+03 | 1.6E+03 | 8.6E+03 | 1.6E+03 | 5.6E+03 | 3.1E+04 | 5.6E+03 |
| 1,3-Dichloropropene | 1.5E+03 | 4.4E+04 | 1.5E+03 | 3.2E+03 | 9.6E+04 | 3.2E+03 | 5.0E+03 | 1.5E+05 | 5.0E+03 | 1.4E+03 | 4.1E+04 | 1.4E+03 | 5.0E+03 | 1.5E+05 | 5.0E+03 |
| Diisopropyl ether | -- | 1.8E+06 | 1.8E+06 | -- | 3.9E+06 | 3.9E+06 | -- | 6.0E+06 | 6.0E+06 | -- | 1.7E+06 | 1.7E+06 | -- | 6.0E+06 | 6.0E+06 |
| 1,4-Dioxane | 7.2E+02 | 4.0E+04 | 7.2E+02 | 1.3E+03 | 7.1E+04 | 1.3E+03 | 1.8E+03 | 1.0E+05 | 1.8E+03 | 5.9E+02 | 3.3E+04 | 5.9E+02 | 1.7E+03 | 9.6E+04 | 1.7E+03 |
| Ethanol | -- | 1.2E+08 | 1.2E+08 | -- | 2.1E+08 | 2.1E+08 | -- | 3.1E+08 | 3.1E+08 | -- | 9.3E+07 | 9.3E+07 | -- | 2.9E+08 | 2.9E+08 |
| Ethyl tert-butyl ether | 8.5E+04 | 1.0E+08 | 8.5E+04 | 1.9E+05 | 2.2E+08 | 1.9E+05 | 2.9E+05 | 3.4E+08 | 2.9E+05 | 8.1E+04 | 9.6E+07 | 8.1E+04 | 2.9E+05 | 3.4E+08 | 2.9E+05 |
| Ethyl acetate | -- | 1.4E+05 | 1.4E+05 | -- | 3.0E+05 | 3.0E+05 | -- | 4.6E+05 | 4.6E+05 | -- | 1.3E+05 | 1.3E+05 | -- | 4.6E+05 | 4.6E+05 |
| Ethylbenzene | 2.6E+03 | 2.4E+06 | 2.6E+03 | 5.7E+03 | 5.3E+06 | 5.7E+03 | 8.8E+03 | 8.2E+06 | 8.8E+03 | 2.5E+03 | 2.3E+06 | 2.5E+03 | 8.9E+03 | 8.2E+06 | 8.9E+03 |
| 4-Ethyltoluene | -- | 9.0E+05 | 9.0E+05 | -- | 1.9E+06 | 1.9E+06 | -- | 3.0E+06 | 3.0E+06 | -- | 8.4E+05 | 8.4E+05 | -- | 3.0E+06 | 3.0E+06 |
| Freon 114 | -- | 2.1E+07 | 2.1E+07 | -- | 4.7E+07 | 4.7E+07 | -- | 7.3E+07 | 7.3E+07 | -- | 2.1E+07 | 2.1E+07 | -- | 7.5E+07 | 7.5E+07 |

**TABLE 5-9. Risk-Based Target Concentrations for Soil Gas – Residents Exposed to Soil Gas Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | Slab-on-Grade Building | | | | | | | | | Trailer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 ft bgs | | | 10 ft bgs | | | 15 ft bgs | | | 5 ft bgs | | | 15 ft bgs | | |
| | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| n-Heptane | -- | 1.1E+06 | 1.1E+06 | -- | 2.3E+06 | 2.3E+06 | -- | 3.6E+06 | 3.6E+06 | -- | 1.0E+06 | 1.0E+06 | -- | 3.7E+06 | 3.7E+06 |
| Hexachlorobutadiene | 6.9E+02 | -- | 6.9E+02 | 1.6E+03 | -- | 1.6E+03 | 2.5E+03 | -- | 2.5E+03 | 7.2E+02 | -- | 7.2E+02 | 2.6E+03 | -- | 2.6E+03 |
| n-Hexane | -- | 1.6E+06 | 1.6E+06 | -- | 3.5E+06 | 3.5E+06 | -- | 5.4E+06 | 5.4E+06 | -- | 1.5E+06 | 1.5E+06 | -- | 5.4E+06 | 5.4E+06 |
| 2-Hexanone | -- | 6.9E+04 | 6.9E+04 | -- | 1.5E+05 | 1.5E+05 | -- | 2.3E+05 | 2.3E+05 | -- | 6.5E+04 | 6.5E+04 | -- | 2.3E+05 | 2.3E+05 |
| alpha-Methyl styrene | -- | 2.6E+06 | 2.6E+06 | -- | 5.7E+06 | 5.7E+06 | -- | 8.8E+06 | 8.8E+06 | -- | 2.5E+06 | 2.5E+06 | -- | 8.9E+06 | 8.9E+06 |
| Methyl tert-butyl ether | 2.3E+04 | 6.7E+06 | 2.3E+04 | 5.0E+04 | 1.4E+07 | 5.0E+04 | 7.7E+04 | 2.2E+07 | 7.7E+04 | 2.2E+04 | 6.3E+06 | 2.2E+04 | 7.7E+04 | 2.2E+07 | 7.7E+04 |
| 4-Methyl-2-pentanone | -- | 7.0E+06 | 7.0E+06 | -- | 1.5E+07 | 1.5E+07 | -- | 2.3E+07 | 2.3E+07 | -- | 6.6E+06 | 6.6E+06 | -- | 2.3E+07 | 2.3E+07 |
| Methylene Chloride | 4.8E+05 | 1.1E+06 | 4.8E+05 | 1.0E+06 | 2.2E+06 | 1.0E+06 | 1.5E+06 | 3.4E+06 | 1.5E+06 | 4.2E+05 | 9.5E+05 | 4.2E+05 | 1.5E+06 | 3.4E+06 | 1.5E+06 |
| Methylmethacrylate | -- | 1.6E+06 | 1.6E+06 | -- | 3.4E+06 | 3.4E+06 | -- | 5.2E+06 | 5.2E+06 | -- | 1.5E+06 | 1.5E+06 | -- | 5.2E+06 | 5.2E+06 |
| Naphthalene | 2.1E+02 | 8.0E+03 | 2.1E+02 | 4.7E+02 | 1.8E+04 | 4.7E+02 | 7.2E+02 | 2.7E+04 | 7.2E+02 | 2.0E+02 | 7.7E+03 | 2.0E+02 | 7.3E+02 | 2.8E+04 | 7.3E+02 |
| n-Octane | -- | 5.3E+04 | 5.3E+04 | -- | 1.2E+05 | 1.2E+05 | -- | 1.8E+05 | 1.8E+05 | -- | 5.1E+04 | 5.1E+04 | -- | 1.8E+05 | 1.8E+05 |
| n-Propylbenzene | -- | 2.7E+06 | 2.7E+06 | -- | 6.0E+06 | 6.0E+06 | -- | 9.3E+06 | 9.3E+06 | -- | 2.6E+06 | 2.6E+06 | -- | 9.4E+06 | 9.4E+06 |
| Propylene | -- | 4.9E+06 | 4.9E+06 | -- | 1.0E+07 | 1.0E+07 | -- | 1.6E+07 | 1.6E+07 | -- | 4.3E+06 | 4.3E+06 | -- | 1.5E+07 | 1.5E+07 |
| Styrene | -- | 2.4E+06 | 2.4E+06 | -- | 5.1E+06 | 5.1E+06 | -- | 7.9E+06 | 7.9E+06 | -- | 2.2E+06 | 2.2E+06 | -- | 7.9E+06 | 7.9E+06 |
| 1,1,1,2-Tetrachloroethane | 1.2E+03 | -- | 1.2E+03 | 2.7E+03 | -- | 2.7E+03 | 4.2E+03 | -- | 4.2E+03 | 1.2E+03 | -- | 1.2E+03 | 4.2E+03 | -- | 4.2E+03 |
| 1,1,2,2-Tetrachloroethane | 1.5E+02 | -- | 1.5E+02 | 3.3E+02 | -- | 3.3E+02 | 5.1E+02 | -- | 5.1E+02 | 1.5E+02 | -- | 1.5E+02 | 5.2E+02 | -- | 5.2E+02 |
| Tetrachloroethene | 3.3E+04 | 1.3E+05 | 3.3E+04 | 7.3E+04 | 2.8E+05 | 7.3E+04 | 1.1E+05 | 4.4E+05 | 1.1E+05 | 3.2E+04 | 1.2E+05 | 3.2E+04 | 1.2E+05 | 4.5E+05 | 1.2E+05 |
| Tetrahydrofuran | -- | 3.5E+06 | 3.5E+06 | -- | 7.2E+06 | 7.2E+06 | -- | 1.1E+07 | 1.1E+07 | -- | 3.1E+06 | 3.1E+06 | -- | 1.1E+07 | 1.1E+07 |
| Toluene | -- | 1.1E+07 | 1.1E+07 | -- | 2.4E+07 | 2.4E+07 | -- | 3.6E+07 | 3.6E+07 | -- | 1.0E+07 | 1.0E+07 | -- | 3.6E+07 | 3.6E+07 |
| 1,2,4-Trichlorobenzene | -- | 7.9E+03 | 7.9E+03 | -- | 1.8E+04 | 1.8E+04 | -- | 2.8E+04 | 2.8E+04 | -- | 7.9E+03 | 7.9E+03 | -- | 2.8E+04 | 2.8E+04 |
| 1,1,1-Trichloroethane | -- | 1.3E+07 | 1.3E+07 | -- | 2.8E+07 | 2.8E+07 | -- | 4.3E+07 | 4.3E+07 | -- | 1.2E+07 | 1.2E+07 | -- | 4.3E+07 | 4.3E+07 |
| 1,1,2-Trichloroethane | 4.2E+02 | 4.9E+02 | 4.2E+02 | 9.1E+02 | 1.1E+03 | 9.1E+02 | 1.4E+03 | 1.7E+03 | 1.4E+03 | 3.9E+02 | 4.7E+02 | 3.9E+02 | 1.4E+03 | 1.7E+03 | 1.4E+03 |
| Trichloroethene | 1.6E+03 | 4.8E+03 | 1.6E+03 | 3.5E+03 | 1.1E+04 | 3.5E+03 | 5.4E+03 | 1.6E+04 | 5.4E+03 | 1.5E+03 | 4.6E+03 | 1.5E+03 | 5.4E+03 | 1.6E+04 | 5.4E+03 |
| Trichlorofluoromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3-Trichloropropane | -- | 8.4E+02 | 8.4E+02 | -- | 1.8E+03 | 1.8E+03 | -- | 2.8E+03 | 2.8E+03 | -- | 8.1E+02 | 8.1E+02 | -- | 2.9E+03 | 2.9E+03 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | -- | 2.1E+07 | 2.1E+07 | -- | 4.7E+07 | 4.7E+07 | -- | 7.3E+07 | 7.3E+07 | -- | 2.1E+07 | 2.1E+07 | -- | 7.5E+07 | 7.5E+07 |
| 1,2,4-Trimethylbenzene | -- | 1.6E+05 | 1.6E+05 | -- | 3.6E+05 | 3.6E+05 | -- | 5.5E+05 | 5.5E+05 | -- | 1.6E+05 | 1.6E+05 | -- | 5.6E+05 | 5.6E+05 |
| 1,3,5-Trimethylbenzene | -- | 1.6E+05 | 1.6E+05 | -- | 3.6E+05 | 3.6E+05 | -- | 5.5E+05 | 5.5E+05 | -- | 1.6E+05 | 1.6E+05 | -- | 5.6E+05 | 5.6E+05 |
| Vinyl acetate | -- | 4.0E+05 | 4.0E+05 | -- | 8.6E+05 | 8.6E+05 | -- | 1.3E+06 | 1.3E+06 | -- | 3.7E+05 | 3.7E+05 | -- | 1.3E+06 | 1.3E+06 |
| Vinyl chloride | 1.0E+03 | 1.7E+05 | 1.0E+03 | 2.2E+03 | 3.5E+05 | 2.2E+03 | 3.3E+03 | 5.4E+05 | 3.3E+03 | 9.0E+02 | 1.5E+05 | 9.0E+02 | 3.2E+03 | 5.3E+05 | 3.2E+03 |
| Xylenes (total) | -- | 2.4E+05 | 2.4E+05 | -- | 5.3E+05 | 5.3E+05 | -- | 8.2E+05 | 8.2E+05 | -- | 2.3E+05 | 2.3E+05 | -- | 8.2E+05 | 8.2E+05 |

**Notes:**

-- = not calculated

bgs = below ground surface

ft = feet

$\mu g/m^3$ = microgram per cubic meter

$RBTC_{SG\text{-}IA\text{-}C}$ = risk-based target concentration, cancer, inhalation of soil gas migrating to indoor air

$RBTC_{SG\text{-}IA\text{-}NC}$ = risk-based target concentration, noncancer, inhalation of soil gas migrating to indoor air

**TABLE 5-10. Risk-Based Target Concentrations for Soil Gas – Indoor Commercial/Industrial Workers Exposed to Soil Gas Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 5 ft bgs | | | 10 ft bgs | | | 15 ft bgs | | |
|---|---|---|---|---|---|---|---|---|---|
| | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| Acetone | -- | 6.8E+08 | 6.8E+08 | -- | 1.6E+09 | 1.6E+09 | -- | 2.4E+09 | 2.4E+09 |
| Acrolein | -- | 4.3E+02 | 4.3E+02 | -- | 1.0E+03 | 1.0E+03 | -- | 1.6E+03 | 1.6E+03 |
| Acrylonitrile | 8.8E+02 | 4.3E+04 | 8.8E+02 | 2.1E+03 | 1.0E+05 | 2.1E+03 | 3.3E+03 | 1.6E+05 | 3.3E+03 |
| tert-Amyl methyl ether | -- | 1.1E+08 | 1.1E+08 | -- | 2.7E+08 | 2.7E+08 | -- | 4.2E+08 | 4.2E+08 |
| Benzene | 5.3E+18 | 4.5E+20 | 5.3E+18 | 3.4E+19 | 2.9E+21 | 3.4E+19 | 6.6E+19 | 5.5E+21 | 6.6E+19 |
| Benzyl chloride | 2.1E+03 | 3.8E+04 | 2.1E+03 | 5.2E+03 | 9.1E+04 | 5.2E+03 | 8.2E+03 | 1.4E+05 | 8.2E+03 |
| Bromodichloromethane | 3.2E+03 | 2.5E+07 | 3.2E+03 | 7.8E+03 | 6.2E+07 | 7.8E+03 | 1.2E+04 | 9.8E+07 | 1.2E+04 |
| Bromoform | 1.7E+05 | -- | 1.7E+05 | 4.0E+05 | -- | 4.0E+05 | 6.4E+05 | -- | 6.4E+05 |
| Bromomethane | -- | 1.2E+05 | 1.2E+05 | -- | 2.9E+05 | 2.9E+05 | -- | 4.6E+05 | 4.6E+05 |
| 1,3-Butadiene | 2.3E+03 | 4.9E+04 | 2.3E+03 | 5.5E+03 | 1.2E+05 | 5.5E+03 | 8.7E+03 | 1.9E+05 | 8.7E+03 |
| 2-Butanone | -- | 1.3E+08 | 1.3E+08 | -- | 3.0E+08 | 3.0E+08 | -- | 4.7E+08 | 4.7E+08 |
| tert-Butyl alcohol | -- | 1.1E+08 | 1.1E+08 | -- | 2.5E+08 | 2.5E+08 | -- | 3.9E+08 | 3.9E+08 |
| n-Butylbenzene | -- | 1.8E+07 | 1.8E+07 | -- | 4.4E+07 | 4.4E+07 | -- | 7.0E+07 | 7.0E+07 |
| sec-Butylbenzene | -- | 1.8E+07 | 1.8E+07 | -- | 4.4E+07 | 4.4E+07 | -- | 7.0E+07 | 7.0E+07 |
| tert-Butylbenzene | -- | 1.8E+07 | 1.8E+07 | -- | 4.4E+07 | 4.4E+07 | -- | 7.0E+07 | 7.0E+07 |
| Carbon disulfide | -- | 1.6E+07 | 1.6E+07 | -- | 3.9E+07 | 3.9E+07 | -- | 6.1E+07 | 6.1E+07 |
| Carbon tetrachloride | 2.0E+04 | 4.2E+06 | 2.0E+04 | 4.8E+04 | 1.0E+07 | 4.8E+04 | 7.5E+04 | 1.6E+07 | 7.5E+04 |
| 3-Chloro-1-propene | 1.2E+04 | 2.6E+04 | 1.2E+04 | 2.9E+04 | 6.3E+04 | 2.9E+04 | 4.6E+04 | 9.9E+04 | 4.6E+04 |
| Chlorobenzene | -- | 1.7E+06 | 1.7E+06 | -- | 4.0E+06 | 4.0E+06 | -- | 6.4E+06 | 6.4E+06 |
| Chloroethane | -- | 2.4E+08 | 2.4E+08 | -- | 5.7E+08 | 5.7E+08 | -- | 9.0E+08 | 9.0E+08 |
| Chloroform | 3.8E+03 | 3.1E+06 | 3.8E+03 | 9.2E+03 | 7.4E+06 | 9.2E+03 | 1.5E+04 | 1.2E+07 | 1.5E+04 |
| Chloromethane | -- | 1.8E+06 | 1.8E+06 | -- | 4.3E+06 | 4.3E+06 | -- | 6.8E+06 | 6.8E+06 |
| Cumene | -- | 1.6E+07 | 1.6E+07 | -- | 3.9E+07 | 3.9E+07 | -- | 6.1E+07 | 6.1E+07 |
| Cyclohexane | -- | 1.8E+08 | 1.8E+08 | -- | 4.4E+08 | 4.4E+08 | -- | 7.0E+08 | 7.0E+08 |
| p-Cymene | -- | 1.3E+07 | 1.3E+07 | -- | 3.1E+07 | 3.1E+07 | -- | 4.9E+07 | 4.9E+07 |
| 1,2-Dibromo-3-chloropropane | 3.2E+01 | 1.4E+04 | 3.2E+01 | 7.8E+01 | 3.3E+04 | 7.8E+01 | 1.2E+02 | 5.3E+04 | 1.2E+02 |
| Dibromochloromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromoethane | 2.5E+02 | 4.9E+05 | 2.548E+02 | 6.20E+02 | 1.2E+06 | 6.20E+02 | 9.8E+02 | 1.9E+06 | 9.85E+02 |
| 1,2-Dichlorobenzene | -- | 8.5E+06 | 8.5E+06 | -- | 2.1E+07 | 2.1E+07 | -- | 3.3E+07 | 3.3E+07 |
| 1,3-Dichlorobenzene | -- | 7.0E+06 | 7.0E+06 | -- | 1.7E+07 | 1.7E+07 | -- | 2.7E+07 | 2.7E+07 |
| 1,4-Dichlorobenzene | 1.1E+04 | 3.5E+07 | 1.1E+04 | 2.7E+04 | 8.4E+07 | 2.7E+04 | 4.3E+04 | 1.3E+08 | 4.3E+04 |
| Dichlorodifluoromethane | -- | 3.2E+06 | 3.2E+06 | -- | 7.7E+06 | 7.7E+06 | -- | 1.2E+07 | 1.2E+07 |
| 1,1-Dichloroethane | 5.1E+04 | -- | 5.1E+04 | 1.2E+05 | -- | 1.2E+05 | 1.9E+05 | -- | 1.9E+05 |
| 1,2-Dichloroethane | 3.0E+03 | 2.0E+05 | 3.0E+03 | 7.3E+03 | 4.8E+05 | 7.3E+03 | 1.2E+04 | 7.6E+05 | 1.2E+04 |
| 1,1-Dichloroethene | -- | 5.6E+06 | 5.6E+06 | -- | 1.4E+07 | 1.4E+07 | -- | 2.2E+07 | 2.2E+07 |
| cis-1,2-Dichloroethene | -- | 1.1E+06 | 1.1E+06 | -- | 2.7E+06 | 2.7E+06 | -- | 4.2E+06 | 4.2E+06 |
| trans-1,2-Dichloroethene | -- | 1.1E+06 | 1.1E+06 | -- | 2.7E+06 | 2.7E+06 | -- | 4.2E+06 | 4.2E+06 |
| 1,2-Dichloropropane | 2.5E+04 | 1.3E+05 | 2.5E+04 | 6.0E+04 | 3.2E+05 | 6.0E+04 | 9.5E+04 | 5.0E+05 | 9.5E+04 |
| 1,3-Dichloropropene | 2.2E+04 | 6.3E+05 | 2.2E+04 | 5.4E+04 | 1.5E+06 | 5.4E+04 | 8.5E+04 | 2.4E+06 | 8.5E+04 |
| Diisopropyl ether | -- | 2.6E+07 | 2.6E+07 | -- | 6.2E+07 | 6.2E+07 | -- | 9.9E+07 | 9.9E+07 |
| 1,4-Dioxane | 9.9E+03 | 5.3E+05 | 9.9E+03 | 2.0E+04 | 1.1E+06 | 2.0E+04 | 3.0E+04 | 1.6E+06 | 3.0E+04 |
| Ethanol | -- | 1.5E+09 | 1.5E+09 | -- | 3.1E+09 | 3.1E+09 | -- | 4.8E+09 | 4.8E+09 |
| Ethyl tert-butyl ether | 1.3E+06 | 1.5E+09 | 1.3E+06 | 3.1E+06 | 3.6E+09 | 3.1E+06 | 4.9E+06 | 5.6E+09 | 4.9E+06 |

**TABLE 5-10. Risk-Based Target Concentrations for Soil Gas – Indoor Commercial/Industrial Workers Exposed to Soil Gas Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 5 ft bgs | | | 10 ft bgs | | | 15 ft bgs | | |
|---|---|---|---|---|---|---|---|---|---|
| | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}IA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| Ethyl acetate | -- | 2.0E+06 | 2.0E+06 | -- | 4.8E+06 | 4.8E+06 | -- | 7.6E+06 | 7.6E+06 |
| Ethylbenzene | 3.9E+04 | 3.5E+07 | 3.9E+04 | 9.5E+04 | 8.5E+07 | 9.5E+04 | 1.5E+05 | 1.4E+08 | 1.5E+05 |
| 4-Ethyltoluene | -- | 1.3E+07 | 1.3E+07 | -- | 3.1E+07 | 3.1E+07 | -- | 4.9E+07 | 4.9E+07 |
| Freon 114 | -- | 3.1E+08 | 3.1E+08 | -- | 7.7E+08 | 7.7E+08 | -- | 1.2E+09 | 1.2E+09 |
| n-Heptane | -- | 1.6E+07 | 1.6E+07 | -- | 3.8E+07 | 3.8E+07 | -- | 6.0E+07 | 6.0E+07 |
| Hexachlorobutadiene | 1.1E+04 | -- | 1.1E+04 | 2.7E+04 | -- | 2.7E+04 | 4.4E+04 | -- | 4.4E+04 |
| n-Hexane | -- | 2.3E+07 | 2.3E+07 | -- | 5.6E+07 | 5.6E+07 | -- | 8.9E+07 | 8.9E+07 |
| 2-Hexanone | -- | 1.0E+06 | 1.0E+06 | -- | 2.4E+06 | 2.4E+06 | -- | 3.7E+06 | 3.7E+06 |
| alpha-Methyl styrene | -- | 3.8E+07 | 3.8E+07 | -- | 9.2E+07 | 9.2E+07 | -- | 1.5E+08 | 1.5E+08 |
| Methyl tert-butyl ether | 3.4E+05 | 9.6E+07 | 3.4E+05 | 8.3E+05 | 2.3E+08 | 8.3E+05 | 1.3E+06 | 3.7E+08 | 1.3E+06 |
| 4-Methyl-2-pentanone | -- | 1.0E+08 | 1.0E+08 | -- | 2.4E+08 | 2.4E+08 | -- | 3.8E+08 | 3.8E+08 |
| Methylene Chloride | 6.9E+06 | 1.5E+07 | 6.9E+06 | 1.6E+07 | 3.5E+07 | 1.6E+07 | 2.6E+07 | 5.6E+07 | 2.6E+07 |
| Methylmethacrylate | -- | 2.2E+07 | 2.2E+07 | -- | 5.4E+07 | 5.4E+07 | -- | 8.5E+07 | 8.5E+07 |
| Naphthalene | 3.2E+03 | 1.2E+05 | 3.2E+03 | 7.8E+03 | 2.8E+05 | 7.8E+03 | 1.2E+04 | 4.5E+05 | 1.2E+04 |
| n-Octane | -- | 7.8E+05 | 7.8E+05 | -- | 1.9E+06 | 1.9E+06 | -- | 3.0E+06 | 3.0E+06 |
| n-Propylbenzene | -- | 4.0E+07 | 4.0E+07 | -- | 9.7E+07 | 9.7E+07 | -- | 1.5E+08 | 1.5E+08 |
| Propylene | -- | 6.8E+07 | 6.8E+07 | -- | 1.6E+08 | 1.6E+08 | -- | 2.5E+08 | 2.5E+08 |
| Styrene | -- | 3.4E+07 | 3.4E+07 | -- | 8.2E+07 | 8.2E+07 | -- | 1.3E+08 | 1.3E+08 |
| 1,1,1,2-Tetrachloroethane | 1.9E+04 | -- | 1.9E+04 | 4.5E+04 | -- | 4.5E+04 | 7.2E+04 | -- | 7.2E+04 |
| 1,1,2,2-Tetrachloroethane | 2.3E+03 | -- | 2.3E+03 | 5.6E+03 | -- | 5.6E+03 | 8.9E+03 | -- | 8.9E+03 |
| Tetrachloroethene | 5.1E+05 | 1.9E+06 | 5.08E+05 | 1.24E+06 | 4.6E+06 | 1.24E+06 | 2.0E+06 | 7.3E+06 | 1.97E+06 |
| Tetrahydrofuran | -- | 4.8E+07 | 4.8E+07 | -- | 1.1E+08 | 1.1E+08 | -- | 1.8E+08 | 1.8E+08 |
| Toluene | -- | 1.6E+08 | 1.6E+08 | -- | 3.8E+08 | 3.8E+08 | -- | 6.0E+08 | 6.0E+08 |
| 1,2,4-Trichlorobenzene | -- | 1.2E+05 | 1.2E+05 | -- | 2.9E+05 | 2.9E+05 | -- | 4.6E+05 | 4.6E+05 |
| 1,1,1-Trichloroethane | -- | 1.9E+08 | 1.9E+08 | -- | 4.5E+08 | 4.5E+08 | -- | 7.1E+08 | 7.1E+08 |
| 1,1,2-Trichloroethane | 6.3E+03 | 7.2E+03 | 6.3E+03 | 1.5E+04 | 1.7E+04 | 1.5E+04 | 2.4E+04 | 2.7E+04 | 2.4E+04 |
| Trichloroethene | 2.4E+04 | 7.0E+04 | 2.39E+04 | 5.80E+04 | 1.7E+05 | 5.80E+04 | 9.2E+04 | 2.7E+05 | 9.21E+04 |
| Trichlorofluoromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3-Trichloropropane | -- | 1.2E+04 | 1.2E+04 | -- | 3.0E+04 | 3.0E+04 | -- | 4.7E+04 | 4.7E+04 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | -- | 3.1E+08 | 3.1E+08 | -- | 7.7E+08 | 7.7E+08 | -- | 1.2E+09 | 1.2E+09 |
| 1,2,4-Trimethylbenzene | -- | 2.4E+06 | 2.4E+06 | -- | 5.8E+06 | 5.8E+06 | -- | 9.1E+06 | 9.1E+06 |
| 1,3,5-Trimethylbenzene | -- | 2.4E+06 | 2.4E+06 | -- | 5.8E+06 | 5.8E+06 | -- | 9.2E+06 | 9.2E+06 |
| Vinyl acetate | -- | 5.7E+06 | 5.7E+06 | -- | 1.4E+07 | 1.4E+07 | -- | 2.2E+07 | 2.2E+07 |
| Vinyl chloride | 1.5E+04 | 2.3E+06 | 1.5E+04 | 3.5E+04 | 5.5E+06 | 3.5E+04 | 5.5E+04 | 8.7E+06 | 5.5E+04 |
| Xylenes (total) | -- | 3.5E+06 | 3.5E+06 | -- | 8.5E+06 | 8.5E+06 | -- | 1.4E+07 | 1.4E+07 |

**Notes:**

-- = not calculated

ft = feet

bgs = below ground surface

$\mu g/m^3$ = microgram per cubic meter

$RBTC_{SG\text{-}IA\text{-}C}$ = risk-based target concentration, cancer, inhalation of soil gas migrating to indoor air

$RBTC_{SG\text{-}IA\text{-}NC}$ = risk-based target concentration, noncancer, inhalation of soil gas migrating to indoor air

**TABLE 5-11. Risk-Based Target Concentrations for Air – Outdoor Commercial/Industrial Workers Exposed to Outdoor Air**

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical | Outdoor Air | | |
|---|---|---|---|
| | $RBTC_{OA-C}$ ($\mu g/m^3$) | $RBTC_{OA-NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| Acetone | -- | 1.5E+05 | 1.5E+05 |
| Acrolein | -- | 9.7E-02 | 9.7E-02 |
| Acrylonitrile | 2.0E-01 | 9.7E+00 | 2.0E-01 |
| tert-Amyl methyl ether | -- | 1.5E+04 | 1.5E+04 |
| Benzene | 1.7E+00 | 1.5E+02 | 1.7E+00 |
| Benzyl chloride | 2.8E-01 | 4.9E+00 | 2.8E-01 |
| Bromobenzene | -- | 2.9E+02 | 2.9E+02 |
| Bromochloromethane | -- | 1.9E+02 | 1.9E+02 |
| Bromodichloromethane | 3.7E-01 | 2.9E+03 | 3.7E-01 |
| Bromoform | 1.2E+01 | -- | 1.2E+01 |
| Bromomethane | -- | 2.4E+01 | 2.4E+01 |
| 1,3-Butadiene | 4.5E-01 | 9.7E+00 | 4.5E-01 |
| 2-Butanone | -- | 2.4E+04 | 2.4E+04 |
| tert-Butyl alcohol | -- | 2.4E+04 | 2.4E+04 |
| n-Butylbenzene | -- | 1.9E+03 | 1.9E+03 |
| sec-Butylbenzene | -- | 1.9E+03 | 1.9E+03 |
| tert-Butylbenzene | -- | 1.9E+03 | 1.9E+03 |
| Carbon disulfide | -- | 3.4E+03 | 3.4E+03 |
| Carbon tetrachloride | 2.3E+00 | 4.9E+02 | 2.3E+00 |
| 3-Chloro-1-propene | 2.3E+00 | 4.9E+00 | 2.3E+00 |
| Chlorobenzene | -- | 2.4E+02 | 2.4E+02 |
| Chloroethane | -- | 4.9E+04 | 4.9E+04 |
| Chloroform | 5.9E-01 | 4.8E+02 | 5.9E-01 |
| Chloromethane | -- | 4.4E+02 | 4.4E+02 |
| 2-Chlorotoluene | -- | 2.4E+02 | 2.4E+02 |
| 4-Chlorotoluene | -- | 2.4E+02 | 2.4E+02 |
| Cumene | -- | 1.9E+03 | 1.9E+03 |
| Cyclohexane | -- | 2.9E+04 | 2.9E+04 |
| p-Cymene | -- | 1.9E+03 | 1.9E+03 |
| 1,2-Dibromo-3-chloropropane | 2.3E-03 | 9.7E-01 | 2.3E-03 |
| Dibromochloromethane | -- | -- | -- |
| 1,2-Dibromoethane | 2.3E-02 | 4.4E+01 | 2.3E-02 |
| Dibromomethane | -- | 1.9E+01 | 1.9E+01 |
| 1,2-Dichlorobenzene | -- | 9.7E+02 | 9.7E+02 |
| 1,3-Dichlorobenzene | -- | 9.7E+02 | 9.7E+02 |
| 1,4-Dichlorobenzene | 1.2E+00 | 3.9E+03 | 1.2E+00 |
| Dichlorodifluoromethane | -- | 4.9E+02 | 4.9E+02 |
| 1,1-Dichloroethane | 8.5E+00 | -- | 8.5E+00 |
| 1,2-Dichloroethane | 5.2E-01 | 3.4E+01 | 5.2E-01 |
| 1,1-Dichloroethene | -- | 9.7E+02 | 9.7E+02 |
| cis-1,2-Dichloroethene | -- | 1.9E+02 | 1.9E+02 |
| trans-1,2-Dichloroethene | -- | 1.9E+02 | 1.9E+02 |
| 1,2-Dichloropropane | 3.7E+00 | 1.9E+01 | 3.7E+00 |
| 1,3-Dichloropropane | -- | 1.9E+01 | 1.9E+01 |
| 2,2-Dichloropropane | -- | 1.9E+01 | 1.9E+01 |
| 1,1-Dichloropropene | -- | 9.7E+01 | 9.7E+01 |
| 1,3-Dichloropropene | 3.4E+00 | 9.7E+01 | 3.4E+00 |
| Diisopropyl ether | -- | 3.4E+03 | 3.4E+03 |

## TABLE 5-11. Risk-Based Target Concentrations for Air – Outdoor Commercial/Industrial Workers Exposed to Outdoor Air

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical | Outdoor Air | | |
|---|---|---|---|
| | $RBTC_{OA-C}$ ($\mu g/m^3$) | $RBTC_{OA-NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| 1,4-Dioxane | 2.7E+00 | 1.5E+02 | 2.7E+00 |
| Ethanol | -- | 4.9E+05 | 4.9E+05 |
| Ethyl tert-butyl ether | 1.7E+02 | 1.9E+05 | 1.7E+02 |
| Ethyl acetate | -- | 3.4E+02 | 3.4E+02 |
| Ethylbenzene | 5.5E+00 | 4.9E+03 | 5.5E+00 |
| 4-Ethyltoluene | -- | 1.9E+03 | 1.9E+03 |
| Freon 114 | -- | 2.4E+04 | 2.4E+04 |
| n-Heptane | -- | 1.9E+03 | 1.9E+03 |
| Hexachlorobutadiene | 6.2E-01 | -- | 6.2E-01 |
| n-Hexane | -- | 3.4E+03 | 3.4E+03 |
| 2-Hexanone | -- | 1.5E+02 | 1.5E+02 |
| alpha-Methyl styrene | -- | 4.9E+03 | 4.9E+03 |
| Methyl tert-butyl ether | 5.2E+01 | 1.5E+04 | 5.2E+01 |
| 4-Methyl-2-pentanone | -- | 1.5E+04 | 1.5E+04 |
| Methylene Chloride | 1.4E+03 | 2.9E+03 | 1.4E+03 |
| Methylmethacrylate | -- | 3.4E+03 | 3.4E+03 |
| Naphthalene | 4.0E-01 | 1.5E+01 | 4.0E-01 |
| n-Octane | -- | 9.7E+01 | 9.7E+01 |
| n-Propylbenzene | -- | 4.9E+03 | 4.9E+03 |
| Propylene | -- | 1.5E+04 | 1.5E+04 |
| Styrene | -- | 4.9E+03 | 4.9E+03 |
| 1,1,1,2-Tetrachloroethane | 1.8E+00 | -- | 1.8E+00 |
| 1,1,2,2-Tetrachloroethane | 2.3E-01 | -- | 2.3E-01 |
| Tetrachloroethene | 5.2E+01 | 1.9E+02 | 5.2E+01 |
| Tetrahydrofuran | -- | 9.7E+03 | 9.7E+03 |
| Toluene | -- | 2.4E+04 | 2.4E+04 |
| 1,2,3-Trichlorobenzene | -- | 9.7E+00 | 9.7E+00 |
| 1,2,4-Trichlorobenzene | -- | 9.7E+00 | 9.7E+00 |
| 1,1,1-Trichloroethane | -- | 2.4E+04 | 2.4E+04 |
| 1,1,2-Trichloroethane | 8.5E-01 | 9.7E-01 | 8.5E-01 |
| Trichloroethene | 3.3E+00 | 9.7E+00 | 3.3E+00 |
| Trichlorofluoromethane | -- | -- | -- |
| 1,2,3-Trichloropropane | -- | 1.5E+00 | 1.5E+00 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | -- | 2.4E+04 | 2.4E+04 |
| 1,2,4-Trimethylbenzene | -- | 2.9E+02 | 2.9E+02 |
| 1,3,5-Trimethylbenzene | -- | 2.9E+02 | 2.9E+02 |
| Vinyl acetate | -- | 9.7E+02 | 9.7E+02 |
| Vinyl chloride | 3.1E+00 | 4.9E+02 | 3.1E+00 |
| Xylenes (total) | -- | 4.9E+02 | 4.9E+02 |

**Notes:**

-- = not calculated

$\mu g/m^3$ = microgram per cubic meter

$RBTC_{OA-C}$ = risk-based target concentration, cancer, inhalation of outdoor air

$RBTC_{OA-NC}$ = risk-based target concentration, noncancer, inhalation of outdoor air

## TABLE 5-12. Risk-Based Target Concentrations for Soil Gas – Construction Workers Exposed to Soil Gas Migrating to Trench Air

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 5 ft below or beside trench | | |
|---|---|---|---|
| | $RBTC_{SG\text{-}TA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}TA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| Acetone | -- | 7.1E+10 | 7.1E+10 |
| Acrolein | -- | 7.7E+05 | 7.7E+05 |
| Acrylonitrile | 9.0E+06 | 1.7E+07 | 9.0E+06 |
| tert-Amyl methyl ether | -- | 6.6E+11 | 6.6E+11 |
| Benzene | 7.0E+25 | 6.2E+26 | 7.0E+25 |
| Benzyl chloride | 6.2E+07 | 1.7E+08 | 6.2E+07 |
| Bromodichloromethane | 5.3E+08 | 5.6E+09 | 5.3E+08 |
| Bromoform | 6.1E+09 | -- | 6.1E+09 |
| Bromomethane | -- | 6.3E+10 | 6.3E+10 |
| 1,3-Butadiene | 1.5E+10 | 1.3E+10 | 1.3E+10 |
| 2-Butanone | -- | 4.3E+09 | 4.3E+09 |
| tert-Butyl alcohol | -- | 3.9E+09 | 3.9E+09 |
| n-Butylbenzene | -- | 1.5E+11 | 1.5E+11 |
| sec-Butylbenzene | -- | 1.7E+11 | 1.7E+11 |
| tert-Butylbenzene | -- | 1.3E+11 | 1.3E+11 |
| Carbon disulfide | -- | 7.8E+11 | 7.8E+11 |
| Carbon tetrachloride | 4.4E+10 | 7.1E+11 | 4.4E+10 |
| 3-Chloro-1-propene | 1.1E+10 | 9.3E+09 | 9.3E+09 |
| Chlorobenzene | -- | 1.5E+11 | 1.5E+11 |
| Chloroethane | -- | 3.6E+12 | 3.6E+12 |
| Chloroform | 1.1E+09 | 9.0E+10 | 1.1E+09 |
| Chloromethane | -- | 1.9E+12 | 1.9E+12 |
| Cumene | -- | 1.1E+11 | 1.1E+11 |
| Cyclohexane | -- | 2.6E+14 | 2.6E+14 |
| p-Cymene | -- | 1.6E+13 | 1.6E+13 |
| 1,2-Dibromo-3-chloropropane | 3.0E+05 | 5.2E+07 | 3.0E+05 |
| Dibromochloromethane | -- | -- | -- |
| 1,2-Dibromoethane | 1.2E+07 | 2.1E+08 | 1.2E+07 |
| 1,2-Dichlorobenzene | -- | 4.4E+11 | 4.4E+11 |
| 1,3-Dichlorobenzene | -- | 6.0E+11 | 6.0E+11 |
| 1,4-Dichlorobenzene | 1.8E+09 | 3.5E+11 | 1.8E+09 |
| Dichlorodifluoromethane | -- | 3.4E+13 | 3.4E+13 |
| 1,1-Dichloroethane | 2.3E+10 | -- | 2.3E+10 |
| 1,2-Dichloroethane | 2.8E+08 | 7.2E+09 | 2.8E+08 |
| 1,1-Dichloroethene | -- | 9.9E+09 | 9.9E+09 |
| cis-1,2-Dichloroethene | -- | 1.4E+11 | 1.4E+11 |
| trans-1,2-Dichloroethene | -- | 6.8E+11 | 6.8E+11 |
| 1,2-Dichloropropane | 5.4E+09 | 2.7E+09 | 2.7E+09 |
| 1,3-Dichloropropene | 5.9E+09 | 1.2E+10 | 5.9E+09 |
| Diisopropyl ether | -- | 3.1E+11 | 3.1E+11 |
| 1,4-Dioxane | 2.5E+06 | 1.3E+08 | 2.5E+06 |
| Ethanol | -- | 2.6E+10 | 2.6E+10 |
| Ethyl tert-butyl ether | 2.4E+11 | 1.1E+13 | 2.4E+11 |
| Ethyl acetate | -- | 8.2E+09 | 8.2E+09 |
| Ethylbenzene | 2.2E+10 | 7.2E+12 | 2.2E+10 |
| 4-Ethyltoluene | -- | 1.6E+13 | 1.6E+13 |
| Freon 114 | -- | 4.0E+16 | 4.0E+16 |
| n-Heptane | -- | 1.4E+15 | 1.4E+15 |
| Hexachlorobutadiene | 7.5E+09 | -- | 7.5E+09 |
| n-Hexane | -- | 3.8E+14 | 3.8E+14 |
| 2-Hexanone | -- | 2.6E+08 | 2.6E+08 |

## TABLE 5-12. Risk-Based Target Concentrations for Soil Gas – Construction Workers Exposed to Soil Gas Migrating to Trench Air

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 5 ft below or beside trench | | |
|---|---|---|---|
| | $RBTC_{SG\text{-}TA\text{-}C}$ ($\mu g/m^3$) | $RBTC_{SG\text{-}TA\text{-}NC}$ ($\mu g/m^3$) | Minimum RBTC ($\mu g/m^3$) |
| alpha-Methyl styrene | -- | 7.1E+11 | 7.1E+11 |
| Methyl tert-butyl ether | 1.7E+10 | 1.9E+11 | 1.7E+10 |
| 4-Methyl-2-pentanone | -- | 1.1E+10 | 1.1E+10 |
| Methylene Chloride | 1.8E+12 | 2.7E+11 | 2.7E+11 |
| Methylmethacrylate | -- | 2.0E+10 | 2.0E+10 |
| Naphthalene | 9.0E+07 | 1.3E+08 | 9.0E+07 |
| n-Octane | -- | 1.1E+14 | 1.1E+14 |
| n-Propylbenzene | -- | 1.2E+12 | 1.2E+12 |
| Propylene | -- | 5.1E+13 | 5.1E+13 |
| Styrene | -- | 8.0E+11 | 8.0E+11 |
| 1,1,1,2-Tetrachloroethane | 3.2E+09 | -- | 3.2E+09 |
| 1,1,2,2-Tetrachloroethane | 6.0E+07 | -- | 6.0E+07 |
| Tetrachloroethene | 6.8E+11 | 1.0E+11 | 1.0E+11 |
| Tetrahydrofuran | -- | 1.0E+10 | 1.0E+10 |
| Toluene | -- | 3.1E+12 | 3.1E+12 |
| 1,2,4-Trichlorobenzene | -- | 4.3E+09 | 4.3E+09 |
| 1,1,1-Trichloroethane | -- | 1.0E+13 | 1.0E+13 |
| 1,1,2-Trichloroethane | 3.8E+08 | 9.5E+08 | 3.8E+08 |
| Trichloroethene | 1.8E+10 | 2.3E+09 | 2.3E+09 |
| Trichlorofluoromethane | -- | 1.2E+13 | 1.2E+13 |
| 1,2,3-Trichloropropane | -- | 1.2E+07 | 1.2E+07 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | -- | 5.7E+15 | 5.7E+15 |
| 1,2,4-Trimethylbenzene | -- | 1.3E+11 | 1.3E+11 |
| 1,3,5-Trimethylbenzene | -- | 1.9E+11 | 1.9E+11 |
| Vinyl acetate | -- | 1.6E+09 | 1.6E+09 |
| Vinyl chloride | 3.7E+10 | 1.8E+11 | 3.7E+10 |
| Xylenes (total) | -- | 2.7E+11 | 2.7E+11 |

**Notes:**

-- = not calculated

bgs = below ground surface

ft = feet

$\mu g/m^3$ = microgram per cubic meter

$RBTC_{SG\text{-}TA\text{-}C}$ = risk-based target concentration, cancer, inhalation of soil gas migrating to trench air

$RBTC_{SG\text{-}TA\text{-}NC}$ = risk-based target concentration, noncancer, inhalation of soil gas migrating to trench air

## TABLE 5-13. Summary of Estimated Soil Gas Cancer Risks and Noncancer Hazard Indices
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Scenario | Depth Interval (ft bgs) | Cancer Risk | Chronic HI |
|---|---|---|---|
| Residents (Slab-on-Grade Scenario) [1] | 5 | 6E-08 - 2E-05 | 0.0004 - 0.03 |
| | 10 - 15 | 2E-07 - 2E-05 | 0.0008 - 0.03 |
| Residents (Trailer Scenario) [1] | 5 | 5E-07 - 1E-05 | 0.003 - 0.03 |
| | 10 - 15 | 3E-07 - 7E-06 | 0.002 - 0.01 |
| Indoor Commercial/Industrial Worker [1] | 5 | 5E-09 - 3E-06 | 0.00002 - 0.007 |
| | 10 - 15 | 4E-09 - 2E-06 | 0.00003 - 0.01 |
| Outdoor Commercial/Industrial Worker [2] | 5 | 2E-10 | 0.000001 |
| | 10 - 15 | 2E-10 | 0.00006 |
| Construction Worker[1] | 5 | 1E-14 - 1E-11 | 0.000000003 - 0.0000002 |
| | 10 - 15 | 5E-14 - 2E-11 | 0.000000007 - 0.00001 |

**Notes:**

bgs = below ground surface

ft = feet

HI = hazard index

OU = Operable Unit

VOC = volatile organic compound

UCL = upper confidence level

[1] The cancer risk and non-cancer chronic HI estimates for the residents, indoor commercial/industrial workers and construction workers were based on the maximum by sample risk/HI results for each scenario.

[2] The cancer risk and non-cancer chronic HI for the outdoor commercial/industrial workers were estimated based on the 95% UCLs calculated using the soil gas VOC data collected in the commercial/industrial area in the OU-2 BHRA Area.

**TABLE 5-14. Risk-Based Target Concentrations for Shallow Groundwater - Residents Exposed to VOCs in Groundwater Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | Slab-on-Grade Building | | | | | | Trailer | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 ft bgs | | | 20 ft bgs | | | 20 ft bgs | | |
| | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) |
| Benzene | 6.4E+16 | 5.6E+18 | 6.4E+16 | 1.4E+17 | 1.2E+19 | 1.4E+17 | 1.4E+17 | 1.3E+19 | 1.4E+17 |
| Bromobenzene | -- | 1.1E+04 | 1.1E+04 | -- | 1.9E+04 | 1.9E+04 | -- | 1.9E+04 | 1.9E+04 |
| Bromochloromethane | -- | 7.0E+03 | 7.0E+03 | -- | 1.2E+04 | 1.2E+04 | -- | 1.2E+04 | 1.2E+04 |
| Bromodichloromethane | 1.3E+01 | 1.0E+05 | 1.3E+01 | 2.1E+01 | 1.7E+05 | 2.1E+01 | 2.2E+01 | 1.8E+05 | 2.2E+01 |
| Bromoform | 2.3E+03 | -- | 2.3E+03 | 4.3E+03 | -- | 4.3E+03 | 4.4E+03 | -- | 4.4E+03 |
| Bromomethane | -- | 1.3E+02 | 1.3E+02 | -- | 2.1E+02 | 2.1E+02 | -- | 2.2E+02 | 2.2E+02 |
| 2-Butanone | -- | 1.3E+07 | 1.3E+07 | -- | 2.5E+07 | 2.5E+07 | -- | 2.5E+07 | 2.5E+07 |
| n-Butylbenzene | -- | 1.4E+04 | 1.4E+04 | -- | 2.3E+04 | 2.3E+04 | -- | 2.3E+04 | 2.3E+04 |
| sec-Butylbenzene | -- | 1.2E+04 | 1.2E+04 | -- | 2.0E+04 | 2.0E+04 | -- | 2.0E+04 | 2.0E+04 |
| tert-Butylbenzene | -- | 1.6E+04 | 1.6E+04 | -- | 2.6E+04 | 2.6E+04 | -- | 2.7E+04 | 2.7E+04 |
| Carbon tetrachloride | 6.1E+00 | 1.4E+03 | 6.1E+00 | 9.9E+00 | 2.2E+03 | 9.9E+00 | 1.0E+01 | 2.3E+03 | 1.0E+01 |
| Chlorobenzene | -- | 5.1E+03 | 5.1E+03 | -- | 8.3E+03 | 8.3E+03 | -- | 8.5E+03 | 8.5E+03 |
| Chloroethane | -- | 1.7E+05 | 1.7E+05 | -- | 2.8E+05 | 2.8E+05 | -- | 2.8E+05 | 2.8E+05 |
| Chloroform | 8.6E+00 | 7.2E+03 | 8.6E+00 | 1.4E+01 | 1.2E+04 | 1.4E+01 | 1.4E+01 | 1.2E+04 | 1.4E+01 |
| Chloromethane | -- | 1.6E+03 | 1.6E+03 | -- | 2.5E+03 | 2.5E+03 | -- | 2.5E+03 | 2.5E+03 |
| 2-Chlorotoluene | -- | 5.6E+03 | 5.6E+03 | -- | 9.2E+03 | 9.2E+03 | -- | 9.4E+03 | 9.4E+03 |
| 4-Chlorotoluene | -- | 4.7E+03 | 4.7E+03 | -- | 7.7E+03 | 7.7E+03 | -- | 7.8E+03 | 7.8E+03 |
| Cumene | -- | 1.5E+04 | 1.5E+04 | -- | 2.5E+04 | 2.5E+04 | -- | 2.6E+04 | 2.6E+04 |
| p-Cymene | -- | 6.9E+01 | 6.9E+01 | -- | 1.1E+02 | 1.1E+02 | -- | 1.1E+02 | 1.1E+02 |
| 1,2-Dibromo-3-chloropropane | 1.4E+00 | 6.3E+02 | 1.4E+00 | 2.8E+00 | 1.3E+03 | 2.8E+00 | 2.9E+00 | 1.3E+03 | 2.9E+00 |
| Dibromochloromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromoethane | 2.9E+00 | 5.9E+03 | 2.9E+00 | 5.3E+00 | 1.1E+04 | 5.3E+00 | 5.5E+00 | 1.1E+04 | 5.5E+00 |
| Dibromomethane | -- | 1.6E+03 | 1.6E+03 | -- | 2.9E+03 | 2.9E+03 | -- | 2.9E+03 | 2.9E+03 |
| 1,2-Dichlorobenzene | -- | 4.4E+04 | 4.4E+04 | -- | 7.3E+04 | 7.3E+04 | -- | 7.5E+04 | 7.5E+04 |
| 1,3-Dichlorobenzene | -- | 2.3E+04 | 2.3E+04 | -- | 3.7E+04 | 3.7E+04 | -- | 3.8E+04 | 3.8E+04 |
| 1,4-Dichlorobenzene | 4.3E+01 | 1.4E+05 | 4.3E+01 | 7.2E+01 | 2.4E+05 | 7.2E+01 | 7.4E+01 | 2.4E+05 | 7.4E+01 |
| Dichlorodifluoromethane | -- | 8.5E+01 | 8.5E+01 | -- | 1.4E+02 | 1.4E+02 | -- | 1.4E+02 | 1.4E+02 |
| 1,1-Dichloroethane | 7.5E+01 | -- | 7.5E+01 | 1.2E+02 | -- | 1.2E+02 | 1.2E+02 | -- | 1.2E+02 |
| 1,2-Dichloroethane | 2.1E+01 | 1.4E+03 | 2.1E+01 | 3.5E+01 | 2.4E+03 | 3.5E+01 | 3.6E+01 | 2.4E+03 | 3.6E+01 |
| 1,1-Dichloroethene | -- | 1.8E+03 | 1.8E+03 | -- | 2.9E+03 | 2.9E+03 | -- | 3.0E+03 | 3.0E+03 |
| cis-1,2-Dichloroethene | -- | 2.3E+03 | 2.3E+03 | -- | 3.8E+03 | 3.8E+03 | -- | 3.9E+03 | 3.9E+03 |
| trans-1,2-Dichloroethene | -- | 1.0E+03 | 1.0E+03 | -- | 1.7E+03 | 1.7E+03 | -- | 1.7E+03 | 1.7E+03 |
| 1,2-Dichloropropane | 7.6E+01 | 4.2E+02 | 7.6E+01 | 1.2E+02 | 6.8E+02 | 1.2E+02 | 1.3E+02 | 7.0E+02 | 1.3E+02 |
| 1,3-Dichloropropane | -- | 1.2E+03 | 1.2E+03 | -- | 2.0E+03 | 2.0E+03 | -- | 2.0E+03 | 2.0E+03 |
| 2,2-Dichloropropane | -- | 5.2E+01 | 5.2E+01 | -- | 8.5E+01 | 8.5E+01 | -- | 8.6E+01 | 8.6E+01 |
| 1,1-Dichloropropene | -- | 8.1E+01 | 8.1E+01 | -- | 1.3E+02 | 1.3E+02 | -- | 1.3E+02 | 1.3E+02 |
| 1,3-Dichloropropene | 5.5E+01 | 1.6E+03 | 5.5E+01 | 9.1E+01 | 2.7E+03 | 9.1E+01 | 9.2E+01 | 2.7E+03 | 9.2E+01 |
| 1,4-Dioxane | 9.7E+03 | 5.4E+05 | 9.7E+03 | 1.8E+04 | 1.0E+06 | 1.8E+04 | 1.8E+04 | 9.8E+05 | 1.8E+04 |
| Ethyl tert-butyl ether | 4.6E+03 | 5.5E+06 | 4.6E+03 | 7.6E+03 | 9.1E+06 | 7.6E+03 | 7.8E+03 | 9.2E+06 | 7.8E+03 |
| Ethylbenzene | 4.7E+01 | 4.4E+04 | 4.7E+01 | 7.7E+01 | 7.2E+04 | 7.7E+01 | 7.9E+01 | 7.3E+04 | 7.9E+01 |
| Hexachlorobutadiene | 1.1E+01 | -- | 1.1E+01 | 1.9E+01 | -- | 1.9E+01 | 2.0E+01 | -- | 2.0E+01 |
| Methylene Chloride | 1.7E+04 | 3.8E+04 | 1.7E+04 | 2.8E+04 | 6.2E+04 | 2.8E+04 | 2.8E+04 | 6.2E+04 | 2.8E+04 |

**TABLE 5-14. Risk-Based Target Concentrations for Shallow Groundwater - Residents Exposed to VOCs in Groundwater Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | Slab-on-Grade Building | | | | | | Trailer | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 ft bgs | | | 20 ft bgs | | | 20 ft bgs | | |
| | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) |
| Naphthalene | 6.3E+01 | 2.4E+03 | 6.3E+01 | 1.1E+02 | 4.3E+03 | 1.1E+02 | 1.2E+02 | 4.4E+03 | 1.2E+02 |
| n-Propylbenzene | -- | 4.0E+04 | 4.0E+04 | -- | 6.5E+04 | 6.5E+04 | -- | 6.6E+04 | 6.6E+04 |
| Styrene | -- | 1.2E+05 | 1.2E+05 | -- | 2.0E+05 | 2.0E+05 | -- | 2.0E+05 | 2.0E+05 |
| 1,1,1,2-Tetrachloroethane | 7.0E+01 | -- | 7.0E+01 | 1.2E+02 | -- | 1.2E+02 | 1.2E+02 | -- | 1.2E+02 |
| 1,1,2,2-Tetrachloroethane | 4.6E+01 | -- | 4.6E+01 | 8.4E+01 | -- | 8.4E+01 | 8.6E+01 | -- | 8.6E+01 |
| Tetrachloroethene | 2.7E+02 | 1.0E+03 | 2.7E+02 | 4.3E+02 | 1.7E+03 | 4.3E+02 | 4.5E+02 | 1.7E+03 | 4.5E+02 |
| Toluene | -- | 2.2E+05 | 2.2E+05 | -- | 3.6E+05 | 3.6E+05 | -- | 3.6E+05 | 3.6E+05 |
| 1,2,3-Trichlorobenzene | -- | 1.0E+03 | 1.0E+03 | -- | 1.8E+03 | 1.8E+03 | -- | 1.8E+03 | 1.8E+03 |
| 1,2,4-Trichlorobenzene | -- | 8.4E+02 | 8.4E+02 | -- | 1.4E+03 | 1.4E+03 | -- | 1.5E+03 | 1.5E+03 |
| 1,1,1-Trichloroethane | -- | 9.6E+04 | 9.6E+04 | -- | 1.6E+05 | 1.6E+05 | -- | 1.6E+05 | 1.6E+05 |
| 1,1,2-Trichloroethane | 6.1E+01 | 7.3E+01 | 6.1E+01 | 1.1E+02 | 1.3E+02 | 1.1E+02 | 1.1E+02 | 1.3E+02 | 1.1E+02 |
| Trichloroethene | 2.1E+01 | 6.5E+01 | 2.1E+01 | 3.5E+01 | 1.1E+02 | 3.5E+01 | 3.5E+01 | 1.1E+02 | 3.5E+01 |
| Trichlorofluoromethane | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3-Trichloropropane | -- | 2.8E+02 | 2.8E+02 | -- | 5.1E+02 | 5.1E+02 | -- | 5.2E+02 | 5.2E+02 |
| 1,2,4-Trimethylbenzene | -- | 4.0E+03 | 4.0E+03 | -- | 6.6E+03 | 6.6E+03 | -- | 6.8E+03 | 6.8E+03 |
| 1,3,5-Trimethylbenzene | -- | 2.9E+03 | 2.9E+03 | -- | 4.7E+03 | 4.7E+03 | -- | 4.8E+03 | 4.8E+03 |
| Vinyl chloride | 4.0E+00 | 6.5E+02 | 4.0E+00 | 6.4E+00 | 1.0E+03 | 6.4E+00 | 6.4E+00 | 1.0E+03 | 6.4E+00 |
| Xylenes (total) | -- | 5.2E+03 | 5.2E+03 | -- | 8.5E+03 | 8.5E+03 | -- | 8.7E+03 | 8.7E+03 |

**Notes:**
-- = not calculated
bgs = below ground surface
ft = feet
µg/L = microgram per liter

$RBTC_{GW.vapor-IA-C}$ = risk-based target concentration, cancer, inhalation of groundwater vapor migrating to indoor air
$RBTC_{GW.vapor-IA-NC}$ = risk-based target concentration, noncancer, inhalation of groundwater vapor migrating to indoor air

**TABLE 5-15. Risk-Based Target Concentrations for Shallow Groundwater - Indoor Commercial/Industrial Workers Exposed to VOCs in Groundwater Migrating to Indoor Air**

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical | 10 ft bgs | | | 20 ft bgs | | |
|---|---|---|---|---|---|---|
| | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) |
| Benzene | 3.8E+17 | 3.1E+19 | 3.8E+17 | 8.3E+17 | 6.9E+19 | 8.3E+17 |
| Bromobenzene | -- | 1.9E+05 | 1.9E+05 | -- | 3.2E+05 | 3.2E+05 |
| Bromochloromethane | -- | 1.1E+05 | 1.1E+05 | -- | 2.0E+05 | 2.0E+05 |
| Bromodichloromethane | 2.2E+02 | 1.7E+06 | 2.2E+02 | 3.7E+02 | 2.9E+06 | 3.7E+02 |
| Bromoform | 4.0E+04 | -- | 4.0E+04 | 7.6E+04 | -- | 7.6E+04 |
| Bromomethane | -- | 2.2E+03 | 2.2E+03 | -- | 3.6E+03 | 3.6E+03 |
| 2-Butanone | -- | 2.0E+08 | 2.0E+08 | -- | 4.2E+08 | 4.2E+08 |
| n-Butylbenzene | -- | 2.3E+05 | 2.3E+05 | -- | 3.9E+05 | 3.9E+05 |
| sec-Butylbenzene | -- | 2.0E+05 | 2.0E+05 | -- | 3.4E+05 | 3.4E+05 |
| tert-Butylbenzene | -- | 2.7E+05 | 2.7E+05 | -- | 4.5E+05 | 4.5E+05 |
| Carbon tetrachloride | 1.1E+02 | 2.3E+04 | 1.1E+02 | 1.8E+02 | 3.8E+04 | 1.8E+02 |
| Chlorobenzene | -- | 8.4E+04 | 8.4E+04 | -- | 1.4E+05 | 1.4E+05 |
| Chloroethane | -- | 2.8E+06 | 2.8E+06 | -- | 4.7E+06 | 4.7E+06 |
| Chloroform | 1.5E+02 | 1.2E+05 | 1.5E+02 | 2.5E+02 | 2.0E+05 | 2.5E+02 |
| Chloromethane | -- | 2.6E+04 | 2.6E+04 | -- | 4.2E+04 | 4.2E+04 |
| 2-Chlorotoluene | -- | 9.3E+04 | 9.3E+04 | -- | 1.6E+05 | 1.6E+05 |
| 4-Chlorotoluene | -- | 7.8E+04 | 7.8E+04 | -- | 1.3E+05 | 1.3E+05 |
| Cumene | -- | 2.6E+05 | 2.6E+05 | -- | 4.2E+05 | 4.2E+05 |
| p-Cymene | -- | 1.1E+03 | 1.1E+03 | -- | 1.9E+03 | 1.9E+03 |
| 1,2-Dibromo-3-chloropropane | 2.4E+01 | 1.0E+04 | 2.4E+01 | 5.0E+01 | 2.2E+04 | 5.0E+01 |
| Dibromochloromethane | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromoethane | 5.1E+01 | 9.8E+04 | 5.1E+01 | 9.4E+01 | 1.8E+05 | 9.4E+01 |
| Dibromomethane | -- | 2.7E+04 | 2.7E+04 | -- | 4.9E+04 | 4.9E+04 |
| 1,2-Dichlorobenzene | -- | 7.3E+05 | 7.3E+05 | -- | 1.2E+06 | 1.2E+06 |
| 1,3-Dichlorobenzene | -- | 3.8E+05 | 3.8E+05 | -- | 6.3E+05 | 6.3E+05 |
| 1,4-Dichlorobenzene | 7.5E+02 | 2.4E+06 | 7.5E+02 | 1.3E+03 | 4.0E+06 | 1.3E+03 |
| Dichlorodifluoromethane | -- | 1.4E+03 | 1.4E+03 | -- | 2.3E+03 | 2.3E+03 |
| 1,1-Dichloroethane | 1.3E+03 | -- | 1.3E+03 | 2.1E+03 | -- | 2.1E+03 |
| 1,2-Dichloroethane | 3.6E+02 | 2.3E+04 | 3.6E+02 | 6.1E+02 | 4.0E+04 | 6.1E+02 |
| 1,1-Dichloroethene | -- | 3.0E+04 | 3.0E+04 | -- | 4.9E+04 | 4.9E+04 |
| cis-1,2-Dichloroethene | -- | 3.8E+04 | 3.8E+04 | -- | 6.4E+04 | 6.4E+04 |
| trans-1,2-Dichloroethene | -- | 1.7E+04 | 1.7E+04 | -- | 2.8E+04 | 2.8E+04 |
| 1,2-Dichloropropane | 1.3E+03 | 6.9E+03 | 1.3E+03 | 2.2E+03 | 1.2E+04 | 2.2E+03 |
| 1,3-Dichloropropane | -- | 1.9E+04 | 1.9E+04 | -- | 3.3E+04 | 3.3E+04 |
| 2,2-Dichloropropane | -- | 8.7E+02 | 8.7E+02 | -- | 1.4E+03 | 1.4E+03 |
| 1,1-Dichloropropene | -- | 1.3E+03 | 1.3E+03 | -- | 2.2E+03 | 2.2E+03 |
| 1,3-Dichloropropene | 9.5E+02 | 2.7E+04 | 9.5E+02 | 1.6E+03 | 4.6E+04 | 1.6E+03 |

**TABLE 5-15. Risk-Based Target Concentrations for Shallow Groundwater - Indoor Commercial/Industrial Workers Exposed to VOCs in Groundwater Migrating to Indoor Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 10 ft bgs | | | 20 ft bgs | | |
|---|---|---|---|---|---|---|
| | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-IA-C}$ (µg/L) | $RBTC_{GW.vapor-IA-NC}$ (µg/L) | Minimum RBTC (µg/L) |
| 1,4-Dioxane | 1.5E+05 | 8.0E+06 | 1.5E+05 | 3.1E+05 | 1.6E+07 | 3.1E+05 |
| Ethyl tert-butyl ether | 8.0E+04 | 9.1E+07 | 8.0E+04 | 1.3E+05 | 1.5E+08 | 1.3E+05 |
| Ethylbenzene | 8.2E+02 | 7.3E+05 | 8.2E+02 | 1.4E+03 | 1.2E+06 | 1.4E+03 |
| Hexachlorobutadiene | 2.0E+02 | -- | 2.0E+02 | 3.4E+02 | -- | 3.4E+02 |
| Methylene Chloride | 2.9E+05 | 6.2E+05 | 2.9E+05 | 4.8E+05 | 1.0E+06 | 4.8E+05 |
| Naphthalene | 1.1E+03 | 3.9E+04 | 1.1E+03 | 2.0E+03 | 7.2E+04 | 2.0E+03 |
| n-Propylbenzene | -- | 6.6E+05 | 6.6E+05 | -- | 1.1E+06 | 1.1E+06 |
| Styrene | -- | 2.0E+06 | 2.0E+06 | -- | 3.3E+06 | 3.3E+06 |
| 1,1,1,2-Tetrachloroethane | 1.2E+03 | -- | 1.2E+03 | 2.1E+03 | -- | 2.1E+03 |
| 1,1,2,2-Tetrachloroethane | 7.9E+02 | -- | 7.9E+02 | 1.5E+03 | -- | 1.5E+03 |
| Tetrachloroethene | 4.6E+03 | 1.7E+04 | 4.6E+03 | 7.7E+03 | 2.9E+04 | 7.7E+03 |
| Toluene | -- | 3.6E+06 | 3.6E+06 | -- | 6.0E+06 | 6.0E+06 |
| 1,2,3-Trichlorobenzene | -- | 1.7E+04 | 1.7E+04 | -- | 3.1E+04 | 3.1E+04 |
| 1,2,4-Trichlorobenzene | -- | 1.4E+04 | 1.4E+04 | -- | 2.5E+04 | 2.5E+04 |
| 1,1,1-Trichloroethane | -- | 1.6E+06 | 1.6E+06 | -- | 2.7E+06 | 2.7E+06 |
| 1,1,2-Trichloroethane | 1.1E+03 | 1.2E+03 | 1.1E+03 | 1.9E+03 | 2.1E+03 | 1.9E+03 |
| Trichloroethene | 3.7E+02 | 1.1E+03 | 3.7E+02 | 6.1E+02 | 1.8E+03 | 6.1E+02 |
| Trichlorofluoromethane | -- | -- | -- | -- | -- | -- |
| 1,2,3-Trichloropropane | -- | 4.6E+03 | 4.6E+03 | -- | 8.7E+03 | 8.7E+03 |
| 1,2,4-Trimethylbenzene | -- | 6.7E+04 | 6.7E+04 | -- | 1.1E+05 | 1.1E+05 |
| 1,3,5-Trimethylbenzene | -- | 4.8E+04 | 4.8E+04 | -- | 8.0E+04 | 8.0E+04 |
| Vinyl chloride | 6.7E+01 | 1.1E+04 | 6.7E+01 | 1.1E+02 | 1.7E+04 | 1.1E+02 |
| Xylenes (total) | -- | 8.7E+04 | 8.7E+04 | -- | 1.4E+05 | 1.4E+05 |

**Notes:**
-- = not calculated
bgs = below ground surface
ft = feet
µg/L = microgram per liter

$RBTC_{GW.vapor-IA-C}$ = risk-based target concentration, cancer, inhalation of groundwater vapor migrating to indoor air

$RBTC_{GW.vapor-IA-NC}$ = risk-based target concentration, noncancer, inhalation of groundwater vapor migrating to indoor air

**TABLE 5-16. Risk-Based Target Concentrations for Shallow Groundwater - Construction Workers Exposed to VOCs in Groundwater Migrating to Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 10 ft bgs | | | 20 ft bgs | | |
|---|---|---|---|---|---|---|
| | $RBTC_{GW.vapor\text{-}TA\text{-}C}$ (µg/L) | $RBTC_{GW.vapor\text{-}TA\text{-}NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor\text{-}TA\text{-}C}$ (µg/L) | $RBTC_{GW.vapor\text{-}TA\text{-}NC}$ (µg/L) | Minimum RBTC (µg/L) |
| Benzene | 1.5E+09 | 1.3E+10 | 1.5E+09 | 1.9E+22 | 1.7E+23 | 1.9E+22 |
| Bromobenzene | -- | 2.3E+07 | 2.3E+07 | -- | 5.3E+07 | 5.3E+07 |
| Bromochloromethane | -- | 1.0E+07 | 1.0E+07 | -- | 2.5E+07 | 2.5E+07 |
| Bromodichloromethane | 2.0E+05 | 2.1E+06 | 2.0E+05 | 4.7E+05 | 4.9E+06 | 4.7E+05 |
| Bromoform | 2.5E+07 | -- | 2.5E+07 | 8.8E+07 | -- | 8.8E+07 |
| Bromomethane | -- | 1.7E+06 | 1.7E+06 | -- | 3.7E+06 | 3.7E+06 |
| 2-Butanone | -- | 6.3E+08 | 6.3E+08 | -- | 3.6E+09 | 3.6E+09 |
| n-Butylbenzene | -- | 2.0E+06 | 2.0E+06 | -- | 4.5E+06 | 4.5E+06 |
| sec-Butylbenzene | -- | 1.8E+06 | 1.8E+06 | -- | 3.9E+06 | 3.9E+06 |
| tert-Butylbenzene | -- | 2.4E+06 | 2.4E+06 | -- | 5.2E+06 | 5.2E+06 |
| Carbon tetrachloride | 1.0E+05 | 1.7E+06 | 1.0E+05 | 2.3E+05 | 3.7E+06 | 2.3E+05 |
| Chlorobenzene | -- | 3.2E+07 | 3.2E+07 | -- | 7.2E+07 | 7.2E+07 |
| Chloroethane | -- | 4.4E+07 | 4.4E+07 | -- | 9.6E+07 | 9.6E+07 |
| Chloroform | 1.4E+05 | 1.1E+07 | 1.4E+05 | 3.1E+05 | 2.5E+07 | 3.1E+05 |
| Chloromethane | -- | 3.3E+07 | 3.3E+07 | -- | 7.2E+07 | 7.2E+07 |
| 2-Chlorotoluene | -- | 5.6E+07 | 5.6E+07 | -- | 1.3E+08 | 1.3E+08 |
| 4-Chlorotoluene | -- | 3.0E+07 | 3.0E+07 | -- | 6.6E+07 | 6.6E+07 |
| Cumene | -- | 2.2E+06 | 2.2E+06 | -- | 4.9E+06 | 4.9E+06 |
| p-Cymene | -- | 1.0E+04 | 1.0E+04 | -- | 2.2E+04 | 2.2E+04 |
| 1,2-Dibromo-3-chloropropane | 8.9E+03 | 1.5E+06 | 8.9E+03 | 5.4E+04 | 9.3E+06 | 5.4E+04 |
| Dibromochloromethane | -- | -- | -- | -- | -- | -- |
| 1,2-Dibromoethane | 3.7E+04 | 6.3E+05 | 3.7E+04 | 1.1E+05 | 1.9E+06 | 1.1E+05 |
| Dibromomethane | -- | 8.5E+06 | 8.5E+06 | -- | 2.3E+07 | 2.3E+07 |
| 1,2-Dichlorobenzene | -- | 2.6E+08 | 2.6E+08 | -- | 6.2E+08 | 6.2E+08 |
| 1,3-Dichlorobenzene | -- | 1.4E+08 | 1.4E+08 | -- | 3.2E+08 | 3.2E+08 |
| 1,4-Dichlorobenzene | 6.9E+05 | 1.3E+08 | 6.9E+05 | 1.6E+06 | 3.0E+08 | 1.6E+06 |
| Dichlorodifluoromethane | -- | 5.6E+05 | 5.6E+05 | -- | 1.2E+06 | 1.2E+06 |
| 1,1-Dichloroethane | 1.2E+06 | -- | 1.2E+06 | 2.7E+06 | -- | 2.7E+06 |
| 1,2-Dichloroethane | 3.2E+05 | 8.3E+06 | 3.2E+05 | 7.7E+05 | 2.0E+07 | 7.7E+05 |
| 1,1-Dichloroethene | -- | 2.3E+04 | 2.3E+04 | -- | 5.0E+04 | 5.0E+04 |
| cis-1,2-Dichloroethene | -- | 1.5E+07 | 1.5E+07 | -- | 3.3E+07 | 3.3E+07 |
| trans-1,2-Dichloroethene | -- | 1.3E+07 | 1.3E+07 | -- | 2.8E+07 | 2.8E+07 |
| 1,2-Dichloropropane | 1.2E+06 | 6.0E+05 | 6.0E+05 | 2.8E+06 | 1.4E+06 | 1.4E+06 |
| 1,3-Dichloropropane | -- | 1.5E+06 | 1.5E+06 | -- | 3.8E+06 | 3.8E+06 |
| 2,2-Dichloropropane | -- | 7.9E+04 | 7.9E+04 | -- | 1.7E+05 | 1.7E+05 |
| 1,1-Dichloropropene | -- | 9.7E+04 | 9.7E+04 | -- | 2.1E+05 | 2.1E+05 |
| 1,4-Dioxane | 2.0E+07 | 1.0E+09 | 2.0E+07 | 2.9E+08 | 1.5E+10 | 2.9E+08 |
| Ethyl tert-butyl ether | 7.5E+07 | 3.4E+09 | 7.5E+07 | 1.7E+08 | 7.8E+09 | 1.7E+08 |

**TABLE 5-16. Risk-Based Target Concentrations for Shallow Groundwater - Construction Workers Exposed to VOCs in Groundwater Migrating to Trench Air**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical | 10 ft bgs | | | 20 ft bgs | | |
|---|---|---|---|---|---|---|
| | $RBTC_{GW.vapor-TA-C}$ (µg/L) | $RBTC_{GW.vapor-TA-NC}$ (µg/L) | Minimum RBTC (µg/L) | $RBTC_{GW.vapor-TA-C}$ (µg/L) | $RBTC_{GW.vapor-TA-NC}$ (µg/L) | Minimum RBTC (µg/L) |
| Ethylbenzene | 8.0E+05 | 2.6E+08 | 8.0E+05 | 1.7E+06 | 5.6E+08 | 1.7E+06 |
| Hexachlorobutadiene | 2.0E+05 | -- | 2.0E+05 | 4.3E+05 | -- | 4.3E+05 |
| Methylene Chloride | 2.8E+08 | 4.1E+07 | 4.1E+07 | 6.1E+08 | 9.1E+07 | 9.1E+07 |
| Naphthalene | 7.8E+05 | 1.1E+06 | 7.8E+05 | 2.4E+06 | 3.4E+06 | 2.4E+06 |
| n-Propylbenzene | -- | 2.6E+07 | 2.6E+07 | -- | 5.6E+07 | 5.6E+07 |
| Styrene | -- | 2.2E+08 | 2.2E+08 | -- | 5.1E+08 | 5.1E+08 |
| 1,1,1,2-Tetrachloroethane | 1.1E+06 | -- | 1.1E+06 | 2.6E+06 | -- | 2.6E+06 |
| 1,1,2,2-Tetrachloroethane | 5.1E+05 | -- | 5.1E+05 | 1.7E+06 | -- | 1.7E+06 |
| Tetrachloroethene | 4.5E+06 | 6.9E+05 | 6.9E+05 | 9.9E+06 | 1.5E+06 | 1.5E+06 |
| Toluene | -- | 1.4E+08 | 1.4E+08 | -- | 3.1E+08 | 3.1E+08 |
| 1,2,3-Trichlorobenzene | -- | 5.6E+06 | 5.6E+06 | -- | 1.5E+07 | 1.5E+07 |
| 1,2,4-Trichlorobenzene | -- | 4.7E+06 | 4.7E+06 | -- | 1.2E+07 | 1.2E+07 |
| 1,1,1-Trichloroethane | -- | 6.3E+07 | 6.3E+07 | -- | 1.4E+08 | 1.4E+08 |
| 1,1,2-Trichloroethane | 8.8E+05 | 2.2E+06 | 8.8E+05 | 2.3E+06 | 5.7E+06 | 2.3E+06 |
| Trichloroethene | 3.6E+05 | 4.5E+04 | 4.5E+04 | 7.9E+05 | 9.9E+04 | 9.9E+04 |
| Trichlorofluoromethane | -- | 2.1E+06 | 2.1E+06 | -- | 4.5E+06 | 4.5E+06 |
| 1,2,3-Trichloropropane | -- | 1.2E+05 | 1.2E+05 | -- | 4.1E+05 | 4.1E+05 |
| 1,2,4-Trimethylbenzene | -- | 8.7E+06 | 8.7E+06 | -- | 1.9E+07 | 1.9E+07 |
| 1,3,5-Trimethylbenzene | -- | 6.2E+06 | 6.2E+06 | -- | 1.4E+07 | 1.4E+07 |
| Vinyl chloride | 6.6E+04 | 3.3E+05 | 6.6E+04 | 1.4E+05 | 7.2E+05 | 1.4E+05 |

**Notes:**
-- = not calculated
bgs = below ground surface
ft = feet
µg/L = microgram per liter

$RBTC_{GW.vapor-TA-C}$ = risk-based target concentration, cancer, inhalation of groundwater vapor migrating to trench air

$RBTC_{GW.vapor-TA-NC}$ = risk-based target concentration, noncancer, inhalation of groundwater vapor migrating to trench air

## TABLE 5-17. Summary of Estimated Shallow Groundwater Cancer Risks and Noncancer Hazard Indices

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Scenario | Cancer Risk | Chronic HI |
|---|---|---|
| Residents (Slab-on-Grade Scenario)[1] | 3E-11 - 1E-04 | 0.00003 - 0.1 |
| Residents (Trailer Scenario)[1] | 1E-05 - 4E-05 | 0.01 - 0.08 |
| Indoor Commercial/Industrial Worker[1] | 2E-12 - 3E-06 | 0.00000007 - 0.004 |
| Outdoor Commercial/Industrial Worker[2] | 2E-08 | 0.00006 |
| Construction Worker[1] | 2E-15 - 7E-09 | 0.0000000006 - 0.0001 |

**Notes:**

HI = hazard index

OU = Operable Unit

VOC = volatile organic compound

UCL = upper confidence limit

[1] The cancer risk and non-cancer chronic HI estimates for residents, indoor commercial/industrial workers and construction workers were based on the maximum by sample risk/HI results for each scenario.

[2] The cancer risk and non-cancer chronic HI for the outdoor commercial/industrial workers were estimated based on the 95% UCLs calculated using the shallow groundwater VOC data collected in the commercial/industrial zone in the western portion of OU-2.

## TABLE 7-2. Soil Gas Data Quality Assessment for Outdoor Commercial/Industrial Worker Scenarios

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Medium | Soil Gas (5 ft bgs) | | Soil Gas (10-15 ft bgs) | |
|---|---|---|---|---|
| Exposure Scenario | Outdoor Commercial/Industrial Worker | | | |
| | Cancer Risk | HI | Cancer Risk | HI |
| Target Cancer Risk or Target HI [1] | $1.49 \times 10^{-4}$ | 1.49 | $1.49 \times 10^{-4}$ | 1.49 |
| Total Cancer Risk/HI based on 95% UCL[2] | 3E-10 | 0.000001 | 2E-10 | 0.00006 |
| Cancer Risk/HI Driver | Chloroform | Chloroform | Chloroform | Chloroform |
| 95% UCL of Driver Chemical Concentration ($\mu g/m^3$) | 1.3E-04 | 1.3E-04 | 1.1E-04 | 1.1E-04 |
| Cancer Risk/HQ based on 95%UCL of Driver Chemical | 2.2E-10 | 0.00000028 | 1.8E-10 | 0.00000022 |
| SD of Driver Chemical Concentration ($\mu g/m^3$) | 1.1E-04 | 1.1E-04 | 7.1E-05 | 7.1E-05 |
| SD of Cancer Risk/HQ from Driver Chemical [3] | 1.9E-10 | 2.4E-07 | 1.2E-10 | 1.4E-07 |
| Number of Samples Required[4] | 2 | 2 | 2 | 2 |
| Sample Size [5] | 35 | 35 | 23 | 23 |

**Notes:**
bgs = below ground surface
ft = feet
$\mu g/m^3$ = microgram per cubic meter
HI = Hazard index
HQ = Hazard quotient
SD = Standard deviation
UCL = Upper confidence limit

[1] Target cancer risk is set as $1.49 \times 10^{-4}$, which can be rounded to $1 \times 10^{-4}$. Target HI is set as 1.49, which can be rounded to 1. These values were input as $Mean_1$ in G*Power, indicating an alternative hypothesis that the mean of population cancer risk or HI is greater than target cancer risk or target HI.

[2] The values were input as $Mean_0$ in G*Power, indicating a null hypothesis that the mean of population cancer risk or non-cancer HI is the same as the cancer risk or non-cancer HI based on the 95% UCL of sample results.

[3] It was assumed that the SD of total cancer risk/HI is similar to the SD of cancer risk/HQ from the driver chemical. These values were input as SD in G*Power to calculate corresponding effect size.

[4] Calculations were conducted using the t tests - Means: difference from constant (one sample case) in the software program G*Power.

[5] Sample size is the number of samples included in the BHRA analysis for soil gas for the outdoor commercial/industrial worker scenario.

**TABLE 7-1. Soil Gas Data Quality Assessment for Resident, Indoor Commercial/Industrial Worker and Construction Worker Scenarios**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Medium | Soil Gas (5 ft bgs) | | | | | | | | Soil Gas (10-15 ft bgs) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exposure Scenario | Resident (Slab-on-Grade Building Scenario) | | Resident (Trailer Scenario) | | Indoor Commercial/ Industrial Worker | | Construction Worker | | Resident (Slab-on-Grade Building Scenario) | | Resident (Trailer Scenario) | | Indoor Commercial/ Industrial Worker | | Construction Worker | |
| Sample Size [1] | 43 | | 2 | | 35 | | 78 | | 35 | | 2 | | 23 | | 58 | |
| $P_1$ [2] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sample Count for Effect Size | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| Effect Size [3] | 0.023 | 0.047 | 0.50 | 1.00 | 0.029 | 0.057 | 0.013 | 0.026 | 0.029 | 0.057 | 0.50 | 1.00 | 0.043 | 0.087 | 0.017 | 0.034 |
| $P_2$ [4] | 0.023 | 0.047 | 0.50 | 1.00 | 0.029 | 0.057 | 0.013 | 0.026 | 0.029 | 0.057 | 0.50 | 1.00 | 0.043 | 0.087 | 0.017 | 0.034 |
| Number of Samples Required [5] | | | | | | | | | | | | | | | | |
| β=15% | 82 | 40 | 3 | NA | 65 | 33 | 145 | 73 | 65 | 33 | 3 | NA | 44 | 21 | 111 | 55 |
| β=20% | 70 | 34 | 3 | NA | 55 | 28 | 123 | 62 | 55 | 28 | 3 | NA | 37 | 18 | 94 | 47 |
| β=25% | 60 | 29 | 2 | NA | 48 | 24 | 106 | 53 | 48 | 24 | 2 | NA | 32 | 16 | 81 | 41 |

**Notes:**
bgs = below ground surface
ft = feet
NA = not available
[1] Sample size is the number of samples included in the BHRA analysis for each exposure scenario.
[2] $P_1$ 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.
[3] Effect size is population proportion, set to defined number of samples over total number of samples.
[4] $P_2$ is $P_1$ plus effect size.
[5] Calculations were conducted using the Exact – Generic binomial test in the software program G*Power.

## TABLE 7-3. Groundwater Data Quality Assessment for Resident, Indoor Commercial/Industrial Worker and Construction Worker Scenarios

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Exposure Scenario | Resident (Slab-on-Grade Building Scenario) | | Resident (Trailer Scenario) | | Indoor Commercial/ Industrial Worker | | Construction Worker | |
|---|---|---|---|---|---|---|---|---|
| Sample Size [1] | 69 | | 4 | | 241 | | 310 | |
| $P_1$ [2] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sample Count for effect size | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| effect size [3] | 0.014 | 0.029 | 0.25 | 0.50 | 0.0041 | 0.0083 | 0.0032 | 0.0065 |
| $P_2$ [4] | 0.014 | 0.029 | 0.25 | 0.50 | 0.0041 | 0.0083 | 0.0032 | 0.0065 |
| Number of Samples Required [5] | | | | | | | | |
| β=15% | 135 | 65 | 7 | 3 | 462 | 237 | 592 | 291 |
| β=20% | 115 | 55 | 6 | 3 | 392 | 194 | 503 | 247 |
| β=25% | 99 | 48 | 5 | 2 | 338 | 167 | 433 | 213 |

**Notes:**

bgs = below ground surface

ft = feet

[1] Sample size is the number of groundwater samples included in the BHRA analysis for each exposure scenario.

[2] $P_1$ 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.

[3] Effect size is population proportion, set to defined number of samples over total number of samples.

[4] $P_2$ is $P_1$ plus effect size.

[5] Calculations were conducted using the Exact – Generic binomial test in the software program G*Power.

## TABLE 7-4. Groundwater Data Quality Assessment for Outdoor Commercial/Industrial Worker Scenarios

**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Exposure Scenario | Outdoor Commercial/Industrial Worker | |
|---|---|---|
| | Cancer Risk | HI |
| Target Cancer Risk or Target HI [1] | $1.49 \times 10^{-4}$ | 1.49 |
| Cancer Risk/HI based on 95% UCL[2] | 2.2E-08 | 0.00006 |
| Cancer Risk/HI Driver | Chloroform | Chloroform |
| 95% UCL of Driver Chemical Concentration ($\mu g/m^3$) | 1.3E-02 | 1.3E-02 |
| Cancer Risk/HQ based on 95%UCL of Driver Chemical | 2.1E-08 | 0.000027 |
| SD of Driver Chemical Concentration ($\mu g/m^3$) | 1.3E-02 | 1.3E-02 |
| SD of Cancer Risk/HQ from Driver Chemical [3] | 2.1E-08 | 2.7E-05 |
| Number of Samples Required[4] | 2 | 2 |
| Sample Size [5] | 241 | 241 |

**Notes:**
bgs = below ground surface
ft = feet
$\mu g/m^3$ = microgram per cubic meter
HI = hazard index
HQ = hazard quotient
SD = standard deviation
UCL = upper confidence limit

[1] Target cancer risk is set as $1.49 \times 10^{-4}$, which can be rounded to $1 \times 10^{-4}$. Target HI is set as 1.49, which can be rounded to 1. These values were input as $Mean_1$ in G*Power, indicating an alternative hypothesis that the mean of population cancer risk or HI is greater than target cancer risk or target HI.

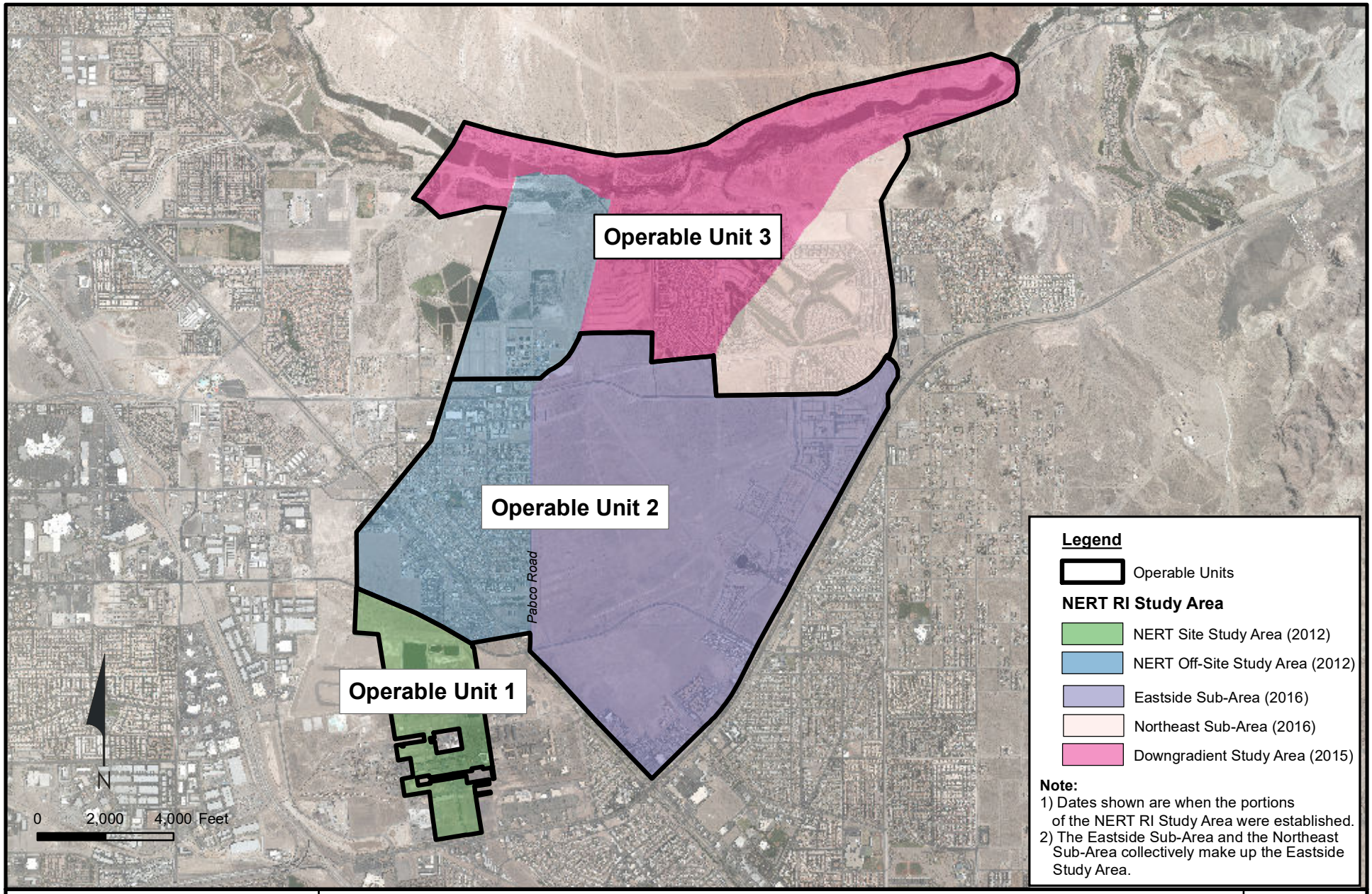
[2] The values were input as $Mean_0$ in G*Power, indicating a null hypothesis that the mean of population cancer risk or non-cancer HI is the same as the cancer risk or non-cancer HI based on the 95% UCL of sample results.

[3] It was assumed that the SD of total cancer risk/HI is similar to the SD of cancer risk/HQ from the driver chemical. These values were input as SD in G*Power to calculate corresponding effect size.

[4] Calculations were conducted using the t tests - Means: difference from constant (one sample case) in the software program G*Power.

[5] Sample size is the number of samples included in the BHRA analysis for soil gas for the outdoor commercial/industrial worker scenario.

# FIGURES



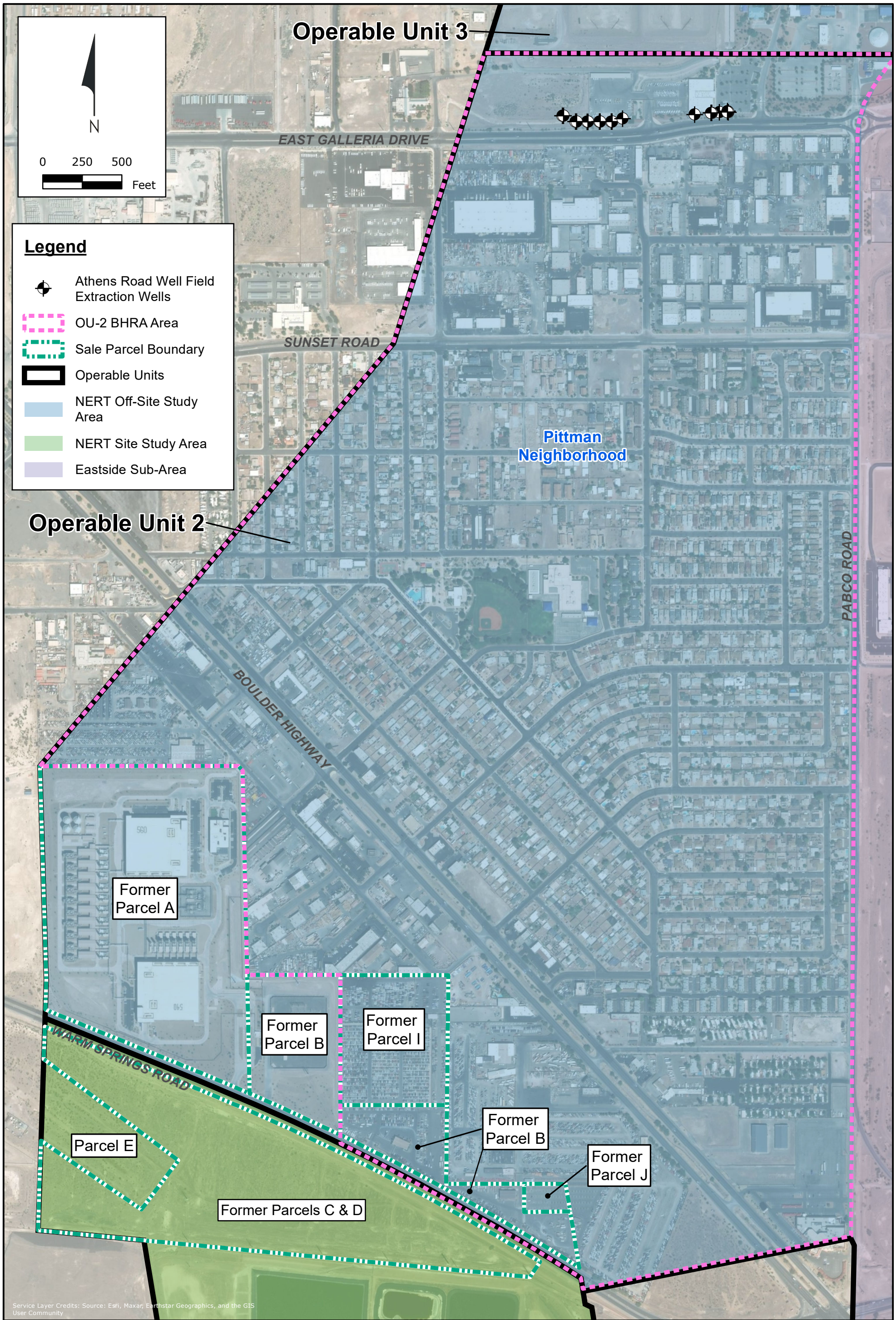

RAMBOLL

**NERT RI Study Areas and Operable Units**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-1**

Drafter: RS Date: 2/15/2023 Contract Number: 1690029369-006 Approved: Revised:

Path: H:\LePetomane\NERT\RI OU-1_OU-2 RI Report\Sections\Section 1 - Introduction\GIS\Fig 1-2 RI Study Area Operable Units.mxd




**Layout of the OU-2 BHRA Area**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-2**

Drafter: AR/RS | Date: 3/3/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

\\wcevlfps1\Eng\LePetomane\NERT\Risk Assessment-Human Health\Offsite_NERT_Study Area\Maps\Results\Fig 1-4_Offsite Study Area_6.10.2021.mxd

## Legend

OU-2 Residential Soil Gas Sample Locations at 5 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Trailer Area
- Former Ditches
- OSSM Site
- TIMET Site
- NERT Site Study Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
[1]The estimated total cancer risks for the slab-on-grade scenario are shown in the main figure; the estimated total cancer risks for the residential trailer scenario at soil gas sample locations near the trailer area are shown in the window box.

N

0 250 500

Feet

### Indoor Air Scenario in Trailer


EAST GALLERIA DRIVE

Operable Unit 2

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

RISG-57 (7E-6)
RISG-58 (6E-6)
RISG-59 (8E-6)
RISG-60 (5E-6)
RISG-62 (2E-6)
RISG-63 (3E-6)
RISG-61
RISG-9
RISG-64
RISG-67
RISG-65
RISG-66
RISG-5 (3E-6)
RISG-7
RISG-68 (1E-5)
RISG-69
RISG-1 (2E-5)
RISG-4 (2E-6)
RISG-8
RISG-70 (9E-6)
RISG-71 (1E-5)
RISG-72
RISG-74 (7E-6)
RISG-73
RISG-75
RISG-29
RISG-77 (1E-5)
RISG-78

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Parcel E

Former Parcel J

Former Parcels C & D

Operable Unit 1

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

\\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure ES-3 Cancer Risk Res 5 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Residents Exposed to VOCs in Soil Gas at 5 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-3**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Residential Soil Gas Sample Locations at 10 to 15 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Trailer Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- Former Ditches
- OSSM Site
- TIMET Site
- NERT Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
[1]The estimated total cancer risks for the slab-on-grade scenario are shown in the main figure; the estimated total cancer risks for the residential trailer scenario at soil gas sample locations near the trailer area are shown in the window box.

N

0 250 500

Feet

### Indoor Air Scenario in Trailer

RISG-77 (7E-6)

RISG-78

Trailer Area

EAST GALLERIA DRIVE

Operable Unit 2

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

RISG-57 (5E-6)

RISG-58 (3E-6)

RISG-59 (5E-6)

RISG-60 (3E-6)

RISG-62 (2E-6)

RISG-63 (2E-6)

RISG-61

RISG-64

RISG-67

RISG-66

RISG-5

RISG-65

RISG-7

RISG-68 (6E-6)

RISG-69

RISG-1 (2E-5)

RISG-4

RISG-70 (8E-6)

RISG-71 (5E-6)

RISG-72

RISG-74 (4E-6)

RISG-73

RISG-29

RISG-75

RISG-77 (7E-6)

RISG-78

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Former Parcel J

Parcel E

Former Parcels C & D

Operable Unit 1

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

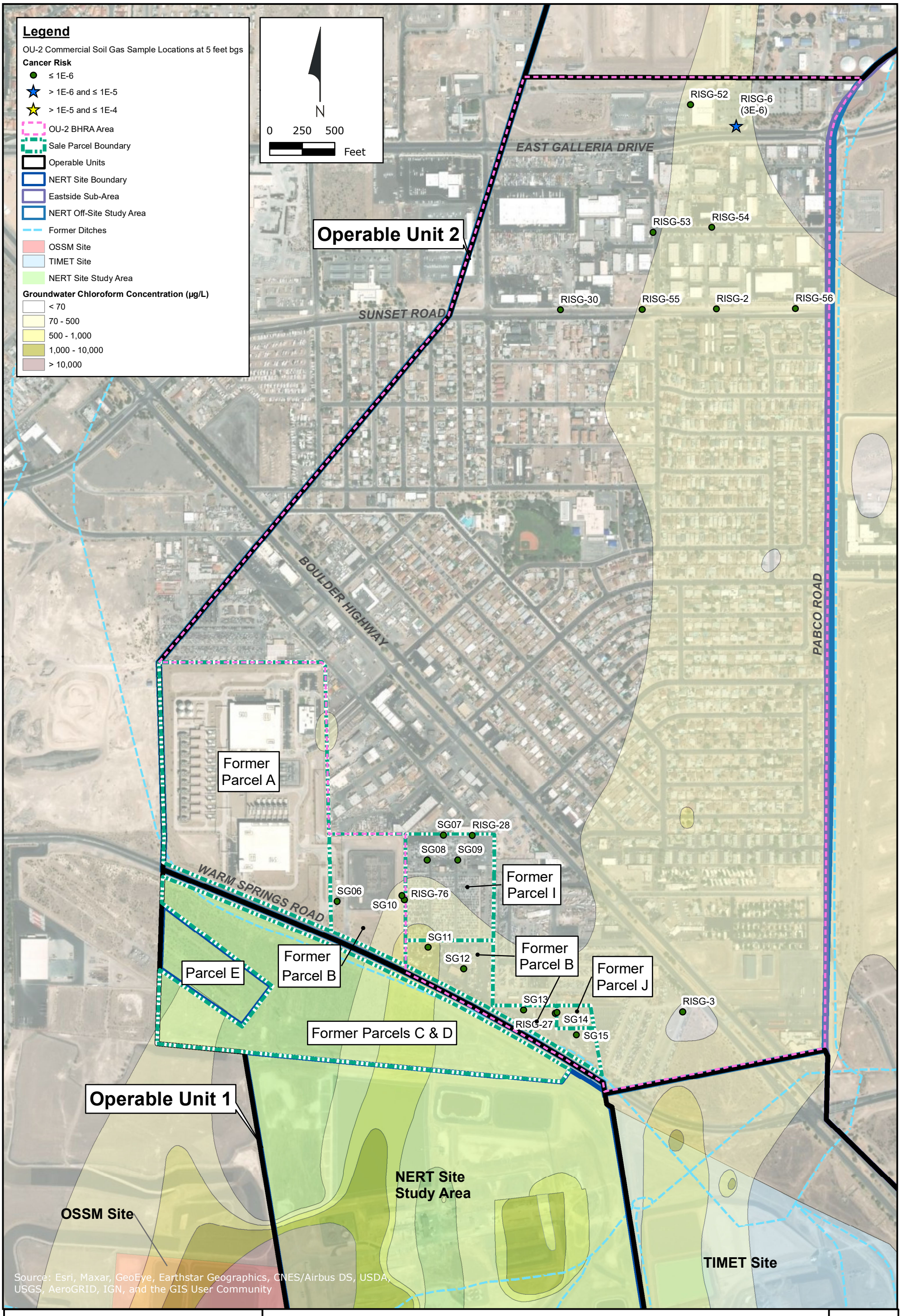
\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure ES-4 Cancer Risk Res 15 ft bgs SG-2.mxd

RAMBOLL

**Estimated Total Cancer Risk for Residents Exposed to VOCs in Soil Gas at 10 to 15 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **ES-4**

Drafter: RZ | Date: 4/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:



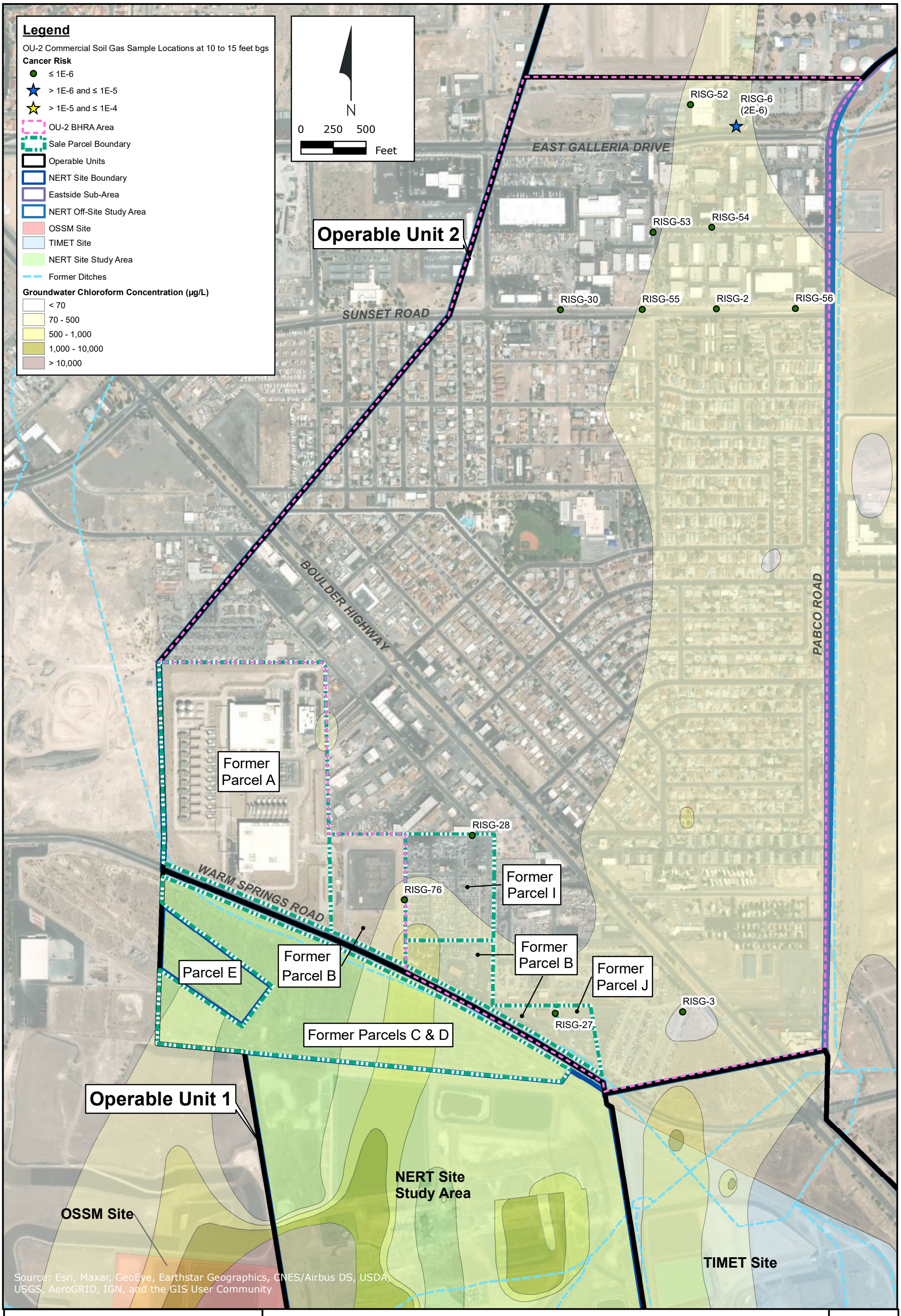

\\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure ES-5 Cancer Risk Com 5 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Indoor Commercial/Industrial Workers Exposed to VOCs in Soil Gas at 5 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-5**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:




\\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure ES-6 Cancer Risk Com 15 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Indoor Commercial/Industrial Workers Exposed to VOCs in Soil Gas at 10 to 15 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-6**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

N

0 500 1,000 Feet

Operable Unit 2

Operable Unit 1

SUNSET RD

BOULDER HWY

PABCO RD

LAKE MEAD PARKWAY

NERT Site Study Area

OSSM Site

TIMET Site

**LEGEND:**

- OU-2 BHRA Area
- Operable Units
- OSSM Site
- TIMET Site
- NERT Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

**AERIAL SOURCE:** SNWA, 2020.

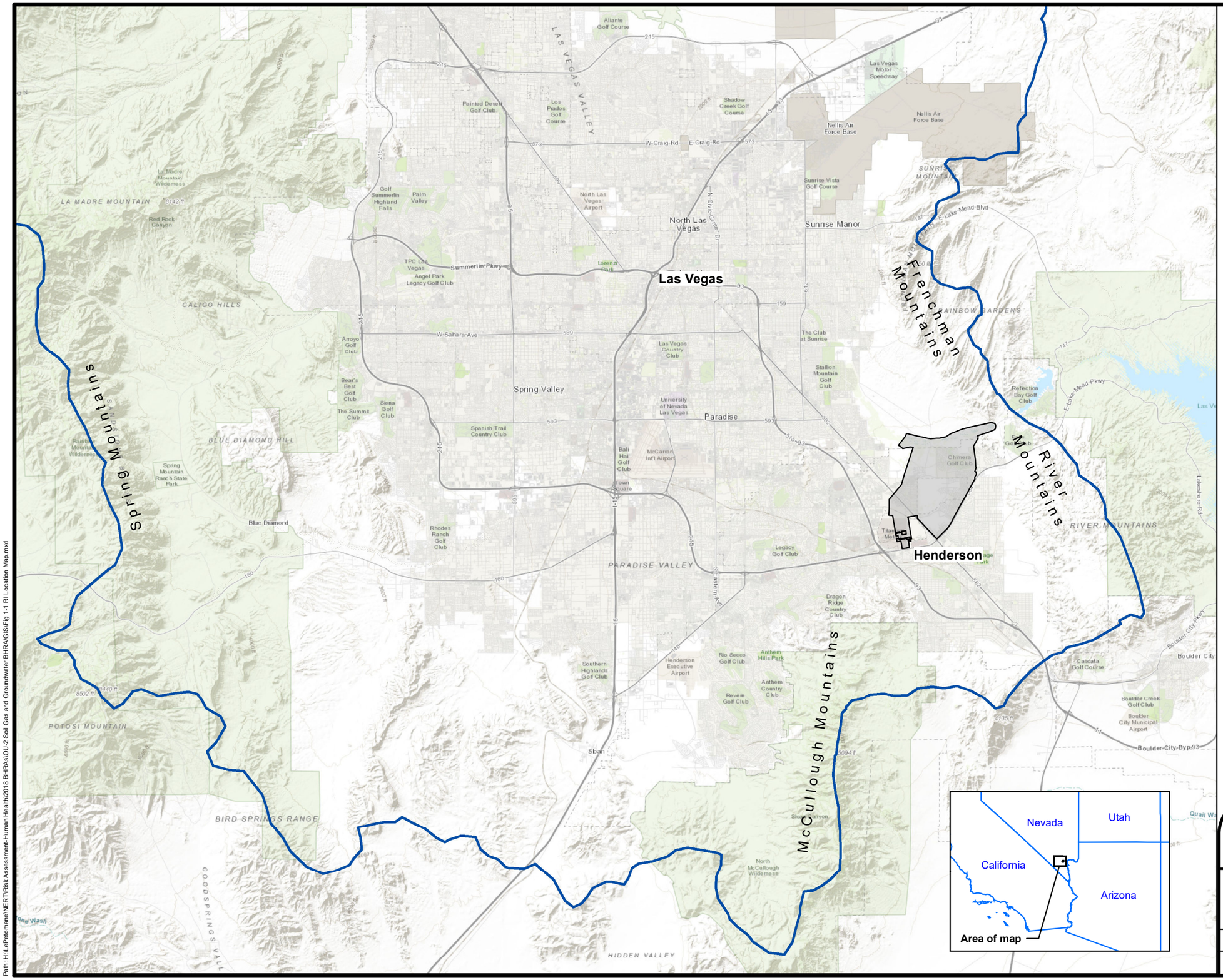
Path: \\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 1-3b BMI Complex and Investigation Areas.mxd

RAMBOLL

**Chloroform Source Areas Upgradient of OU-2 BHRA Area**
**(Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**ES-7**

| Drafter: | Date: 08/31/2023 | Contract Number: 1690029369-006 | Approved by: | Revised: |
|---|---|---|---|---|




**Legend**

- Las Vegas Valley Hydrologic Basin
- NERT RI Study Area

**Note:**
See Figure 1-2 and 1-3 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: | Contract Number: | | Figure |
|---|---|---|---|
| 2/28/2023 | 1690029369-006 | | 1-1 |
| Drafter: RS | Approved: | Revised: | |

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 1-1 RI Location Map.mxd

N

0 1,500 3,000 Feet

Las Vegas Wash

Operable Unit 3

BMI

GALLERIA DR
(Formerly Athens Road)

SUNSET RD

BOULDER HWY

PABCO RD

BMI

WARM SPRINGS RD

LAKE MEAD PARKWAY

Operable Unit 2

BMI
(CAMU)

NERT

TIMET

OLIN

Current BMI
Complex

Operable Unit 1

LAKE MEAD PARKWAY

US HIGHWAY 95

NEVADA

HENDERSON

**Legend**

- Cadence Master Planned Community
- Current BMI Complex
- Operable Units

**Land Ownership**

- BMI
- Bureau of Reclamation
- City of Henderson
- Clark County
- Coyote Valley
- Henderson Groundwater
- Lhoist
- NERT
- Former NERT-Owned Property
- Olin
- TIMET
- WAPA

**AERIAL SOURCE:** SNWA, 2020.

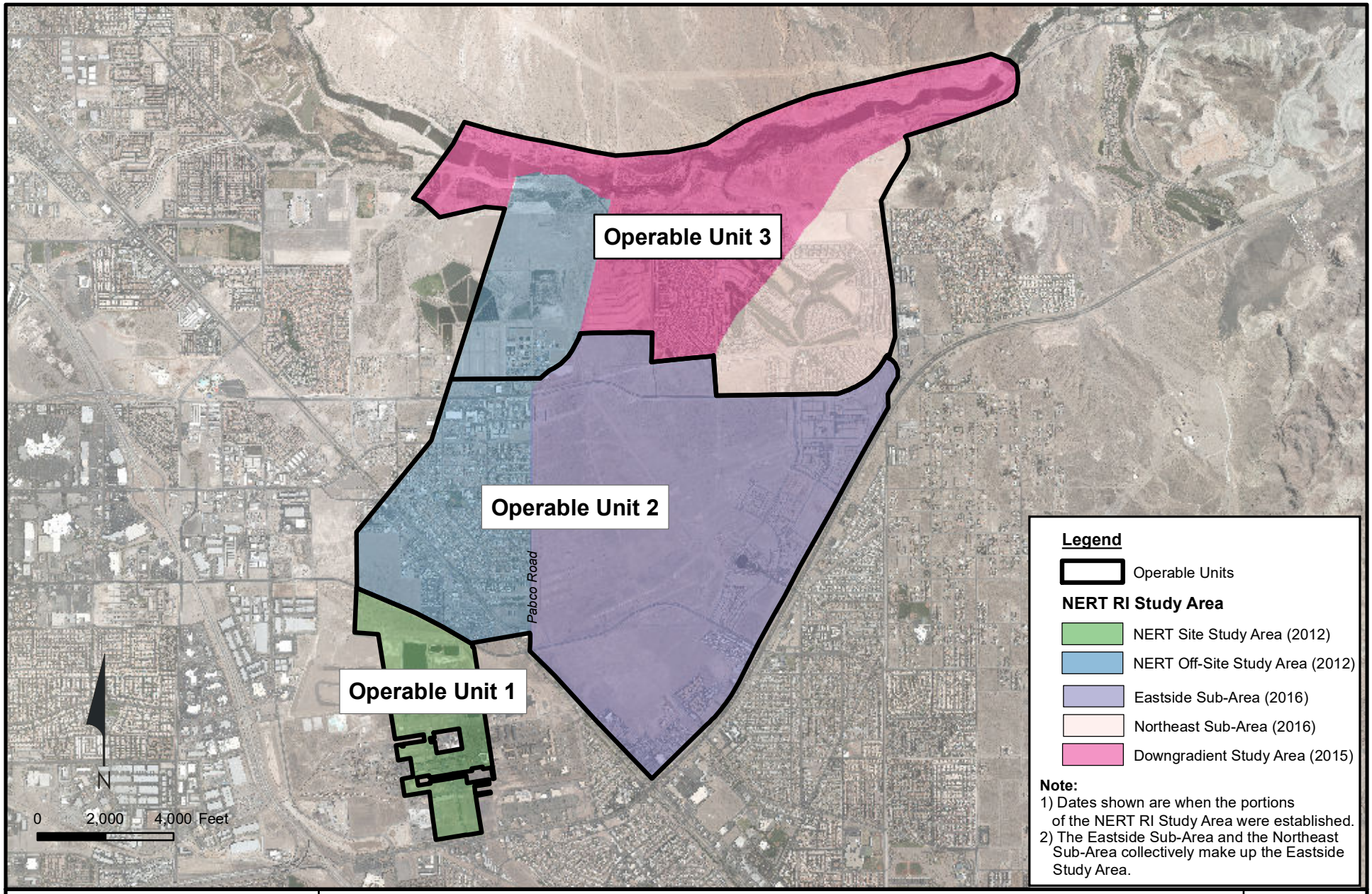
Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 1-2 BMI Complex Land Ownership and Surrounding Area.mxd

RAMBOLL

**Major Land Ownership in the RI Study Area**
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
**1-2**

Drafter: RS/JC | Date: 2023/03/16 | Contract Number: 1690029369-006 | Approved by: | Revised:




RAMBOLL

**NERT RI Study Areas and Operable Units**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**1-3**

Drafter: RS Date: 2/15/2023 Contract Number: 1690029369-006 Approved: Revised:

Path: H:\LePetomane\NERT\RI OU-1_OU-2 RI Report\Sections\Section 1 - Introduction\GIS\Fig 1-2 RI Study Area Operable Units.mxd

Operable Unit 3

N

0 250 500

Feet

EAST GALLERIA DRIVE

SUNSET ROAD

Pittman Neighborhood

PABCO ROAD

BOULDER HIGHWAY

Operable Unit 2

Former Parcel A

Former Parcel B

Former Parcel I

WARM SPRINGS ROAD

Parcel E

Former Parcel B

Former Parcel J

Former Parcels C & D

**Legend**

- Athens Road Well Field Extraction Wells
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- NERT Off-Site Study Area
- NERT Site Study Area
- Eastside Sub-Area



RAMBOLL

**Layout of the OU-2 BHRA Area**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**1-4**

Drafter: AR/RS | Date: 2/28/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

\\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 1-4_Offsite Study Area_6.10.2021.mxd

## Legend

- Soil Gas Location, Chloroform Concentration (µg/m³) Below 4,000 µg/m³
- Soil Gas Location, Chloroform Concentration (µg/m³) Above 4,000 µg/m³
- Target Indoor Air Sampling
- OU-2 BHRA Area
- NERT Site

**November 2019 Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

N

0 250 500

Feet

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

WARM SPRINGS ROAD

PABCO ROAD

COMMERCIAL / INDUSTRIAL

RESIDENTIAL

RESIDENTIAL

COMMERCIAL / INDUSTRIAL

NERT Site

TIMET Site

OSSM Site

RISG-30 120
RISG-55 4,300
RISG-2 2,400
RISG-56 2,800
RISG-57 4,100
RISG-58 2,900
RISG-59 4,600
RISG-60 2,600
RISG-61 240
RISG-62 1,400
RISG-63 1,900
RISG-64 550
RISG-67 550
RISG-65 410
RISG-66 200
RISG-7 130
RISG-5 230
RISG-68 5,100
RISG-69 590
RISG-1 9,400
RISG-4 490
RISG-70 6,800
RISG-71 3,900
RISG-72 600
RISG-73 620
RISG-29 910
RISG-74 2,300
RISG-75 610
RISG-77 5,800
RISG-78 290



H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 1 - Target Indoor Air Sampling Areas.mxd

RAMBOLL

**Target Indoor Air Sampling Areas and Chloroform Soil Gas Concentrations (10-15 ft bgs) (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **3-1**

Drafter: JC | Date: 2021-09-30 | Contract Number: 1690029369-006 | Approved by: | Revised:

N

0 250 500

Feet

**Legend**

- Soil Gas Sample Locations
- Shallow Groundwater Sample Locations
- OU-2 BHRA Area
- Former Ditches
- Sale Parcel Boundary
- Operable Units
- NERT Off-Site Study Area
- Eastside Sub-Area
- NERT Site Boundary

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

WARM SPRINGS ROAD

PABCO ROAD

ARP-3A, ARP-5A, ARP-6B, ARP-7, ARP-2A, MW-K4, ARP-1, ARP-4A, PC-145, PC-144, PC-143, PC-136, RISG-6, PC-142, RISG-52, PC-160, PC-135A, PC-134A, PC-122, PC-55, PC-101R, PC-149, ART-6, PC-18, PC-148

RISG-53, PC-123, RISG-54, PC-177

PC-132, RISG-30, PC-130, PC-128, PC-127, PC-24, PC-126, PC-124, PC-153R, PC-153, PC-194, PC-131, PC-50, PC-129, RISG-55, RISG-2, PC-125, RISG-56

PC-190, RISG-57

RISG-58, RISG-59, PC-161, PC-162, PC-193, PC-163, PC-164, RISG-60

RISG-62, RISG-63, RISG-61, PC-28, RISG-64, PC-165, PC-166, RISG-9, PC-31, RISG-67, RISG-65, RISG-66, PC-169, RISG-5, PC-167, RISG-7, PC-168, RISG-68

PC-192, PC-171, RISG-69, PC-66, PC-67, RISG-1, RISG-4, PC-172D, RISG-8, PC-179, PC-65, PC-64, BHE1-10, RISG-70, RISG-71, RISG-72, RISG-74, RISG-73, RISG-75, PC-71, PC-184, PC-175, RISG-29, PC-180, M-44, SG07, PC-174, PC-72, RISG-28, PC-183, PC-186, PC-181, SG08, SG09, RISG-77, RISG-78, SG06, SG10, PC-37, PC-187R, RISG-76, PC-187, PC-54, SG11, SG12, PC-188, SG13, M-48A, SG14, PC-21A, RISG-3, RISG-27, PC-189, SG15

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Parcel E

Former Parcels C & D

Former Parcel J

Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

\\wcevlfps1\Eng\LePetomane\RERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 4-1 Groundwater and Soil Gas Locations-2.mxd

RAMBOLL

**Soil Gas Probes and Shallow Groundwater Wells Included in the OU-2 BHRA (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-1**

Drafter: JA | Date: 3/7/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

N

0 250 500

Feet

**Legend**

OU-2 Soil Gas Sample Locations at 5 feet bgs

**Category**

- Less than detection limit
- <Q1
- Q1 - Q3
- >Q3 - Q3+1.5*IQR
- >Q3+1.5*IQR

OU-2 BHRA Area

Sale Parcel Boundary

Operable Units

Eastside Sub-Area

NERT Off-Site Study Area

NERT Site Boundary

Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
Q1 = 178 µg/m$^3$, Q3 = 1,650 µg/m$^3$,
Q3+1.5*IQR = 3,860 µg/m$^3$

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

WARM SPRINGS ROAD

PABCO ROAD

RISG-52
RISG-6
RISG-53
RISG-54
RISG-2
RISG-55
RISG-56
RISG-30
RISG-57
RISG-58
RISG-59
RISG-60
RISG-62
RISG-63
RISG-61
RISG-64
RISG-9
RISG-67
RISG-65
RISG-66
RISG-5
RISG-7
RISG-68
RISG-69
RISG-1
RISG-4
RISG-8
RISG-70
RISG-71
RISG-72
RISG-74
RISG-73
RISG-29
RISG-75
RISG-78
RISG-77
SG07
RISG-28
SG08
SG09
SG06
SG10
RISG-76
SG11
SG12
SG13
RISG-27
SG14
SG15
RISG-3

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Former Parcel J

Parcel E

Former Parcels C & D

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

\\wcevlfps1\Eng\LePetomane\WERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 4-2 SG Chloroform Quartile Plot - 5 ft_04.01.2021_.mxd

RAMBOLL

**Spatial Quartile Plot for Chloroform in Soil Gas Samples at 5 feet bgs (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-2**

Drafter: SS | Date: 3/7/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

N

0 250 500

Feet

**Legend**

OU-2 Soil Gas Sample Locations at 10 to 15 feet bgs

**Category**

- Less than detection limit
- <Q1
- Q1 - Q3
- >Q3 - Q3+1.5*IQR
- >Q3+1.5*IQR
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- Eastside Sub-Area
- NERT Off-Site Study Area
- NERT Site Boundary
- Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Notes:
Q1 = 490 µg/m$^3$, Q3 = 4,680 µg/m$^3$,
Q3+1.5*IQR = 11,000 µg/m$^3$

EAST GALLERIA DRIVE
SUNSET ROAD
BOULDER HIGHWAY
WARM SPRINGS ROAD
PABCO ROAD

RISG-52
RISG-6
RISG-53
RISG-54
RISG-2
RISG-55
RISG-56
RISG-30
RISG-57
RISG-58
RISG-59
RISG-60
RISG-62
RISG-63
RISG-61
RISG-64
RISG-67
RISG-65
RISG-66
RISG-5
RISG-7
RISG-68
RISG-69
RISG-1
RISG-4
RISG-70
RISG-71
RISG-72
RISG-74
RISG-73
RISG-29
RISG-75
RISG-28
RISG-78
RISG-77
RISG-76
RISG-27
RISG-3

Former Parcel A
Former Parcel I
Former Parcel B
Former Parcel B
Former Parcel J
Parcel E
Former Parcels C & D

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

\\wcevlfps1\Eng\LePetomane\WERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 4-3 SG Chloroform Quartile Plot - 10-15 ft_04.01.2021.mxd

RAMBOLL

**Spatial Quartile Plot for Chloroform in Soil Gas Samples at 10 to 15 feet bgs (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-3**

Drafter: SS | Date: 3/7/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

N

0 250 500

Feet

**Legend**

- OU-2 Shallow Groundwater Sample Locations

**Category**

- Less than detection limit
- <Q1
- Q1 - Q3
- >Q3 - Q3+1.5*IQR
- >Q3+1.5*IQR
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- Eastside Sub-Area
- NERT Off-Site Study Area
- NERT Site Boundary
- Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
Q1 = 1.0 µg/L, Q3 = 130 µg/L, Q3+1.5*IQR = 324 µg/L

EAST GALLERIA DRIVE
SUNSET ROAD
BOULDER HIGHWAY
WARM SPRINGS ROAD
PABCO ROAD

ARP-2A, ARP-3A, ARP-4A, ARP-5A, ARP-6B, ARP-7, ARP-1, MW-K4, PC-145, PC-143, PC-144, PC-136, PC-148, PC-142, PC-160, PC-135A, PC-122, PC-55, PC-134A, PC-149, PC-18, PC-101R, PC-123, PC-177, PC-153R, PC-194, PC-50, PC-130, PC-128, PC-24, PC-125, PC-124, PC-153, PC-132, PC-131, PC-129, PC-127, PC-126, PC-190, PC-161, PC-162, PC-193, PC-163, PC-164, PC-28, PC-31, PC-165, PC-166, PC-169, PC-167, PC-168, PC-171, PC-66, PC-192, PC-67, PC-172D, PC-64, PC-65, PC-179, BHE1-10, Former Parcel A, PC-175, PC-180, PC-181, PC-183, PC-184, PC-186, PC-174, PC-72, PC-71, M-44, PC-37, PC-187R, PC-187, Former Parcel I, PC-54, Former Parcel B, Former Parcel B, Parcel E, PC-188, M-48A, Former Parcel J, PC-21A, PC-189, Former Parcels C & D

Service Layer Credits: Source: Esri, Maxar,

\\wcevlfps1\Eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Fig 4-4 GW Chloroform Quartile Plot_04.01.2021_.mxd

RAMBOLL

**Spatial Quartile Plot for Chloroform in Groundwater Samples**
**(Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-4**

Drafter: SS | Date: 3/7/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Unit Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- NERT Site Boundary

**Chloroform Concentration in Soil Gas Samples at 5ft bgs ($\mu g/m^3$) - log scale**

- ≤ 25.7 (0.10 x RBTC)
- 257 (1.0 x RBTC)
- 2,570 (10 x RBTC)
- ≥ 25,700 (100 x RBTC)

- ≤ 25.7 (0.10 x RBTC)
- 257 (1.0 x RBTC)
- 2,570 (10 x RBTC)
- ≥ 25,700 (100 x RBTC)

**Notes:**

1. RBTC For Chloroform in Soil Gas (5 ft) = 257 $\mu g/m^3$

2. Maximum Chloroform concentration = 11,000 $\mu g/m^3$ = 42.7 x RTBC

3. Though the western portion of Parcel B is not included in the OU-2 BHRA Area (Figure 1-4), soil gas and shallow groundwater data collected in the entire former Parcel B were used to obtain better spatial coverage for the area.

DRIVE

SUNSET ROAD

PABCO ROAD

WARM SPRINGS ROAD

N

0 240 480

Feet

Service Layer Credits: World Imagery: Maxar

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\interpolation\interpolation.aprx

RAMBOLL

**Spatial Concentration Plot for Chloroform in Soil Gas Samples at 5 feet bgs**
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
**4-5**

Drafter: JC | Date: 2023-04-25 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Unit Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- NERT Site Boundary

**Chloroform Concentration in Soil Gas Samples at 10 - 15ft bgs (µg/m$^3$) - log scale**

- ≤ 85.5 (0.10 x RBTC)
- 855 (1.0 x RBTC)
- 8,550 (10 x RBTC)
- ≥ 85,500 (100 x RBTC)

- ≤ 85.5 (0.10 x RBTC)
- 855 (1.0 x RBTC)
- 8,550 (10 x RBTC)
- ≥ 85,500 (100 x RBTC)

**Notes:**

1. RBTC For Chloroform in Soil Gas (10-15 ft) = 855 µg/m$^3$

2. Maximum Chloroform concentration = 22,000 µg/m$^3$ = 25.7 x RBTC

3. Though the western portion of Parcel B is not included in the OU-2 BHRA Area (Figure 1-4), soil gas and shallow groundwater data collected in the entire former Parcel B were used to obtain better spatial coverage for the area..

DRIVE

SUNSET ROAD

PABCO ROAD

WARM SPRINGS ROAD

N

0 240 480

Feet

Service Layer Credits: World Imagery: Maxar

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\interpolation\interpolation.aprx

RAMBOLL

**Spatial Concentration Plot for Chloroform in Soil Gas Samples at 10 to 15 feet bgs** Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
**4-6**

Drafter: JC | Date: 2023-04-25 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Unit Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- NERT Site Boundary

**Chloroform Concentration in Groundwater Samples (µg/L) - log scale**

- ≤ 0.857 (0.10 x RBTC)
- 8.57 (1.0 x RBTC)
- 85.7 (10 x RBTC)
- ≥ 857 (100 x RBTC)

- ≤ 0.857 (0.10 x RBTC)
- 8.57 (1.0 x RBTC)
- 85.7 (10 x RBTC)
- ≥ 857 (100 x RBTC)

**Notes:**

1. RBTC For Chloroform in Groundwater = 8.57 µg/L

2. Maximum Chloroform concentration = 1,000 µg/L = 117 x RTBC

3. Though the western portion of Parcel B is not included in the OU-2 BHRA Area (Figure 1-4), soil gas and shallow groundwater data collected in the entire former Parcel B were used to obtain better spatial coverage for the area.

DRIVE

SUNSET ROAD

PABCO ROAD

WARM SPRINGS ROAD

N

0 240 480

Feet

Service Layer Credits: World Imagery: Maxar

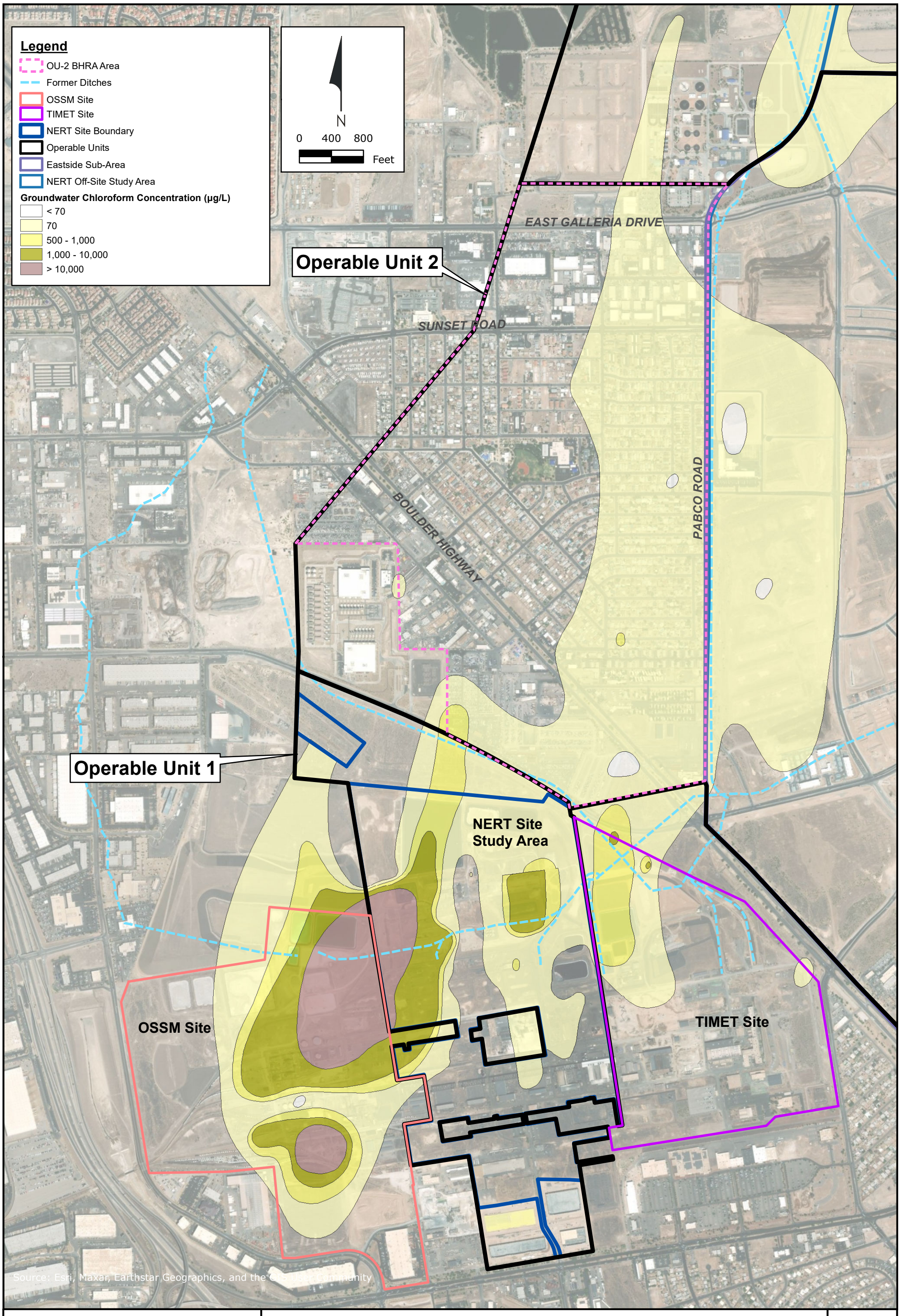
\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\interpolation\interpolation.aprx

RAMBOLL

**Spatial Concentration Plot for Chloroform in Groundwater Samples**
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
**4-7**

Drafter: JC | Date: 2023-04-25 | Contract Number: 1690029369-006 | Approved by: | Revised:



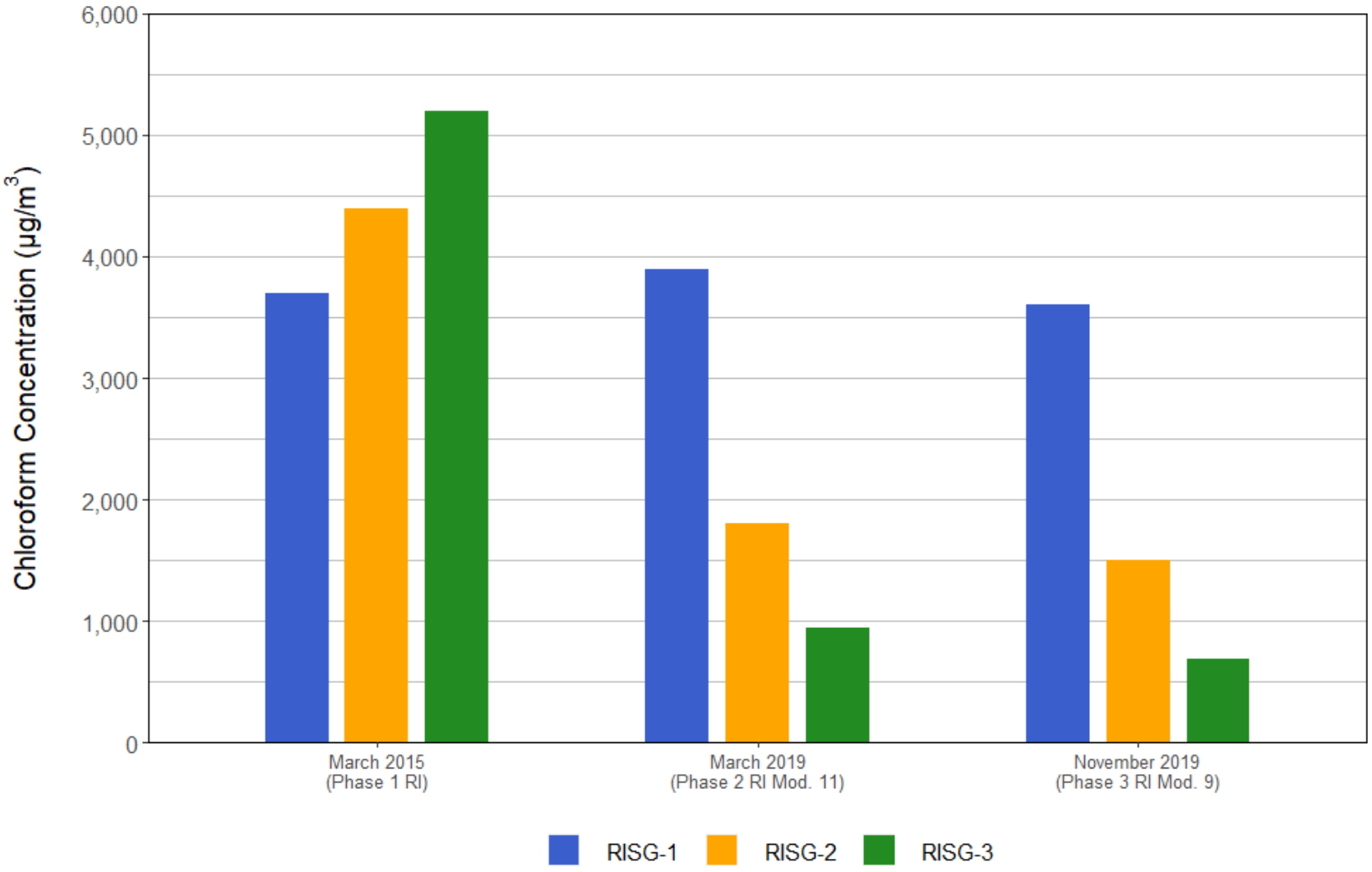

\\WCEVLFPS11\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 4-8 Chloroform Plume.mxd

RAMBOLL

**Chloroform Plumes coming onto the OU-2 BHRA Area**
**(Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Reponse Trust Site, Henderson, Nevada

Figure **4-8**

Drafter: SS | Date: 8/31/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:




RAMBOLL

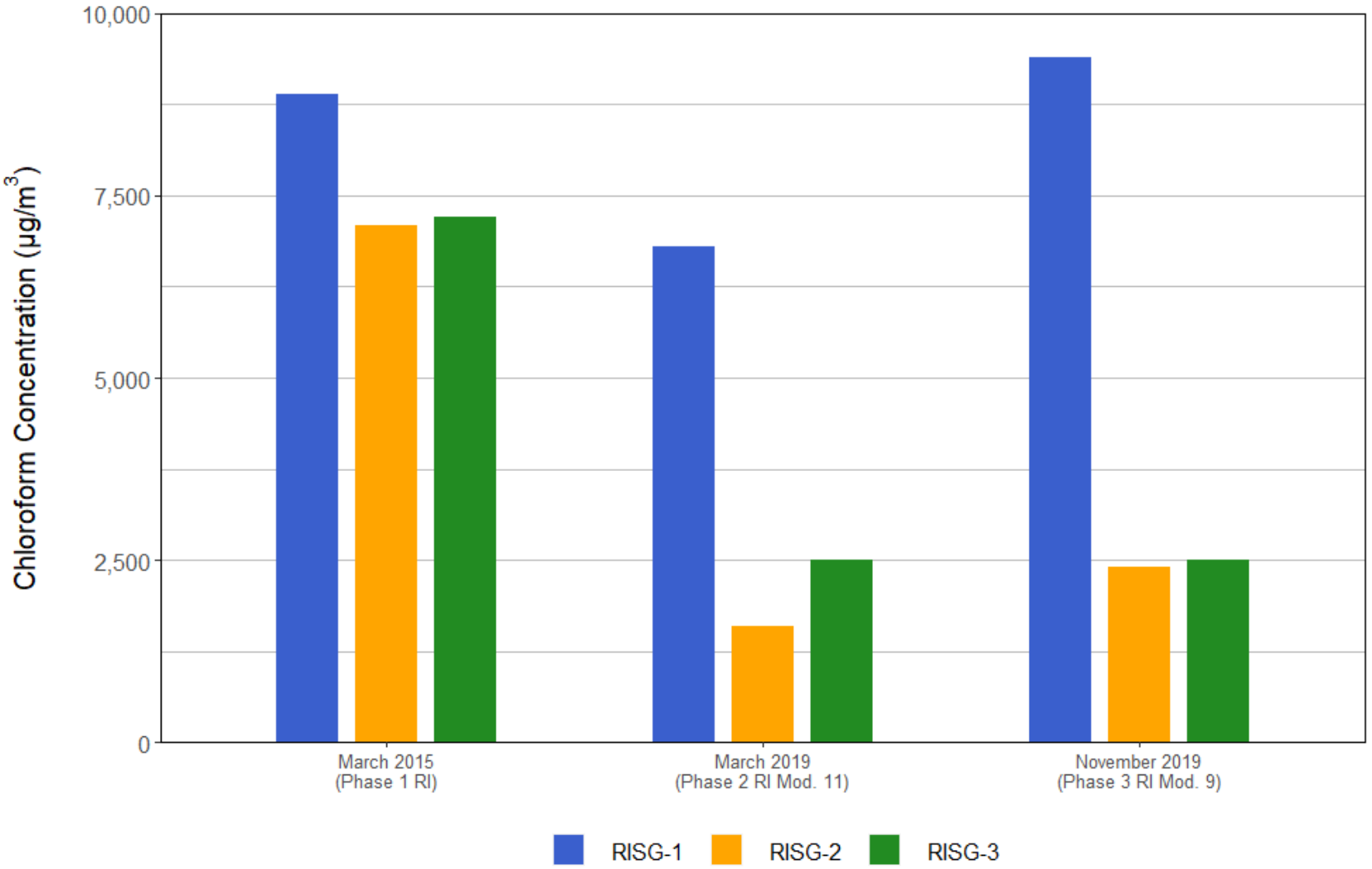
**Temporal Distribution of Chloroform Concentrations at Selected 5 feet bgs Soil Gas Sample Locations**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**4-9**

Drafter: JA Date: 2/9/2023 Contract Number: 1690029369-006 Approved by: Revised:




RAMBOLL

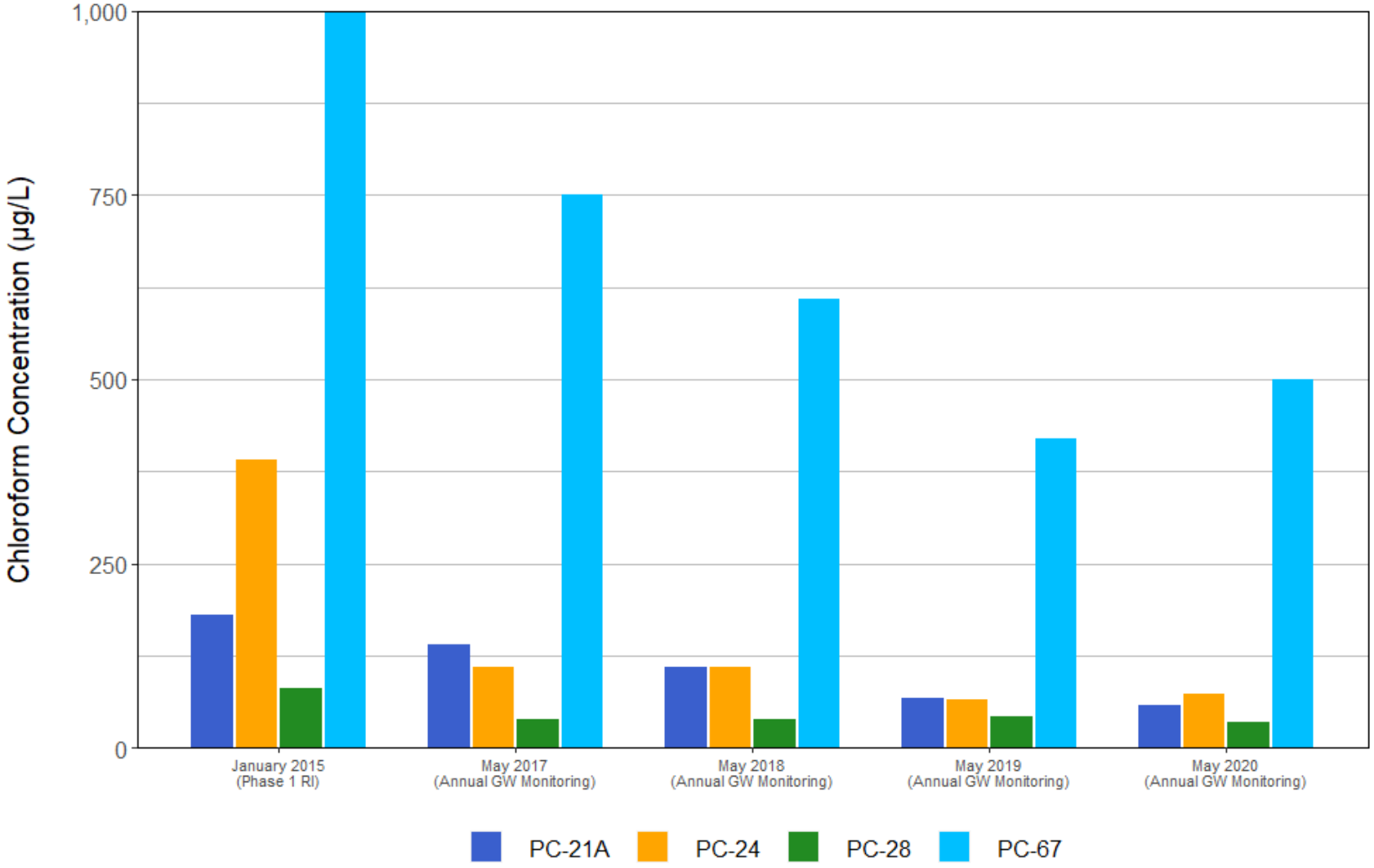
**Temporal Distribution of Chloroform Concentrations at Selected 10 to 15 feet bgs Soil Gas Sample Locations**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**4-10**

Drafter: JA Date: 2/9/2023 Contract Number: 1690029369-006 Approved by: Revised:




RAMBOLL

**Temporal Distribution of Chloroform Concentrations in Selected Shallow Groundwater Samples**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**4-11**

Drafter: JA Date: 2/9/2023 Contract Number: 1690029369-006 Approved by: Revised:

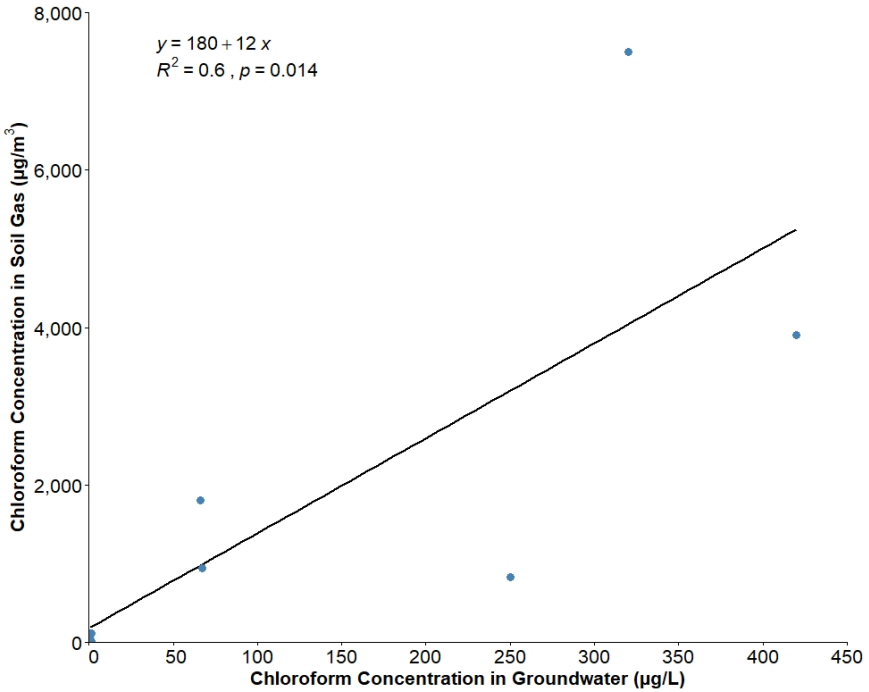
| Soil Gas | | | Groundwater | | |
|---|---|---|---|---|---|
| **Boring ID** | **Sample Date** | **Chloroform Concentration (µg/m³)** | **Well ID** | **Sample Date** | **Chloroform Concentration (µg/L)** |
| RISG-1 | 3/11/2019 | 3,900 | PC-67 | 5/10/2019 | 420 |
| RISG-2 | 3/14/2019 | 1,800 | PC-24 | 5/13/2019 | 66 |
| RISG-3 | 3/15/2019 | 940 | PC-21A | 5/10/2019 | 67 |
| RISG-6 | 3/22/2019 | 7,500 | PC-122 | 5/8/2019 | 320 |
| RISG-8 | 3/21/2019 | 17 | PC-64 | 5/10/2019 | 1.50 |
| RISG-9 | 3/14/2019 | 34.5 * | PC-31 | 5/9/2019 | 0.70 |
| RISG-27 | 3/15/2019 | 830 | M-48A | 5/10/2019 | 250 |
| RISG-30 | 3/15/2019 | 110 | PC-50 | 5/9/2019 | 1.5 |

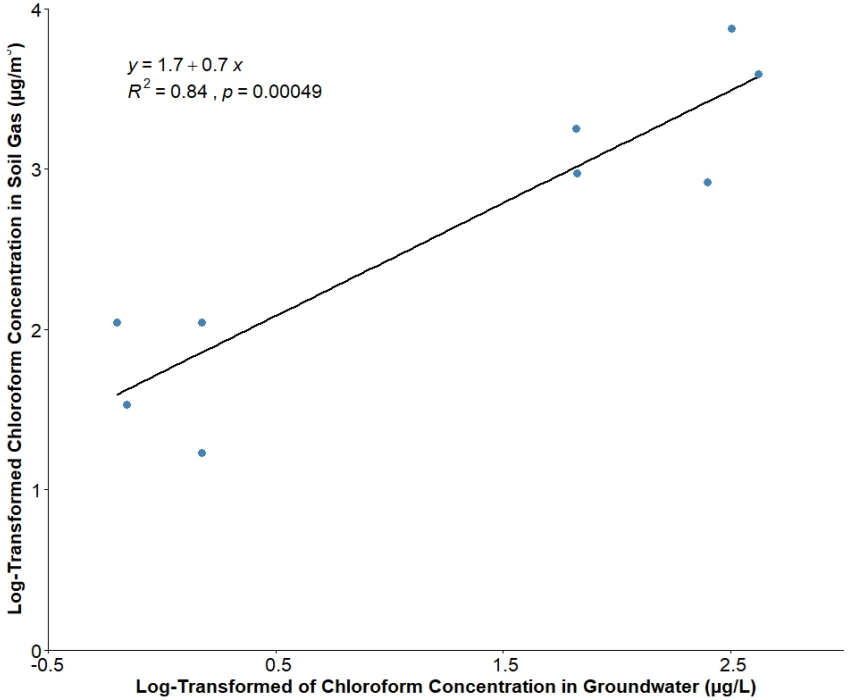
**Notes:**
µg/m³ = microgram per cubic meter

µg/L = microgram per liter

ft bgs = feet below ground surface

* A field duplicate was collected at this location, and the average concentration between the primary sample and the field duplicate sample was used.




RAMBOLL

**Scatterplot of Chloroform Concentrations in Co-located Soil Gas (5 ft bgs) and Shallow Groundwater Samples**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-12**

Drafter: JA Date: 2/9/2023 Contract Number: 1690029369-006 Approved by: Revised:

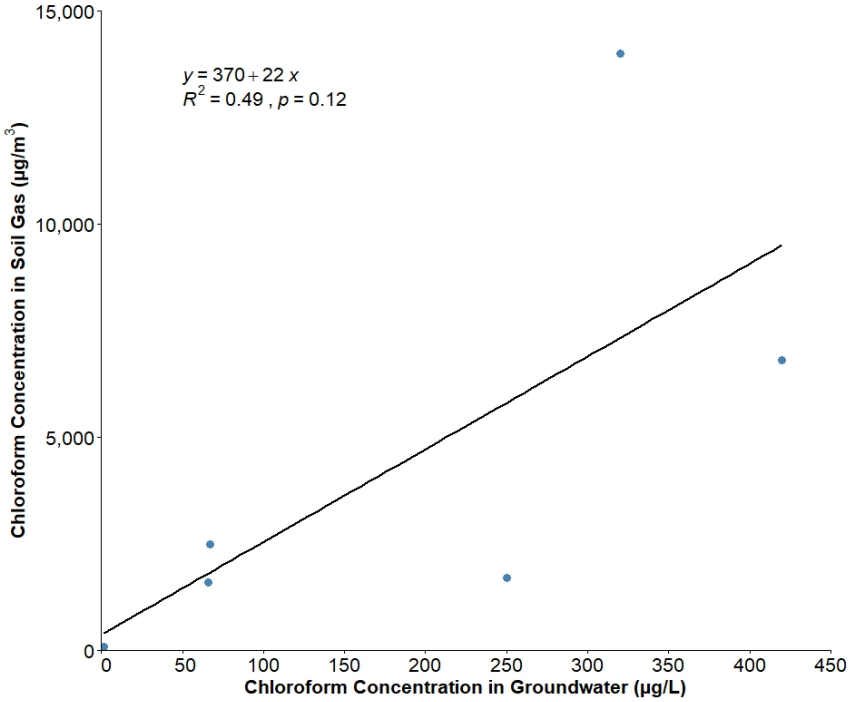
| Soil Gas | | | Groundwater | | |
|---|---|---|---|---|---|
| **Boring ID** | **Sample Date** | **Chloroform Concentration (µg/m³)** | **Well ID** | **Sample Date** | **Chloroform Concentration (µg/L)** |
| RISG-1 | 3/11/2019 | 6,800 | PC-67 | 5/10/2019 | 420 |
| RISG-6 | 3/22/2019 | 14000 * | PC-122 | 5/8/2019 | 320 |
| RISG-27 | 3/15/2019 | 1,700 | M-48A | 5/10/2019 | 250 |
| RISG-3 | 3/15/2019 | 2,500 | PC-21A | 5/10/2019 | 67 |
| RISG-2 | 3/14/2019 | 1,600 | PC-24 | 5/13/2019 | 66 |
| RISG-30 | 3/15/2019 | 90 | PC-50 | 5/9/2019 | 1.5 |

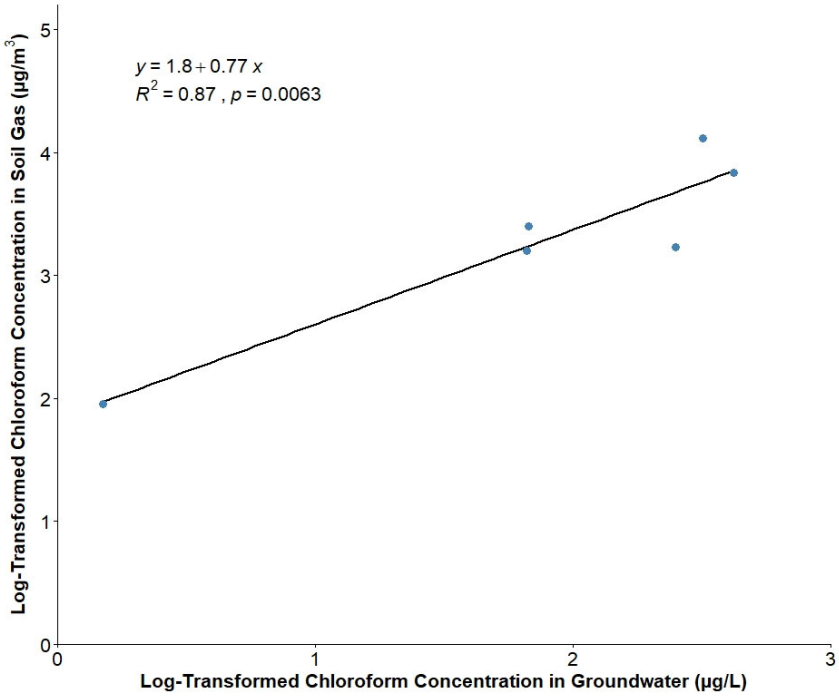
**Notes:**
µg/m³ = microgram per cubic meter

µg/L = microgram per liter

ft bgs = feet below ground surface

* A field duplicate was collected at this location, and the average concentration between the primary sample and the field duplicate sample was used.




RAMBOLL

## Scatterplot of Chloroform Concentrations in Co-located Soil Gas (10 to 15 ft bgs) and Shallow Groundwater Samples

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-13**

Drafter: JA Date: 2/9/2023 Contract Number: 1690029369-006 Approved by: Revised:

TIMET EXTRACTION WELLS

OSSM EXTRACTION WELLS

NERT EXTRACTION WELLS (Interceptor Well Field)

AMPAC EXTRACTION WELLS

NERT SITE STUDY AREA

NERT BARRIER WALL

NERT EXTRACTION WELLS (Athens Road Well Field)

NERT EXTRACTION WELLS (Seep Well Field)

WETLANDS PARK

HIGHLANDS PRECIPITATION

MOUNTAINS

SURFACE RUNOFF

OU-1

OU-2

OU-3

TIMET

OSSM

PITTMAN NEIGHBORHOOD

MASTER-PLANNED COMMUNITY

BIRD VIEWING PRESERVE

Former Upper BMI Ponds

Former Alpha Ditch

Former Beta Ditch

Former COH Southern RIBs

Former COH Northern RIBs

WESTON HILLS

TUSCANY VILLAGE

LAS VEGAS WASH

FRENCHMAN MOUNTAINS FAN DEPOSITS

BEDROCK

BASE OF SHALLOW WATER-BEARING ZONE

BASE OF MIDDLE WATER-BEARING ZONE

GROUNDWATER TABLE

MUDDY CREEK FM

ALLUVIUM

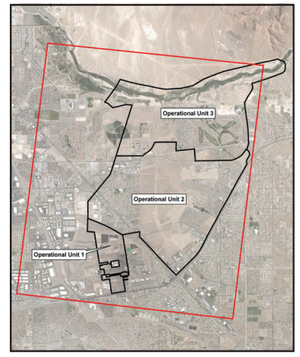
SOUTH

NORTH

(NOT TO SCALE)

**LEGEND:**

- Alluvium
- Muddy Creek Formation
- Bedrock
- Mixed Land Use (Residential and Commercial)
- BMI Complex
- Business / Industrial
- Wetlands Park (Recreational)
- Undeveloped Land
- Extraction Wells
- Source Zone Infiltration
- Potential Vapor Intrusion
- Master-Planned Community
- Runoff and Recharge
- Surface Runoff
- Groundwater Flow Direction




RAMBOLL

**Conceptual Site Model: NERT RI Study Area**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**4-14**

Drafter: RS | Date: 2/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

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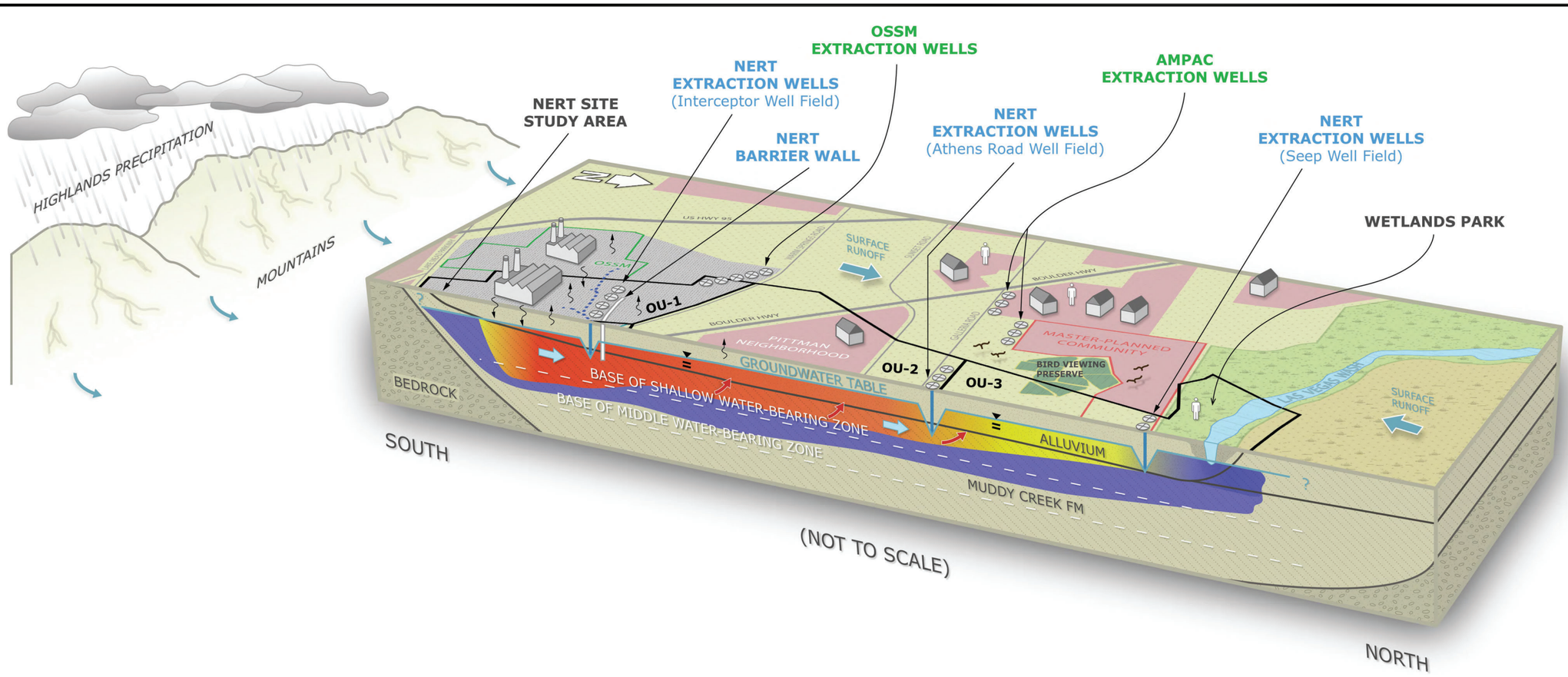
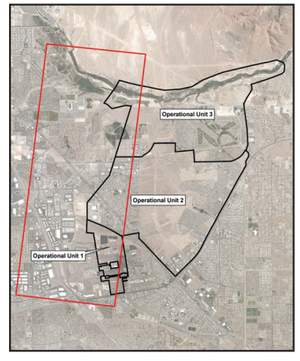



**LEGEND:**

- Alluvium
- Muddy Creek Formation
- Bedrock
- Mixed Land Use (Residential and Commercial)
- BMI Complex
- Business / Industrial
- Wetlands Park (Recreational)
- Undeveloped Land
- Extraction Wells
- Source Zone Infiltration
- Potential Vapor Intrusion
- Master-Planned Community
- Runoff and Recharge
- Surface Runoff
- Groundwater Flow Direction
- Upward Contaminant Migration

**EXPLANATION:**
Relative Groundwater Concentrations

Higher — Lower




RAMBOLL

**Conceptual Site Model: NERT Site Study Area to Las Vegas Wash**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **4-15**

Drafter: RS | Date: 2/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

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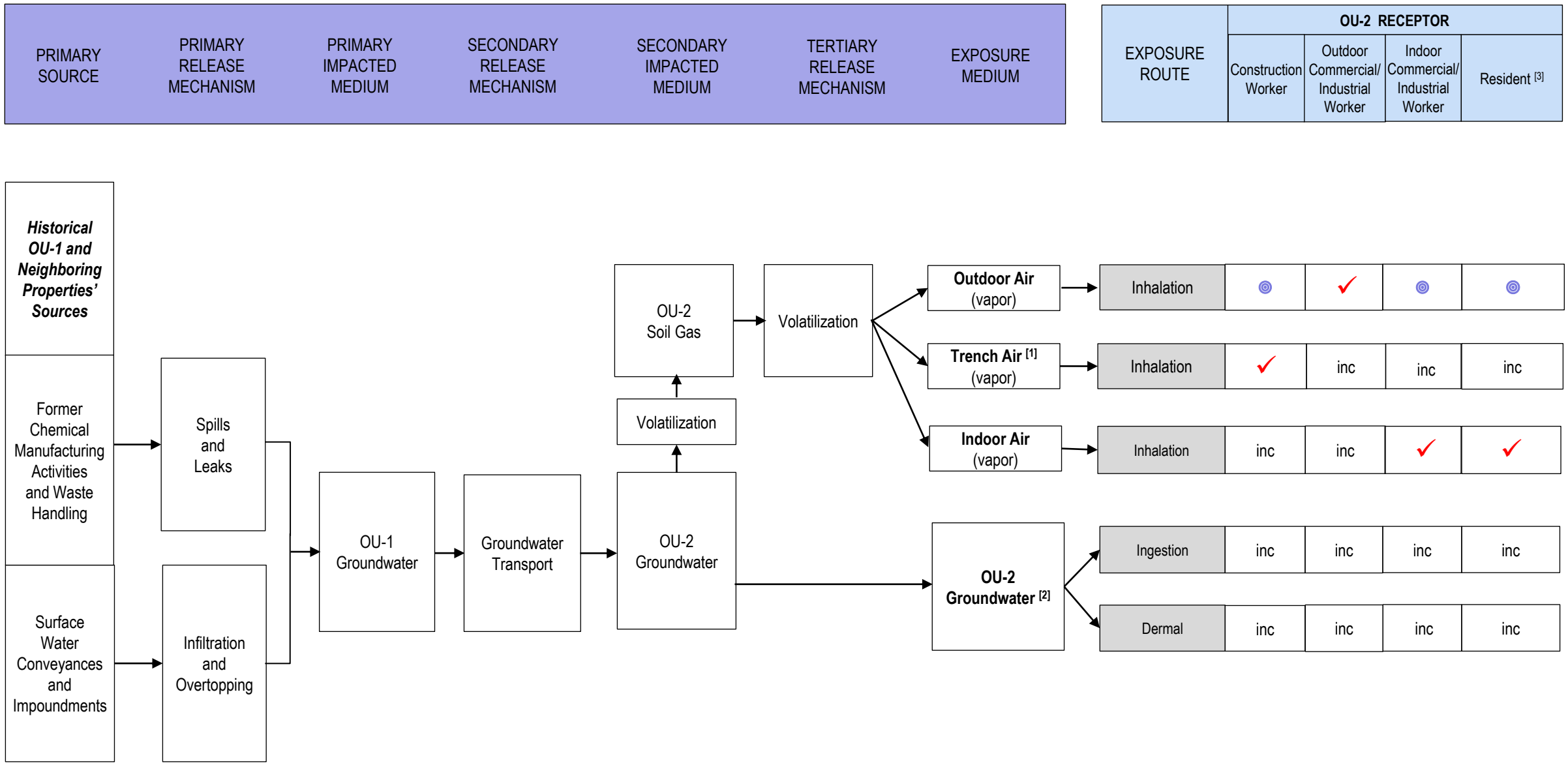



RAMBOLL

**Conceptual Site Model for Human Exposures in the OU-2 BHRA Area**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-1**

Drafter: KZ | Date: 2/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

H:\LePetomane\NERT\BHRA\Report\Figures

Notes:

| | |
|---|---|
| BHRA | Baseline health risk assessment |
| bgs | below ground surface |
| ft | Feet |
| OU | Operable unit |
| VOC | Volatile organic compound |

[1] 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.

[2] Exposure via domestic use of groundwater is not evaluated because groundwater in OU-2 is not and will not be used as a source of drinking water. Incidental ingestion of and dermal contact with groundwater during short-term construction activities are not considered complete exposure pathways in most of the OU-2 BHRA Area because depth to groundwater is >10 feet below ground surface (bgs). Depths to groundwater in a very limited area near monitoring wells PC-161 and PC-162 were identified to be shallower than 10 ft bgs in OU-2. Due to limited numbers of wells with depth to groundwater shallower than 10 ft bgs in OU-2 and the low concentrations detected at these two wells, significant health risks are not expected to occur through the groundwater direct contact pathway in this area. Health risks associated with this pathway are not quantitatively evaluated but semi-quantitatively discussed in the uncertainty analysis in the OU-2 BHRA Report.

[3] The exposure to VOCs migrating to indoor air for the residents are evaluated under both a slab-on-grade building scenario and a trailer home scenario.

Key:

| | |
|---|---|
| inc | Incomplete exposure pathway |
| ✓ | Complete exposure pathway; evaluated quantitatively in the BHRA. |
| ◎ | The exposure to VOCs in outdoor air is not quantitatively evaluated for construction workers and indoor commercial/industrial workers, or residents because it is expected to be much lower than the exposure to VOCs in trench air or indoor air. |

RAMBOLL

**Conceptual Site Model for Human Exposures in the OU-2 BHRA Area**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-1**

Drafter: KZ | Date: 2/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

H:\LePetomane\NERT\BHRA\Report\Figures

## Legend

OU-2 Residential Soil Gas Sample Locations at 5 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Trailer Area
- Former Ditches
- OSSM Site
- TIMET Site
- NERT Site Study Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
[1]The estimated total cancer risks for the slab-on-grade scenario are shown in the main figure; the estimated total cancer risks for the residential trailer scenario at soil gas sample locations near the trailer area are shown in the window box.

N

0 250 500

Feet

### Indoor Air Scenario in Trailer

RISG-77 (1E-5)

RISG-78

Trailer Area

Operable Unit 2

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

RISG-57 (7E-6)

RISG-58 (6E-6)

RISG-59 (8E-6)

RISG-60 (5E-6)

RISG-62 (2E-6)

RISG-63 (3E-6)

RISG-61

RISG-9

RISG-64

RISG-67

RISG-65

RISG-66

RISG-5 (3E-6)

RISG-7

RISG-68 (1E-5)

RISG-69

RISG-1 (2E-5)

RISG-4 (2E-6)

RISG-8

RISG-70 (9E-6)

RISG-71 (1E-5)

RISG-72

RISG-74 (7E-6)

RISG-73

RISG-75

RISG-29

RISG-77 (1E-5)

RISG-78

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Parcel E

Former Parcel J

Former Parcels C & D

Operable Unit 1

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\WERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-2 Cancer Risk Res 5 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Residents Exposed to VOCs in Soil Gas at 5 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-2**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Residential Soil Gas Sample Locations at 10 to 15 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Trailer Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- Former Ditches
- OSSM Site
- TIMET Site
- NERT Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
[1]The estimated total cancer risks for the slab-on-grade scenario are shown in the main figure; the estimated total cancer risks for the residential trailer scenario at soil gas sample locations near the trailer area are shown in the window box.

N

0 250 500

Feet

### Indoor Air Scenario in Trailer

RISG-77 (7E-6)

RISG-78

Trailer Area

EAST GALLERIA DRIVE

Operable Unit 2

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

RISG-57 (5E-6)

RISG-58 (3E-6)

RISG-59 (5E-6)

RISG-60 (3E-6)

RISG-62 (2E-6)

RISG-63 (2E-6)

RISG-61

RISG-64

RISG-67

RISG-66

RISG-5

RISG-65

RISG-7

RISG-68 (6E-6)

RISG-69

RISG-1 (2E-5)

RISG-4

RISG-70 (8E-6)

RISG-71 (5E-6)

RISG-72

RISG-74 (4E-6)

RISG-73

RISG-29

RISG-75

RISG-77 (7E-6)

RISG-78

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Former Parcel J

Parcel E

Former Parcels C & D

Operable Unit 1

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

\\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-3 Cancer Risk Res 15 ft bgs SG-2.mxd

RAMBOLL

**Estimated Total Cancer Risk for Residents Exposed to VOCs in Soil Gas at 10 to 15 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-3**

Drafter: RZ | Date: 4/6/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Commercial Soil Gas Sample Locations at 5 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- Former Ditches
- OSSM Site
- TIMET Site
- NERT Site Study Area

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

N

0 250 500

Feet

Operable Unit 2

Operable Unit 1

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

RISG-52

RISG-6 (3E-6)

RISG-53

RISG-54

RISG-30

RISG-55

RISG-2

RISG-56

Former Parcel A

Former Parcel B

Former Parcel C & D

Former Parcel I

Former Parcel J

Parcel E

SG07

RISG-28

SG08

SG09

SG06

RISG-76

SG10

SG11

SG12

SG13

RISG-27

SG14

SG15

RISG-3

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-4 Cancer Risk Com 5 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Indoor Commercial/Industrial Workers Exposed to VOCs in Soil Gas at 5 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-4**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Commercial Soil Gas Sample Locations at 10 to 15 feet bgs

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- OSSM Site
- TIMET Site
- NERT Site Study Area
- Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

N

0 250 500

Feet

RISG-52

RISG-6 (2E-6)

EAST GALLERIA DRIVE

Operable Unit 2

RISG-53

RISG-54

RISG-30

RISG-55

RISG-2

RISG-56

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

Former Parcel A

RISG-28

WARM SPRINGS ROAD

RISG-76

Former Parcel I

Former Parcel B

Parcel E

Former Parcel B

Former Parcel J

RISG-3

RISG-27

Former Parcels C & D

Operable Unit 1

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\WERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-5 Cancer Risk Com 15 ft bgs SG.mxd

RAMBOLL

**Estimated Total Cancer Risk for Indoor Commercial/Industrial Workers Exposed to VOCs in Soil Gas at 10 to 15 feet bgs Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-5**

Drafter: RZ | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Residential Shallow Groundwater Wells

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Trailer Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- OSSM Site
- TIMET Site
- NERT Site Study Area
- Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

Note:
[1]The estimated total cancer risks for the slab-on-grade scenario are shown in the main figure; the estimated total cancer risks for the residential trailer scenario at groundwater well locations near the trailer area are shown in the window box.

N

0 250 500

Feet

**Indoor Air Scenario in Trailer**

PC-174 (1E-5)

PC-175 (4E-5)

Trailer Area

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

**Operable Unit 2**

**Operable Unit 1**

PC-190

PC-161

PC-162

PC-193 (2E-5)

PC-163 (2E-5)

PC-164 (2E-5)

PC-28 (9E-6)

PC-165

PC-31

PC-166

PC-169 (5E-6)

PC-168 (5E-5)

PC-167

PC-192 (2E-6)

PC-66

PC-67 (1E-4)

PC-172D (1E-5)

PC-179 (1E-5)

PC-65

PC-64

BHE1-10

PC-174 (1E-5)

PC-175 (4E-5)

Former Parcel A

Former Parcel I

Former Parcel B

Former Parcel B

Parcel E

Former Parcel J

Former Parcels C & D

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\WERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-6 Cancer Risk Res GW.mxd

RAMBOLL

**Estimated Total Cancer Risk for Residents Exposed to VOCs in Shallow Groundwater Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-6**

Drafter: JA | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

## Legend

OU-2 Commercial Shallow Groundwater Wells

**Cancer Risk**

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- OU-2 BHRA Area
- Sale Parcel Boundary
- Operable Units
- NERT Site Boundary
- Eastside Sub-Area
- NERT Off-Site Study Area
- OSSM Site
- TIMET Site
- NERT Site Study Area
- Former Ditches

**Groundwater Chloroform Concentration (µg/L)**

- < 70
- 70 - 500
- 500 - 1,000
- 1,000 - 10,000
- > 10,000

N

0 250 500

Feet

Operable Unit 2

Operable Unit 1

EAST GALLERIA DRIVE

SUNSET ROAD

BOULDER HIGHWAY

PABCO ROAD

WARM SPRINGS ROAD

ARP-1, ARP-2A, ARP-3A, MW-K4, ARP-4A, ARP-5A, ARP-6B, ARP-7

PC-160, PC-143, PC-144, PC-145, PC-122 (2E-6), PC-142, PC-149, ART-6, PC-55, PC-134A, PC-148, PC-136, PC-18, PC-135A, PC-101R

PC-123, PC-177

PC-153, PC-153R, PC-194, PC-132, PC-50, PC-131, PC-130, PC-128, PC-129, PC-127, PC-24 (2E-6), PC-125, PC-126 (2E-6), PC-124 (2E-6)

PC-171

Former Parcel A

PC-71, PC-72, PC-181, PC-183, PC-184, PC-180, M-44, PC-186

PC-187 (3E-6), PC-187R (2E-6), PC-37, PC-54

Former Parcel I

Former Parcel B

Parcel E

Former Parcel B

PC-188 (2E-6), PC-189, M-48A, PC-21A

Former Parcel J

Former Parcels C & D

NERT Site Study Area

OSSM Site

TIMET Site

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-2 Soil Gas and Groundwater BHRA\GIS\Figure 5-7 Cancer Risk Com GW.mxd

RAMBOLL

**Estimated Total Cancer Risk for Indoor Commercial/Industrial Workers Exposed to VOCs in Shallow Groundwater Migrating to Indoor Air (Chloroform Plume as Depicted in the RI Report for OU-1 and OU-2)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-7**

Drafter: JA | Date: 4/5/2023 | Contract Number: 1690029369-006 | Approved by: | Revised:

# APPENDICES
# (ELECTRONIC FILES AVAILABLE UPON REQUEST)

# APPENDIX A
# ZONE OF INFLUENCE FOR REMEDIAL INVESTIGATION SOIL GAS SAMPLES

**TABLE A-1. Soil Gas Sampling Zone of Influence Descriptions, Phase 2 RI Modification No. 11**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| LOCATION ID | FIGURE # | DESCRIPTION OF STRUCTURES WITHIN ZONE OF INFLUENCE |
|---|---|---|
| RISG-1 | A-1.1 | One monitoring well (PC-67); street utilities; asphalt street; five housing structures with concrete driveways and gravel covered lots. |
| RISG-2 | A-1.2 | One monitoring well (PC-24); street utilities; asphalt street; one industrial building to the north with asphalt parking lot. |
| RISG-3 | A-1.3 | One monitoring well (PC-21A); automobile salvage yard on dirt lot. |
| RISG-4 | A-1.4 | Two monitoring wells (PC-172 and PC-172D); street utilities; asphalt street; six housing structures with concrete driveways and gravel covered lots. |
| RISG-5 | A-1.5 | One monitoring well (PC-169); street utilities; asphalt street; three housing structures with concrete driveways and gravel covered lots. |
| RISG-6 | A-1.6 | Two monitoring wells (PC-122 and ART-7); street utilities; asphalt street; asphalt parking lot to the north. |
| RISG-7 | A-1.7 | One monitoring well (PC-167); street utilities; asphalt street; five housing structures with concrete driveways and gravel covered lots. |
| RISG-8 | A-1.8 | Two monitoring wells (PC-64 and PC-179); street utilities; asphalt street; six housing structures with concrete driveways and grass or gravel covered lots. |
| RISG-9 | A-1.9 | One monitoring well (PC-166); street utilities; asphalt street; unpaved dirt lot; concrete parking lot to the north. |
| RISG-27 | A-1.10 | Two monitoring wells (M-48A and PC-189); two industrial buildings; automobile salvage yard on asphalt. |
| RISG-28 | A-1.11 | Two monitoring wells (M-96 and PC-186); one industrial building; automobile salvage yard on asphalt. |
| RISG-29 | A-1.12 | One monitoring well (PC-175); street utilities; asphalt street; six housing structures with concrete driveways and gravel covered lots. |
| RISG-30 | A-1.13 | One monitoring well (PC-50); street utilities; asphalt street; contractor/trucker storage lot and asphalt parking lot to the north. |

**Note:**
RI = Remedial Investigation

**TABLE A-2. Soil Gas Sampling Zone of Influence Descriptions, Phase 3 RI Modification No. 9**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| LOCATION ID [1] | FIGURE # | DESCRIPTION OF STRUCTURES WITHIN ZONE OF INFLUENCE |
|---|---|---|
| RISG-52 | A-2.1 | Industrial building; utility vehilce parking on asphalt; concrete storm water drainage ditch. |
| RISG-53 | A-2.2 | Street utilities; asphalt street; one industrial building to the west with asphalt parking. |
| RISG-54 | A-2.3 | One monitoring well (PC-123); street utilities; asphalt street; one industrial building to the north; asphalt parking lot. |
| RISG-55 | A-2.4 | One monitoring well (PC-128); street utilities; asphalt street; dirt lot to the north. |
| RISG-56 | A-2.5 | One monitoring well (PC-124); street utilities; asphalt street; newly paved asphalt parking (to the north not shown on the aerial). |
| RISG-57 | A-2.6 | Street utilities; asphalt street; three apartment housing structures with asphalt parking and grass lots. |
| RISG-58 | A-2.7 | Street utilities; asphalt street; eleven housing structures with concrete driveways and gravel covered lots. |
| RISG-59 | A-2.8 | Street utilities; asphalt street; eleven housing structures with concrete driveways and gravel covered lots. |
| RISG-60 | A-2.9 | Street utilities; asphalt street; four housing structures with concrete driveways and gravel covered lots. |
| RISG-61 | A-2.10 | One monitoring well (PC-28); street utilities; asphalt street; two housing structures with concrete driveways and gravel covered lots; elementary school building and asphalt paving to the south; dirt lot to the west. |
| RISG-62 | A-2.11 | Street utilities; asphalt street; two housing structures with concrete driveways and gravel covered lots; dirt lot to the west. |
| RISG-63 | A-2.12 | Street utilities; asphalt street; eleven housing structures with concrete driveways and gravel covered lots. |
| RISG-64 | A-2.13 | Street utilities; asphalt street; eleven housing structures with concrete driveways and gravel covered lots. |
| RISG-65 | A-2.14 | Street utilities; asphalt street; three housing structures with concrete driveways and gravel covered lots; asphalt parking. |
| RISG-66 | A-2.15 | Street utilities; asphalt street; eleven housing structures with concrete driveways and gravel covered lots. |
| RISG-67 | A-2.16 | Street utilities; asphalt street; nine housing structures with concrete driveways and gravel covered lots. |
| RISG-68 | A-2.17 | Street utilities; asphalt street; six housing structures with concrete driveways and gravel covered lots. |
| RISG-69 | A-2.18 | Two monitoring wells (PC-66 and PC-192); street utilities; asphalt street; seven housing structures with concrete driveways and gravel covered lots. |
| RISG-70 | A-2.19 | Street utilities; asphalt street; eight housing structures with concrete driveways and gravel covered lots. |
| RISG-71 | A-2.20 | Street utilities; asphalt street; four housing structures with concrete driveways and gravel covered lots. |
| RISG-72 | A-2.21 | Street utilities; asphalt street; seven housing structures with concrete driveways and gravel covered lots. |
| RISG-73 | A-2.22 | Street utilities; asphalt street; eight housing structures with concrete driveways and gravel covered lots. |
| RISG-74 | A-2.23 | Street utilities; asphalt street; six housing structures with concrete driveways and gravel covered lots. |
| RISG-75 | A-2.24 | Street utilities; asphalt street; five housing structures with concrete driveways and gravel covered lots. |
| RISG-76 | A-2.25 | One monitoring well (PC-187R); automobile salvage yard on asphalt; construction employee dirt parking lot. |
| RISG-77 | A-2.26 | Street utilities; asphalt street; two housing structures with concrete driveways; asphalt parking lot. |

## TABLE A-2. Soil Gas Sampling Zone of Influence Descriptions, Phase 3 RI Modification No. 9

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| LOCATION ID [1] | FIGURE # | DESCRIPTION OF STRUCTURES WITHIN ZONE OF INFLUENCE |
|---|---|---|
| RISG-78 | A-2.27 | Street utilities; asphalt street; four mobile homes with dirt parking lot; dirt lot to the north. |

**Notes:**

RI = Remedial Investigation

[1] This table only includes the new soil gas probes installed in Phase 3 RI Modification No. 9. Soil gas probes sampled in Phase 2 RI Modification No. 11 (see Table A-1) were re-sampled in Phase 3 RI Modification No. 9; these locations are not included in this table.

# ATTACHMENT A-1
# SOIL GAS LOCATION ZONE OF INFLUENCE FIGURES, PHASE 2 RI MODIFICATION NO. 11

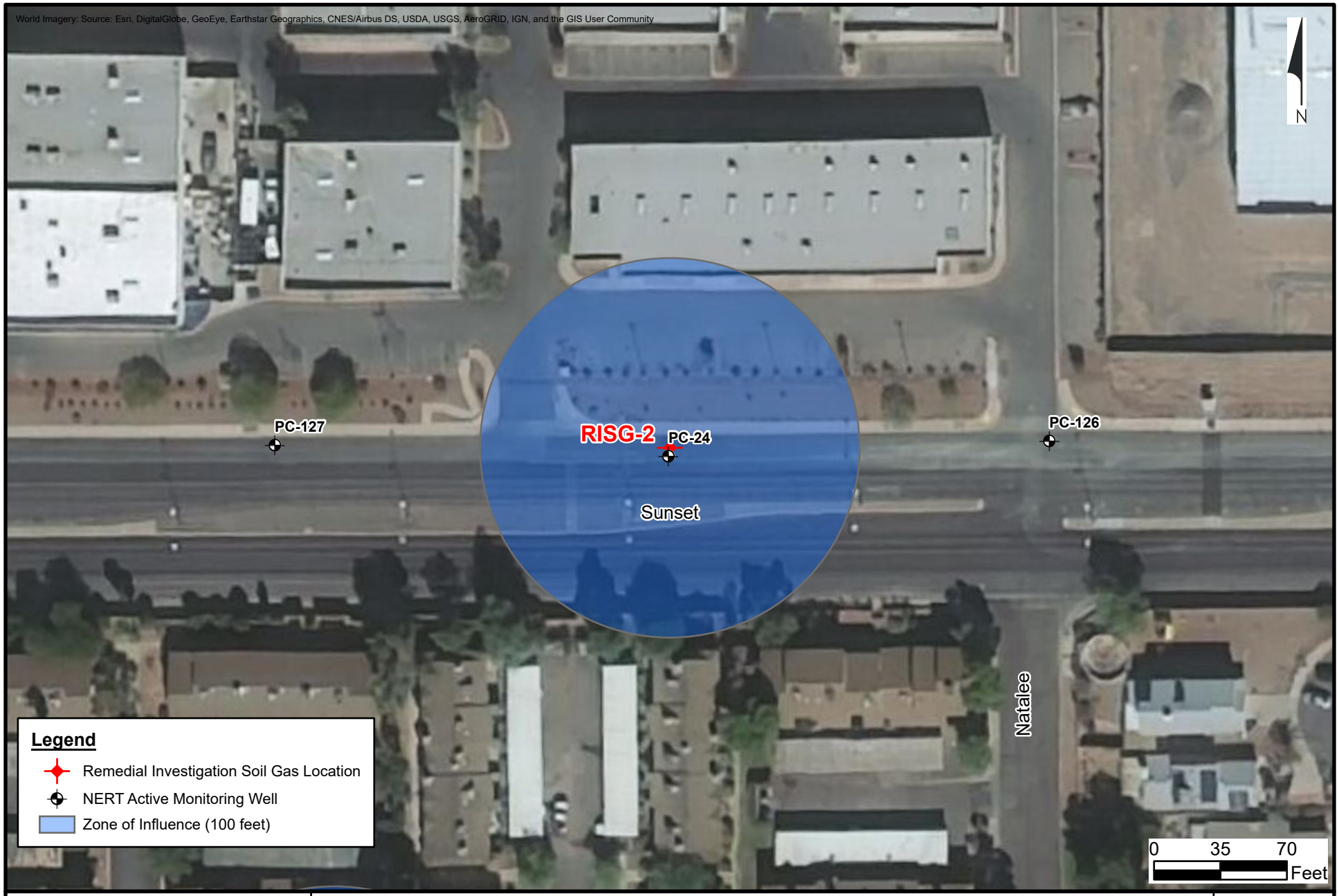

RAMBOLL

**Soil Gas Location: RISG-1 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.1**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map



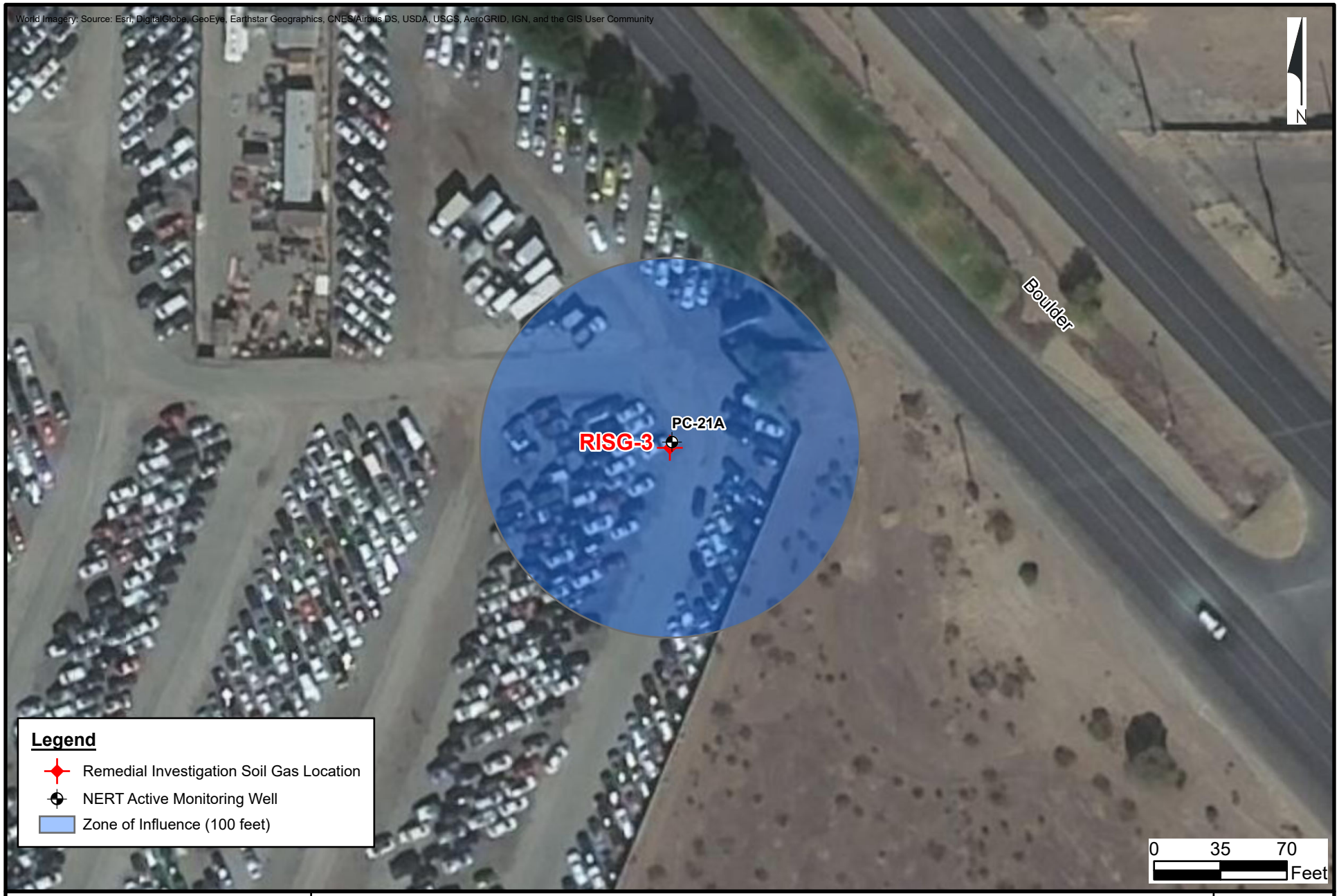

RAMBOLL

**Soil Gas Location: RISG-2 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.2**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map



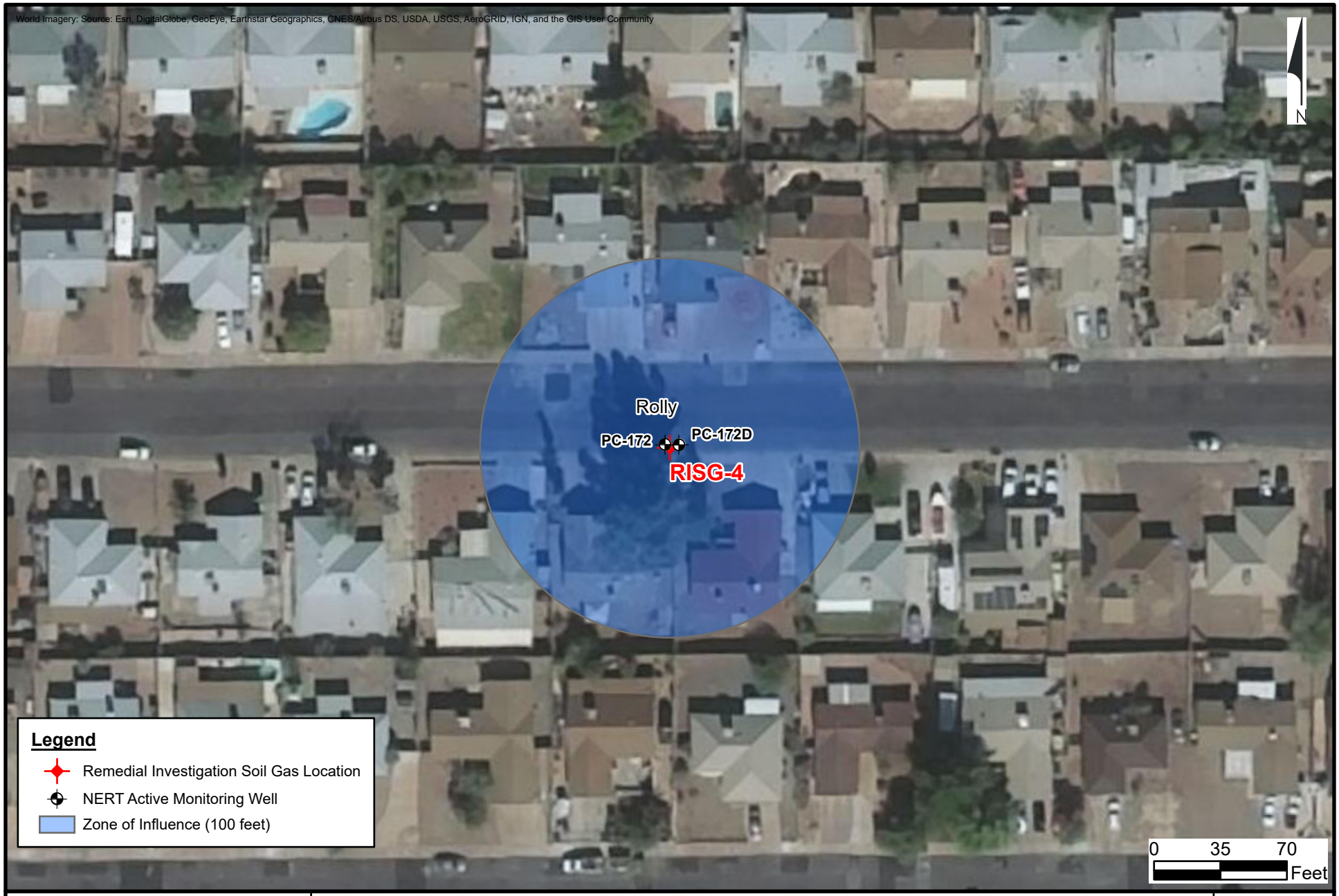

RAMBOLL

**Soil Gas Location: RISG-3 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.3**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-4 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.4**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

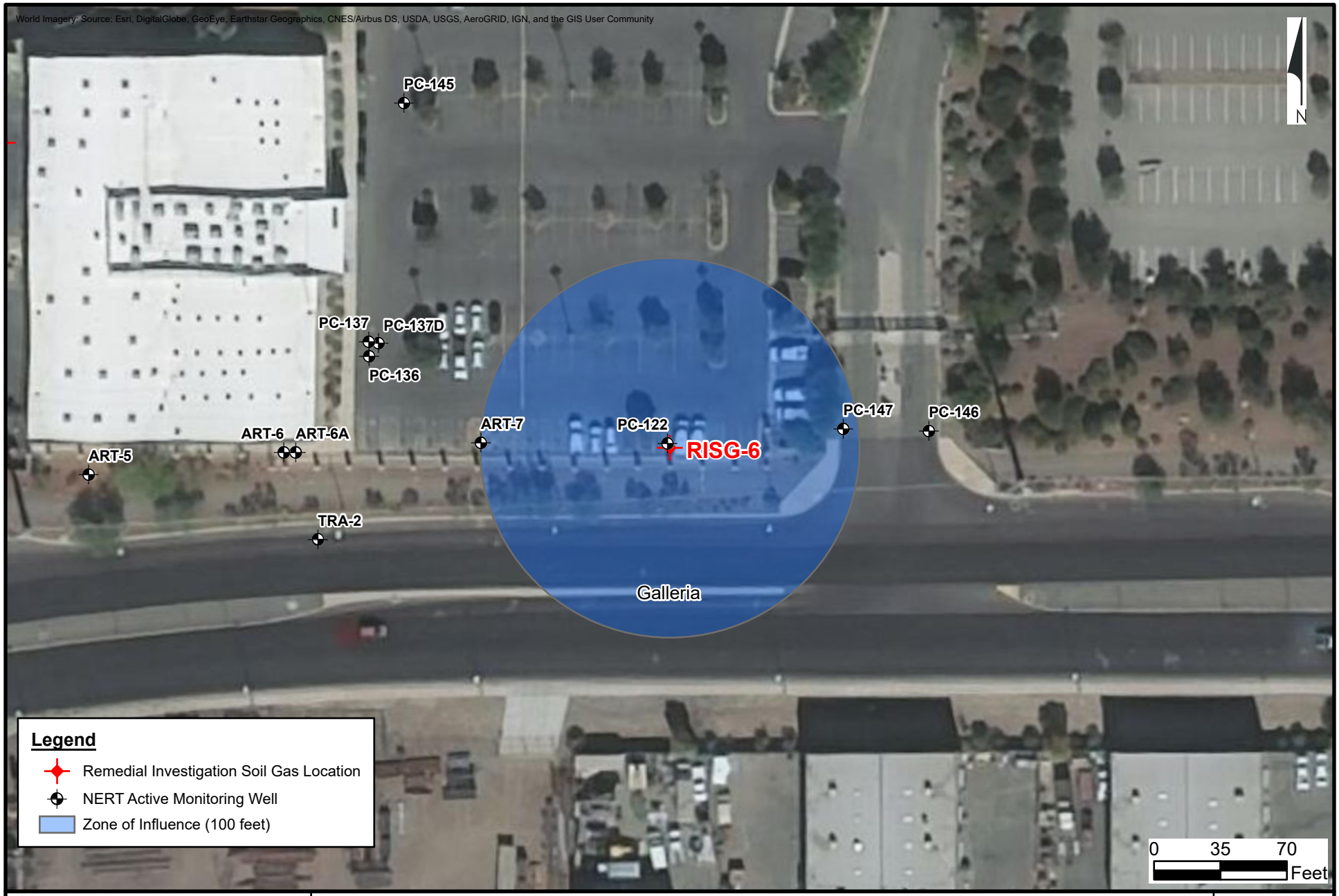

RAMBOLL

**Soil Gas Location: RISG-5 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.5**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-6 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.6**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-7 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.7**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-8 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.8**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

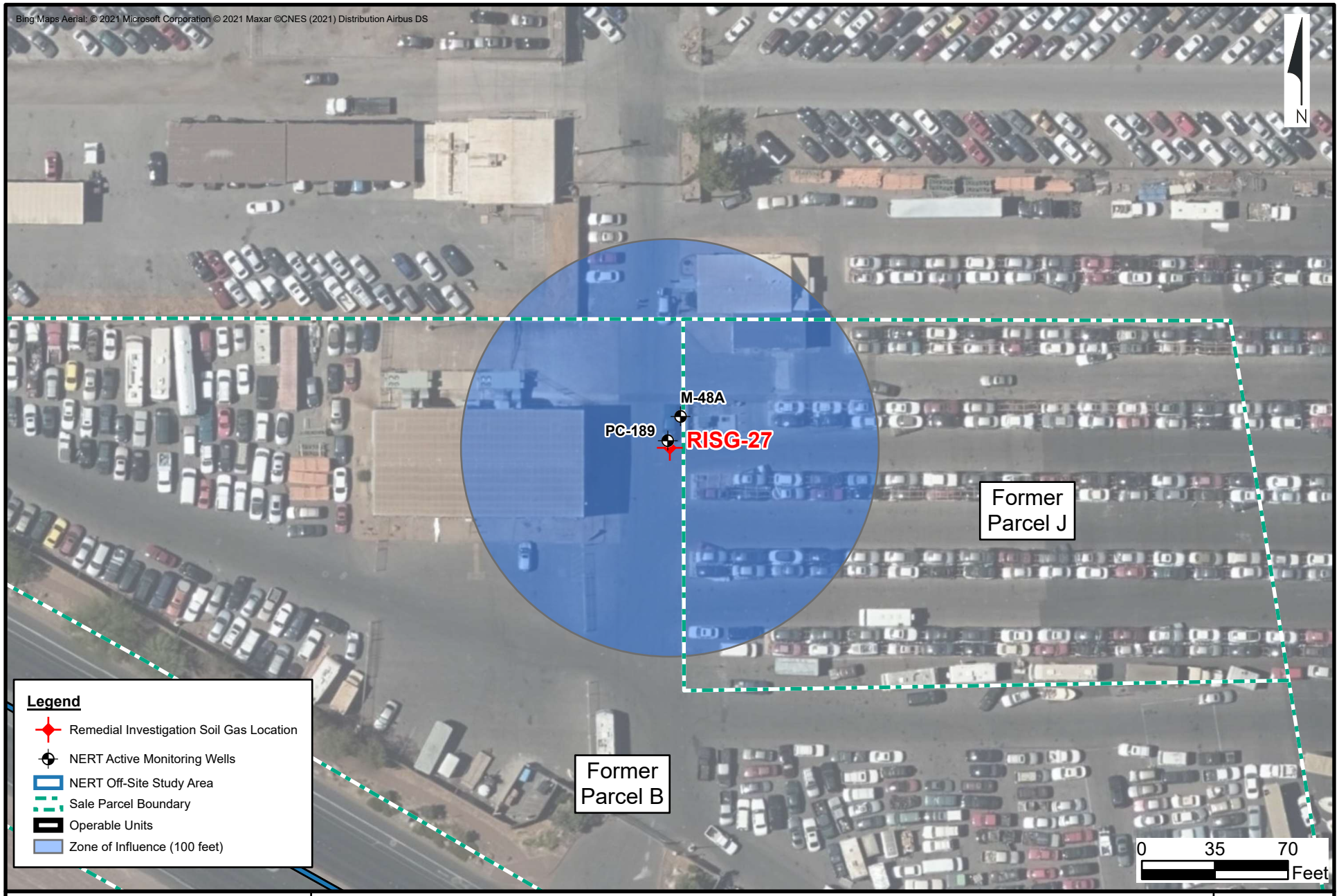

RAMBOLL

**Soil Gas Location: RISG-9 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.9**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map



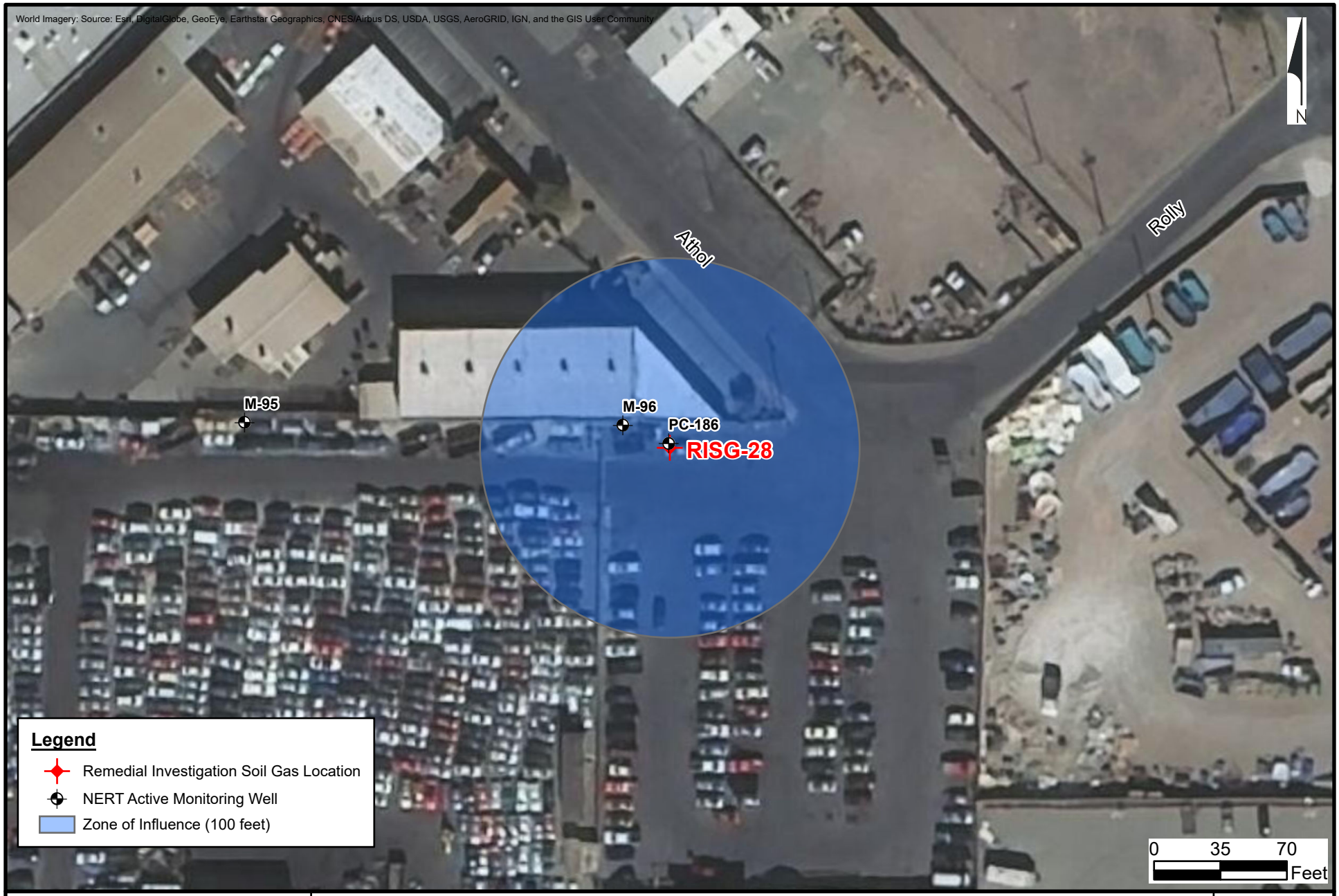

RAMBOLL

**Soil Gas Location: RISG-27 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.10**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\A-1.23



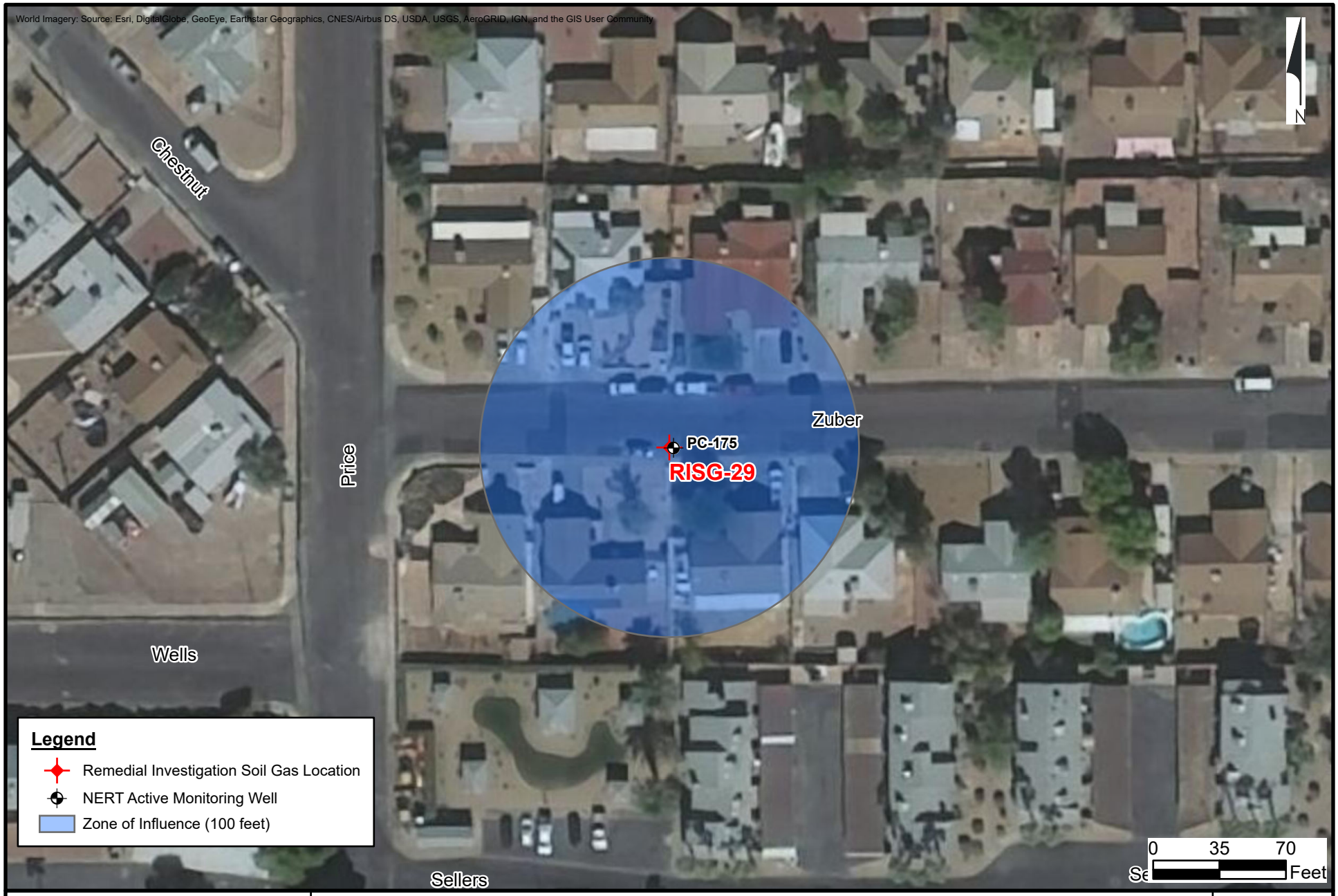

RAMBOLL

**Soil Gas Location: RISG-28 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.11**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map



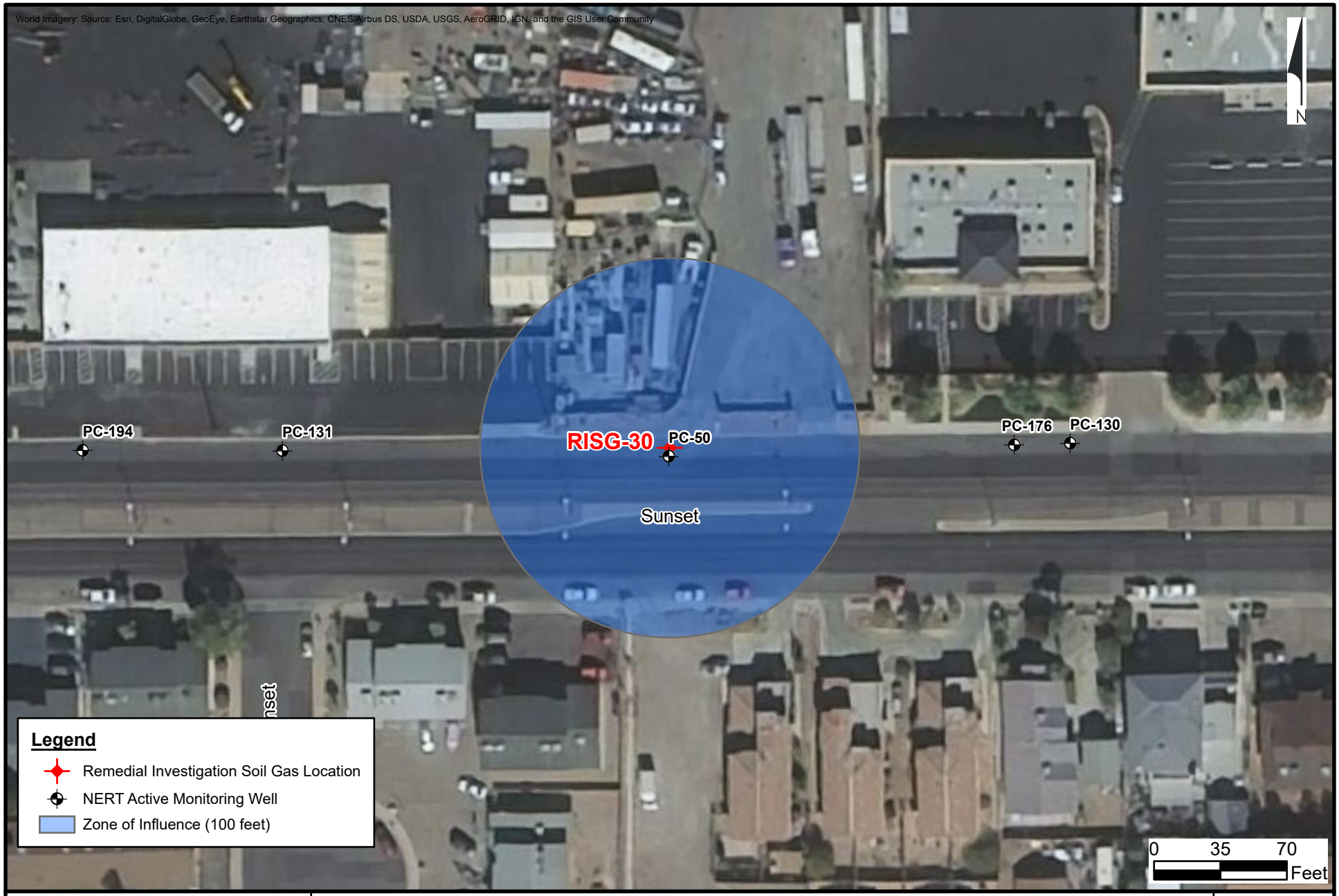

RAMBOLL

**Soil Gas Location: RISG-29 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.12**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

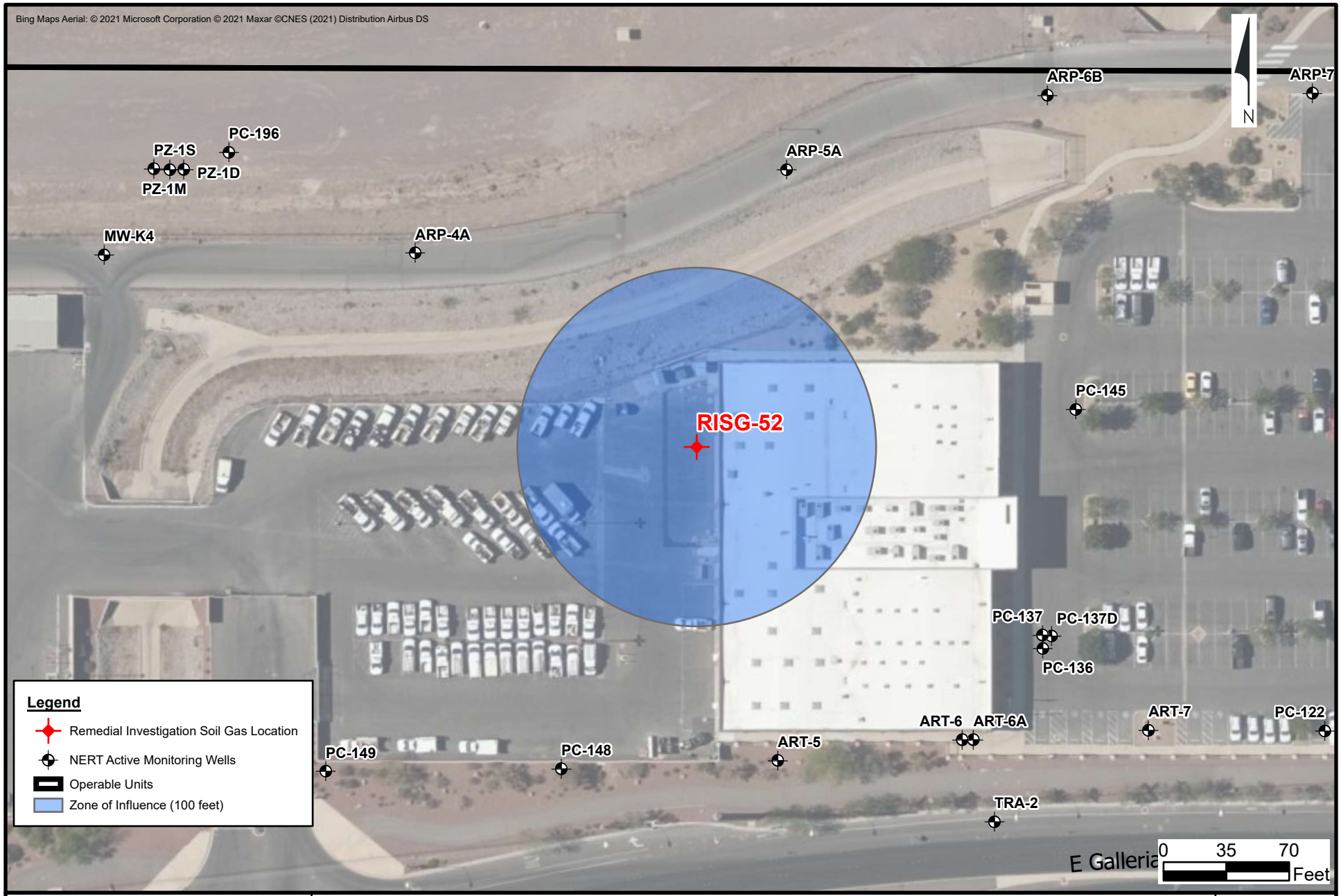
**Soil Gas Location: RISG-30 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-1.13**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | | Revised: | |
|---|---|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

# ATTACHMENT A-2
# SOIL GAS LOCATION ZONE OF INFLUENCE FIGURES, PHASE 3 RI MODIFICATION NO. 9



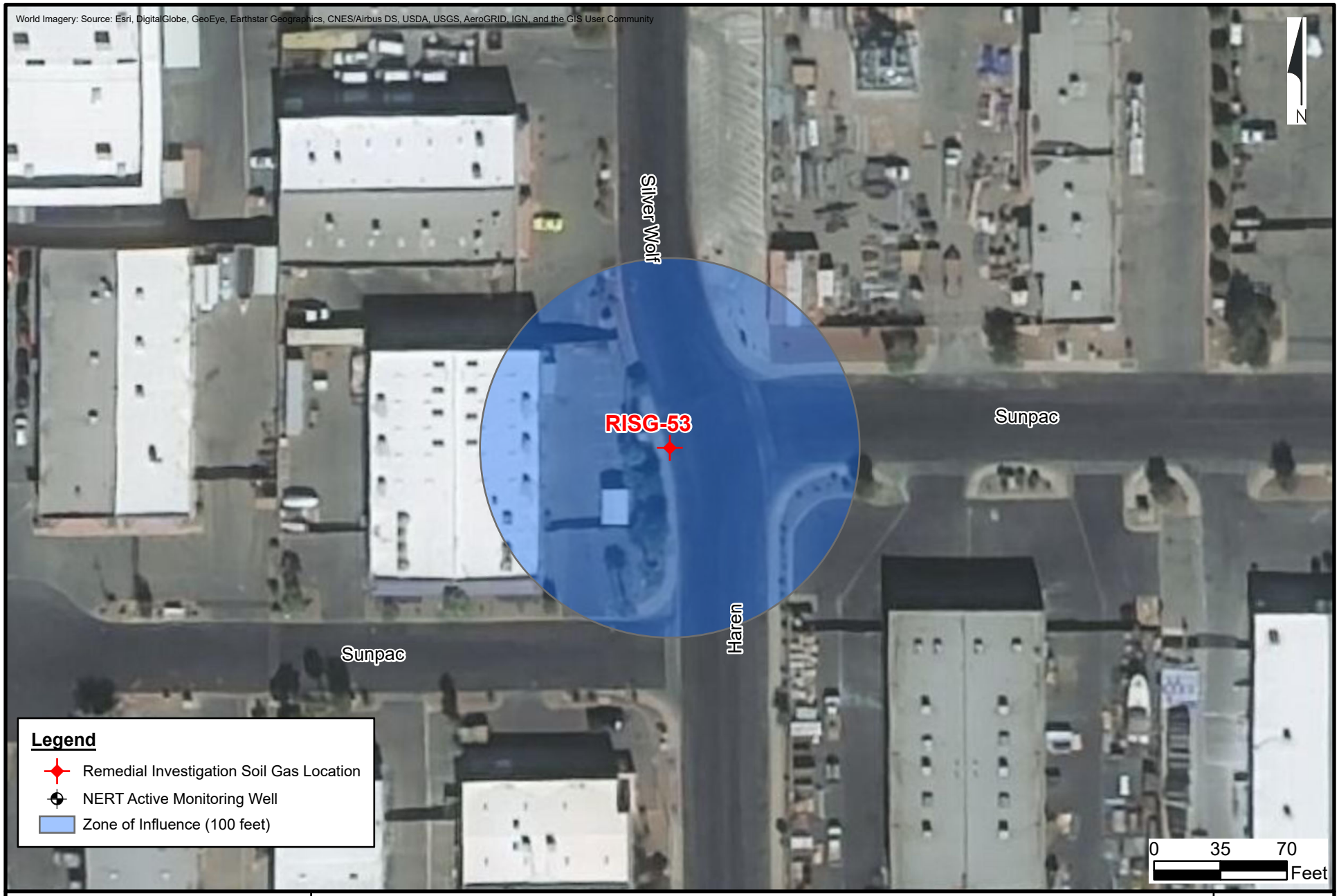

RAMBOLL

**Soil Gas Location: RISG-52 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.1**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\A-2.13



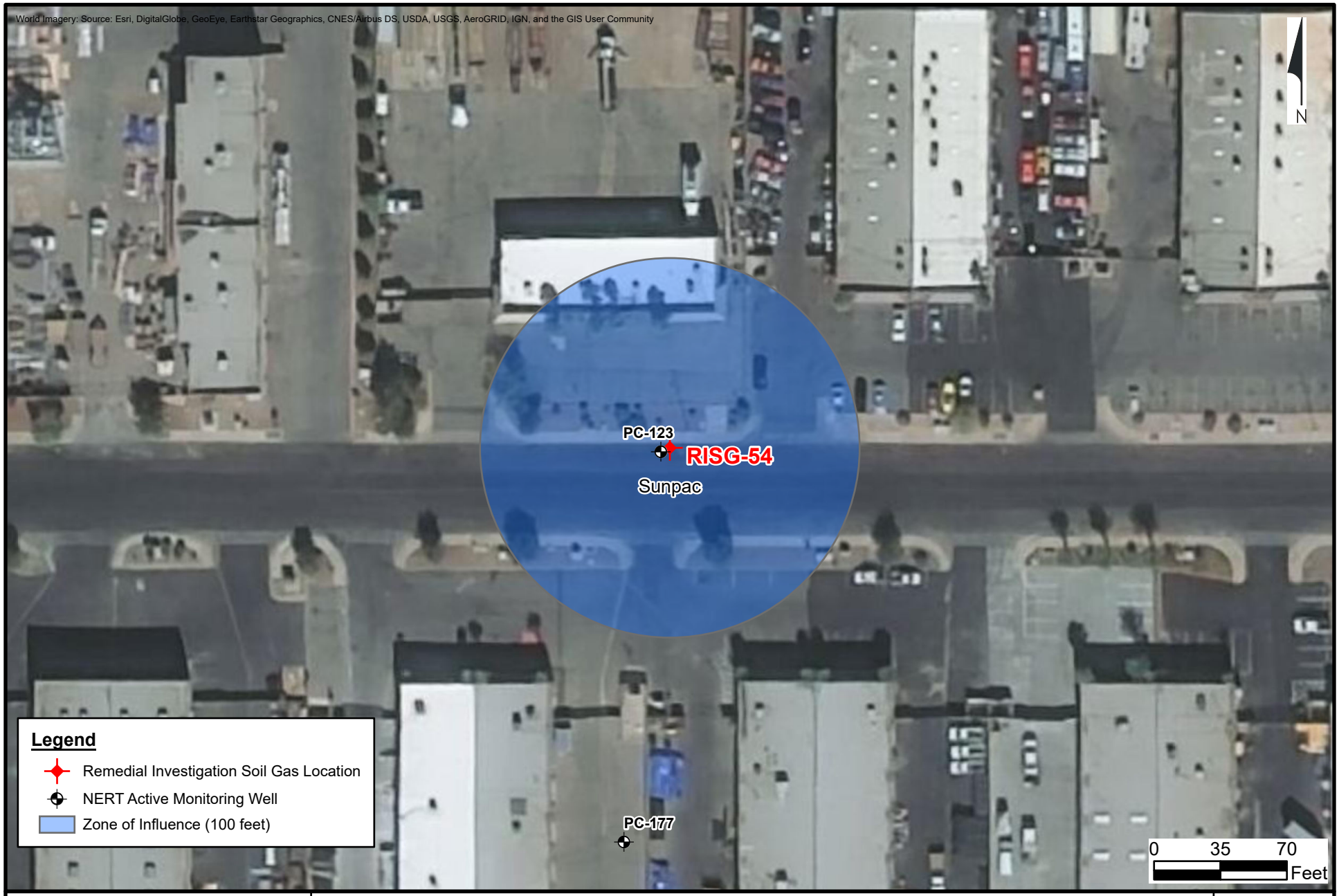

RAMBOLL

**Soil Gas Location: RISG-53 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.2**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-54 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.3**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-55 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.4**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-56 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.5**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-57 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.6**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

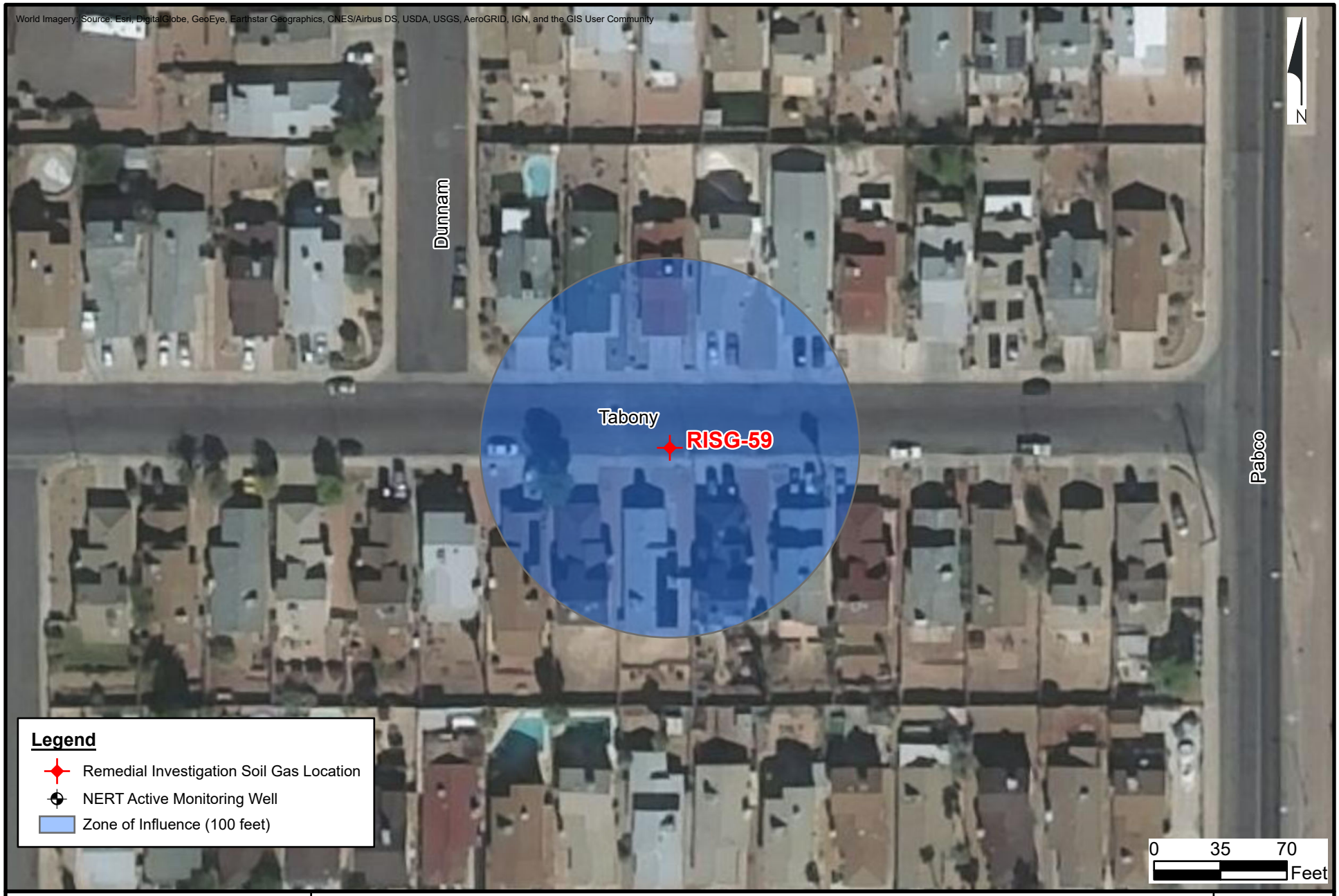

RAMBOLL

**Soil Gas Location: RISG-58 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.7**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-59 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.8**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

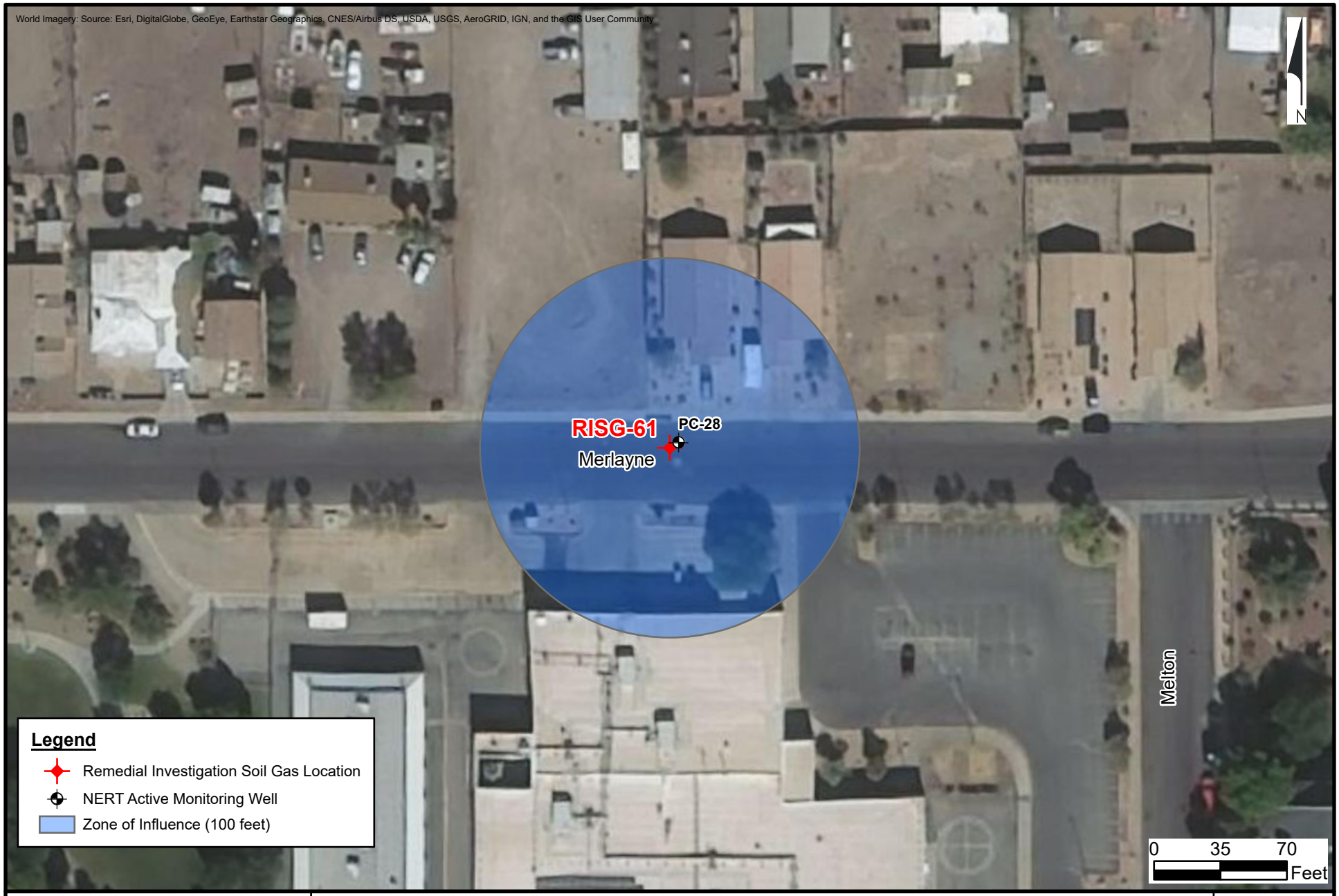

RAMBOLL

**Soil Gas Location: RISG-60 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.9**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-61 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.10**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-62 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.11**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-63 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.12**

Drafter: GM Date: 1/20/2023 Contract Number: 1690029369-006 Approved: Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-64 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.13**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

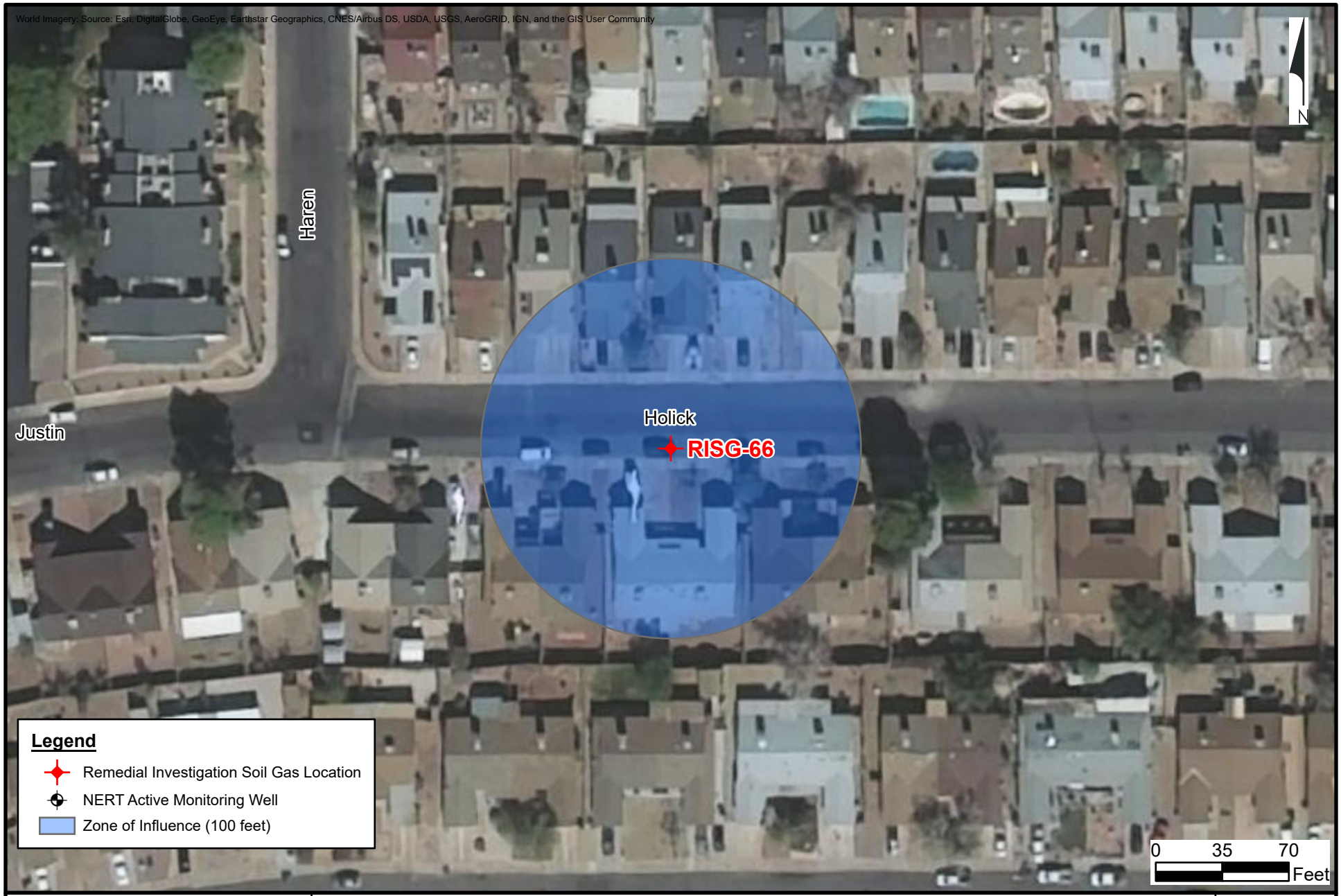

RAMBOLL

**Soil Gas Location: RISG-65 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.14**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-66 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.15**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-67 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.16**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-68 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.17**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-69 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.18**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

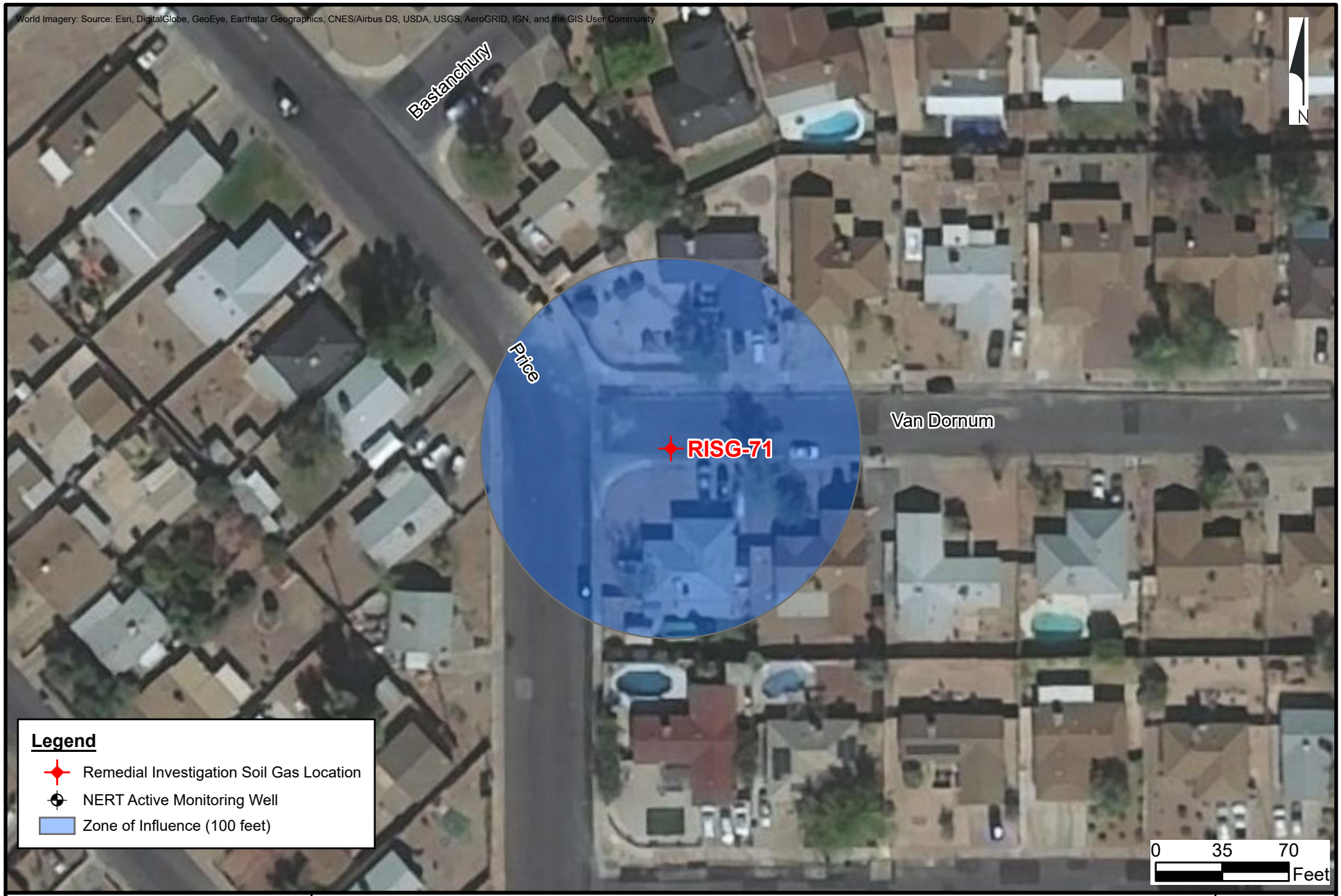

RAMBOLL

**Soil Gas Location: RISG-70 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.19**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-71 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.20**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

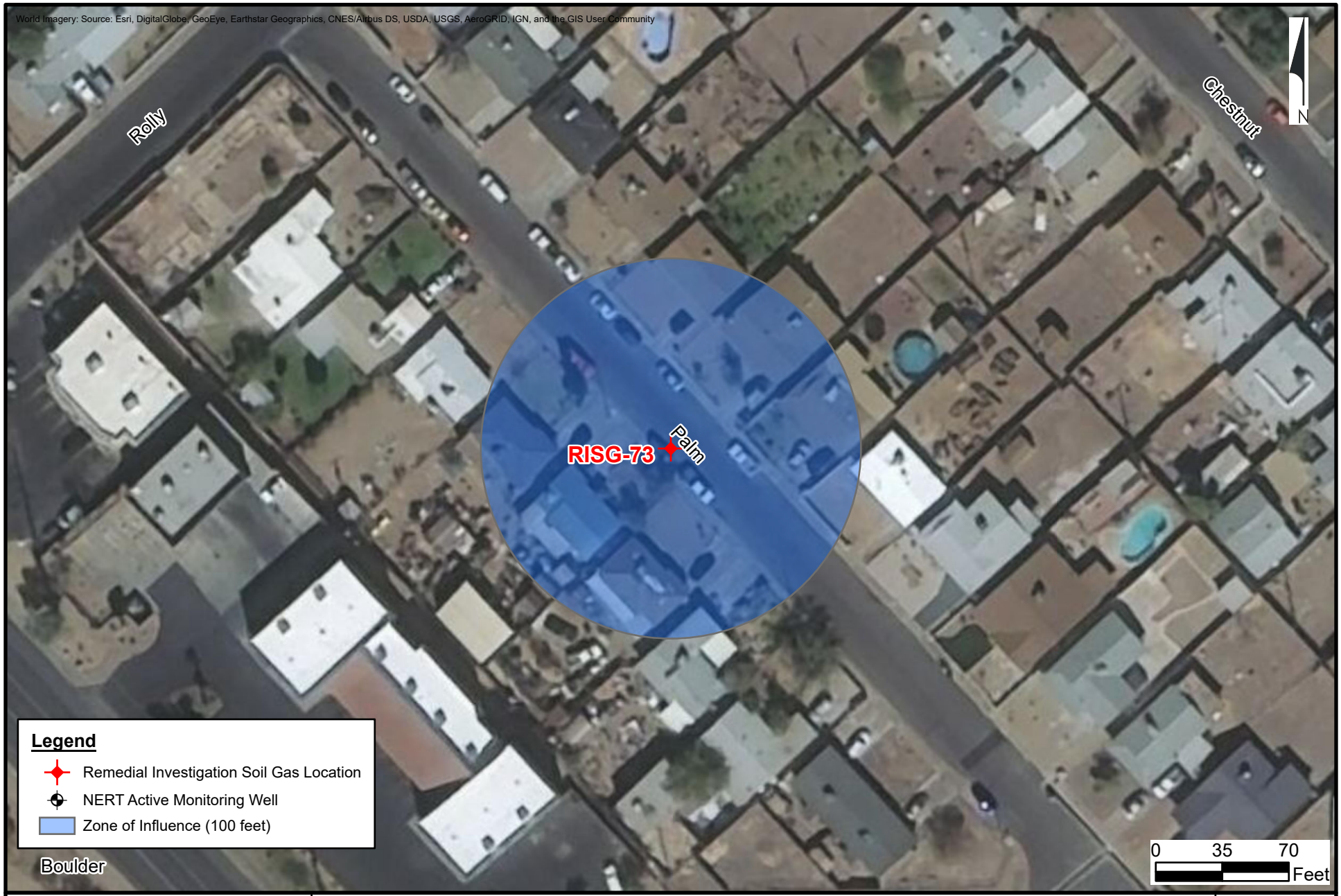

RAMBOLL

**Soil Gas Location: RISG-72 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.21**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map




RAMBOLL

**Soil Gas Location: RISG-73 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.22**

Drafter: GM | Date: 1/20/2023 | Contract Number: 1690029369-006 | Approved: | Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-74 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.23**

Drafter: GM Date: 1/20/2023 Contract Number: 1690029369-006 Approved: Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

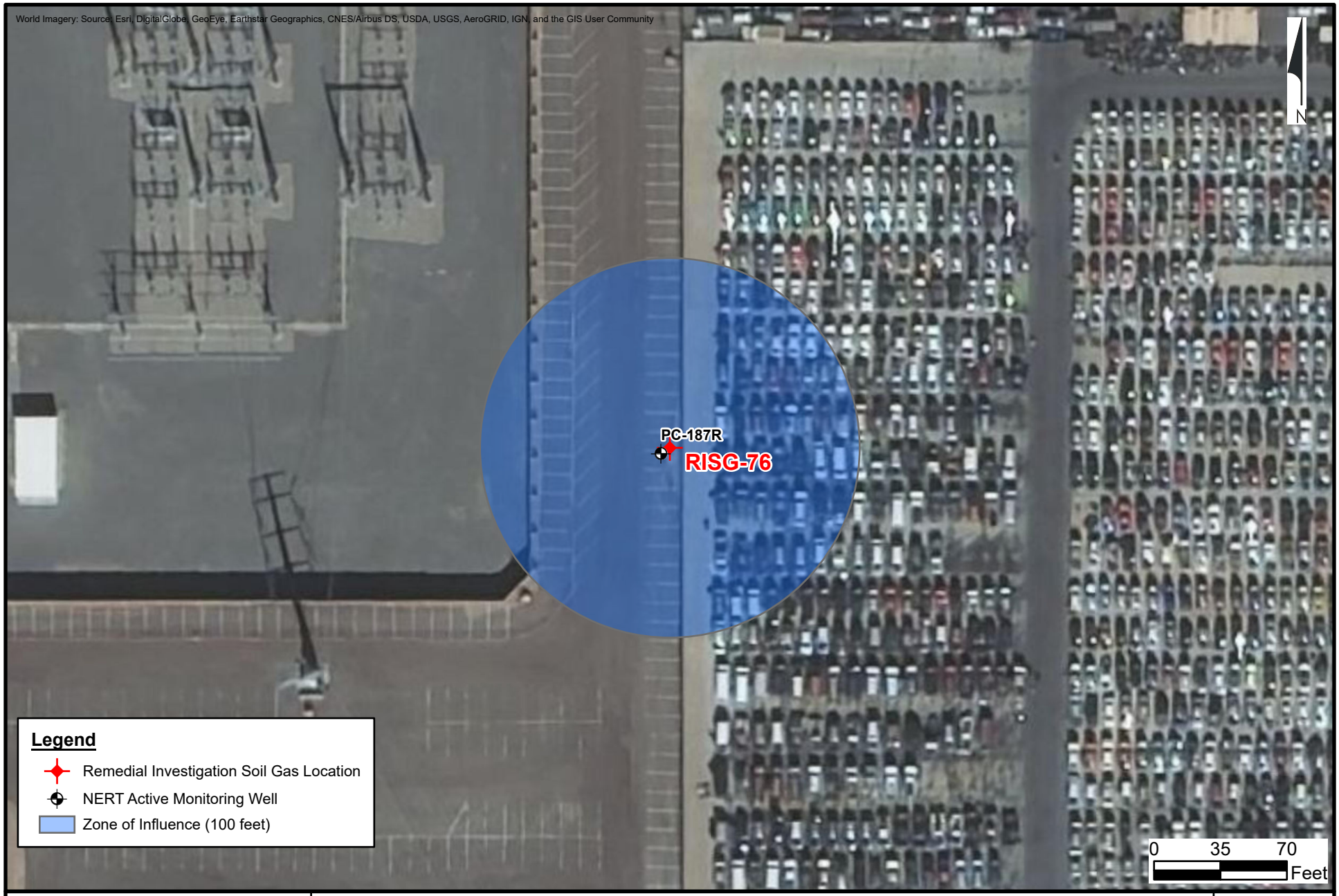

RAMBOLL

**Soil Gas Location: RISG-75 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.24**

Drafter: GM Date: 1/20/2023 Contract Number: 1690029369-006 Approved: Revised:

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\A-2.36




RAMBOLL

**Soil Gas Location: RISG-76 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.25**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-77 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.26**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map


RAMBOLL

**Soil Gas Location: RISG-78 and Zone of Influence**
Nevada Environmental Response Trust
Henderson, Nevada

Figure
**A-2.27**

| Drafter: | GM | Date: | 1/20/2023 | Contract Number: | 1690029369-006 | Approved: | Revised: |
|---|---|---|---|---|---|---|---|

Path: H:\LePetomane\NERT\GIS\Risk Assessment\Human Health\RiskAssessment_HH_03202020.aprx\Soil Gas Sampling Location Map

# APPENDIX B
# DATA VALIDATION SUMMARY REPORTS AND TABLES – SOIL GAS (PROVIDED ELECTRONICALLY)

# APPENDIX C
# DATA VALIDATION SUMMARY REPORTS AND TABLES – SHALLOW GROUNDWATER (PROVIDED ELECTRONICALLY)

# APPENDIX D
# SOIL GAS BHRA DATA SET (PROVIDED ELECTRONICALLY)

# Attachment D-1

## Processing of OU-2 Soil Gas BHRA Data Set

This attachment presents the details about the data processing steps for the soil gas baseline health risk assessment (BHRA) data set for the western portion of Operable Unit 2 (OU-2).

As a first step, the analytical results of soil gas samples collected within the western portion of OU-2 as part of the 2008 Phase B Soil Gas Investigation (ENSR Corporation [ENSR] 2008a), the 2015 Phase 1 Remedial Investigation (RI) (ENVIRON 2014), the 2019 Phase 2 RI Modification No. 11 (Ramboll 2018), and the 2019-2020 Phase 3 RI Modification No. 9 (Ramboll 2019) were extracted from the NERT project database maintained by Ramboll on behalf of the Trust. These data are also included in the corresponding data validation summary reports (DVSRs) submitted to the Nevada Division of Environmental Protection (NDEP) (ENSR 2008b, Ramboll 2017, 2020, 2021). Five Phase B soil gas samples collected at five locations (SG01, SG02, SG03, SG04, and SG05) within the former Parcel A were excluded from this BHRA because the parcel has a no further action (NFA) determination for the vapor intrusion pathway and the soil gas data collected in this area are not needed in the BHRA for the western portion of OU-2.

After identifying the preliminary set of soil gas data for the BHRA, an initial task was implemented to 1) identify and correct inconsistencies in data entries and 2) create additional fields to support data management and interpretation. 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. The following steps of data processing were completed:

- Standardize the Chemical Abstract Service (CAS) registry number for m,p-xylene from 136777-61-2 to 179601-23-1;
- Fix the soil gas data collected from the 2008 Phase B Soil Gas Investigation and associated with field and laboratory blank contamination that were originally qualified as nondetects based on the NDEP guidance at that time. In accordance with the current NDEP guidance, if there were detections between the sample quantitation limit (SQL) and the practical quantitation limit (PQL) for samples with blank contamination, these data were changed from non-detected values (U qualified) to detected values (J qualified) at reported concentrations. Table B-2 summarizes the revisions of the 2008 soil gas data for blank contamination; and
- Calculate the data for total isomers for use in the BHRA. The purpose of this step is to generate the data in the same chemical form as the toxicity values. For example, the data for m,p-xylenes and o-xylene in the same sample were summed to calculate the data for xylenes (total) for which the toxicity values are reported; the data for cis-1,3-dichloropropene and trans-1,3-dichloropropene in the same sample were summed to calculate the data for 1,3-dichloropropene (total) for which the toxicity values are reported.

The OU-2 soil gas BHRA data set derived after the above data processing steps is presented in Appendix D, Table D-1. Table D-2 presents the isomer data used for the xylenes (total)

and 1,3-dichloropropene (total) calculation described above. Reason codes for qualification are included along with each qualified data point except for the calculated xylenes (total) and 1,3-dichloropropene (total) data as well as some records from the 2008 Phase B Soil Gas Investigation. The 2008 qualified soil gas data did not include reason codes for otherwise unqualified nondetects or detected values between the SQL and PQL.

Except for the calculated xylenes (total) and 1,3-dichloropropene (total) values, after standardizing the CAS number for m,p-xylene and revising the 2008 soil gas data in the Black Mountain Industrial (BMI) database for blank contamination based on Table B-2, all data from Tables D-1 and D-2 should 1:1 match the BMI database when joining on the following column pairs: sample_name / sample_id_field, report_cas_rn / cas_id, and report_unit_to use / result_units_raw.

**References:**

ENSR Corporation (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.

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

Ramboll US Corporation (Ramboll). 2017. Data Validation Summary Report, Remedial Investigation Sampling Phase 1, Soil Gas Remediation Sampling, March 2015. September 14. NDEP approved January 25, 2018.

Ramboll. 2018. RI Phase 2 Modification No. 11: Recommended Soil Gas Sampling Locations, Nevada Environmental Response Trust Site, Henderson, Nevada. May 23. NDEP approved June 21, 2018.

Ramboll. 2019. 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. 2020. 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. 2021. Data Validation Summary Report, Remedial Investigation Sampling Phase 3, February 2019 through January 2020, Nevada Environmental Response Trust, Henderson, Nevada. January 13. NDEP approved January 27, 2021.

# APPENDIX E
# SHALLOW GROUNDWATER BHRA DATA SET (PROVIDED ELECTRONICALLY)

# Attachment E-1

## Processing of OU-2 Shallow Groundwater BHRA Data Set

This attachment presents the details about the data processing steps for the groundwater baseline health risk assessment (BHRA) data set for the western portion of Operable Unit 2 (OU-2).

As a first step, the analytical results of volatile organic compounds (VOCs) in shallow groundwater samples collected at shallow groundwater monitoring wells (with top of well screens less than 60 feet below ground surface [bgs]) within the western portion of OU-2 were extracted from the NERT project database maintained by Ramboll on behalf of the Trust. The groundwater investigations which were used as the data sources for the BHRA included the Phase 1 Remedial Investigation (RI), Phase 2 RI, and Phase 3 RI (Ramboll 2021a), and 2016-2020 Annual Groundwater Monitoring sampling events (Ramboll Environ 2016, 2017a, Ramboll 2018a, 2019a, 2021b). These data are also included in the corresponding data validation summary reports (DVSRs) submitted to the Nevada Division of Environmental Protection (NDEP) (Ramboll Environ 2017b, Ramboll 2018b, 2018c, 2018d, 2019c, 2019d, 2019e, 2020, 2021c). Shallow groundwater samples collected within the former Parcel A were excluded from this BHRA because this parcel has a no further action (NFA) determination for the vapor intrusion pathway and the groundwater data collected in this area are not needed for the purpose of the BHRA evaluation for groundwater in the western portion of OU-2.[1]

After identifying the preliminary set of data for the BHRA, an initial task was implemented to 1) identify and correct inconsistencies in data entries and 2) create additional fields to support data management and interpretation. 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. The following steps of data processing were completed:

- Standardize the Chemical Abstract Service (CAS) registry number for m,p-xylene from 136777-61-2 to 179601-23-1;
- Identify a unique result for use in the BHRA for sample/analyte pairs for which more than one result was reported. For example, if two results were reported for a chemical in the same sample – one by United States Environmental Protection Agency (USEPA) Method 8260B SIM and the other by USEPA Method 8260 – the result used in the BHRA was identified as the value reported by the most appropriate analytical method for that chemical or the most conservative value if the two analytical methods are equally suitable for that chemical. The data excluded from the BHRA data set during this processing step are summarized in Appendix C, Table C-1.
- Calculate the data for total isomers for use in the BHRA. The purpose of this step is to generate the data in the same chemical form as the toxicity values. For example, the data for m,p-xylenes and o-xylene in the same sample were summed to calculate the

[1] The western portion of former Parcel B also received a NFA determination for the vapor intrusion pathway but the groundwater data collected in Parcel B were used to obtain better spatial coverage in evaluation of the health risks for the vapor intrusion pathway in the neighboring Parcels I and J.

data for xylenes (total) for which the toxicity values are reported; the data for cis-1,3-dichloropropene and trans-1,3-dichloropropene in the same sample were summed to calculate the data for 1,3-dichloropropene (total) for which the toxicity values are reported.

The OU-2 shallow groundwater BHRA data set derived after the above data processing steps is presented in Appendix E, Table E-1. Table E-2 presents the isomer data used for the xylenes (total) and 1,3-dichloropropene (total) calculation described above. Except for the calculated xylenes (total) and 1,3-dichloropropene (total) values, after standardizing the CAS number for m,p-xylene, all data from Tables E-1 and E-2 should 1:1 match the Black Mountain Industrial (BMI) database when joining on the following column pairs: sample_name / sample_id_field, report_cas_rn / cas_id_raw, and BMI_analytical_method / analytical_method.[2]

**References:**

Ramboll Environ US Corporation (Ramboll Environ). 2016. Annual Remedial Performance Report for Chromium and Perchlorate, July 2015 through June 2016. October 31. NDEP approved December 6, 2016.

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

Ramboll Environ. 2017b. Data Validation Summary Report for July through December 2016 Semi-Annual Remedial Performance Sampling, Revision 1, Nevada Environmental Response Trust (NERT), Henderson, Nevada. June 26. NDEP approved August 17, 2017.

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

Ramboll. 2018b. Data Validation Summary Report Revision 1, January through March and May 2015 Groundwater Remedial Investigation Sampling, Nevada Environmental Response Trust Site, Henderson, Nevada. June 22. NDEP approved August 14, 2018.

Ramboll. 2018c. Data Validation Summary Report, Revision 1, January through June 2016, Annual Remedial Performance Sampling, Nevada Environmental Response Trust Henderson, Nevada. June 20. NDEP approved July 10, 2018.

Ramboll. 2018d. Data Validation Summary Report, Revision 1, Annual Remedial Performance Sampling January through June 2017 and Artesian Well Sampling August 2017, Nevada Environmental Response Trust Henderson, Nevada. 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.

[2] Pending NDEP approval on the DVSR for the groundwater data collected in the 2020 groundwater monitoring and GWETS performance monitoring program (Ramboll 2021c).

Ramboll. 2019b. Data Validation Summary Report, Phase 3 Remedial Investigation Sampling, December 2017 through November 2018, Nevada Environmental Response Trust Site, Henderson, Nevada. September 17. NDEP approved October 28, 2019.

Ramboll. 2019c. Data Validation Summary Report, Revision 1, Soil and Groundwater Remedial Investigation Phase 2, July through November 2017, Nevada Environmental Response Trust Site, Henderson, Nevada. May 31. NDEP approved June 3, 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. 2020. 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. 2021a. Remedial Investigation Report for OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada. July 9. Under NDEP review.

Ramboll. 2021b. Annual Groundwater Monitoring and GWETS Performance Report, Nevada Environmental Response Trust Site, Henderson, Nevada. February 26. NDEP approved May 6, 2021.

Ramboll. 2021c. Data Validation Summary Report for the Groundwater Monitoring and GWETS Performance Report for January through June 2020, Nevada Environmental Response Trust, Henderson, Nevada. February 26. Under NDEP review.

# APPENDIX F
# PHASE 2 RI MODIFICATION NO. 11
# SOIL PHYSICAL PROPERTY DATA

**Petroleum Services Division**
3437 Landco Dr.
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www.corelab.com

July 11, 2019

Ross Russell
Ramboll US Corporation
2200 Powell Street, Suite 700
Emeryville, CA 94608

Subject: Physical Properties
CL File No.: 1900856

Dear Mr. Russell:

Enclosed are final physical properties data for the 25 samples submitted to our laboratory from your NERT Project (Project No. 169001 1200-028 (Task M03)).

Appropriate ASTM, EPA or API methodologies were used for this project and SOP's are available on request. The samples for this project are currently in storage and will be retained for thirty days past completion of testing at no charge. At the end of thirty days, the samples will be disposed. You may contact us regarding continued storage, disoposal, or return of the samples.

Thank you for this opportunity to be of service to Ramboll US Corporation. Please do not hesitate to contact us at (661-325-5657) if you have any questions regarding these results or if we can be of any additional service.

Sincerely,
Core Laboratories

Eva Lopez
Core Analyst

# Physical Properties Data

Petroleum Services

**Ramboll US Corporation**

Core Lab File No: 1900856

Project Name: NERT RI Phase 2

Project Number: 169001 1200-028

| | | METHODS: | API RP40 ASTM D2216 | | API RP40 ASTM D2937 | API RP40 | Walkley-Black | |
|---|---|---|---|---|---|---|---|---|
| Sample ID. | Depth ft. | Sample [1] Orientation | Mositure Content % weight | Mositure Content $cm^3/cm^3$ | Dry Bulk Density $g/cm^3$ | Total Porosity [2] %Vb [3] | Total Organic Carbon mg/kg | Fractional Organic Carbon g/g |
| PT-RISG1-4.6-5.0-20190226 | 4.6-5.0 | V | 10.1 | 0.167 | 1.66 | 38.3 | 2400 | 2.40E-03 |
| PT-RISG1-9.6-10.0-20190226 | 9.6-10.0 | V | 14.9 | 0.226 | 1.52 | 43.4 | 3000 | 3.00E-03 |
| PT-RISG1-14.6-15.0-20190226 | 14.6-15.0 | V | 20.2 | 0.318 | 1.57 | 41.0 | 3700 | 3.70E-03 |
| PT-RISG2-4.6-5.0-20190226 | 4.6-5.0 | V | 10.0 | 0.172 | 1.71 | 36.1 | 3100 | 3.10E-03 |
| PT-RISG2-9.6-10.0-20190226 | 9.6-10.0 | V | 11.4 | 0.195 | 1.71 | 35.7 | 3000 | 3.00E-03 |
| PT-RISG2-14.6-15.0-20190226 | 14.6-15.0 | V | 8.54 | 0.156 | 1.83 | 31.7 | 3400 | 3.40E-03 |
| PT-RISG3-4.6-5.0-20190226 | 4.6-5.0 | V | 7.03 | 0.129 | 1.83 | 32.5 | 2400 | 2.40E-03 |
| PT-RISG3-9.6-10.0-20190226 | 9.6-10.0 | V | 11.2 | 0.190 | 1.70 | 37.1 | 3000 | 3.00E-03 |
| PT-RISG3-14.6-15.0-20190226 | 14.6-15.0 | V | 11.8 | 0.199 | 1.68 | 36.9 | 3400 | 3.40E-03 |
| PT-RISG4-4.6-5.0-20190226 | 4.6-5.0 | V | 6.87 | 0.121 | 1.77 | 34.2 | 3000 | 3.00E-03 |
| PT-RISG4-9.6-10.0-20190226 | 9.6-10.0 | V | 8.88 | 0.152 | 1.71 | 36.2 | 2900 | 2.90E-03 |
| PT-RISG4-14.6-15.0-20190226 | 14.6-15.0 | V | 14.0 | 0.217 | 1.55 | 42.1 | 3500 | 3.50E-03 |
| PT-RISG5-4.6-5.0-20190226 | 4.6-5.0 | V | -- | -- | -- | -- | 2900 | 2.90E-03 |
| PT-RISG5-9.6-10.0-20190226 | 9.6-10.0 | V | 10.8 | 0.183 | 1.70 | 36.5 | 2900 | 2.90E-03 |

# Physical Properties Data

Petroleum Services

**Ramboll US Corporation**

Core Lab File No: 1900856

Project Name: NERT RI Phase 2

Project Number: 169001 1200-028

| | | METHODS: | API RP40 ASTM D2216 | | API RP40 ASTM D2937 | API RP40 | Walkley-Black | |
|---|---|---|---|---|---|---|---|---|
| Sample ID. | Depth ft. | Sample [1] Orientation | Mositure Content % weight | Mositure Content $cm^3/cm^3$ | Dry Bulk Density $g/cm^3$ | Total Porosity [2] %Vb [3] | Total Organic Carbon mg/kg | Fractional Organic Carbon g/g |
| PT-RISG5-14.6-15.0-20190226 | 14.6-15.0 | V | 6.34 | 0.112 | 1.77 | 33.8 | 2600 | 2.60E-03 |
| PT-RISG6-12.0-12.5 | 12-12.5 | V | 5.05 | 0.089 | 1.77 | 33.5 | 3900 | 3.90E-03 |
| PT-RISG6-14.5-15 | 14.5-15 | V | 5.57 | 0.079 | 1.42 | 47.5 | 2600 | 2.60E-03 |
| PT-RISG6-4.7-5.0 | 4.7-5.0 | V | -- | -- | -- | -- | 3800 | 3.80E-03 |
| PT-RISG7-4.6-5.0-20190226 | 4.6-5.0 | V | 14.6 | 0.232 | 1.59 | 40.2 | 4200 | 4.20E-03 |
| PT-RISG7-9.6-10.0-20190226 | 9.6-10.0 | V | 36.1 | 0.546 | 1.51 | 42.3 | 2700 | 2.70E-03 |
| PT-RISG8-4.5-5.0 | 4.5-5.0 | V | 10.6 | 0.186 | 1.75 | 34.6 | 3400 | 3.40E-03 |
| PT-RISG8-9.5-10.0 | 9.5-10.0 | V | 14.9 | 0.243 | 1.63 | 38.9 | 3500 | 3.50E-03 |
| PT-RISG8-14.5-15.0 | 14.5-15.0 | V | 20.2 | 0.337 | 1.67 | 37.4 | 3100 | 3.10E-03 |
| PT-RISG9-4.6-5.0-20190226 | 4.6-5.0 | V | 10.3 | 0.177 | 1.72 | 35.3 | 2100 | 2.10E-03 |
| PT-RISG9-9.6-10.0-20190226 | 9.6-10.0 | V | 12.6 | 0.227 | 1.80 | 32.3 | 3100 | 3.10E-03 |

(1) Sample Orientation: H = horizontal; V = vertical.

(2) Total Porosity = no pore fluids in place; all interconnected pore channels.

(3) Vb = Bulk Volume, cc.

(--) = Physical tests not requested

# ATTERBERG LIMITS AND SOIL CLASSIFICATION DATA

PETROLEUM SERVICES

**Ramboll US Corporation**
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028

Core Lab File No.: 1900856

| METHODS: | | ASTM D4318 | | | ASTM D4318 | ASTM D2487 | USDA |
|---|---|---|---|---|---|---|---|
| | | Atterberg Limits [1] | | | USCS / Plasticity | USCS | USDA/SCS [2] |
| Sample ID | Depth, ft. | Liquid Limit LL | Plastic Limit PL | Plasticity Index PI | Chart Symbol (Fines: <#40 Sieve) | Classification Group Symbol: Name | Soil Texture Scheme |
| PT-RISG1-4.6-5.0-20190226 | 4.6-5.0 | 46 | 33 | 13 | ML | SM: Silty sand | Gravelly sand |
| PT-RISG1-9.6-10.0-20190226 | 9.6-10.0 | 55 | 40 | 15 | MH | SP-SM: Poorly graded sand with silt | Gravelly sand |
| PT-RISG1-14.6-15.0-20190226 | 14.6-15.0 | 47 | 40 | 7 | ML | SM: Silty sand | Sandy loam |
| PT-RISG2-4.6-5.0-20190226 | 4.6-5.0 | 35 | 23 | 12 | CL | SP-SC: Poorly graded sand with clay | Sand |
| PT-RISG2-9.6-10.0-20190226 | 9.6-10.0 | 38 | 28 | 10 | ML | SM: Silty sand | Gravelly loamy sand |
| PT-RISG2-14.6-15.0-20190226 | 14.6-15.0 | 27 | 18 | 9 | CL | SC: Clayey sand | Gravelly loamy sand |
| PT-RISG3-4.6-5.0-20190226 | 4.6-5.0 | | Non-Plastic | | NP | SW-SM: Well-graded sand with silt | Gravelly sand |
| PT-RISG3-9.6-10.0-20190226 | 9.6-10.0 | 35 | 26 | 9 | ML | SW-SM: Well-graded sand with silt and gravel | Extremely gravelly loamy sand |
| PT-RISG3-14.6-15.0-20190226 | 14.6-15.0 | 37 | 27 | 10 | ML | SM: Silty sand | Gravelly sand |
| PT-RISG4-4.6-5.0-20190226 | 4.6-5.0 | 32 | 22 | 10 | CL | SC: Clayey sand | Very gravelly loamy sand |
| PT-RISG4-9.6-10.0-20190226 | 9.6-10.0 | 35 | 30 | 5 | ML | SP-SM: Poorly graded sand with silt and gravel | Very gravelly loamy sand |
| PT-RISG4-14.6-15.0-20190226 | 14.6-15.0 | 44 | 30 | 14 | ML | SM: Silty sand | Very gravelly loamy sand |
| PT-RISG5-4.6-5.0-20190226 | 4.6-5.0 | 35 | 26 | 9 | ML | SP-SM: Poorly graded sand with silt | Very gravelly sand |
| PT-RISG5-9.6-10.0-20190226 | 9.6-10.0 | 37 | 25 | 12 | ML | SW-SM: Well-graded sand with silt | Gravelly sand |
| PT-RISG5-14.6-15.0-20190226 | 14.6-15.0 | 33 | 21 | 12 | CL | SW-SC: Well-graded sand with clay | Gravelly sand |
| PT-RISG6-12.0-12.5-20190226 | 12-12.5 | 30 | 20 | 10 | CL | SC: Clayey sand | Very gravelly loamy sand |
| PT-RISG6-14.5-15-20190226 | 14.5-15 | | Non-Plastic | | NP | SP-SM: Poorly graded sand with silt | Sand |
| PT-RISG6-4.7-5.0-20190226 | 4.7-5.0 | 37 | 21 | 16 | CL | SP-SC: Poorly graded sand with clay | Very gravelly loamy sand |
| PT-RISG7-4.6-5.0-20190226 | 4.6-5.0 | 46 | 33 | 13 | ML | SM: Silty sand | Very gravelly loamy sand |
| PT-RISG7-9.6-10.0-20190226 | 9.6-10.0 | 49 | 36 | 13 | ML | SM: Silty sand | Gravelly loamy sand |

# ATTERBERG LIMITS AND SOIL CLASSIFICATION DATA

PETROLEUM SERVICES

**Ramboll US Corporation**
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028

Core Lab File No.: 1900856

| METHODS: | | ASTM D4318 | | | ASTM D4318 | ASTM D2487 | USDA |
|---|---|---|---|---|---|---|---|
| Sample ID | Depth, ft. | Atterberg Limits [1] Liquid Limit LL | Plastic Limit PL | Plasticity Index PI | USCS / Plasticity Chart Symbol (Fines: <#40 Sieve) | USCS Classification Group Symbol: Name | USDA/SCS [2] Soil Texture Scheme |
| PT-RISG8-4.5-5.0 | 4.5-5.0 | 34 | 23 | 11 | CL | SP-SC: Poorly graded sand with clay | Very gravelly sand |
| PT-RISG8-9.5-10.0 | 9.5-10.0 | 42 | 30 | 12 | ML | SP-SM: Poorly graded sand with silt | Very gravelly sand |
| PT-RISG8-14.5-15.0 | 14.5-15.0 | 39 | 32 | 7 | ML | SM: Silty sand | Gravelly loamy sand |
| PT-RISG9-4.6-5.0-20190226 | 4.6-5.0 | 45 | 22 | 23 | CL | SC: Clayey sand | Gravelly sand |
| PT-RISG9-9.6-10.0-20190226 | 9.6-10.0 | 44 | 25 | 19 | CL | SC: Clayey sand | Very gravelly loamy sand |

USCS: Unified Soil Classification System
USDA: US Department of Agriculture
SCS: Soil Conservation Service

(1) Silt assumed as fine fraction for NON-PLASTIC (NP) samples.
(2) Sand considered to be >No. 200 sieve for USDA SOIL TEXTURE SCHEME.

# MECHANICAL SIEVE PARTICLE SIZE SUMMARY

**Petroleum Services**

**Company: Ramboll US Corporation**
**Project Name: NERT RI Phase 2**
**Project Number: 169001 1200-028 (Task M03)**

**CL File No.: 1900856**
**Date: 6/28/2019**

| Sample ID | Grain Size Description** (Mean from Folk) | Median Grain Size, mm | Component Percentages | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Gravel | Sand | | | Silt | Clay |
| | | | | Coarse | Medium | Fine | | |
| RISG-1_4.6-5.0 | Medium Grain Sand | 1.3285 | 1.84 | 16.09 | 56.92 | 12.30 | 11.98 | 0.87 |
| RISG-1_9.6-10.0 | Medium Grain Sand | 1.3482 | 0.57 | 17.53 | 58.50 | 12.11 | 10.35 | 0.94 |
| RISG-1_14.6-15.0 | Fine Grain Sand | 0.3315 | 0.00 | 5.50 | 34.58 | 26.27 | 31.24 | 2.41 |
| RISG-2_4.6-5.0 | Medium Grain Sand | 1.3611 | 0.94 | 12.87 | 61.99 | 12.29 | 10.98 | 0.93 |
| RISG-2_9.6-10 | Medium Grain Sand | 1.0350 | 0.00 | 17.54 | 44.31 | 17.99 | 18.56 | 1.59 |
| RISG-2_14.6-15.0 | Medium Grain Sand | 1.2248 | 0.00 | 21.05 | 48.49 | 15.64 | 13.08 | 1.74 |
| RISG-3_4.6-5.0 | Medium Grain Sand | 0.5219 | 5.58 | 16.71 | 32.61 | 34.54 | 9.80 | 0.76 |
| RISG-3_9.6-10.0 | Medium Grain Sand | 2.4254 | 16.68 | 49.93 | 7.59 | 17.27 | 8.23 | 0.29 |
| RISG-3_14.6-15.0 | Medium Grain Sand | 0.6276 | 0.00 | 30.90 | 26.33 | 29.98 | 12.28 | 0.51 |
| RISG-4_4.6-5.0 | Medium Grain Sand | 0.8838 | 0.00 | 42.87 | 16.48 | 26.28 | 13.87 | 0.50 |
| RISG-4_9.6-10.0 | Medium Grain Sand | 2.1626 | 19.65 | 35.02 | 14.27 | 20.16 | 10.50 | 0.41 |
| RISG-4_14.6-15.0 | Medium Grain Sand | 0.9012 | 10.13 | 26.64 | 26.16 | 24.91 | 11.68 | 0.48 |
| RISG-5_4.6-5.0 | Medium Grain Sand | 1.0671 | 13.10 | 28.39 | 26.58 | 23.99 | 7.57 | 0.36 |

**All sizes classed using USCS scale

# MECHANICAL SIEVE PARTICLE SIZE SUMMARY

**Petroleum Services**

**Company: Ramboll US Corporation**
**Project Name: NERT RI Phase 2**
**Project Number: 169001 1200-028 (Task M03)**

**CL File No.: 1900856**
**Date: 6/28/2019**

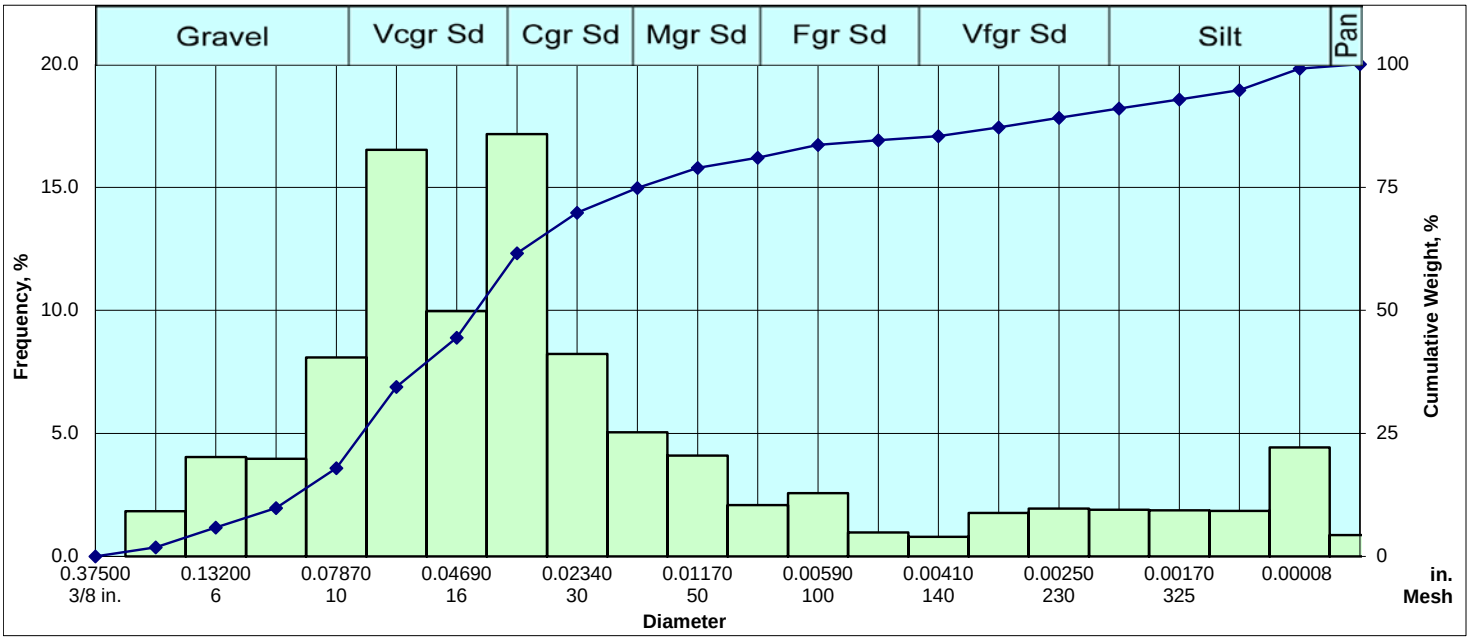
| Sample ID | Grain Size Description** (Mean from Folk) | Median Grain Size, mm | Component Percentages | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Gravel | Sand | | | Silt | Clay |
| | | | | Coarse | Medium | Fine | | |
| RISG-5_9.6-10.0 | Medium Grain Sand | 1.2386 | 0.00 | 21.93 | 47.46 | 19.35 | 10.41 | 0.84 |
| RISG-5_14.6-15.0 | Medium Grain Sand | 1.3455 | 13.19 | 17.96 | 44.74 | 14.33 | 8.98 | 0.80 |
| RISG-6_12.0-12.5 | Medium Grain Sand | 2.0792 | 19.03 | 34.89 | 9.67 | 22.24 | 13.18 | 0.98 |
| RISG_6_14.5-15.0 | Medium Grain Sand | 1.2746 | 0.00 | 13.53 | 68.80 | 11.15 | 5.90 | 0.62 |
| RISG-6_4.7-5.0 | Medium Grain Sand | 2.1135 | 12.66 | 39.25 | 18.36 | 21.13 | 8.33 | 0.28 |
| RISG-7_4.6-5.0 | Medium Grain Sand | 0.8636 | 7.06 | 28.98 | 24.51 | 26.63 | 12.41 | 0.41 |
| RISG-7_9.6-10.0 | Medium Grain Sand | 0.5945 | 3.92 | 25.37 | 26.06 | 28.07 | 15.92 | 0.66 |
| RISG-8_4.5-5.0 | Medium Grain Sand | 1.1794 | 8.60 | 33.85 | 24.68 | 22.96 | 9.56 | 0.35 |
| RISG-8_9.5-10.0 | Medium Grain Sand | 1.0783 | 9.22 | 25.85 | 25.57 | 28.67 | 10.44 | 0.24 |
| RISG-8_14.5-15.0 | Medium Grain Sand | 0.6399 | 9.20 | 17.83 | 23.96 | 31.47 | 16.97 | 0.57 |
| RISG-9_4.6-5.0 | Medium Grain Sand | 0.6788 | 2.06 | 20.84 | 29.31 | 34.54 | 12.83 | 0.42 |
| RISG-9_9.6-10.0 | Medium Grain Sand | 1.1340 | 2.92 | 33.73 | 24.96 | 25.41 | 12.36 | 0.63 |

**All sizes classed using USCS scale

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-1_4.6-5.0

## Mechanical Sieve Particle Size Analysis



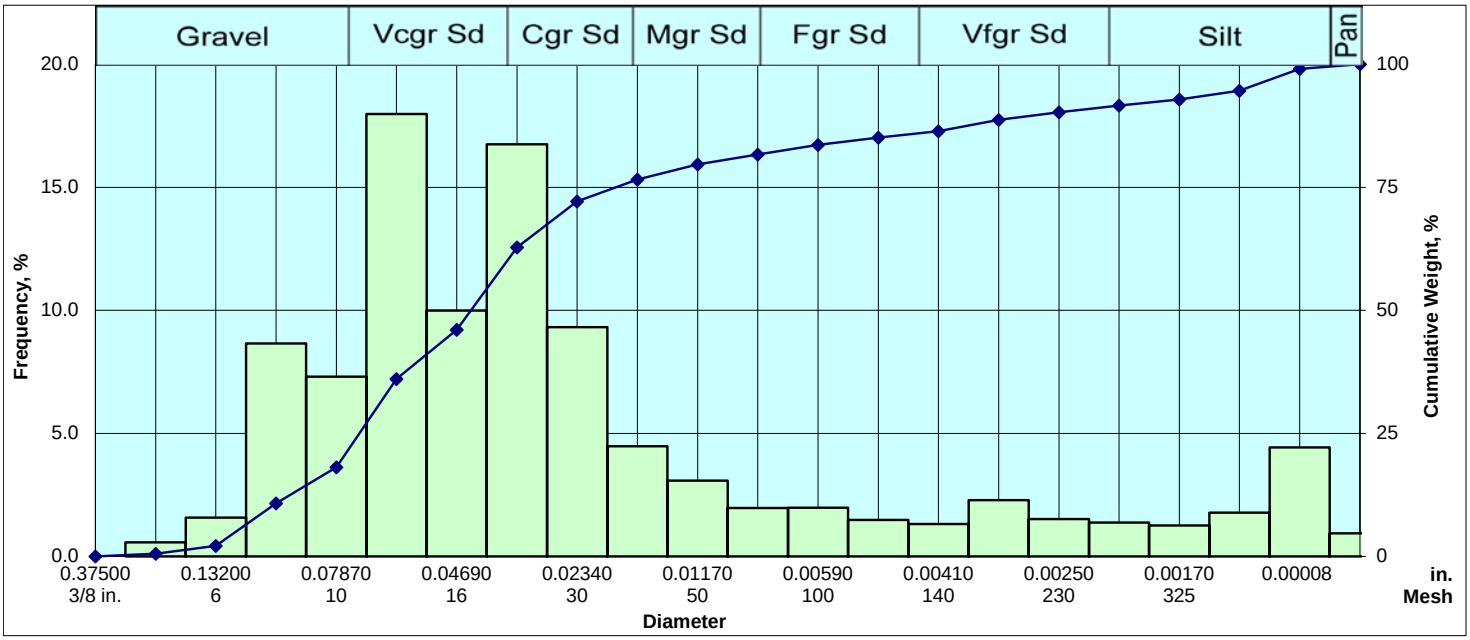

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 1.838 | 1.838 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 4.044 | 5.882 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 3.962 | 9.845 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 8.088 | 17.933 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 16.516 | 34.449 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 9.971 | 44.421 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 17.164 | 61.585 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 8.225 | 69.809 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.039 | 74.849 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.092 | 78.940 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 2.090 | 81.031 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 2.574 | 83.605 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 0.979 | 84.584 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 0.795 | 85.379 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 1.772 | 87.150 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.940 | 89.090 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.902 | 90.992 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.872 | 92.864 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.845 | 94.709 |
| | | 0.00008 | 0.0020 | 9.00 | 4.424 | 99.133 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.866 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0523 | 0.0523 | 0.0523 |
| (mm) | 1.3285 | 1.3285 | 1.3285 |
| Mean | Medium sand sized | | |
| (in) | 0.0551 | 0.0274 | 0.0340 |
| (mm) | 1.3997 | 0.6968 | 0.8640 |
| Sorting | Very poor | | |
| | 1.928 | 1.898 | 2.013 |
| Skewness | Strongly fine skewed | | |
| | 0.861 | 0.491 | 0.443 |
| Kurtosis | Very leptokurtic | | |
| | 0.247 | 0.850 | 1.519 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2278 | 5.7864 | -2.5327 |
| 10 | 0.1311 | 3.3310 | -1.7360 |
| 16 | 0.1022 | 2.5966 | -1.3766 |
| 25 | 0.0868 | 2.2060 | -1.1414 |
| 50 | 0.0523 | 1.3285 | -0.4098 |
| 75 | 0.0234 | 0.5935 | 0.7526 |
| 84 | 0.0074 | 0.1870 | 2.4192 |
| 90 | 0.0027 | 0.0693 | 3.8518 |
| 95 | 0.0018 | 0.0445 | 4.4888 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-1_9.6-10.0

## Mechanical Sieve Particle Size Analysis



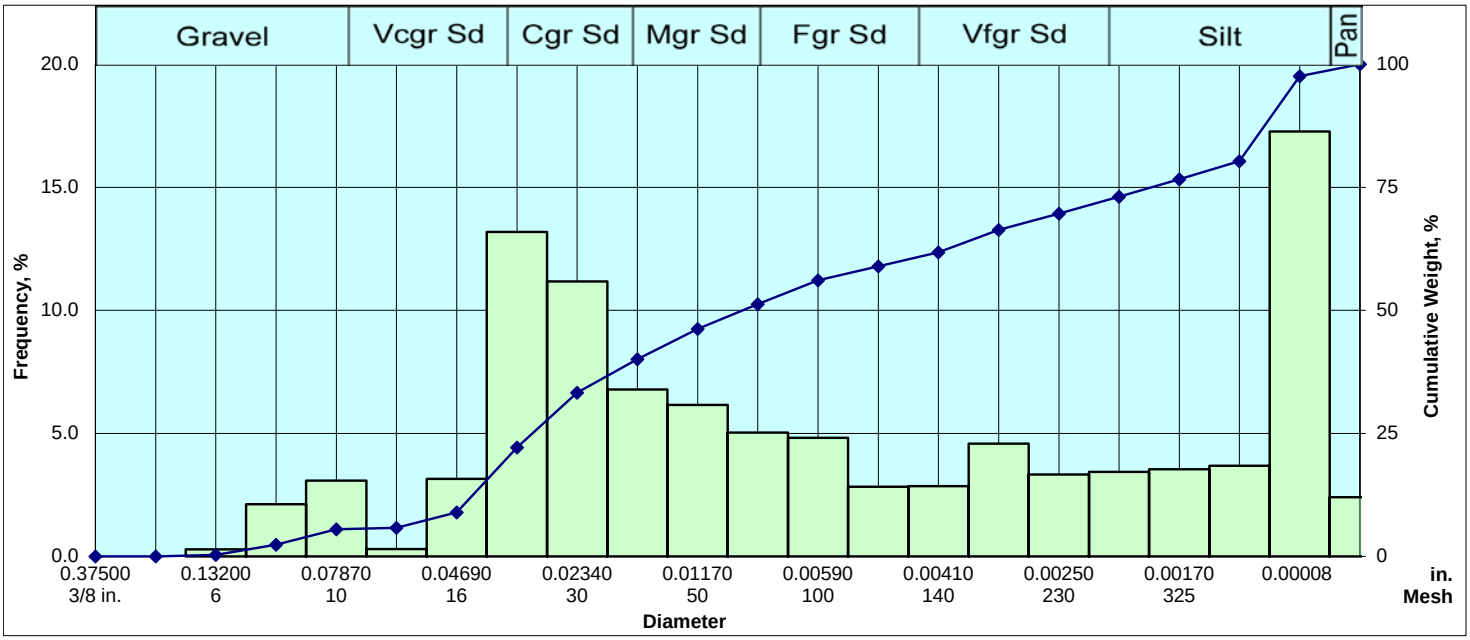

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.568 | 0.568 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 1.573 | 2.142 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 8.654 | 10.795 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.299 | 18.094 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 17.974 | 36.069 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 9.988 | 46.056 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 16.748 | 62.804 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 9.316 | 72.120 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 4.476 | 76.596 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 3.084 | 79.680 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 1.970 | 81.650 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 1.976 | 83.626 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.483 | 85.108 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.312 | 86.420 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.289 | 88.709 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.518 | 90.227 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.375 | 91.602 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.253 | 92.855 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.783 | 94.637 |
| | | 0.00008 | 0.0020 | 9.00 | 4.423 | 99.060 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.940 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Very coarse sand sized | | |
| (in) | 0.0531 | 0.0531 | 0.0531 |
| (mm) | 1.3482 | 1.3482 | 1.3482 |
| Mean | Coarse sand sized | | |
| (in) | 0.0573 | 0.0284 | 0.0350 |
| (mm) | 1.4554 | 0.7205 | 0.8879 |
| Sorting | Poor | | |
| | 1.796 | 1.876 | 1.937 |
| Skewness | Strongly fine skewed | | |
| | 0.918 | 0.482 | 0.488 |
| Kurtosis | Very leptokurtic | | |
| | 0.225 | 0.757 | 1.600 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1688 | 4.2876 | -2.1002 |
| 10 | 0.1370 | 3.4787 | -1.7985 |
| 16 | 0.1041 | 2.6441 | -1.4028 |
| 25 | 0.0875 | 2.2217 | -1.1517 |
| 50 | 0.0531 | 1.3482 | -0.4310 |
| 75 | 0.0271 | 0.6891 | 0.5371 |
| 84 | 0.0077 | 0.1963 | 2.3485 |
| 90 | 0.0031 | 0.0796 | 3.6506 |
| 95 | 0.0017 | 0.0444 | 4.4925 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-1_14.6-15.0

## Mechanical Sieve Particle Size Analysis



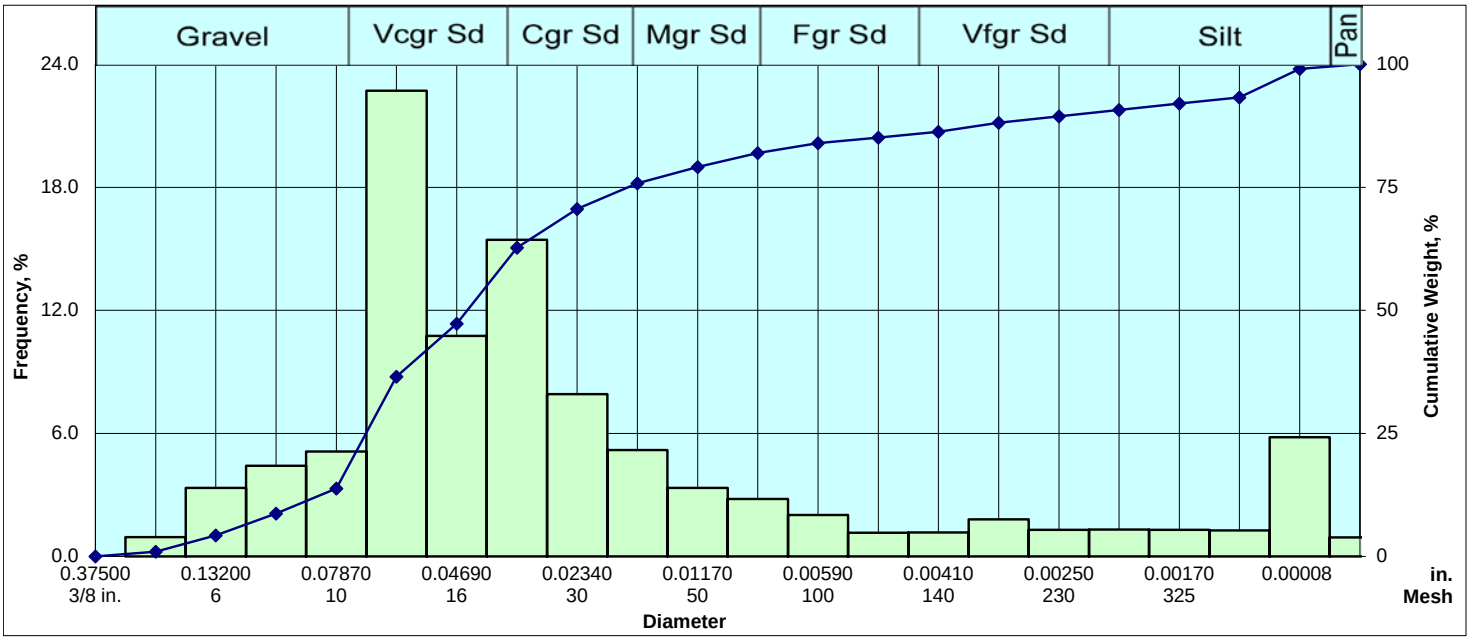

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 0.289 | 0.289 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 2.122 | 2.411 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 3.086 | 5.497 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 0.294 | 5.790 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 3.148 | 8.938 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 13.186 | 22.123 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 11.172 | 33.295 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.783 | 40.078 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.160 | 46.238 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.030 | 51.268 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.816 | 56.084 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.831 | 58.915 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.851 | 61.767 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 4.579 | 66.345 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 3.324 | 69.669 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 3.430 | 73.100 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 3.545 | 76.644 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 3.679 | 80.323 |
| | | 0.00008 | 0.0020 | 9.00 | 17.267 | 97.590 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 2.410 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Fine sand sized | | |
| (in) | 0.0131 | 0.0131 | 0.0131 |
| (mm) | 0.3315 | 0.3315 | 0.3315 |
| Mean | Fine sand sized | | |
| (in) | 0.0227 | 0.0093 | 0.0104 |
| (mm) | 0.5763 | 0.2362 | 0.2645 |
| Sorting | Very poor | | |
| | 4.359 | 2.441 | 2.131 |
| Skewness | Finely skewed | | |
| | 0.758 | 0.200 | 0.114 |
| Kurtosis | Very platykurtic | | |
| | 0.387 | 0.232 | 0.580 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.0992 | 2.5193 | -1.3330 |
| 10 | 0.0544 | 1.3823 | -0.4670 |
| 16 | 0.0505 | 1.2822 | -0.3586 |
| 25 | 0.0431 | 1.0950 | -0.1310 |
| 50 | 0.0131 | 0.3315 | 1.5928 |
| 75 | 0.0023 | 0.0576 | 4.1168 |
| 84 | 0.0017 | 0.0435 | 4.5225 |
| 90 | 0.0016 | 0.0411 | 4.6055 |
| 95 | 0.0015 | 0.0390 | 4.6785 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-2_4.6-5.0

## Mechanical Sieve Particle Size Analysis



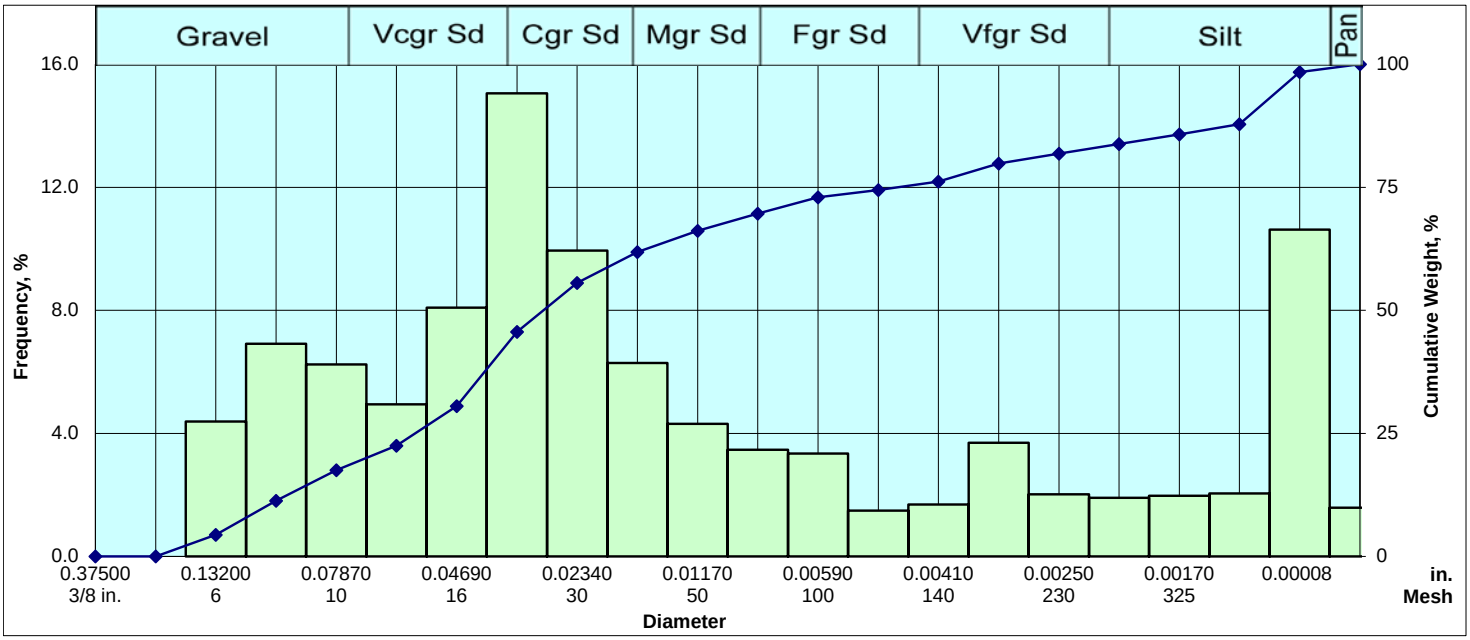

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.939 | 0.939 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 3.335 | 4.274 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 4.415 | 8.690 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 5.120 | 13.809 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 22.704 | 36.513 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 10.754 | 47.268 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 15.437 | 62.705 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 7.913 | 70.617 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.184 | 75.802 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 3.336 | 79.138 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 2.803 | 81.941 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 2.022 | 83.963 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.148 | 85.112 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.170 | 86.281 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 1.813 | 88.094 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.300 | 89.393 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.311 | 90.705 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.294 | 91.999 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.263 | 93.262 |
| | | 0.00008 | 0.0020 | 9.00 | 5.809 | 99.071 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.929 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0536 | 0.0536 | 0.0536 |
| (mm) | 1.3611 | 1.3611 | 1.3611 |
| Mean | Medium sand sized | | |
| (in) | 0.0555 | 0.0275 | 0.0344 |
| (mm) | 1.4106 | 0.6988 | 0.8727 |
| Sorting | Poor | | |
| | 1.849 | 1.734 | 1.885 |
| Skewness | Strongly fine skewed | | |
| | 0.867 | 0.555 | 0.520 |
| Kurtosis | Very leptokurtic | | |
| | 0.255 | 0.937 | 1.553 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1779 | 4.5199 | -2.1763 |
| 10 | 0.1219 | 3.0966 | -1.6307 |
| 16 | 0.0915 | 2.3253 | -1.2174 |
| 25 | 0.0859 | 2.1826 | -1.1260 |
| 50 | 0.0536 | 1.3611 | -0.4447 |
| 75 | 0.0251 | 0.6387 | 0.6469 |
| 84 | 0.0083 | 0.2100 | 2.2515 |
| 90 | 0.0027 | 0.0694 | 3.8479 |
| 95 | 0.0017 | 0.0429 | 4.5427 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-2_9.6-10

## Mechanical Sieve Particle Size Analysis



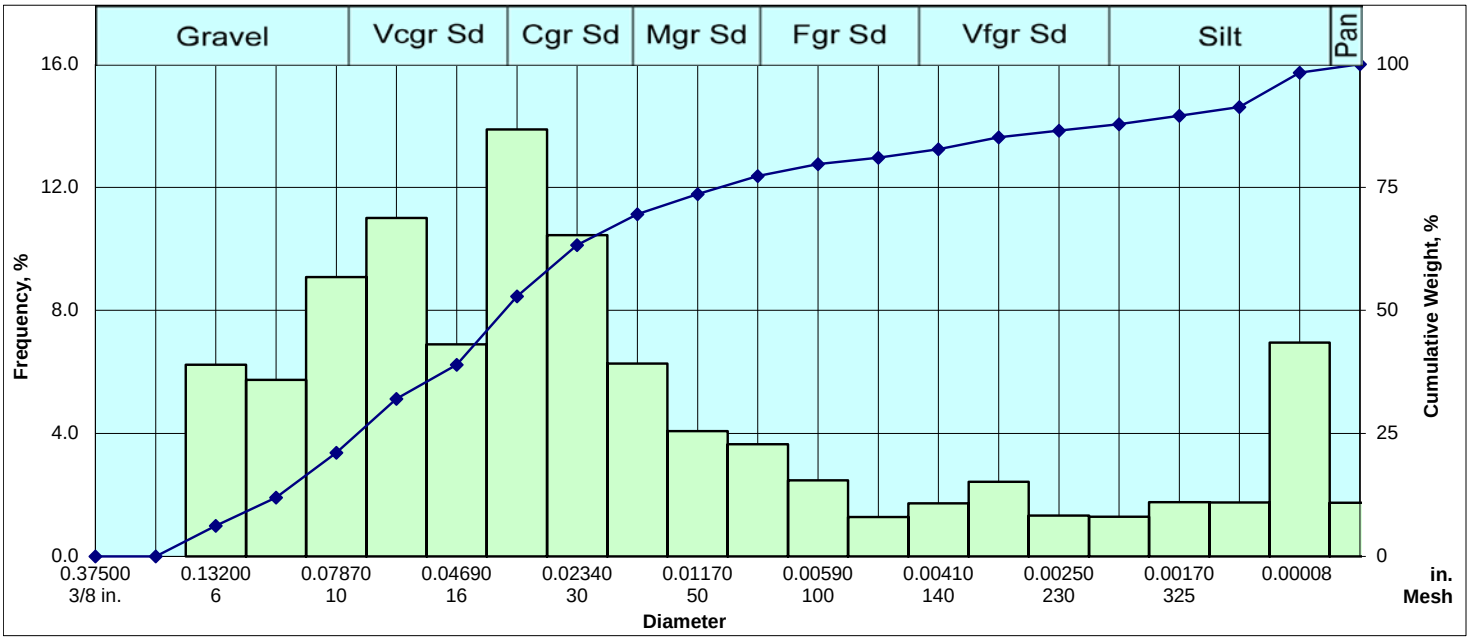

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 4.386 | 4.386 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 6.912 | 11.298 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 6.246 | 17.544 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 4.943 | 22.487 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 8.085 | 30.572 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 15.058 | 45.630 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 9.942 | 55.573 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.285 | 61.858 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.306 | 66.164 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 3.469 | 69.633 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 3.348 | 72.981 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.491 | 74.472 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.684 | 76.157 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.693 | 79.850 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.015 | 81.865 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.908 | 83.772 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.971 | 85.743 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.049 | 87.792 |
| | | 0.00008 | 0.0020 | 9.00 | 10.620 | 98.412 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 1.588 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0407 | 0.0407 | 0.0407 |
| (mm) | 1.0350 | 1.0350 | 1.0350 |
| Mean | Medium sand sized | | |
| (in) | 0.0385 | 0.0158 | 0.0217 |
| (mm) | 0.9778 | 0.4014 | 0.5504 |
| Sorting | Very poor | | |
| | 3.572 | 2.698 | 2.386 |
| Skewness | Strongly fine skewed | | |
| | 0.491 | 0.506 | 0.438 |
| Kurtosis | Platykurtic | | |
| | 0.234 | 0.268 | 0.764 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1821 | 4.6256 | -2.2097 |
| 10 | 0.1422 | 3.6129 | -1.8532 |
| 16 | 0.1025 | 2.6047 | -1.3811 |
| 25 | 0.0714 | 1.8135 | -0.8588 |
| 50 | 0.0407 | 1.0350 | -0.0496 |
| 75 | 0.0056 | 0.1422 | 2.8143 |
| 84 | 0.0024 | 0.0618 | 4.0152 |
| 90 | 0.0017 | 0.0435 | 4.5214 |
| 95 | 0.0016 | 0.0402 | 4.6349 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-2_14.6-15.0

## Mechanical Sieve Particle Size Analysis



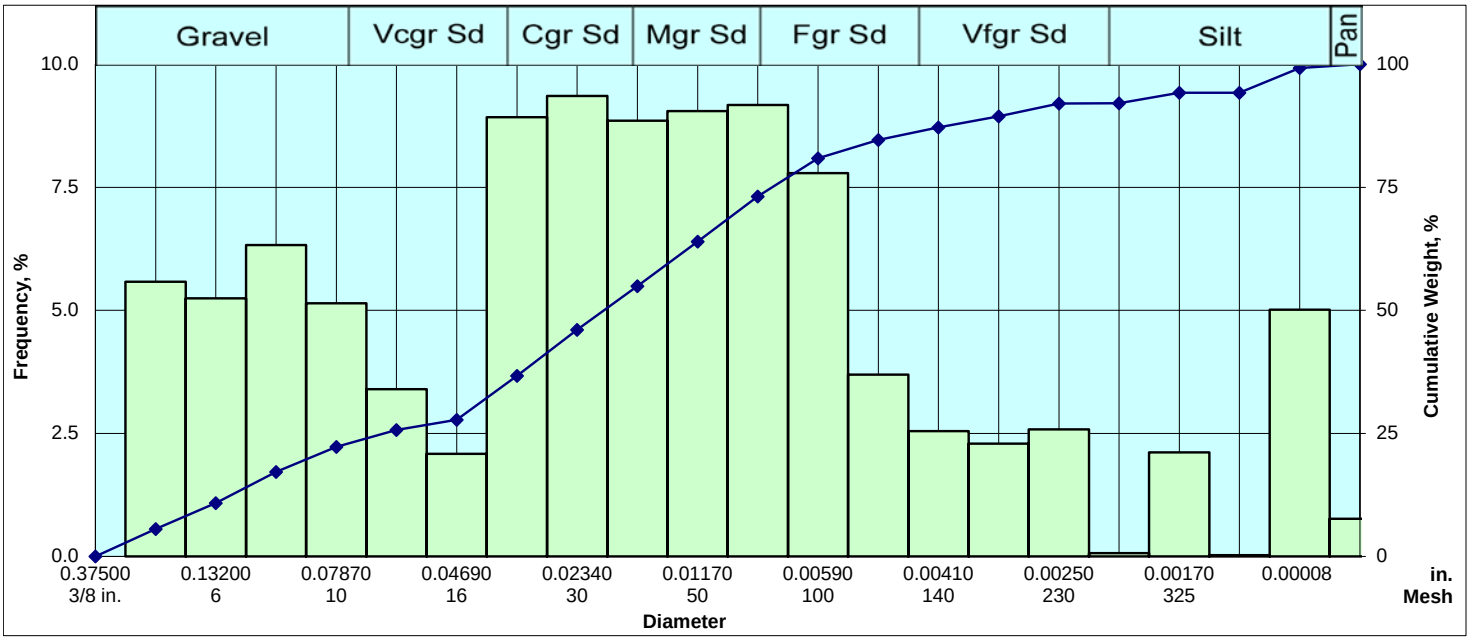

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 6.229 | 6.229 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 5.741 | 11.970 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 9.081 | 21.051 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 10.999 | 32.050 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 6.894 | 38.944 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 13.880 | 52.824 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 10.447 | 63.272 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.266 | 69.537 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.075 | 73.612 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 3.651 | 77.263 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 2.476 | 79.738 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.281 | 81.020 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.729 | 82.748 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.427 | 85.175 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.325 | 86.500 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.294 | 87.794 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.764 | 89.557 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.751 | 91.308 |
| | | 0.00008 | 0.0020 | 9.00 | 6.950 | 98.259 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 1.741 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0482 | 0.0482 | 0.0482 |
| (mm) | 1.2248 | 1.2248 | 1.2248 |
| Mean | Medium sand sized | | |
| (in) | 0.0513 | 0.0228 | 0.0293 |
| (mm) | 1.3041 | 0.5791 | 0.7433 |
| Sorting | Very poor | | |
| | 2.431 | 2.330 | 2.241 |
| Skewness | Strongly fine skewed | | |
| | 0.749 | 0.464 | 0.420 |
| Kurtosis | Lepokurtic | | |
| | 0.245 | 0.525 | 1.136 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2239 | 5.6871 | -2.5077 |
| 10 | 0.1508 | 3.8304 | -1.9375 |
| 16 | 0.1146 | 2.9106 | -1.5413 |
| 25 | 0.0878 | 2.2307 | -1.1575 |
| 50 | 0.0482 | 1.2248 | -0.2925 |
| 75 | 0.0149 | 0.3775 | 1.4055 |
| 84 | 0.0045 | 0.1152 | 3.1178 |
| 90 | 0.0020 | 0.0510 | 4.2940 |
| 95 | 0.0016 | 0.0413 | 4.5983 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-3_4.6-5.0

## Mechanical Sieve Particle Size Analysis



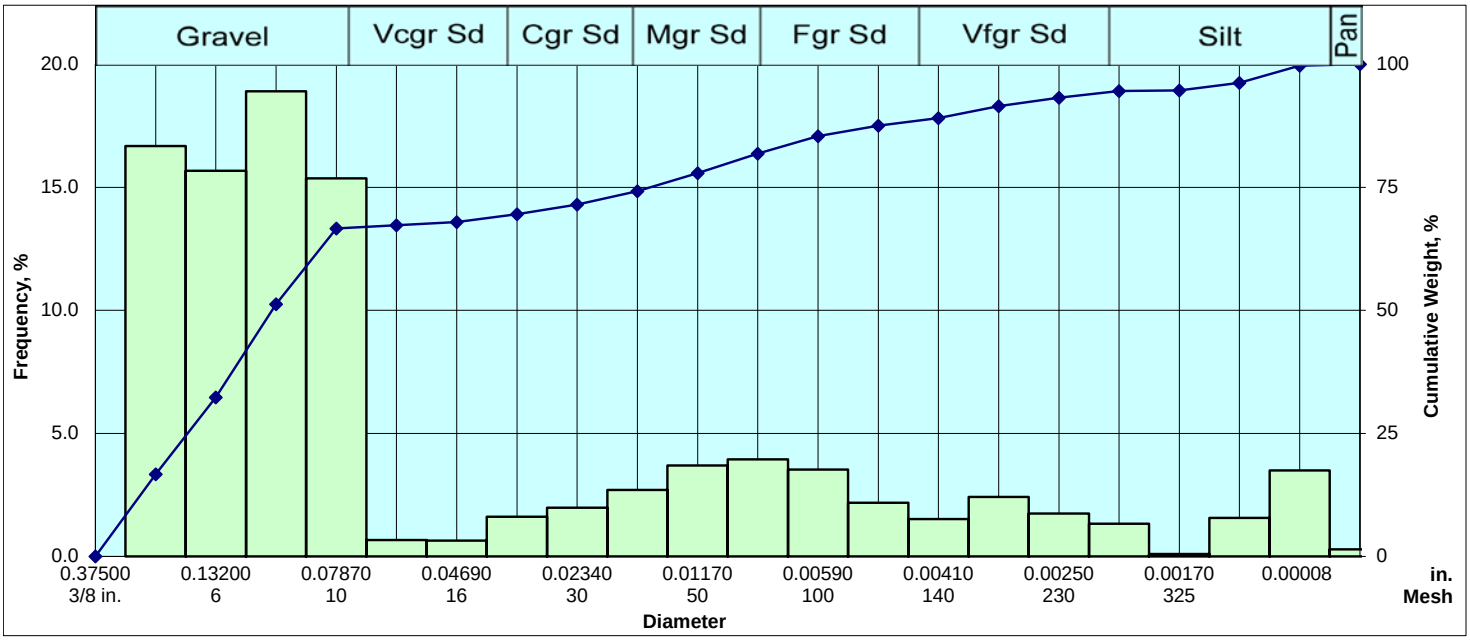

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 5.581 | 5.581 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 5.242 | 10.823 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 6.325 | 17.147 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 5.141 | 22.288 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 3.396 | 25.684 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.083 | 27.767 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 8.925 | 36.693 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 9.355 | 46.048 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 8.854 | 54.902 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 9.047 | 63.950 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 9.172 | 73.122 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 7.786 | 80.908 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.693 | 84.601 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.547 | 87.148 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.290 | 89.438 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.584 | 92.022 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.064 | 92.086 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 2.114 | 94.200 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.024 | 94.223 |
| | | 0.00008 | 0.0020 | 9.00 | 5.014 | 99.238 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.762 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0205 | 0.0205 | 0.0205 |
| (mm) | 0.5219 | 0.5219 | 0.5219 |
| Mean | Medium sand sized | | |
| (in) | 0.0338 | 0.0225 | 0.0219 |
| (mm) | 0.8590 | 0.5725 | 0.5551 |
| Sorting | Very poor | | |
| | 2.778 | 2.149 | 2.156 |
| Skewness | Near symmetrical | | |
| | 1.049 | -0.062 | 0.003 |
| Kurtosis | Mesokurtic | | |
| | 0.189 | 0.661 | 0.992 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2065 | 5.2441 | -2.3907 |
| 10 | 0.1405 | 3.5698 | -1.8358 |
| 16 | 0.1000 | 2.5396 | -1.3446 |
| 25 | 0.0599 | 1.5209 | -0.6049 |
| 50 | 0.0205 | 0.5219 | 0.9382 |
| 75 | 0.0078 | 0.1970 | 2.3434 |
| 84 | 0.0051 | 0.1291 | 2.9538 |
| 90 | 0.0028 | 0.0724 | 3.7881 |
| 95 | 0.0015 | 0.0372 | 4.7488 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-3_9.6-10.0

## Mechanical Sieve Particle Size Analysis



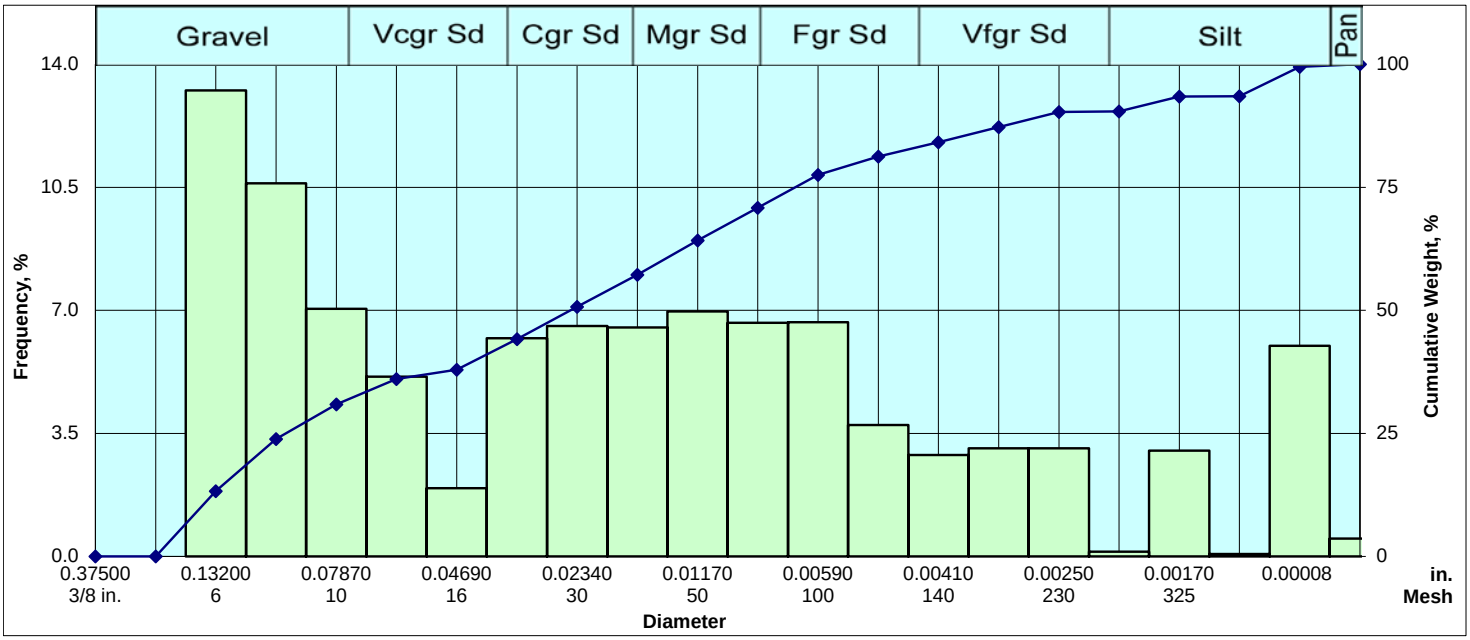

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 16.678 | 16.678 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 15.668 | 32.346 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 18.902 | 51.248 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 15.364 | 66.613 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 0.667 | 67.280 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 0.637 | 67.917 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 1.607 | 69.524 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 1.981 | 71.505 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 2.699 | 74.204 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 3.689 | 77.893 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 3.942 | 81.836 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 3.528 | 85.363 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.183 | 87.547 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.516 | 89.063 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.416 | 91.479 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.739 | 93.217 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.334 | 94.552 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.101 | 94.653 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.567 | 96.220 |
| | | 0.00008 | 0.0020 | 9.00 | 3.492 | 99.711 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.289 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Coarse sand sized | | |
| (in) | 0.0955 | 0.0955 | 0.0955 |
| (mm) | 2.4254 | 2.4254 | 2.4254 |
| Mean | Medium sand sized | | |
| (in) | 0.0867 | 0.0365 | 0.0503 |
| (mm) | 2.2022 | 0.9273 | 1.2777 |
| Sorting | Very poor | | |
| | 3.173 | 2.414 | 2.349 |
| Skewness | Strongly fine skewed | | |
| | 0.521 | 0.575 | 0.557 |
| Kurtosis | Mesokurtic | | |
| | 0.275 | 0.561 | 0.927 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3180 | 8.0760 | -3.0136 |
| 10 | 0.2619 | 6.6520 | -2.7338 |
| 16 | 0.1946 | 4.9432 | -2.3055 |
| 25 | 0.1577 | 4.0064 | -2.0023 |
| 50 | 0.0955 | 2.4254 | -1.2782 |
| 75 | 0.0157 | 0.3980 | 1.3290 |
| 84 | 0.0068 | 0.1740 | 2.5232 |
| 90 | 0.0037 | 0.0940 | 3.4116 |
| 95 | 0.0017 | 0.0434 | 4.5245 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-3_14.6-15.0

## Mechanical Sieve Particle Size Analysis



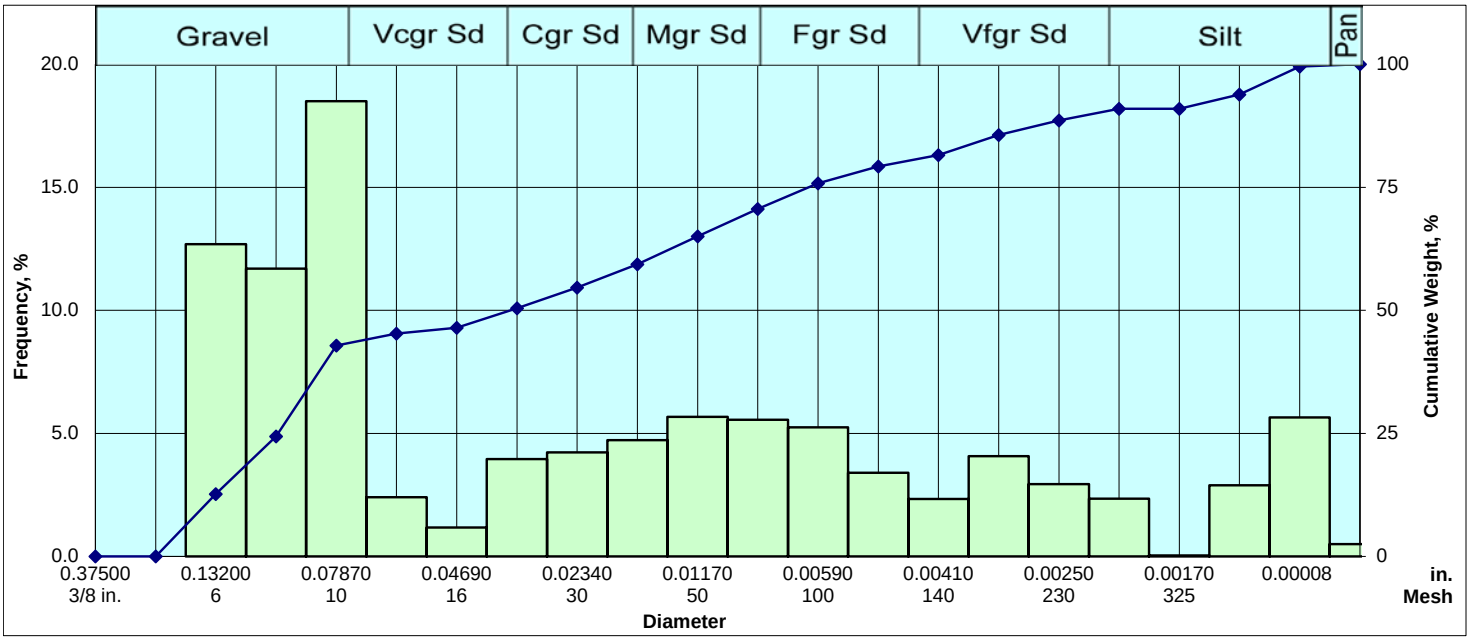

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 13.253 | 13.253 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 10.613 | 23.866 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.039 | 30.905 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.114 | 36.019 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.941 | 37.960 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.208 | 44.168 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.555 | 50.723 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.511 | 57.234 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.967 | 64.201 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 6.648 | 70.850 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 6.665 | 77.514 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.739 | 81.254 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.887 | 84.141 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.074 | 87.215 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 3.074 | 90.289 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.137 | 90.426 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 3.008 | 93.434 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.066 | 93.500 |
| | | 0.00008 | 0.0020 | 9.00 | 5.993 | 99.494 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.506 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0247 | 0.0247 | 0.0247 |
| (mm) | 0.6276 | 0.6276 | 0.6276 |
| Mean | Medium sand sized | | |
| (in) | 0.0487 | 0.0226 | 0.0233 |
| (mm) | 1.2377 | 0.5752 | 0.5921 |
| Sorting | Very poor | | |
| | 3.644 | 2.427 | 2.251 |
| Skewness | Finely skewed | | |
| | 1.007 | 0.052 | 0.124 |
| Kurtosis | Platykurtic | | |
| | 0.293 | 0.411 | 0.752 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1662 | 4.2218 | -2.0779 |
| 10 | 0.1454 | 3.6936 | -1.8850 |
| 16 | 0.1218 | 3.0937 | -1.6293 |
| 25 | 0.0906 | 2.3020 | -1.2029 |
| 50 | 0.0247 | 0.6276 | 0.6721 |
| 75 | 0.0068 | 0.1734 | 2.5279 |
| 84 | 0.0042 | 0.1069 | 3.2253 |
| 90 | 0.0025 | 0.0641 | 3.9629 |
| 95 | 0.0014 | 0.0366 | 4.7714 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-4_4.6-5.0

## Mechanical Sieve Particle Size Analysis



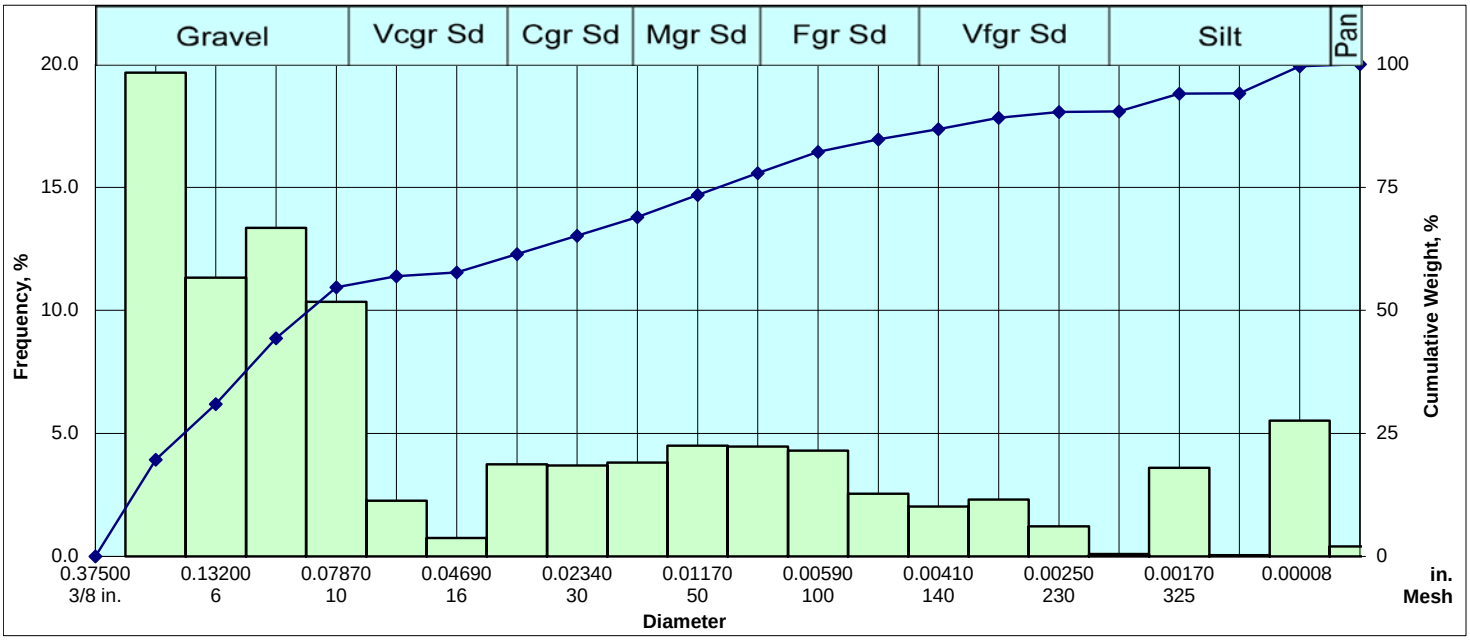

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 12.685 | 12.685 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 11.692 | 24.377 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 18.493 | 42.870 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 2.407 | 45.277 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.177 | 46.454 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 3.951 | 50.405 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 4.226 | 54.631 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 4.723 | 59.354 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 5.670 | 65.024 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.548 | 70.572 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 5.250 | 75.821 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.401 | 79.222 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.338 | 81.560 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 4.073 | 85.634 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.942 | 88.576 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 2.346 | 90.922 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.038 | 90.960 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.896 | 93.856 |
| | | 0.00008 | 0.0020 | 9.00 | 5.648 | 99.504 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.496 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0348 | 0.0348 | 0.0348 |
| (mm) | 0.8838 | 0.8838 | 0.8838 |
| Mean | Medium sand sized | | |
| (in) | 0.0494 | 0.0204 | 0.0244 |
| (mm) | 1.2538 | 0.5180 | 0.6190 |
| Sorting | Very poor | | |
| | 3.834 | 2.567 | 2.318 |
| Skewness | Strongly fine skewed | | |
| | 0.693 | 0.300 | 0.321 |
| Kurtosis | Platykurtic | | |
| | 0.305 | 0.331 | 0.722 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1653 | 4.1982 | -2.0698 |
| 10 | 0.1436 | 3.6464 | -1.8665 |
| 16 | 0.1208 | 3.0693 | -1.6179 |
| 25 | 0.0924 | 2.3479 | -1.2314 |
| 50 | 0.0348 | 0.8838 | 0.1782 |
| 75 | 0.0063 | 0.1597 | 2.6465 |
| 84 | 0.0034 | 0.0874 | 3.5157 |
| 90 | 0.0022 | 0.0569 | 4.1347 |
| 95 | 0.0015 | 0.0369 | 4.7609 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-4_9.6-10.0

## Mechanical Sieve Particle Size Analysis



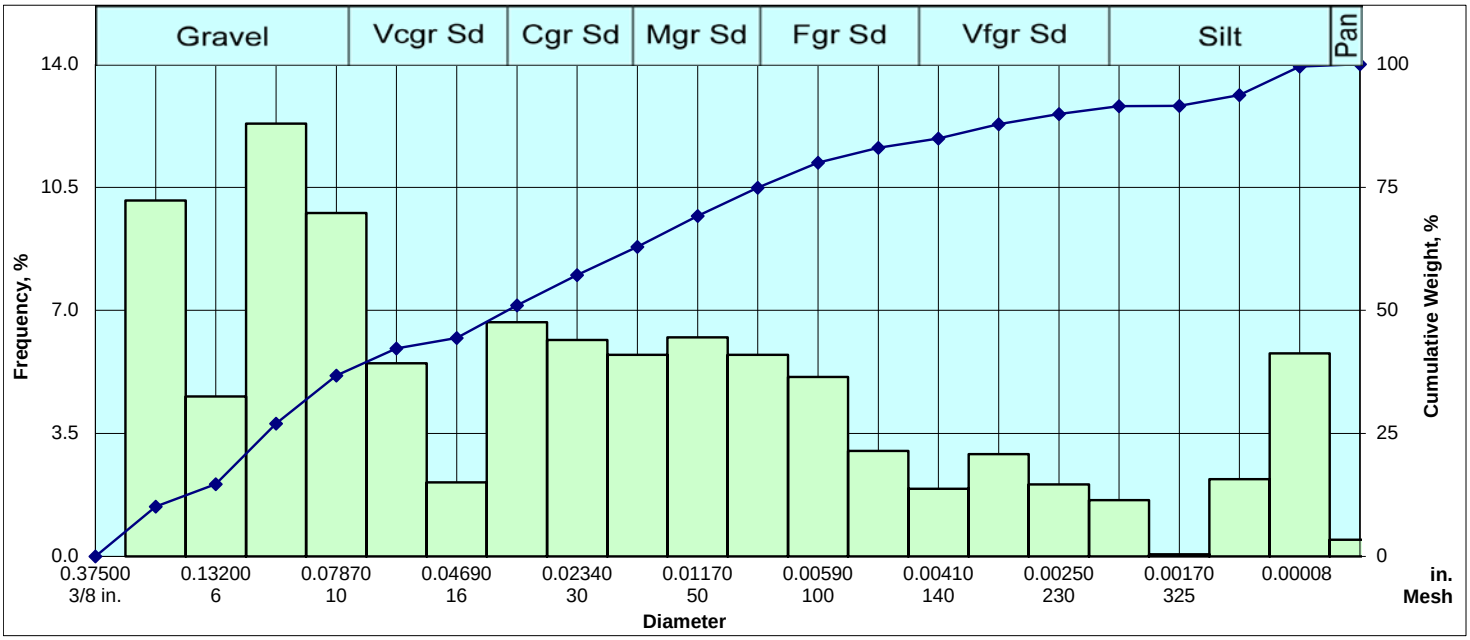

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 19.653 | 19.653 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 11.327 | 30.980 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 13.347 | 44.327 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 10.347 | 54.675 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 2.265 | 56.940 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 0.753 | 57.693 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 3.747 | 61.440 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 3.692 | 65.132 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 3.808 | 68.940 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.500 | 73.440 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 4.463 | 77.904 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.298 | 82.202 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.547 | 84.749 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.033 | 86.781 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.314 | 89.096 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.218 | 90.314 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.104 | 90.418 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 3.606 | 94.024 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.049 | 94.073 |
| | | 0.00008 | 0.0020 | 9.00 | 5.520 | 99.593 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.407 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0851 | 0.0851 | 0.0851 |
| (mm) | 2.1626 | 2.1626 | 2.1626 |
| Mean | Medium sand sized | | |
| (in) | 0.0858 | 0.0340 | 0.0462 |
| (mm) | 2.1792 | 0.8634 | 1.1726 |
| Sorting | Very poor | | |
| | 3.897 | 2.706 | 2.536 |
| Skewness | Strongly fine skewed | | |
| | 0.485 | 0.490 | 0.496 |
| Kurtosis | Platykurtic | | |
| | 0.272 | 0.442 | 0.815 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3264 | 8.2916 | -3.0516 |
| 10 | 0.2789 | 7.0831 | -2.8244 |
| 16 | 0.2218 | 5.6330 | -2.4939 |
| 25 | 0.1610 | 4.0892 | -2.0318 |
| 50 | 0.0851 | 2.1626 | -1.1128 |
| 75 | 0.0106 | 0.2692 | 1.8930 |
| 84 | 0.0052 | 0.1323 | 2.9176 |
| 90 | 0.0026 | 0.0661 | 3.9193 |
| 95 | 0.0015 | 0.0371 | 4.7539 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-4_14.6-15.0

## Mechanical Sieve Particle Size Analysis



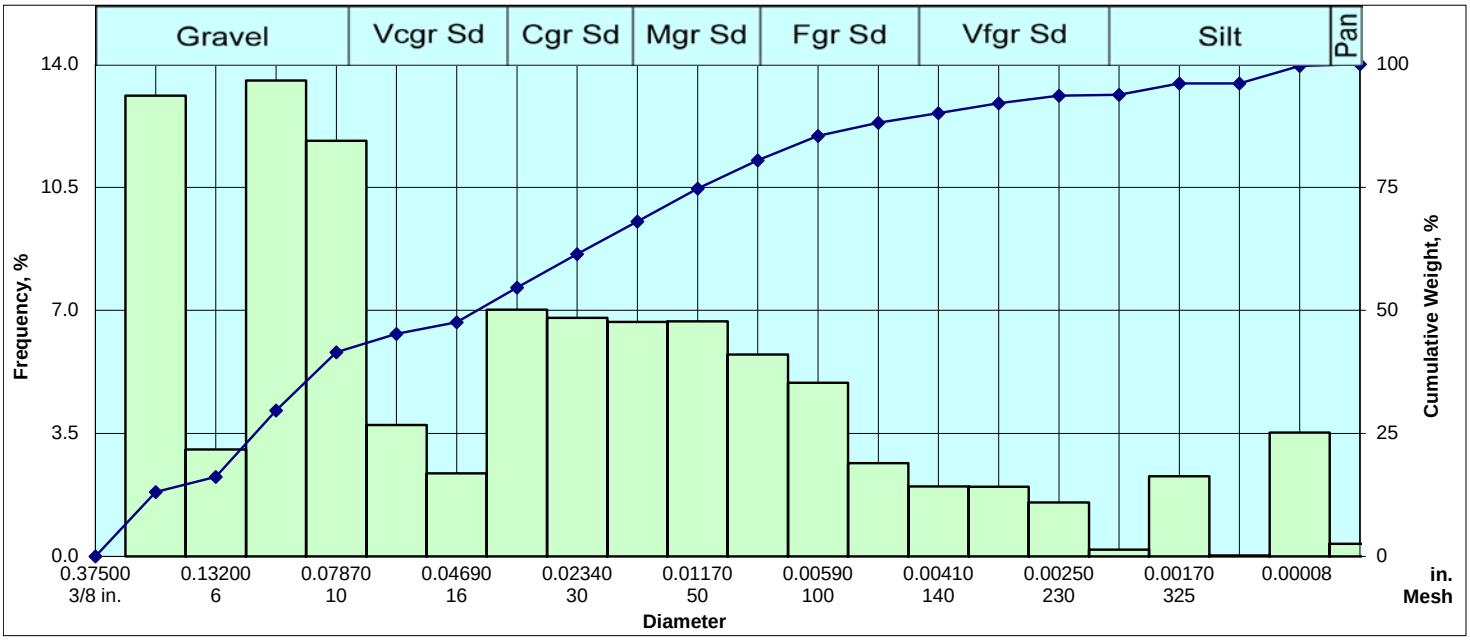

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 10.128 | 10.128 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 4.551 | 14.679 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 12.314 | 26.993 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 9.771 | 36.764 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.497 | 42.261 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.110 | 44.372 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.661 | 51.033 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.153 | 57.186 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.738 | 62.923 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.229 | 69.152 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.738 | 74.890 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 5.104 | 79.994 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.003 | 82.996 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.927 | 84.924 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.913 | 87.837 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.052 | 89.890 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.597 | 91.487 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.062 | 91.550 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.195 | 93.745 |
| | | 0.00008 | 0.0020 | 9.00 | 5.777 | 99.521 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.479 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0355 | 0.0355 | 0.0355 |
| (mm) | 0.9012 | 0.9012 | 0.9012 |
| Mean | Medium sand sized | | |
| (in) | 0.0538 | 0.0241 | 0.0274 |
| (mm) | 1.3655 | 0.6111 | 0.6955 |
| Sorting | Very poor | | |
| | 3.459 | 2.408 | 2.356 |
| Skewness | Finely skewed | | |
| | 0.809 | 0.233 | 0.223 |
| Kurtosis | Platykurtic | | |
| | 0.243 | 0.579 | 0.870 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2817 | 7.1550 | -2.8390 |
| 10 | 0.1894 | 4.8101 | -2.2661 |
| 16 | 0.1277 | 3.2438 | -1.6977 |
| 25 | 0.0992 | 2.5202 | -1.3336 |
| 50 | 0.0355 | 0.9012 | 0.1501 |
| 75 | 0.0083 | 0.2107 | 2.2470 |
| 84 | 0.0045 | 0.1151 | 3.1189 |
| 90 | 0.0025 | 0.0623 | 4.0044 |
| 95 | 0.0014 | 0.0368 | 4.7643 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-5_4.6-5.0

## Mechanical Sieve Particle Size Analysis



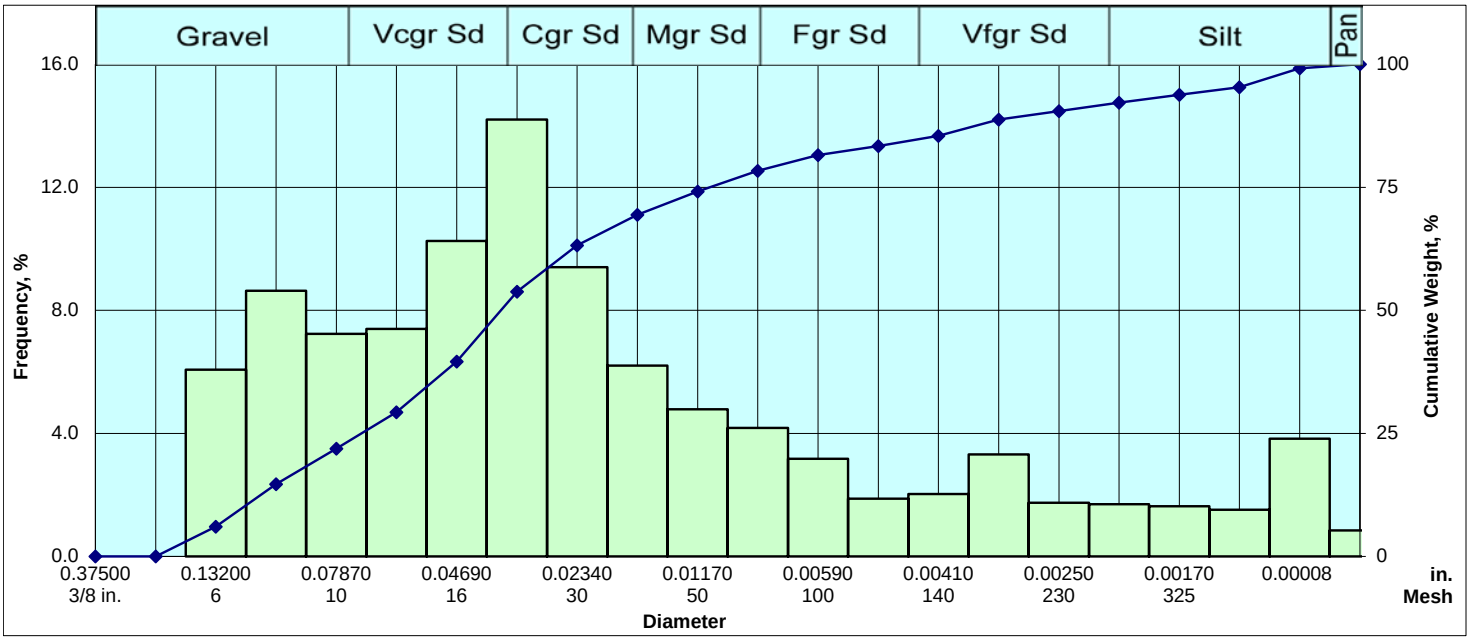

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 13.104 | 13.104 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 3.041 | 16.145 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 13.533 | 29.678 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 11.820 | 41.497 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 3.739 | 45.236 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.364 | 47.600 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 7.019 | 54.619 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.788 | 61.406 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.672 | 68.078 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.685 | 74.763 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.743 | 80.506 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.942 | 85.448 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.651 | 88.099 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.991 | 90.090 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 1.983 | 92.073 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.537 | 93.611 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.197 | 93.808 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 2.283 | 96.090 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.030 | 96.120 |
| | | 0.00008 | 0.0020 | 9.00 | 3.523 | 99.643 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.357 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0420 | 0.0420 | 0.0420 |
| (mm) | 1.0671 | 1.0671 | 1.0671 |
| Mean | Medium sand sized | | |
| (in) | 0.0590 | 0.0298 | 0.0334 |
| (mm) | 1.4993 | 0.7580 | 0.8496 |
| Sorting | Very poor | | |
| | 3.020 | 2.172 | 2.192 |
| Skewness | Finely skewed | | |
| | 0.839 | 0.227 | 0.223 |
| Kurtosis | Mesokurtic | | |
| | 0.209 | 0.680 | 0.938 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3027 | 7.6876 | -2.9425 |
| 10 | 0.2313 | 5.8753 | -2.5547 |
| 16 | 0.1345 | 3.4167 | -1.7726 |
| 25 | 0.1064 | 2.7022 | -1.4341 |
| 50 | 0.0420 | 1.0671 | -0.0938 |
| 75 | 0.0117 | 0.2964 | 1.7545 |
| 84 | 0.0066 | 0.1682 | 2.5720 |
| 90 | 0.0042 | 0.1069 | 3.2262 |
| 95 | 0.0019 | 0.0488 | 4.3564 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG_5_9.6-10.0

## Mechanical Sieve Particle Size Analysis



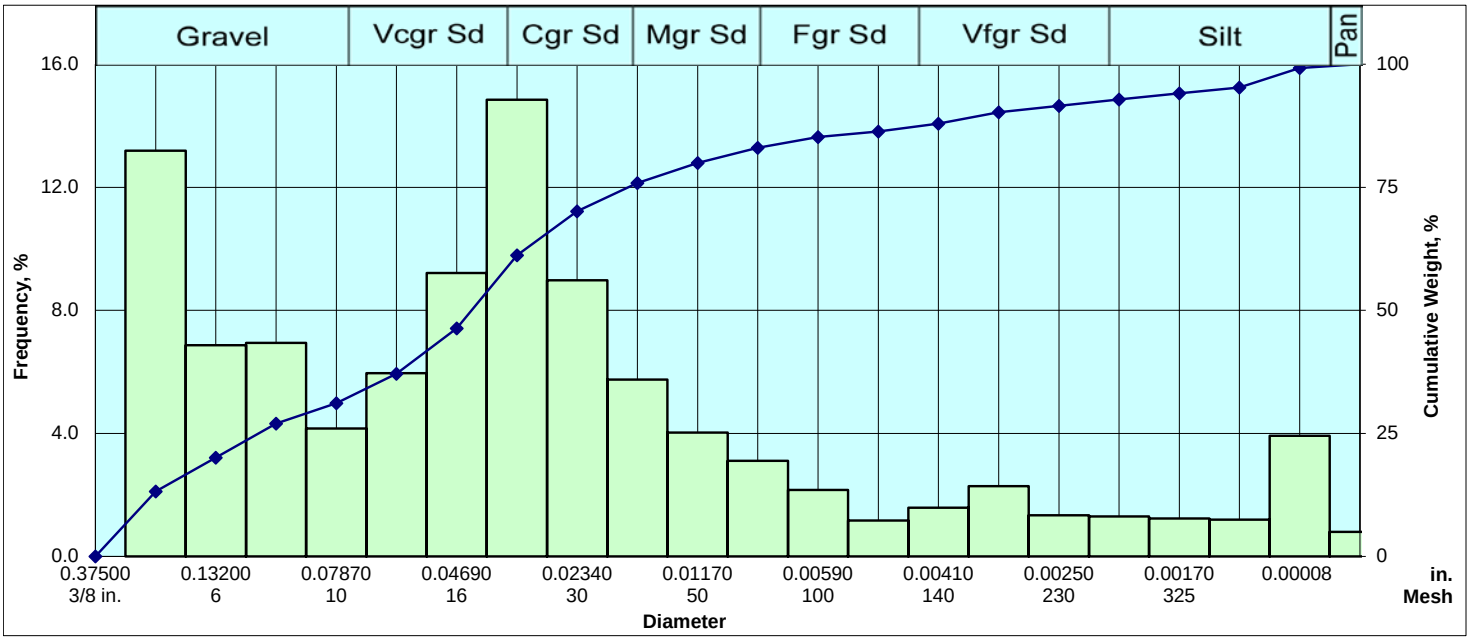

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 6.066 | 6.066 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 8.633 | 14.699 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.233 | 21.932 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 7.397 | 29.328 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 10.254 | 39.582 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 14.201 | 53.783 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 9.404 | 63.188 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.204 | 69.392 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.780 | 74.172 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 4.176 | 78.348 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 3.174 | 81.522 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.879 | 83.401 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.033 | 85.433 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.312 | 88.745 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.743 | 90.488 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.700 | 92.189 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.628 | 93.817 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.517 | 95.334 |
| | | 0.00008 | 0.0020 | 9.00 | 3.825 | 99.159 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.841 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0488 | 0.0488 | 0.0488 |
| (mm) | 1.2386 | 1.2386 | 1.2386 |
| Mean | Medium sand sized | | |
| (in) | 0.0514 | 0.0265 | 0.0325 |
| (mm) | 1.3054 | 0.6726 | 0.8244 |
| Sorting | Very poor | | |
| | 2.350 | 2.238 | 2.164 |
| Skewness | Strongly fine skewed | | |
| | 0.759 | 0.394 | 0.382 |
| Kurtosis | Lepokurtic | | |
| | 0.225 | 0.542 | 1.147 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2199 | 5.5849 | -2.4815 |
| 10 | 0.1619 | 4.1121 | -2.0399 |
| 16 | 0.1249 | 3.1719 | -1.6654 |
| 25 | 0.0870 | 2.2107 | -1.1445 |
| 50 | 0.0488 | 1.2386 | -0.3087 |
| 75 | 0.0158 | 0.4002 | 1.3211 |
| 84 | 0.0056 | 0.1426 | 2.8097 |
| 90 | 0.0033 | 0.0837 | 3.5789 |
| 95 | 0.0018 | 0.0468 | 4.4186 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG_5_14.6-15.0

## Mechanical Sieve Particle Size Analysis



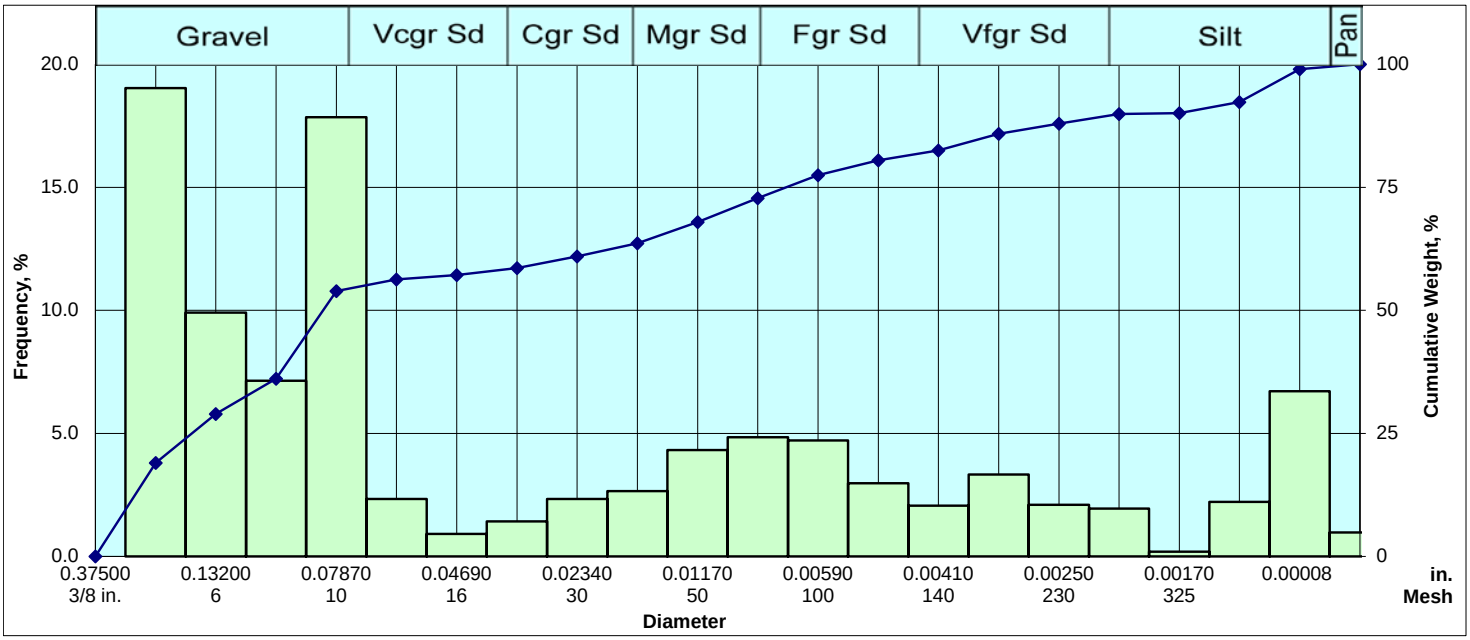

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 13.187 | 13.187 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 6.868 | 20.055 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 6.937 | 26.992 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 4.155 | 31.147 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.959 | 37.106 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 9.215 | 46.321 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 14.846 | 61.167 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 8.979 | 70.146 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.746 | 75.891 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.027 | 79.919 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 3.112 | 83.031 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 2.158 | 85.189 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 1.166 | 86.355 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 1.586 | 87.941 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.282 | 90.223 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.338 | 91.560 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.296 | 92.856 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 1.232 | 94.088 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 1.197 | 95.285 |
| | | 0.00008 | 0.0020 | 9.00 | 3.919 | 99.205 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.795 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0530 | 0.0530 | 0.0530 |
| (mm) | 1.3455 | 1.3455 | 1.3455 |
| Mean | Medium sand sized | | |
| (in) | 0.0864 | 0.0552 | 0.0545 |
| (mm) | 2.1954 | 1.4028 | 1.3834 |
| Sorting | Very poor | | |
| | 2.424 | 2.429 | 2.452 |
| Skewness | Near symmetrical | | |
| | 1.151 | -0.025 | 0.081 |
| Kurtosis | Lepokurtic | | |
| | 0.142 | 0.681 | 1.310 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.5298 | 13.4578 | -3.7504 |
| 10 | 0.4347 | 11.0406 | -3.4647 |
| 16 | 0.2974 | 7.5544 | -2.9173 |
| 25 | 0.1477 | 3.7520 | -1.9077 |
| 50 | 0.0530 | 1.3455 | -0.4281 |
| 75 | 0.0251 | 0.6388 | 0.6466 |
| 84 | 0.0103 | 0.2605 | 1.9407 |
| 90 | 0.0042 | 0.1079 | 3.2128 |
| 95 | 0.0018 | 0.0469 | 4.4141 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-6_12.0-12.5

## Mechanical Sieve Particle Size Analysis



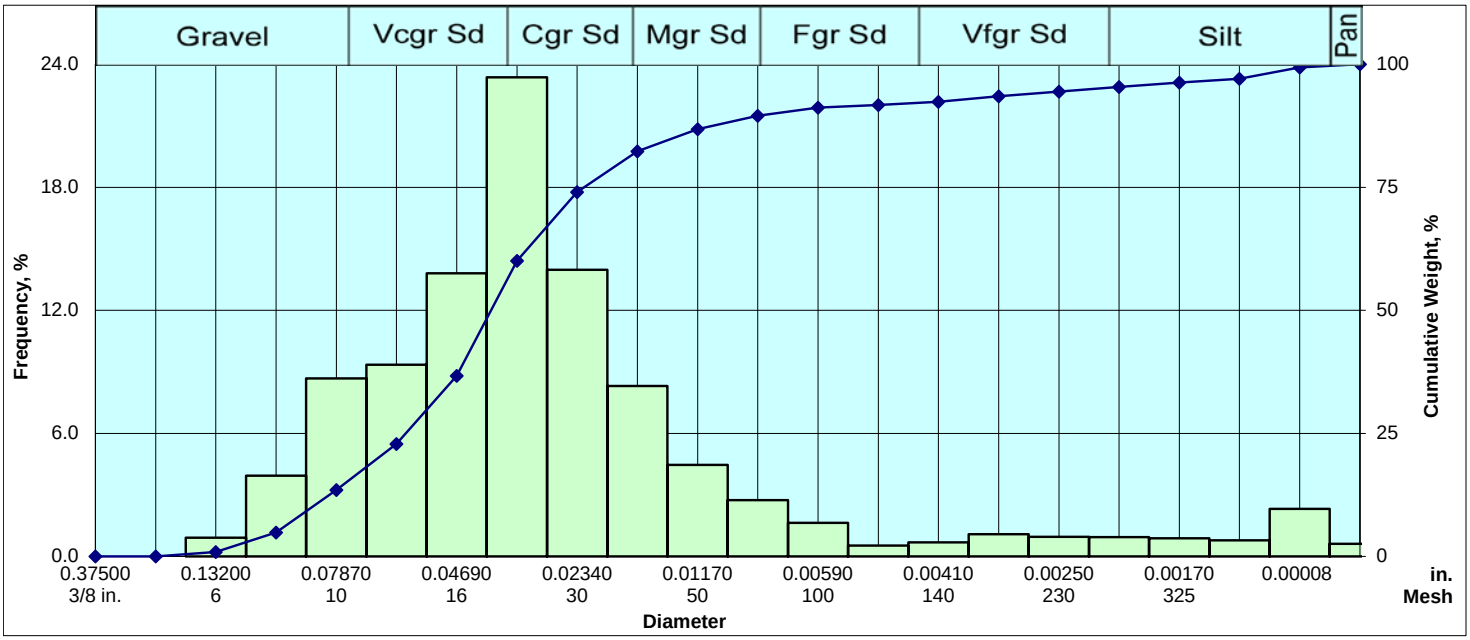

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 19.033 | 19.033 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 9.913 | 28.945 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 7.137 | 36.082 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 17.843 | 53.925 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 2.339 | 56.265 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 0.912 | 57.177 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 1.427 | 58.604 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 2.339 | 60.944 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 2.657 | 63.600 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.322 | 67.922 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 4.837 | 72.760 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.718 | 77.478 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.974 | 80.452 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.062 | 82.514 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.331 | 85.845 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.102 | 87.946 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.943 | 89.889 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.198 | 90.087 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.220 | 92.308 |
| | | 0.00008 | 0.0020 | 9.00 | 6.713 | 99.020 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.980 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Coarse sand sized | | |
| (in) | 0.0819 | 0.0819 | 0.0819 |
| (mm) | 2.0792 | 2.0792 | 2.0792 |
| Mean | Medium sand sized | | |
| (in) | 0.0805 | 0.0280 | 0.0401 |
| (mm) | 2.0449 | 0.7124 | 1.0181 |
| Sorting | Very poor | | |
| | 4.626 | 2.950 | 2.664 |
| Skewness | Strongly fine skewed | | |
| | 0.406 | 0.524 | 0.508 |
| Kurtosis | Platykurtic | | |
| | 0.268 | 0.329 | 0.727 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3249 | 8.2521 | -3.0448 |
| 10 | 0.2758 | 7.0043 | -2.8082 |
| 16 | 0.2168 | 5.5068 | -2.4612 |
| 25 | 0.1538 | 3.9072 | -1.9661 |
| 50 | 0.0819 | 2.0792 | -1.0560 |
| 75 | 0.0072 | 0.1826 | 2.4535 |
| 84 | 0.0036 | 0.0922 | 3.4396 |
| 90 | 0.0019 | 0.0485 | 4.3653 |
| 95 | 0.0014 | 0.0359 | 4.7999 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG_6_14.5-15.0

## Mechanical Sieve Particle Size Analysis



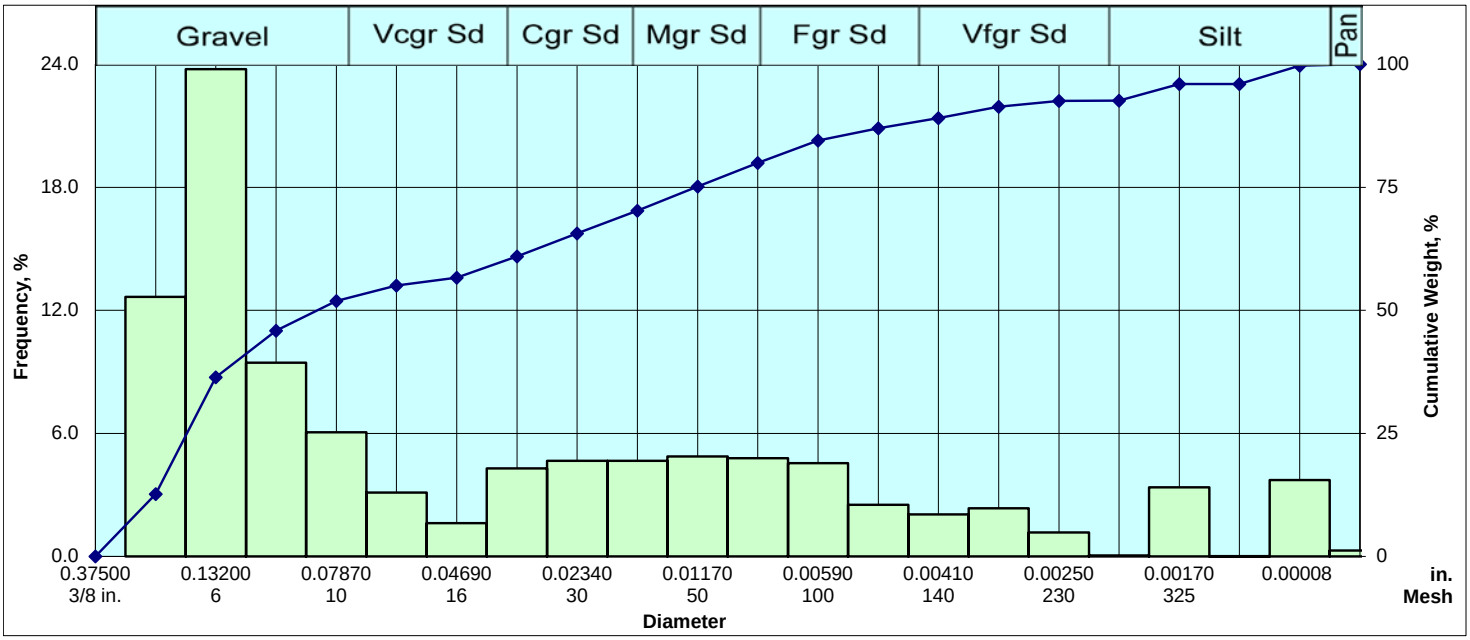

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 0.000 | 0.000 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 0.914 | 0.914 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 3.931 | 4.845 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 8.684 | 13.528 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 9.342 | 22.870 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 13.807 | 36.677 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 23.366 | 60.042 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 13.976 | 74.018 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 8.313 | 82.332 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.459 | 86.790 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 2.748 | 89.539 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 1.634 | 91.173 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 0.534 | 91.707 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 0.682 | 92.389 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 1.089 | 93.478 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 0.956 | 94.434 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.945 | 95.379 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.886 | 96.265 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.792 | 97.057 |
| | | 0.00008 | 0.0020 | 9.00 | 2.323 | 99.379 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.621 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0502 | 0.0502 | 0.0502 |
| (mm) | 1.2746 | 1.2746 | 1.2746 |
| Mean | Medium sand sized | | |
| (in) | 0.0537 | 0.0433 | 0.0455 |
| (mm) | 1.3640 | 1.1003 | 1.1555 |
| Sorting | Poor | | |
| | 1.525 | 1.042 | 1.372 |
| Skewness | Strongly fine skewed | | |
| | 0.982 | 0.204 | 0.355 |
| Kurtosis | Very leptokurtic | | |
| | 0.219 | 1.697 | 1.892 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1312 | 3.3323 | -1.7365 |
| 10 | 0.1088 | 2.7623 | -1.4658 |
| 16 | 0.0892 | 2.2647 | -1.1794 |
| 25 | 0.0751 | 1.9074 | -0.9316 |
| 50 | 0.0502 | 1.2746 | -0.3500 |
| 75 | 0.0323 | 0.8205 | 0.2855 |
| 84 | 0.0210 | 0.5345 | 0.9037 |
| 90 | 0.0108 | 0.2752 | 1.8616 |
| 95 | 0.0027 | 0.0678 | 3.8822 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-6_4.7-5.0

## Mechanical Sieve Particle Size Analysis



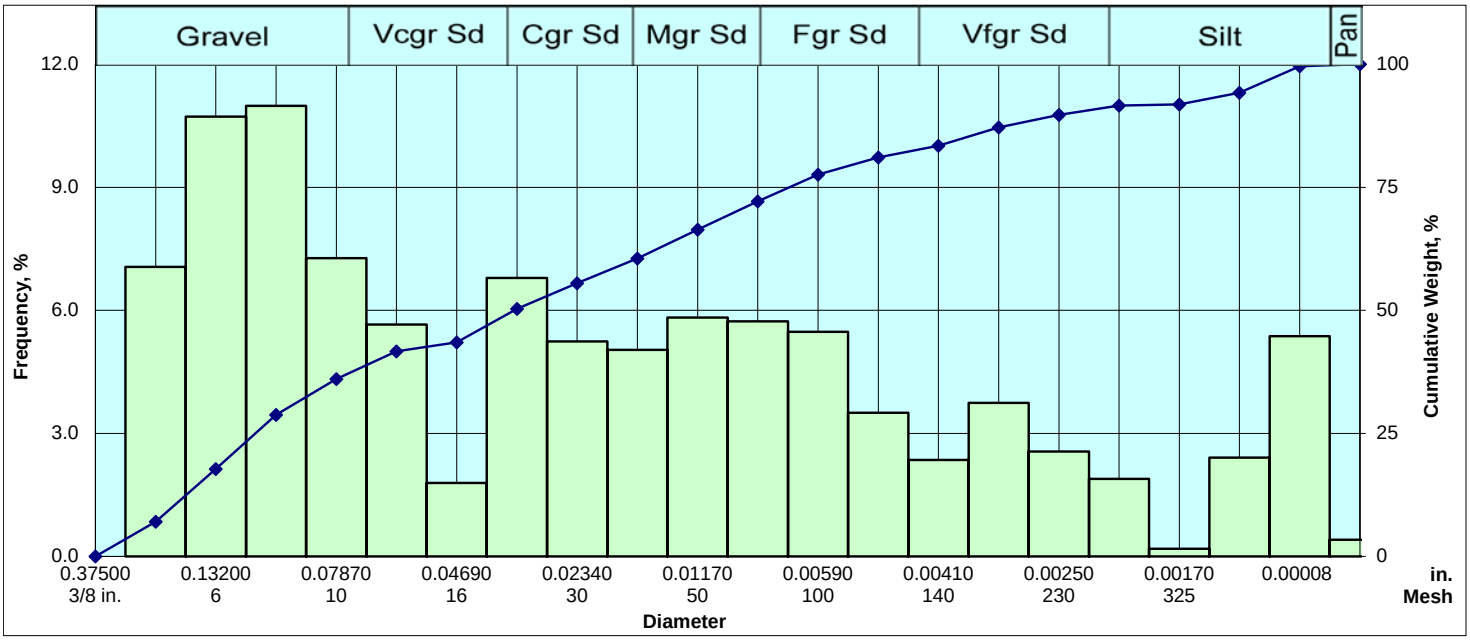

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 12.660 | 12.660 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 23.753 | 36.413 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 9.445 | 45.858 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 6.049 | 51.907 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 3.117 | 55.024 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.630 | 56.654 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 4.288 | 60.942 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 4.662 | 65.604 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 4.662 | 70.266 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 4.875 | 75.142 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 4.787 | 79.928 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.546 | 84.474 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.520 | 86.994 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.046 | 89.040 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.353 | 91.393 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.176 | 92.569 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.044 | 92.613 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 3.374 | 95.987 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.010 | 95.997 |
| | | 0.00008 | 0.0020 | 9.00 | 3.722 | 99.719 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.281 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Coarse sand sized | | |
| (in) | 0.0832 | 0.0832 | 0.0832 |
| (mm) | 2.1135 | 2.1135 | 2.1135 |
| Mean | Medium sand sized | | |
| (in) | 0.0852 | 0.0332 | 0.0451 |
| (mm) | 2.1632 | 0.8440 | 1.1462 |
| Sorting | Very poor | | |
| | 3.640 | 2.431 | 2.327 |
| Skewness | Strongly fine skewed | | |
| | 0.523 | 0.545 | 0.520 |
| Kurtosis | Platykurtic | | |
| | 0.329 | 0.508 | 0.806 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3002 | 7.6241 | -2.9306 |
| 10 | 0.2263 | 5.7481 | -2.5231 |
| 16 | 0.1793 | 4.5532 | -2.1869 |
| 25 | 0.1584 | 4.0227 | -2.0082 |
| 50 | 0.0832 | 2.1135 | -1.0796 |
| 75 | 0.0120 | 0.3036 | 1.7196 |
| 84 | 0.0062 | 0.1565 | 2.6761 |
| 90 | 0.0037 | 0.0934 | 3.4212 |
| 95 | 0.0019 | 0.0473 | 4.4008 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-7_4.6-5.0

## Mechanical Sieve Particle Size Analysis



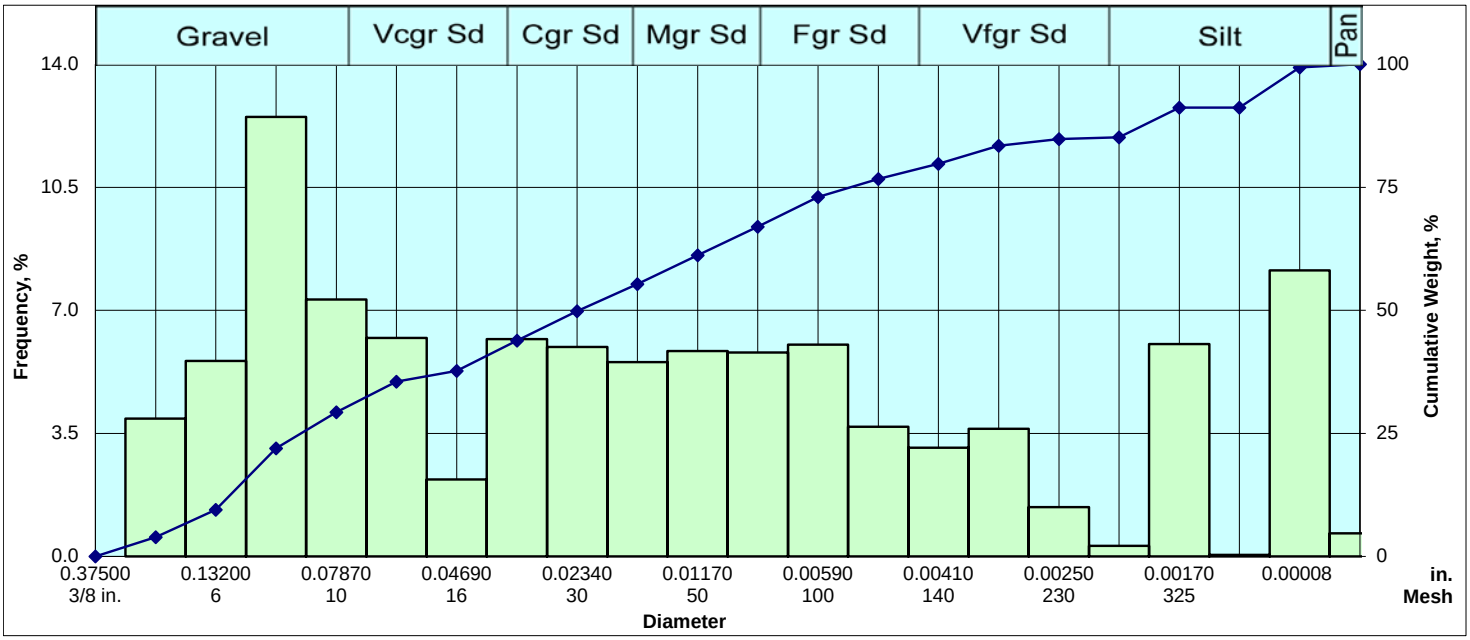

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 7.062 | 7.062 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 10.723 | 17.785 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 10.985 | 28.770 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.271 | 36.041 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.655 | 41.696 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.794 | 43.490 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.790 | 50.280 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 5.241 | 55.521 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.032 | 60.553 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 5.822 | 66.375 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.733 | 72.109 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 5.477 | 77.585 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.500 | 81.085 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.349 | 83.434 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.745 | 87.179 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.558 | 89.737 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.888 | 91.625 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.188 | 91.814 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.406 | 94.220 |
| | | 0.00008 | 0.0020 | 9.00 | 5.372 | 99.592 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.408 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0340 | 0.0340 | 0.0340 |
| (mm) | 0.8636 | 0.8636 | 0.8636 |
| Mean | Medium sand sized | | |
| (in) | 0.0567 | 0.0237 | 0.0267 |
| (mm) | 1.4395 | 0.6025 | 0.6793 |
| Sorting | Very poor | | |
| | 3.881 | 2.572 | 2.402 |
| Skewness | Finely skewed | | |
| | 0.806 | 0.202 | 0.217 |
| Kurtosis | Platykurtic | | |
| | 0.293 | 0.432 | 0.772 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2416 | 6.1368 | -2.6175 |
| 10 | 0.1719 | 4.3664 | -2.1264 |
| 16 | 0.1411 | 3.5831 | -1.8412 |
| 25 | 0.1063 | 2.6998 | -1.4328 |
| 50 | 0.0340 | 0.8636 | 0.2116 |
| 75 | 0.0071 | 0.1793 | 2.4798 |
| 84 | 0.0040 | 0.1013 | 3.3031 |
| 90 | 0.0024 | 0.0616 | 4.0208 |
| 95 | 0.0015 | 0.0372 | 4.7489 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-7_9.6-10.0

## Mechanical Sieve Particle Size Analysis



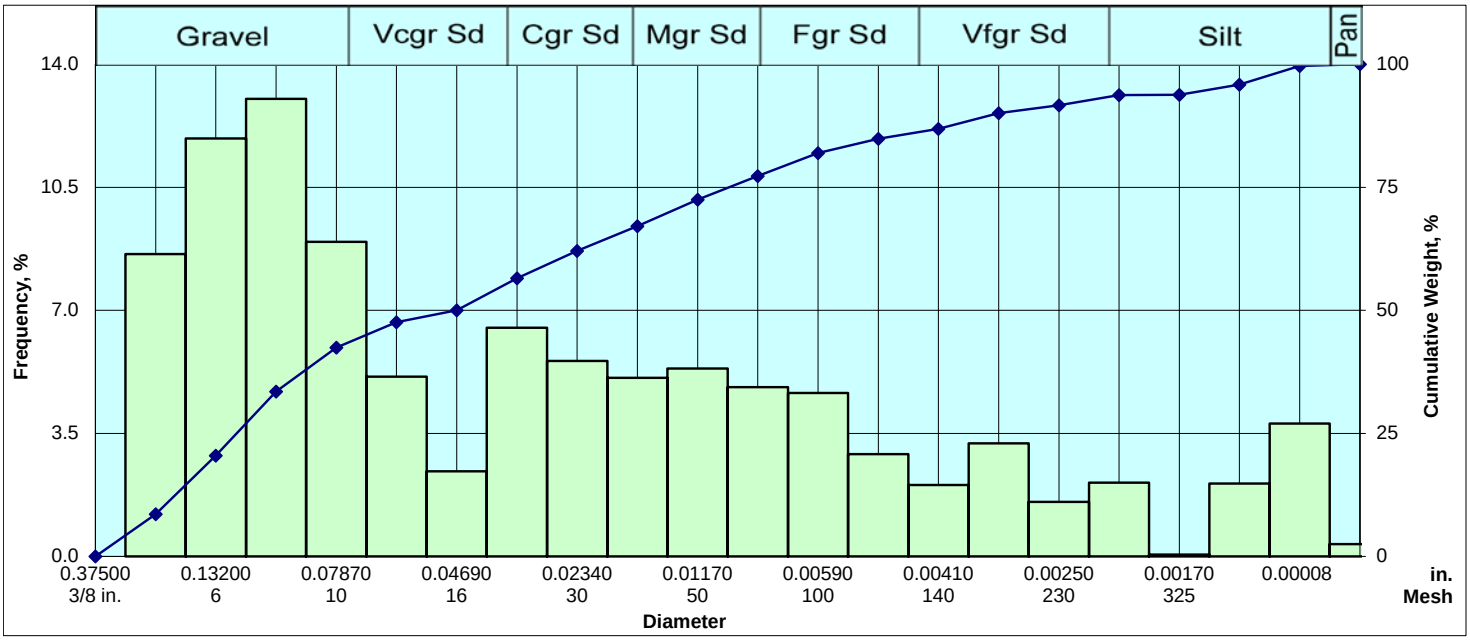

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 3.919 | 3.919 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 5.560 | 9.479 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 12.497 | 21.976 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.308 | 29.284 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 6.212 | 35.496 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.187 | 37.683 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.185 | 43.868 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 5.957 | 49.825 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.523 | 55.348 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 5.841 | 61.189 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.799 | 66.988 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 6.026 | 73.014 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.686 | 76.700 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 3.093 | 79.792 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.627 | 83.420 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.403 | 84.823 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.302 | 85.125 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 6.037 | 91.162 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.048 | 91.209 |
| | | 0.00008 | 0.0020 | 9.00 | 8.133 | 99.342 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.658 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0234 | 0.0234 | 0.0234 |
| (mm) | 0.5945 | 0.5945 | 0.5945 |
| Mean | Medium sand sized | | |
| (in) | 0.0462 | 0.0175 | 0.0193 |
| (mm) | 1.1738 | 0.4455 | 0.4904 |
| Sorting | Very poor | | |
| | 4.024 | 2.669 | 2.392 |
| Skewness | Finely skewed | | |
| | 0.924 | 0.156 | 0.161 |
| Kurtosis | Platykurtic | | |
| | 0.318 | 0.308 | 0.712 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.1763 | 4.4777 | -2.1628 |
| 10 | 0.1303 | 3.3087 | -1.7263 |
| 16 | 0.1116 | 2.8334 | -1.5025 |
| 25 | 0.0870 | 2.2110 | -1.1447 |
| 50 | 0.0234 | 0.5945 | 0.7503 |
| 75 | 0.0054 | 0.1365 | 2.8727 |
| 84 | 0.0028 | 0.0700 | 3.8357 |
| 90 | 0.0018 | 0.0465 | 4.4254 |
| 95 | 0.0014 | 0.0354 | 4.8196 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-8_4.5-5.0

## Mechanical Sieve Particle Size Analysis



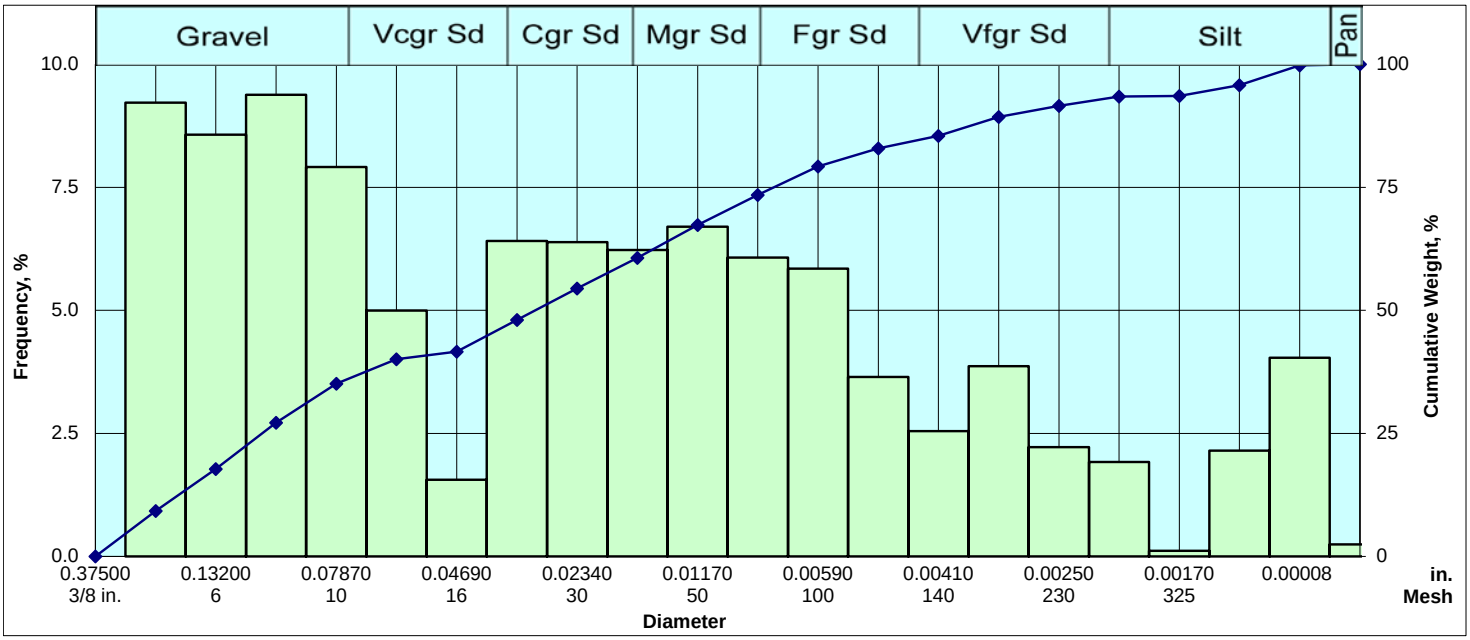

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 8.603 | 8.603 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 11.888 | 20.492 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 13.015 | 33.506 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 8.948 | 42.454 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.115 | 47.569 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.418 | 49.987 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.507 | 56.495 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 5.559 | 62.054 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.078 | 67.132 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 5.347 | 72.478 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 4.812 | 77.290 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 4.646 | 81.936 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 2.910 | 84.845 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.030 | 86.876 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.213 | 90.089 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 1.555 | 91.644 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 2.099 | 93.743 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.056 | 93.799 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.074 | 95.873 |
| | | 0.00008 | 0.0020 | 9.00 | 3.777 | 99.650 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.350 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0464 | 0.0464 | 0.0464 |
| (mm) | 1.1794 | 1.1794 | 1.1794 |
| Mean | Medium sand sized | | |
| (in) | 0.0642 | 0.0282 | 0.0333 |
| (mm) | 1.6305 | 0.7163 | 0.8458 |
| Sorting | Very poor | | |
| | 3.442 | 2.437 | 2.334 |
| Skewness | Strongly fine skewed | | |
| | 0.741 | 0.295 | 0.306 |
| Kurtosis | Platykurtic | | |
| | 0.305 | 0.511 | 0.846 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2653 | 6.7395 | -2.7526 |
| 10 | 0.1805 | 4.5855 | -2.1971 |
| 16 | 0.1527 | 3.8790 | -1.9557 |
| 25 | 0.1184 | 3.0071 | -1.5884 |
| 50 | 0.0464 | 1.1794 | -0.2380 |
| 75 | 0.0100 | 0.2539 | 1.9778 |
| 84 | 0.0052 | 0.1323 | 2.9185 |
| 90 | 0.0030 | 0.0759 | 3.7206 |
| 95 | 0.0016 | 0.0409 | 4.6101 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-8_9.5-10.0

## Mechanical Sieve Particle Size Analysis



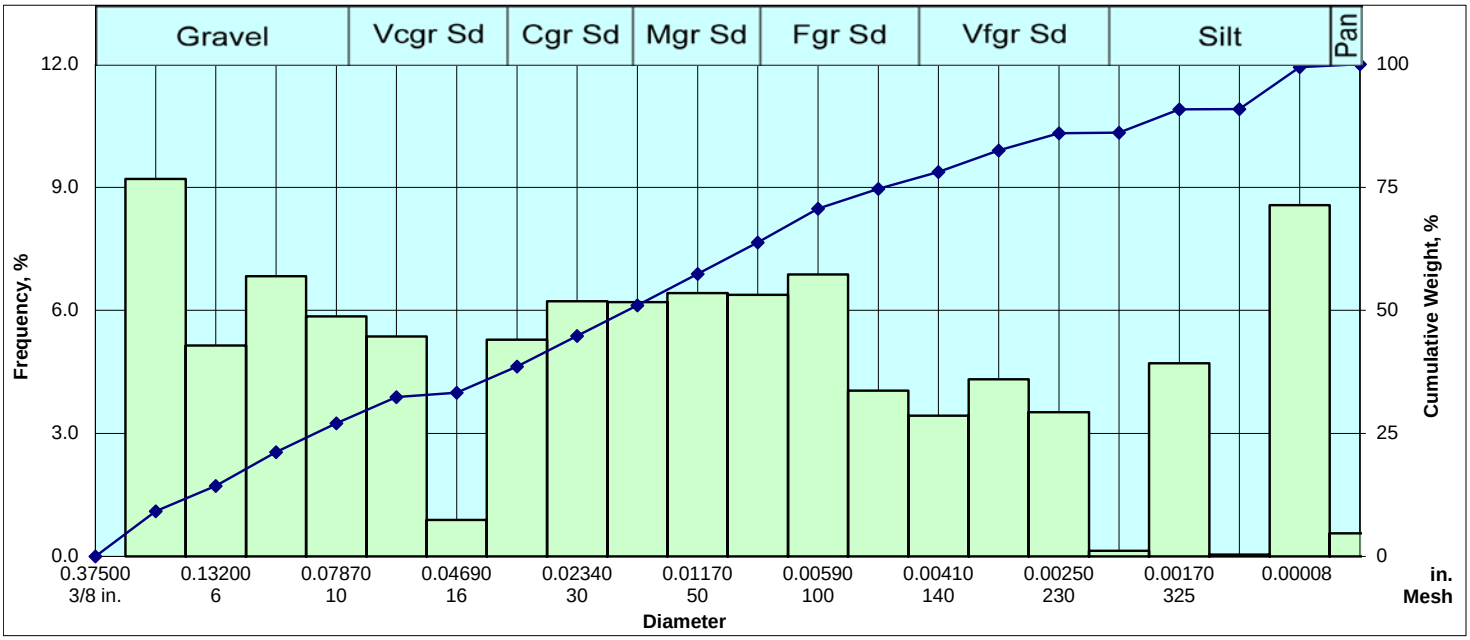

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 9.222 | 9.222 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 8.566 | 17.788 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 9.376 | 27.165 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.910 | 35.075 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 4.993 | 40.068 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.555 | 41.623 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.409 | 48.032 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.386 | 54.418 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.224 | 60.642 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.699 | 67.341 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 6.073 | 73.414 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 5.846 | 79.260 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.646 | 82.906 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.543 | 85.449 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 3.866 | 89.315 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.223 | 91.538 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 1.918 | 93.456 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.112 | 93.568 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.149 | 95.717 |
| | | 0.00008 | 0.0020 | 9.00 | 4.038 | 99.755 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.245 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0425 | 0.0425 | 0.0425 |
| (mm) | 1.0783 | 1.0783 | 1.0783 |
| Mean | Medium sand sized | | |
| (in) | 0.0777 | 0.0352 | 0.0375 |
| (mm) | 1.9747 | 0.8941 | 0.9517 |
| Sorting | Very poor | | |
| | 3.647 | 2.683 | 2.557 |
| Skewness | Finely skewed | | |
| | 0.934 | 0.101 | 0.111 |
| Kurtosis | Platykurtic | | |
| | 0.189 | 0.496 | 0.881 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.4889 | 12.4186 | -3.6344 |
| 10 | 0.3570 | 9.0686 | -3.1809 |
| 16 | 0.2260 | 5.7416 | -2.5215 |
| 25 | 0.1446 | 3.6732 | -1.8770 |
| 50 | 0.0425 | 1.0783 | -0.1088 |
| 75 | 0.0109 | 0.2761 | 1.8566 |
| 84 | 0.0055 | 0.1392 | 2.8443 |
| 90 | 0.0038 | 0.0965 | 3.3740 |
| 95 | 0.0019 | 0.0477 | 4.3908 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: Risg-8_14.5-15.0

## Mechanical Sieve Particle Size Analysis



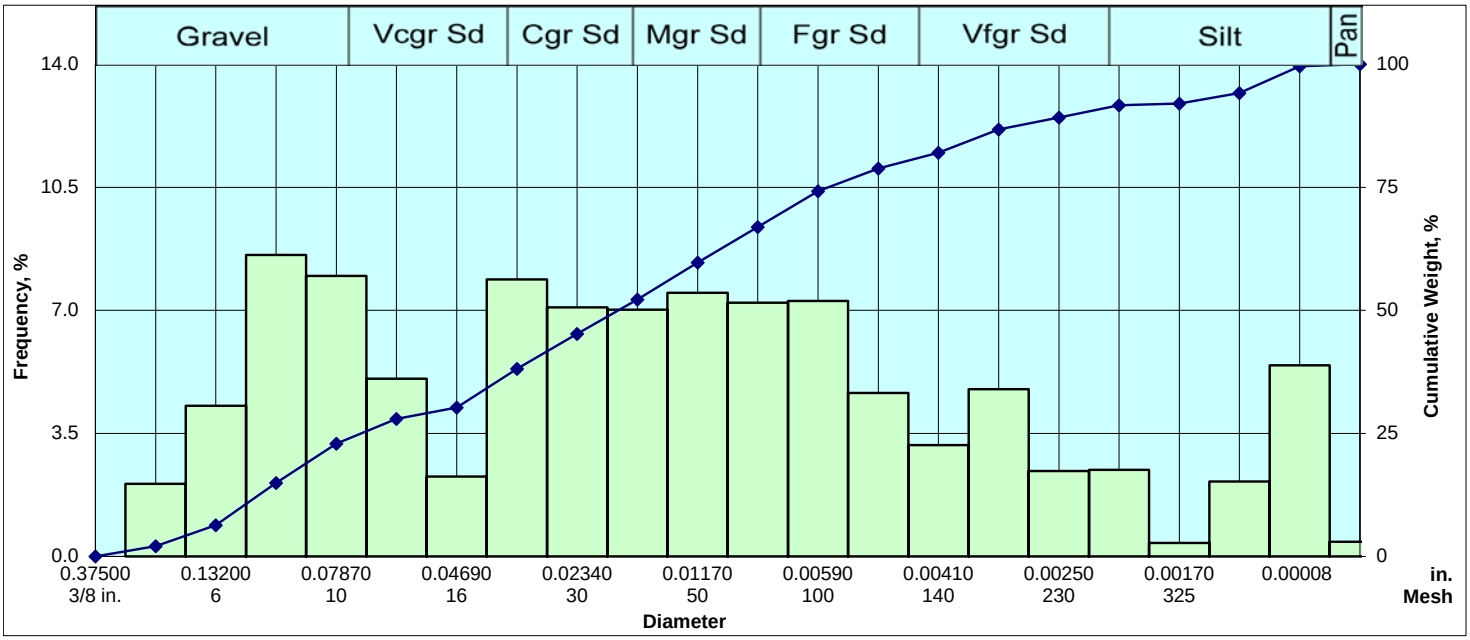

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 9.204 | 9.204 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 5.144 | 14.348 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 6.834 | 21.182 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 5.850 | 27.032 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.361 | 32.394 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 0.888 | 33.281 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 5.283 | 38.564 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.224 | 44.788 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 6.201 | 50.989 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 6.420 | 57.409 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 6.380 | 63.789 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 6.877 | 70.665 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 4.045 | 74.710 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 3.429 | 78.139 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 4.322 | 82.462 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 3.518 | 85.979 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.139 | 86.118 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 4.711 | 90.829 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.043 | 90.871 |
| | | 0.00008 | 0.0020 | 9.00 | 8.563 | 99.434 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.566 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0252 | 0.0252 | 0.0252 |
| (mm) | 0.6399 | 0.6399 | 0.6399 |
| Mean | Medium sand sized | | |
| (in) | 0.0561 | 0.0251 | 0.0252 |
| (mm) | 1.4259 | 0.6386 | 0.6390 |
| Sorting | Very poor | | |
| | 4.276 | 2.788 | 2.640 |
| Skewness | Near symmetrical | | |
| | 0.988 | 0.001 | -0.020 |
| Kurtosis | Platykurtic | | |
| | 0.147 | 0.474 | 0.804 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.4887 | 12.4119 | -3.6337 |
| 10 | 0.3451 | 8.7651 | -3.1318 |
| 16 | 0.1737 | 4.4116 | -2.1413 |
| 25 | 0.1065 | 2.7039 | -1.4351 |
| 50 | 0.0252 | 0.6399 | 0.6442 |
| 75 | 0.0058 | 0.1479 | 2.7574 |
| 84 | 0.0036 | 0.0924 | 3.4353 |
| 90 | 0.0022 | 0.0548 | 4.1908 |
| 95 | 0.0016 | 0.0416 | 4.5864 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-9_4.6-5.0

## Mechanical Sieve Particle Size Analysis



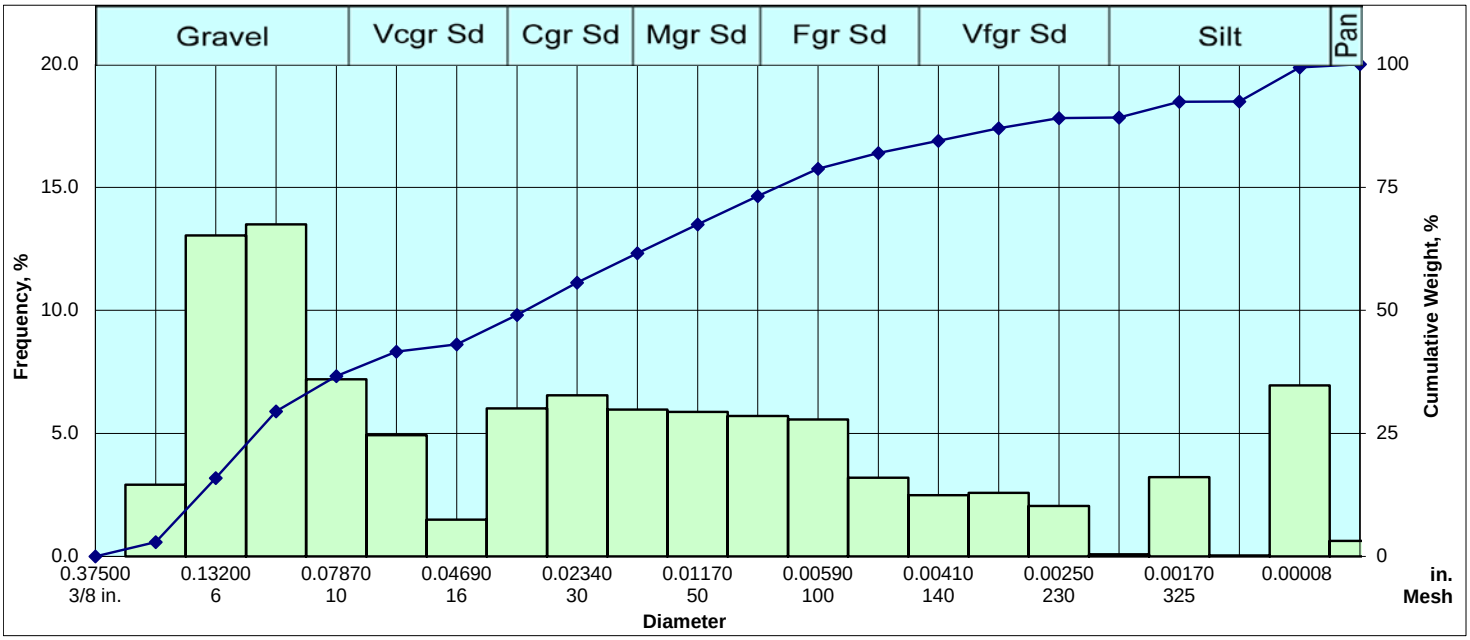

| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 2.063 | 2.063 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 4.288 | 6.351 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 8.576 | 14.927 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.979 | 22.906 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 5.059 | 27.965 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 2.269 | 30.234 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 7.876 | 38.110 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 7.084 | 45.194 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 7.018 | 52.212 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 7.496 | 59.708 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 7.214 | 66.922 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 7.263 | 74.184 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 4.652 | 78.836 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 3.165 | 82.001 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 4.755 | 86.756 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.426 | 89.182 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 2.459 | 91.641 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 0.380 | 92.021 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 2.128 | 94.149 |
| | | 0.00008 | 0.0020 | 9.00 | 5.435 | 99.584 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.416 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0267 | 0.0267 | 0.0267 |
| (mm) | 0.6788 | 0.6788 | 0.6788 |
| Mean | Medium sand sized | | |
| (in) | 0.0475 | 0.0242 | 0.0250 |
| (mm) | 1.2061 | 0.6135 | 0.6345 |
| Sorting | Very poor | | |
| | 3.316 | 2.390 | 2.279 |
| Skewness | Near symmetrical | | |
| | 0.982 | 0.061 | 0.083 |
| Kurtosis | Platykurtic | | |
| | 0.246 | 0.496 | 0.848 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.2459 | 6.2463 | -2.6430 |
| 10 | 0.1636 | 4.1543 | -2.0546 |
| 16 | 0.1266 | 3.2169 | -1.6857 |
| 25 | 0.0870 | 2.2110 | -1.1447 |
| 50 | 0.0267 | 0.6788 | 0.5590 |
| 75 | 0.0079 | 0.2011 | 2.3138 |
| 84 | 0.0046 | 0.1170 | 3.0953 |
| 90 | 0.0028 | 0.0710 | 3.8159 |
| 95 | 0.0017 | 0.0439 | 4.5095 |

Company: Ramboll US Corporation
Project Name: NERT RI Phase 2
Project Number: 169001 1200-028 (Task M03)

CL File No.: 1900856
Sample ID: RISG-9_9.6-10.0

## Mechanical Sieve Particle Size Analysis




| Particle Size Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Diameter | | | | Weight % | |
| | [US Mesh] | [in.] | [mm] | [ ϕ ] | [Incl.] | [Cum.] |
| Gravel | 3/8 in. | 0.37500 | 9.5000 | -3.25 | 0.000 | 0.000 |
| | 4 | 0.18700 | 4.7500 | -2.25 | 2.920 | 2.920 |
| | 6 | 0.13200 | 3.3500 | -1.75 | 13.039 | 15.959 |
| | 8 | 0.09370 | 2.3600 | -1.25 | 13.492 | 29.452 |
| | 10 | 0.07870 | 2.0000 | -1.00 | 7.199 | 36.651 |
| Very Coarse Sand | 14 | 0.05550 | 1.4100 | -0.50 | 4.929 | 41.580 |
| | 16 | 0.04690 | 1.1800 | -0.25 | 1.495 | 43.075 |
| Coarse Sand | 20 | 0.03310 | 0.8500 | 0.25 | 6.011 | 49.086 |
| | 30 | 0.02340 | 0.6000 | 0.75 | 6.550 | 55.636 |
| Medium Sand | 40 | 0.01650 | 0.4250 | 1.25 | 5.971 | 61.607 |
| | 50 | 0.01170 | 0.3000 | 1.75 | 5.875 | 67.482 |
| Fine Sand | 70 | 0.00830 | 0.2120 | 2.25 | 5.704 | 73.186 |
| | 100 | 0.00590 | 0.1500 | 2.75 | 5.563 | 78.749 |
| | 120 | 0.00490 | 0.1250 | 3.00 | 3.197 | 81.946 |
| Very Fine Sand | 140 | 0.00410 | 0.1060 | 3.25 | 2.492 | 84.438 |
| | 200 | 0.00290 | 0.0750 | 3.75 | 2.578 | 87.016 |
| | 230 | 0.00250 | 0.0630 | 4.00 | 2.054 | 89.070 |
| Silt | 270 | 0.00210 | 0.0530 | 4.25 | 0.091 | 89.161 |
| | 325 | 0.00170 | 0.0450 | 4.50 | 3.222 | 92.383 |
| | 400 | 0.00150 | 0.0380 | 4.75 | 0.035 | 92.418 |
| | | 0.00008 | 0.0020 | 9.00 | 6.955 | 99.373 |
| Clay | Pan | 0.00002 | 0.0005 | 11.00 | 0.627 | 100.000 |

| Sorting Statistics (Folk) | | | |
|---|---|---|---|
| Parameter | Trask | Inman | Folk |
| Median | Medium sand sized | | |
| (in) | 0.0446 | 0.0446 | 0.0446 |
| (mm) | 1.1340 | 1.1340 | 1.1340 |
| Mean | Medium sand sized | | |
| (in) | 0.0804 | 0.0309 | 0.0349 |
| (mm) | 2.0416 | 0.7836 | 0.8864 |
| Sorting | Very poor | | |
| | 3.748 | 2.598 | 2.464 |
| Skewness | Finely skewed | | |
| | 0.897 | 0.205 | 0.219 |
| Kurtosis | Platykurtic | | |
| | 0.258 | 0.479 | 0.826 |
| Percentile | [in.] | [mm] | [phi] |
| 5 | 0.3442 | 8.7423 | -3.1280 |
| 10 | 0.2725 | 6.9209 | -2.7910 |
| 16 | 0.1868 | 4.7458 | -2.2466 |
| 25 | 0.1501 | 3.8119 | -1.9305 |
| 50 | 0.0446 | 1.1340 | -0.1814 |
| 75 | 0.0107 | 0.2713 | 1.8820 |
| 84 | 0.0051 | 0.1294 | 2.9501 |
| 90 | 0.0024 | 0.0604 | 4.0494 |
| 95 | 0.0017 | 0.0424 | 4.5597 |

**To: Larry Kunkel, Core Laboratories**
**3470 Landco Drive, Bakersfield, CA 93308**

**NERT Project Work Order No. CL-2019-003**
Nevada Environmental Reponse Trust (NERT)
Henderson, Nevada

**Ramboll Project No.:** 169001 1200-028 (Task M03)

**PHYSICAL TESTING REQUEST**
**for Soil Gas Probe Borings** (sent 3/5/19 and 3/20/19)

**Date:** **April 30, 2019**
**Submitted by:** Ramboll, 2200 Powell Street, Suite 700
Emeryville, CA 94608

**Ramboll Contact:** Ross Russell, (510) 420-2520

| | Boring | Soil Sample Depth (ft bgs) | Soil Sample Name | Container type (number) | Grain Size (+ USCS class.) (Note 3) | Atterberg Limits | Moisture Content | Dry Bulk Density | Total Porosity | HYDRAULIC CONDUCTIVITY | | | Total Organic Carbon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Vertical (to water) | Height of Unsaturated Soil Above Water Table | Height of Saturated Soil Below Water Table | |
| 1 | RISG-1 | 4.6 - 5.0 | PT-RISG1-4.6-5.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 2 | RISG-1 | 9.6 - 10.0 | PT-RISG1-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 3 | RISG-1 | 14.6 - 15.0 | PT-RISG1-14.6-15.0- 20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 4 | RISG-2 | 4.6 - 5.0 | PT-RISG2-4.6-5.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 5 | RISG-2 | 9.6 - 10.0 | PT-RISG2-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 6 | RISG-2 | 14.6 - 15.0 | PT-RISG2-14.6-15.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 7 | RISG-3 | 4.6 - 5.0 | PT-RISG3-4.6-5.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 8 | RISG-3 | 9.6 - 10.0 | PT-RISG3-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 9 | RISG-3 | 14.6 - 15.0 | PT-RISG3-14.6-15.0- 20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 10 | RISG-4 | 4.6 - 5.0 | PT-RISG4-4.6-5.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 11 | RISG-4 | 9.6 - 10.0 | PT-RISG4-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 12 | RISG-4 | 14.6 - 15.0 | PT-RISG4-14.6-15.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 13 | RISG-5 | 4.6 - 5.0 | PT-RISG5-4.6-5.0-20190226 | Glass jar | X | -- | -- | -- | -- | -- | -- | -- | X |
| 14 | RISG-5 | 9.6 - 10.0 | PT-RISG5-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 15 | RISG-5 | 14.6 - 15.0 | PT-RISG5-14.6-15.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 16 | RISG-6 | 12.0 - 12.5 | PT-RISG6-12.0-12.5 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 17 | RISG-6 | 14.5 - 15.0 | PT-RISG6-14.5-15.0 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 18 | RISG-6 | 4.7 - 5.0 | PT-RISG6-4.7-5.0 | Glass jar | X | -- | -- | -- | -- | -- | -- | -- | X |
| 19 | RISG-7 | 4.6 - 5.0 | PT-RISG7-4.6-5.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 20 | RISG-7 | 9.6 - 10.0 | PT-RISG7-9.6-10.0-20190226 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 21 | RISG-8 | 4.5 - 5.0 | PT-RISG8-4.5-5.0 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 22 | RISG-8 | 5.0 - 10.0 | PT-RISG8-5.0-10.0 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 23 | RISG-8 | 10.0 - 15.0 | PT-RISG8-10.0-15.0 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 24 | RISG-9 | 4.6 - 5.0 | PT-RISG9-4.6-5.0-20190222 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| 25 | RISG-9 | 9.6 - 10.0 | PT-RISG9-9.6-10.0-20190222 | Plastic liner | X | X (1) | X | X | X | -- | -- | -- | X |
| | | | **TOTALS:** | | **25** | **23** | **23** | **23** | **23** | | | | **25** |

**Notes:**
(1) If necessary for classification of fines.
(2) SOIL SAMPLES ARE LIKELY CONTAMINATED (perchlorate, metals, VOCs).
(3) Please include both the USCS and Wentworth grain size summaries in the lab report.

# APPENDIX G
# RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION (PROVIDED ELECTRONICALLY)

# APPENDIX H
# UCL INPUT AND OUTPUT FILES FOR OUTDOOR AIR EXPOSURE POINT CONCENTRATIONS (PROVIDED ELECTRONICALLY)

# APPENDIX I
# SUPPORTING FILES FOR VAPOR INTRUSION MODELING (PROVIDED ELECTRONICALLY)

# APPENDIX I-1
# SUPPORTING FILES FOR JOHNSON AND ETTINGER MODELING

# APPENDIX I-2
# SUPPORTING FILES FOR BIOVAPOR MODELING

# APPENDIX J
# INDOOR AIR QUALITY SAMPLING RESULTS (PROVIDED ELECTRONICALLY)

# APPENDIX J-1
# LAB REPORTS FOR MODIFICATION NO. 1 TO THE BHRA WORK PLAN, REVISION 1

# APPENDIX J-2
# TECHNICAL MEMORANDUM FOR INDOOR AIR SAMPLING

# APPENDIX K
# SUPPORTING DOCUMENTS FOR SEMI-QUANTITATIVE EVALUATION OF DIRECT CONTACT WITH SHALLOW GROUNDWATER FOR THE CONSTRUCTION WORKER

**TABLE K-1. Screening of Groundwater Results at PC-161 and PC-162**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical Group | Chemical Name | Minimum Detect | Average Detect | Maximum Detect | Groundwater Screening Levels (GWSL)[1] | | Construction Worker Groundwater | Unit | Ratio of Maximum Detect to CWGWSL |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Level | Source | Level | | |
| General Chemistry | Bromide | 10 | 10 | 10 | 11 | BCL | 7.9E+04 | mg/L | 1.3E-04 |
| | Chlorate | 0.039 | 1.5 | 2.4 | 1.0 | BCL | 7.0E+03 | mg/L | 3.4E-04 |
| | Nitrate (as N) | 15 | 17 | 19 | 10 | MCL | 7.0E+04 | mg/L | 2.7E-04 |
| | Nitrate Nitrite as N | 3.4 | 3.7 | 4.3 | 10 | MCL | 7.0E+04 | mg/L | 6.1E-05 |
| | Perchlorate | 0.0087 | 25 | 35 | 0.015 | PRG | 1.1E+02 | mg/L | 3.3E-01 |
| | Phosphorus (total) | 0.028 | 0.096 | 0.14 | 0.00067 | BCL | 4.7E+00 | mg/L | 3.0E-02 |
| Metals | Arsenic | 0.031 | 0.10 | 0.16 | 0.010 | MCL | 7.0E+01 | mg/L | 2.3E-03 |
| | Boron | 1.6 | 2.1 | 2.6 | 6.7 | BCL | 4.7E+04 | mg/L | 5.6E-05 |
| | Iron | 0.12 | 0.12 | 0.12 | 23 | BCL | 1.6E+05 | mg/L | 7.3E-07 |
| | Magnesium | 98 | 157 | 220 | 189 | BCL | 1.3E+06 | mg/L | 1.7E-04 |
| | Manganese | 0.72 | 1.5 | 2.3 | 0.80 | BCL | 5.6E+03 | mg/L | 4.1E-04 |
| | Strontium | 5.4 | 8.4 | 11 | 20 | BCL | 1.4E+05 | mg/L | 7.9E-05 |
| | Vanadium | 0.013 | 0.046 | 0.079 | 0.17 | BCL | 1.2E+03 | mg/L | 6.8E-05 |
| VOCs | Chlorobenzene | 6.2 | 6.3 | 6.4 | 100 | MCL | 7.0E+05 | µg/L | 9.1E-06 |
| | Chloroform | 0.28 | 0.32 | 0.34 | 70 | MCLG | 4.9E+05 | µg/L | 6.9E-07 |
| | 1,2-Dichlorobenzene | 3.4 | 6.7 | 10 | 600 | MCL | 4.2E+06 | µg/L | 2.4E-06 |
| | 1,3-Dichlorobenzene | 0.25 | 1.2 | 2.0 | 81 | BCL | 5.6E+05 | µg/L | 3.5E-06 |
| | 1,4-Dichlorobenzene | 5.1 | 8.8 | 13 | 75 | MCL | 5.3E+05 | µg/L | 2.5E-05 |
| | 1,1-Dichloroethane | 0.95 | 1.4 | 2.0 | 2.7 | BCL | 1.9E+04 | µg/L | 1.1E-04 |
| | 1,4-Dioxane | 1.4 | 1.6 | 1.9 | 0.67 | BCL | 4.7E+03 | µg/L | 4.0E-04 |
| | 1,2,3-Trichlorobenzene | 0.59 | 0.88 | 1.3 | 27 | BCL | 1.9E+05 | µg/L | 7.0E-06 |
| | 1,2,4-Trichlorobenzene | 3.7 | 5.7 | 8.6 | 70 | MCL | 4.9E+05 | µg/L | 1.8E-05 |
| | Trichloroethene | 2.4 | 2.5 | 2.6 | 5.0 | MCL | 3.5E+04 | µg/L | 7.4E-05 |
| | 1,2,3-Trichloropropane | 0.0039 | 0.0044 | 0.0053 | 0.0022 | BCL | 1.6E+01 | µg/L | 3.4E-04 |

**Notes:**

-- = not available or not calculated
mg/L = milligram per liter
µg/L = microgram per liter
BCL = Residential Water Basic Comparison Level (NDEP 2023)
CWGWSL = construction worker groundwater screening level
MCL = Maximum Contaminant Level (USEPA 2023a).
MCLG = Maximum Contaminant Level Goal (USEPA 2023a).
NDEP = Nevada Division of Environmental Protection
RSL = Regional Screening Levels (RSLs) for tapwater (USEPA 2023b).
USEPA = United States Environmental Protection Agency
VOC = Volatile organic compound

[1] The groundwater screening levels were from the sources listed in the table as recommended in the NDEP BCL Table (NDEP 2023).
[2] The construction worker groundwater screening levels were calculated based on the groundwater screening levels from the sources listed below and ratio of intake factors for drinking water pathway and incidental groundwater ingestion pathway shown in Table K-2. The lower of the ratios of cancer and noncancer intake factors is conservatively used to develop the construction worker groundwater screening levels.

**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. 2023a. National Primary Drinking Water Regulations. Code of Federal Regulations, 40 CFR Part 141. Accessed July 2023.

USEPA. 2023b. Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. May.

**TABLE K-2. Exposure Assumption Comparison - Drinking Water Pathway vs. Incidental Ingestion of Groundwater Pathway for Construction Worker**

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Exposure Factors [1] | Units | Symbol | Drinking Water | | Construction Worker (Wet Trench Scenarios) | |
|---|---|---|---|---|---|---|
| | | | Value | Source | Value | Source |
| **Receptor-Specific Exposure Factors** | | | | | | |
| Target Risk | unitless | TR | 1E-06 | -- | 1E-06 | -- |
| Target Hazard Quotient | unitless | THQ | 1 | -- | 1 | -- |
| **Population-Specific Exposure Assumptions** | | | | | | |
| Exposure Frequency | days/year | EF | 350 | | 5 | [1] |
| Exposure Duration | years | ED | 70 | USEPA 2023 | 1 | USEPA 2023 |
| Body Weight | $kg_{BW}$ | BW | 80 | USEPA 2023 | 80 | USEPA 2023 |
| Averaging Time for Carcinogens | days | $AT_c$ | 25,550 | USEPA 2023 | 25,550 | USEPA 2023 |
| Averaging Time for Noncarcinogens | days | $AT_{nc}$ | 25,550 | USEPA 2023 | 365 | USEPA 2023 |
| **Drinking Water/Groundwater Ingestion** | | | | | | |
| Water Ingestion Rate | $L_{gw}$/day | $IR_{gw}$ | 2.0 | USEPA 2023 | 0.020 | VDEQ 2023 |
| **Intake Factor for Water Ingestion, cancer** | $L_{gw}/kg_{BW}$/day | $IF_{gw.ing\_c}$ | 2.4E-02 | -- | 4.9E-08 | USEPA 1989 |
| **Intake Factor for Water, noncancer** | $L_{gw}/kg_{BW}$/day | $IF_{gw.ing\_nc}$ | 2.4E-02 | -- | 3.4E-06 | USEPA 1989 |

**Ratio of Intake Factors for Drinking Water and Incidental Ingestion of Groundwater, cancer: 490,000**

**Ratio of Intake Factors for Drinking Water and Incidental Ingestion of Groundwater, noncancer: 7,000**

**Notes:**

-- = Not applicable

NDEP = Nevada Division of Environmental Protection

RSL = Regional Screening Level

USEPA = United States Environmental Protection Agency

VDEQ = Virginia Department of Environmental Quality

[1] It was assumed that a construction worker would be conducting small-scaled utility or landscaping work for five days in the area near PC-161 and PC-162.

**Sources:**

Virginia Department of Environmental Quality (VDEQ). 2023. Virginia Unified Risk Assessment Model - VURAM User's Guide. Appendix 3. August.

USEPA. 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part A). Interim Final. December.

USEPA. 2023. User's Guide for Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. May.